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2022

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Project ID:	Project Acronym:	Evaluation Panel:
864921	**SULFAGING**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Milos Filipovic**
Host Institution:	Leibniz-Institut Fur Analytische Wissenschaften-Isas-Ev - DEU

Decoding protein persulfidation signaling

Life originally emerged and flourished in hydrogen sulfide (H2S)-rich environment and literature published in the past decade started to recognize that H2S is a mediator of many physiological and pathological processes. Exposure to H2S can put animals into suspended animation-like state while the lifespan extensions by the dietary restriction are caused by H2S accumulation. Disturbances in its production are linked to the development of neurodegenerative diseases and cancer, among many others. A new post-translational modification (PTM) of cysteine residues called protein persulfidation (i.e., converting cysteine residues PSH to persulfides, PSSH) has been suggested as a unifying mechanism behind all these effects. Therefore, an understanding of protein persulfidation has not only a fundamental potential, e.g. unraveling new signaling pathways, but also a pharmacological potential in fighting aging and diseases. However, the underlying mechanisms of H2S-mediated PSSH formation are still unclear, mainly due to the lack of a reliable and selective methodology for PSSH labeling. Here, using cutting-edge methodology for PSSH labeling developed by our team, combined with proteomics, metabolomics and molecular biology, and by working on different model systems (cells, C. elegans, rodents) we intend to (i) gain high-resolution structural, functional, quantitative, and spatio-temporal information on PSSH dynamics and position this evolutionary conserved PTM in the global cell signalling scheme, particularly in relation to other cysteine PTMs, (ii) understand the intricate relation between aging and PSSH and (iii) identify the protein targets whose change of function by persulfidation is implicated in aging and disease progression. The ultimate objective is to pave the way for the development of innovative therapeutic strategies that will permit targeted redox control of cell metabolism, and delay aging and disease progression.

Link to the ERC project webpage: www.group-filipovic-sulfaging.com

Keywords of the ERC project: aging, thiol redox signaling, hydrogen sulfide, persulfidation, sulfenylation, proteomics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
864971	**BacNanoMachine**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Marc Erhardt**
Host Institution:	Humboldt-Universitat Zu Berlin - DEU

Reconstructing the coordinated self-assembly of a bacterial nanomachine

Life has evolved diverse protein machines and bacteria provide many fascinating examples. Despite being unicellular organisms of relatively small size, bacteria produce sophisticated nanomachines with a high degree of self-organization. The motility organelle of bacteria, the flagellum, is a prime example of complex bacterial nanomachines. Flagella are by far the most prominent extracellular structures known in bacteria and made through self-assembly of several dozen different kinds of proteins and thus represents an ideal model system to study sub-cellular compartmentalization and self-organization. The flagellum can function as a macromolecular motility machine only if its many building blocks assemble in a coordinated manner. However, previous studies have focused on phenotypic and genetic analyses, or the characterization of isolated sub-components. Crucially, how bacteria orchestrate the many different cellular processes in time and space in order to construct a functional motility organelle remains enigmatic. The present proposal constitutes a comprehensive research program with the aim to obtain a holistic understanding of the underlying principles that allow bacteria to control and coordinate the simultaneous self-assembly processes of several multi-component nanomachines within a single cell. Towards this goal, we will combine for the first time the visualization of the dynamic self-assembly of individual flagella with quantitative single-cell gene expression analyses, re-engineering of the genetic network and biophysical modeling in order to develop a biophysical model of flagella self-assembly. This novel, integrative approach will allow us to move beyond the classical, descriptive characterization of protein complexes towards an engineering-type understanding of the extraordinarily robust and coordinated assembly of a multi-component molecular machine.

Link to the ERC project webpage:

Keywords of the ERC project: Salmonella, flagella, motility, gene regulation, microfluidics, microscopy, protein secretion

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
865797	**DITSB**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Annarita Miccio**
Host Institution:	Institut National De La Sante Et De La Recherche Medicale (Inserm) - FRA

Development of Innovative Therapeutic Strategies for beta-hemoglobinopathies

Beta-thalassemia and sickle cell disease (SCD) are caused by mutations affecting the synthesis or the structure of the adult hemoglobin (Hb) beta-chain. The only definitive cure is transplantation of allogeneic hematopoietic stem cells (HSCs) from an HLA-matched donor, an option available to <30% of the patients. The clinical severity of beta-hemoglobinopathies is alleviated by the co-inheritance of mutations causing expression of fetal gamma-globin in adult life - a condition termed hereditary persistence of fetal hemoglobin (HPFH). Transplantation of autologous, genetically modified HSCs is an attractive therapeutic option for patients lacking a suitable donor. To this aim, genome editing approaches based on the use of site-specific nucleases have been explored by many groups, including ours. These approaches may either revert the single point mutation causing SCD or reactivate fetal globin expression, by mimicking HPFH mutations or by decreasing the level of BCL11A, a master repressor of fetal Hb synthesis. Site-specific nucleases, however, generate double-strand breaks (DSBs) in the genome and raise safety concerns for clinical applications, particularly when used in DSB-sensitive HSCs. In this proposal, we aim at exploiting targeted base-editing to develop novel, efficacious and safe strategies for beta-hemoglobinopathies without generating DSBs. This will be attempted by (i) correcting the SCD-causing mutation, (ii) mimicking HPFH mutations in the gamma-globin promoters, or (iii) modulating the activity of a BCL11A erythroid-specific enhancer. These approaches will be tested in human adult erythroid cell lines and patient HSCs, differentiated in vitro and in vivo into mature red cells to evaluate editing efficiency, fetal Hb expression, phenotypic cell correction and biosafety. The ultimate goal of the project is to provide sufficient proof of efficacy and safety to enable the clinical development of base-edited HSCs for the therapy of beta-hemoglobinopathies.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
866011	**MemDense**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Robert Ernst**
Host Institution:	Universitaet Des Saarlandes - DEU

Cellular control of membrane protein density in the endoplasmic reticulum via the unfolded protein response

All cells must balance the production of proteins and lipids to maintain membrane functions. Imbalances in protein folding and lipid metabolism cause endoplasmic reticulum (ER) stress associated with a wide range of complex diseases including diabetes, neurodegeneration, and viral infections. The central homeostatic program of the ER is the unfolded protein response (UPR), which senses unfolded proteins in the ER to control protein synthesis, chaperone abundance, and lipid metabolism. Through these mechanisms, the UPR centrally controls decisions between cell survival, adaptation, and apoptosis. The field has focused almost exclusively on soluble proteins as triggers of the UPR, while the more abundant membrane proteins have been neglected. Our finding of UPR activation by membrane aberrancies provides a radically new perspective and allows us to address central questions in membrane and cell biology: How is the density of ER membrane proteins sensed and controlled? How are misfolded membrane proteins recognized to mount adaptive responses?

Focusing on the conceptual advance that UPR transducers sense signals from the membrane, we will 1) establish and reconstitute the machinery for sensing membrane protein crowding, 2) identify mechanisms coordinating protein and lipid homeostasis between organelles, 3) study the molecular recognition of misfolded membrane proteins by the UPR.

Key to this endeavor is our unique combination of genetic, biochemical, and biophysical tools for parallel characterization of the UPR in vivo and in vitro. Combining this framework with novel strategies for an immuno-isolation of organelles, we are primed to answer how membrane aberrancies cause chronic ER stress. By establishing the UPR as a quality control system for membrane proteins, and providing novel tools and valuable resources to the community, MemDense will have wide impact on our molecular and cellular understanding of ER homeostasis and the many diseases related to ER stress.

Link to the ERC project webpage:

Keywords of the ERC project: membrane quality control, unfolded protein response, lipid bilayer stress, membrane homeostasis

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
866250	**mARs**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Orsolya Barabas**
Host Institution:	Universite De Geneve - CHE

mARs: Mobile DNA driven antibiotic resistance spreading: molecular strategies, control and evolution for broad distribution

Antibiotic resistance (AR) is spreading rapidly, leading to the development of highly virulent pathogens and multidrug-resistant 'superbugs', a major health concern of our era. Mobile DNA elements, transposons and integrons, effectively drive the spread of AR genes in microbial interaction hotspots, such as bacterial communities in humans and natural environments. Yet, our knowledge of their mechanisms remains very sparse. It is unclear how DNA movement occurs on the molecular level and how it is controlled in cells and communities; biochemical and structural data are rare and our view on their diversity and evolution is limited. Here I propose an integrated approach combining bioinformatics, genetics, microbiology, biochemistry, and structural biology to elucidate the mechanisms and diversity of mobile DNA driven resistance spreading. I want to (a) investigate the molecular mechanisms and regulation of AR gene movement in vitro, in model bacteria and in gut bacterial communities; (b) dissect the structure of the underlying molecular machineries to reveal how protein-DNA interplay promotes gene transfer; and (c) characterize the diversity, evolution and functional success of distinct molecular pathways. Mechanistic work will focus on selected mobile elements that confer resistance to last resort drugs and promiscuous gene carriers with high prevalence in health care. Bioinformatic quests will draw on recent (meta)genomic data to chart the clinical significance of molecular insights in situ. By bridging disciplines, I want to provide functionally annotated molecular movies of gene movement and explain how specific molecular strategies evolved to enable broad dissemination of resistance determinants. The insights gained in this research will provide in-depth knowledge on major AR transfer pathways and will have key implications for the development of novel intervention strategies and preventive measures aimed at reducing dissemination of drug resistance in bacteria.

Link to the ERC project webpage:

Keywords of the ERC project: mobile genetic elements, bacteria, mechanism, antibiotic resistance, gene transfer, evolution

Keywords that characterize the scientific profile of the potential visiting researcher/s: bioinformatics, genome annotation, microscopy, bacteriology, drug screening, structural biology

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Project ID:	Project Acronym:	Evaluation Panel:
883240	**MONOCHROME**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Gijs Wuite**
Host Institution:	Stichting Vu - NLD

Disentangling metaphase chromosome organisation one chromosome at a time

Chromosomes assume their most compact state during metaphase just before they are separated. In this process of cell division the chromosomes experience high forces and genomic defects can occur then. Many techniques have built considerable understanding of metaphase chromosome structure and a multitude of models have been put forward how cells organize their chromosomes during metaphase. Yet, given the complexity of the process and limitations of the methods to study them, it is far from being fully understood. The breakthrough opportunity in this regard is the development of tools that allow real-time, 3D, super-resolution imaging and manipulation of entire non-fixed metaphase chromosomes under nearphysiological conditions. Here I propose to quantitatively image the proteins that establish the architecture of metaphase chromosomes and disentangle the connection between its architecture, internal protein dynamics and mechanics at the multi-protein as well as the single-molecule level. For this project I plan to expand the combination of optical manipulation and fluorescent microscopy by introducing force-induced expansion microscopy together with advanced labeling and imaging techniques that ultimately will permit real-time, 3D, super-resolution quantitative analysis of complex (protein) structures within native non-fixed metaphase chromosomes. With this kind of instrument it becomes possible to validate and/or challenge the current models of metaphase organization as well as explore the physical properties of chromosomes but also study chromosome separation dynamics. My extensive experience handling biological systems and pushing instrumental boundaries gives me an excellent starting point to address key research questions with regards to metaphase chromosomes. In doing so I can improve our understanding of chromosome organization which is important because chromosome defects can have devastating consequences leading to for example cancer or fragile X syndrome.

Link to the ERC project webpage:

Keywords of the ERC project:

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Project ID:	Project Acronym:	Evaluation Panel:
947709	**HyDegronomics**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Itay Koren**
Host Institution:	Bar Ilan University - ISR

Cracking the Code for Protein Quality Control Mechanisms Recognizing Exposed Hydrophobicity in Protein Substrates

Proteostasis is a highly regulated process by which cells maintain a healthy proteome. Loss of proteostasis is a common feature of aging and disease. To preserve proteostasis, the cell has developed protein quality control (PQC) pathways that monitor a proteins's fate from synthesis to degradation. Exposed hydrophobic residues in aberrant or mislocalized protein substrates is a key feature recognized by distinct PQC mechanisms. If not handled properly, exposed hydrophobicity can result in protein aggregation and subsequent reduced cell fitness. To prevent accumulation of toxic aggregates, cells are equipped both with chaperones and proteolytic pathways. Within the degradation systems, E3 ligases are the major determinants of specificity, which is achieved through their selective recognition of specific short peptide motifs, or degrons, in substrate proteins. Despite the growing list of PQC players and substrates, it has yet to be determined what are the client range, selectivity and specificity of each of the PQC mechanisms. The objective of this proposal is to systematically investigate the exposed hydrophobicity "code" and to advance the state-of-the-art of the PQC field. Here, we utilize the GPS-peptidome method that we recently developed together with genetics, biochemistry, cell biology and proteomic approaches to: (1) map distinct classes of hydrophobic degrons to elucidate the specificity of substrate selection; (2) identify novel E3 ligases playing a role in PQC pathways, explore redundancies among them and identify endogenous substrates proteome- wide; (3) investigate the physiological significance of PQC mechanisms. This work will provide a comprehensive view of PQC pathways that recognize hydrophobicity. This is critical to further our understanding on how aberrant features in proteins are recognized and can provide valuable information for the development of new therapeutic intervention strategies that target abnormal proteins implicated in disease.

Link to the ERC project webpage:

Keywords of the ERC project: Protein quality control, degrons, E3 ligases, ubiquitination

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
950262	**DDX TRANSIT**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Maria Hondele**
Host Institution:	Universitaet Basel - CHE

DEAD-box ATPases as master regulators of phase-separated compartments to control cellular RNA flux and the remodeling of RNA-protein complexes

Life ultimately depends on the tight control of gene expression, which requires an ordered and efficient processing of various RNA molecules. Messenger RNAs (mRNAs) – bound by a constantly changing coat of passenger proteins - transit from transcription in the nucleus to translation and ultimately decay in the cytoplasm. Similarly, ribosomal rRNAs migrate through the nucleolus where they gradually en-counter ribosomal proteins to assemble functional ribosomes. Still, we know very little about the pro-cesses that orchestrate this flux of RNA in a temporal and spatial manner.

Intriguingly, many RNA processing steps occur in membraneless organelles formed by liquid-liquid phase separation, e.g. nuclear speckles or the nucleolus, but the function of condensate formation in RNA processing is not known. I have discovered that the family of DEAD-box ATPases (DDXs) are master regulators of RNA-containing membraneless organelles, from bacteria to man. DDXs use their low-complexity domains and ATPase activity to regulate condensate dynamics and RNA flux through these compartments.

I propose that cells use DDX-controlled condensate 'stations' to establish an RNA 'transit map' to reg-ulate the cellular flux of mRNA and rRNA molecules and to spatially and temporally control RNA pro-cessing. In three work packages, I will (1) characterize central DDXs that control mRNA flux and use DDX mutants as unique tools to map passenger protein changes along the life of an mRNA; (2) charac-terize how DDXs regulate the formation of the phase-separated nucleolar environment and facilitate the flux of rRNA during ribosome assembly; (3) dissect how DDX condensates function as biomolecular filters to selectively enrich or exclude proteins, and how selectivity contributes to the remodeling of the RNA protein coat and directional RNA flux.

Our research will provide key novel insight into our understanding of RNA processing and uncover novel layers of gene expression regulation.

Link to the ERC project webpage:

Keywords of the ERC project: condensate, RNA, DEAD-box ATPase, membrane less organelle

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101001288	**KARMA**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Chiara Ambrogio**
Host Institution:	Universita Degli Studi Di Torino - ITA

From the understanding of KRAS-RAF membrane dynamics to new therapeutic strategies in cancer

Cellular homeostasis is controlled by the RAS-MAPK pathway. This pathway is dysregulated in human diseases, especially cancer, in which more than 50% of cases carry aberrations that hyperactivate RAS-MAPK signaling. In this context, KRAS mutations are the most frequent oncogenic drivers. Therapeutic suppression of pathogenic KRAS-RAF-MAPK signaling to achieve disease control in cancer patients still represents a challenging target. KRAS dimers and multimers at the membrane (collectively referred, together with adaptors and effectors, as to "KRAS signalosome") influence the activation of KRAS signaling. I provided the first biological evidence that dimerization is required for the function of oncogenic KRAS (Ambrogio et al, Cell, 2018). Indeed, one fascinating and still largely unexplored aspect of KRAS biology is the functional impact of KRAS complexes at the membrane for signaling and drug sensitivity. No inhibitors of oncogenic KRAS clustering have been identified so far. Interestingly, wild-type KRAS antagonizes oncogenic KRAS, resulting in reduced oncogenic signaling. The overarching goal of this proposal is the characterization in vitro and in vivo of the "KRAS signalosome" in terms of functional dynamics and related actionable vulnerabilities. My strong background in KRAS biology provides me with the expertise to propose an ambitious, yet feasible plan to understand the tumor suppressor effect of wild-type KRAS protomers in mutant KRAS-driven complexes by identifying and validating membrane interactors differentially recruited by wild-type and mutant KRAS (Work package 1). In parallel, I will study the relevance of RAF kinases localization at the membrane as key feature to sustain oncogenic MAPK activity in vivo (Work package 2). Finally, I will screen new compounds to interfere with RAFs function at the cell membrane and will determine the therapeutic impact of disrupting mutant KRAS signalosome using mouse models in vivo (Work package 3).

Link to the ERC project webpage: https://ambrogiolab.com

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101018608	**CBASS**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Malcolm White**
Host Institution:	The University Court Of The University Of St Andrews - GBR

CBASS: Life, Death and cyclic nucleotides

All living things are subject to attack by viruses. Cells have evolved many different immune systems to protect themselves, including the adaptive and innate immune systems of vertebrates and the CRISPR and restriction:modification systems of bacteria. Viruses have developed potent countermeasures to subvert these systems, and this perpetual arms race has been a strong driving force in evolution throughout the history of life on Earth. CBASS (cyclic-oligonucleotide-based antiphage signalling systems) is a newly discovered bacterial immune system with evolutionary links to the eukaryotic cGAS-STING innate immune pathway. CBASS generates an astonishing array of cyclic di- and tri-nucleotide signalling molecules that in turn activate a diverse range of effector proteins to combat phage infection. These cyclic nucleotide second messengers thus lead to life or death decisions for infected cells. CBASS are abundant in pathogens and the microbes that dominate the human digestive system: this microbiome and the viruses that infect it are now implicated in diverse aspects of human health. This is a powerful and complex defence system, but fundamental aspects are not understood. How is viral infection detected by bacteria, triggering cyclic nucleotide production? What are the consequences for the cell: does activation inevitably lead to cell death, or is there a mechanism to switch it off? What role does protein modification play? Furthermore, how do viruses overcome CBASS defence? These questions will be addressed using a cutting-edge combination of structural and molecular biology, bioinformatics, biochemistry and microbiology. We propose a ground-breaking study of CBASS defence, with a focus on discovery of new enzymes, pathways and mechanisms. This work will open up new paradigms in bacterial cell signalling with broad implications for our understanding of microbial physiology, infection and the evolution of immune systems.

Link to the ERC project webpage:

Keywords of the ERC project: CRISPR, antiviral immunity, phage defence, nucleases

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101021133	**ChemoTaxi**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Peijun Zhang**
Host Institution:	Diamond Light Source Limited - GBR

Molecular choreography of bacterial chemotaxis signalling

For nearly six decades, chemotaxis - a ubiquitous biological behaviour enabling the movement of a cell or organism toward or away from chemicals -has served as a paradigmatic model for the study of cellular sensory signal transduction and motile behavior. The relatively simple chemotaxis machinery of E. coli is the best understood signal transduction system and serves as a powerful tool for investigating the molecular mechanisms that proteins use to detect, process, and transmit signals. The sensory apparatus of E. coli cells is an ordered array of hundreds of basic core signalling units consisting of three essential components, the transmembrane chemoreceptors, the histidine kinase, and the adaptor protein. The core units further assemble into a two-dimensional lattice array which allows cells to amplify and integrate many varied and possibly conflicting signals to locate optimal growing conditions.

To understand the underlying molecular mechanisms of chemosensory array assembly, activation and high cooperativity, it is essential to determine the precise interactions between the core signalling components in the context of the array. We propose to use a combination of cutting-edge cryoET structural methods and multi-scale molecular simulations, as well as in vivo functional assays, to investigate the structural and dynamical mechanisms underlying signal transduction and regulation. The research plan is divided into three aims:

1. Determine the structural basis of signal transduction and array cooperativity
2. Define conformational states and dynamics of the array
3. Obtain time-resolved structural snapshots of signalling pathway

Our results will establish, in atomistic detail, the chemotaxis signalling pathway that is shared by diverse chemotactic species, including a wide-range of human and plant pathogens, thus impact on multiple disciplines, from antimicrobial drug development to understanding responses to hormones and neurotransmitters in eukaryotic cells.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101040138	**cofacTau**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Yann Fichou**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Cofactors at the core of tau prion behaviour

Tau is an intrinsically disordered protein that regulates microtubule activity in neurons. Aggregation of tau into amyloid fibrils is diagnostic of several diseases, termed tauopathies, that include Alzheimer's disease. Distinct amyloid aggregate structures, so-called "strains", are involved in different tauopathies. These assemblies can spread and recapitulate pathological phenotypes when injected in cells and animals. This is the hallmark that tau aggregates follow a prion behaviour. To date, the factors guiding the formation or propagation of specific strains are unknown. Showcasing this crucial gap in knowledge is the fact that none of the brain-extracted tau amyloid structures has been reproduced in vitro. This project intends to establish a paradigm shift for the very definition of tau strain. I propose the novel hypothesis that the co-aggregation of tau with other biomolecules such as lipids or polyanions, so-called cofactors, is a defining property of tau prion strains. To demonstrate this hypothesis, I will test that the tau-cofactor interactions (i) dictate the structure of tau aggregates, (ii) enable structure replication through seeding and (iii) dictate the neuropathology developed in cells and mice after inoculation of tau seeds. My approach is to study the pathological properties and the conformational evolution of tau aggregates in the presence of biologically-relevant cofactors possessing different physico-chemical properties. By mapping the interactions between tau and cofactors, my goal is also to establish the canonical rules governing tau structural differentiation. This proposal combines multiple methods including EPR and NMR spectroscopy, AFM-based nanospectroscopy, biochemistry, cell biology and animal histology. The proposed paradigm shift would have a very high impact in the field of tauopathies, for example by enabling accurate structure-based drug discovery, revealing new drug targets and pinpointing key deleterious metabolic pathways.

Link to the ERC project webpage: www.fichou-lab.cnrs.fr

Keywords of the ERC project: Tau protein, Amyloid, Biochemistry, structural biology, biophysics, EPR spectroscopy

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101041982	**IntrinsicReceptors**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Florian Wilfling**
Host Institution:	Max Planck Gesellschaft Zur Foerderung Der Wissenschaften E.V. - DEU

Intrinsic autophagy receptors: identity and cellular mechanisms.

Macromolecular complexes (MC) are cellular machines that perform a wide array of vital tasks. They operate in a controlled, coordinated fashion within the crowded environment of the cell. Accumulation of dysfunctional MCs leads to age-related diseases. Despite recent technological advancements, it still remains elusive for many of them how excess or dysfunctional MCs are sensed and removed. I have recently established a role of intrinsic receptors in degradation of the nuclear pore complex and the clathrin-mediated endocytosis machinery by selective autophagy. Intrinsic receptors represent functional subunits of the macromolecular machine but can if needed recruit the autophagy machinery to engulf and degrade the complex. As such intrinsic receptors provide an in-built quality control function that monitors the assembly state and/or functionality of macromolecular machines. I hypothesize that this is a conserved and widely used principle existing within various MCs and that there is a common, yet unexplored, regulatory pathway underlying the intrinsic receptors' mode of action. In the proposed project, I will employ a combination of genetic screening, mass spectrometry and cryo-electron tomography to systematically define intrinsic receptors and their working principles in cells. I will use systematic discovery approaches to determine how many MCs contain intrinsic receptors, how the degradation of intrinsic receptors and their cargo is regulated, and how this is orchestrated with autophagosome biogenesis. My results will not only provide insights into a novel cellular quality-control mechanism but also unravel novel aspects of selective autophagosome biogenesis. Importantly, both accumulation of dysfunctional complexes and impairment of autophagy are linked to aging and age-related diseases. Therefore, my results will contribute to understand the role of autophagy in these processes and have the potential to provide new pharmacological therapeutic avenues.

Link to the ERC project webpage:

Keywords of the ERC project: autophagy, molecular machines, liquid-liquid phase separation, electron tomography

Keywords that characterize the scientific profile of the potential visiting researcher/s: electron tomography, mass spectrometry, cell biology, biochemistry

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Project ID:	Project Acronym:	Evaluation Panel:
101043452	**BioPhage**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Pavel Plevka**
Host Institution:	Masarykova Univerzita - CZE

Phage infection of bacterial biofilm

In 2017, the World Health Organization declared Staphylococcus aureus to be an antibiotic-resistant pathogen for which new therapeutics are urgently needed. Upon infection, S. aureus forms biofilms that can only be treated by the long-term application of several antibiotics in high doses or the surgical removal of the infected tissues. An alternative approach, phage therapy, has not been approved for clinical use, because the effects of phage infection on a biofilm are not sufficiently characterized. We propose to study the dynamics of the propagation of Herelleviridae phage phi812 in a S. aureus biofilm and molecular details of phi812 replication in a cell. We integrated a microfluidic system into a light-sheet microscope to enable continuous multi-day observation of the phage infection of a biofilm. We will determine how sub-populations of metabolically dormant or phage-resistant cells in a biofilm provide herd immunity against phi812 infection. Our system enables the fixation of biofilm segments for subsequent correlative imaging by serial block-face scanning electron microscopy to identify the interactions of phages with bacterial cells. We will use focused ion beam milling together with cryo-electron microscopy and tomography to determine high-resolution structures of previously uncharacterized phi812 replication and assembly intermediates in S. aureus cells. We will study the function of bacterial membranes and macromolecular complexes in the initiation and completion of phage genome delivery, the assembly of phage portal complexes and heads, and the mechanisms of genome packaging and head-tail attachment. This proposal's biological significance lies in its focus on the as-yet uncharacterized interactions of phages and bacteria under biologically and clinically relevant conditions. Our analyses of phage spread in a biofilm, herd immunity against phage infection, and phage replication in cells may identify approaches for making phage therapy more effective.

Link to the ERC project webpage: https://plevkalab.ceitec.cz

Keywords of the ERC project: phage, biofilm, staphylococcus, aureus, cryo-EM, cryo-ET, FIBM, LSFM, lightsheet fluorescence microscopy, time-lapse imaging, reconstruction

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101045340	**GTPaseNet**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Martin Loose**
Host Institution:	Institute Of Science And Technology Austria - AUT

Synthetic and structural biology of Rab GTPase networks

Eukaryotic cells are characterized by their compartmentalization into hundreds of different membrane-bound organelles with unique biochemical identities. Small GTPases of the Rab family play a central role in this organization, but how they are able to generate spatiotemporal order in the complex cellular environment is currently not known. Most previous studies on Rab GTPases have either relied on describing their behavior in living cells or in highly reductionist biochemical assays. However, neither of these two approaches can explain the dynamic activity patterns of Rab GTPases associated with their cellular functions. It has become clear that Rab GTPases are controlled in sophisticated regulatory networks with emergent, self-organizing properties. To obtain a mechanistic understanding of these Rab GTPase systems, new experimental assays are now required. In this proposal, we will use a “bottom-up” synthetic biology approach to rebuild the biochemical networks of Rab GTPases from purified components and demonstrate their self-organization into spatiotemporal activity patterns in vitro. We will combine these reconstitution experiments with cryo-electron microscopy to elucidate the structures of membrane-recruited Rab GTPase regulators. Finally, we will use microfabrication and laser lithography to prepare a mimic for the compartmentalized cell and find out how Rab GTPase signaling systems sense and process preexisting geometric and biochemical cues as in the living cell. This project will provide novel, quantitative information from different scales, from the emergent ensemble behavior down to the molecular structure of protein complexes. Together, this data will reveal how signaling systems of Rab GTPases control membrane identities in space and time, thereby improving our understanding of the intracellular organization of the eukaryotic cell.

Link to the ERC project webpage: https://looselab.pages.ist.ac.at/research/small-gtpase-networks/

Keywords of the ERC project: Small GTPases, in vitro reconstitution

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101052783	**INSITUFOLD**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr F. Ulrich Hartl**
Host Institution:	Max Planck Gesellschaft Zur Foerderung Der Wissenschaften E.V. - DEU

In situ analysis of chaperone mediated protein folding and stability

Molecular chaperones mediate protein folding and conformational maintenance. Failure of these fundamental cellular functions results in a breakdown of protein homeostasis (proteostasis) and facilitates the manifestation of diseases associated with protein aggregation. Much progress has been made in understanding the mechanisms of individual chaperone systems, such as the Hsp70s and the chaperonins, based on analyses in vitro. How these machineries function in the intact cell is not well understood, however. The goal of this proposal is to observe and characterize the dynamic action of the major chaperone systems and their interplay in intact cells in real time.Using live cell single molecule imaging combined with biochemical analyses, proteomic profiling, and genetic screening, we will address the following questions:

i) How does the chaperone machinery assist protein chains during and after translation to achieve folding and assembly? We will develop single particle tracking to monitor the chaperone engagement of nascent chains in situ in mammalian cells.

ii) How is the conformational stability of chaperone clients assessed, maintained and triaged in healthy cells and in cells burdened with pathological aggregates? We will track the interactions of metastable proteins with chaperones and proteolytic machinery.

iii) What is the efficiency of protein folding across the proteome under normal conditions and in chaperone-deficient cells? Pulse proteolysis/mass spectrometry will be developed to analyze the folding of nascent polypeptides and will be scaled to analyze the entire proteome of different cell types. By depleting specific proteostasis components we will explore the capacity of the chaperone network for compensatory rewiring and identify vulnerable proteins with an obligate chaperone dependence.

Overall, this work will employ new technology to advance our understanding of the chaperone system in protein folding and proteome maintenance at the cellular level.

Link to the ERC project webpage:

Keywords of the ERC project: protein folding, molecular chaperones, in vivo imaging, proteomics

Keywords that characterize the scientific profile of the potential visiting researcher/s: single molecule imaging; proteomics; cellular biochemistry of proteins

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Project ID:	Project Acronym:	Evaluation Panel:
803852	**Mito-recombine**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Hansong Ma**
Host Institution:	The Chancellor, Masters And Scholars Of The University Of Cambridge - GBR

Homologous recombination and its application in manipulating animal mitochondrial DNA

Mitochondrial DNA (mtDNA) is a multi-copy genome that works with the nuclear genome to control energy production and various cellular processes. To date, disorders associated with mutations in mtDNA are among the most common genetically inherited metabolic diseases1. However, our knowledge regarding many aspects of mtDNA biology remains limited, and we know even less about how it influences development and organismal traits. This is largely due to our inability to manipulate mtDNA. Recently, a colleague and I developed novel genetic tools in Drosophila that allowed us to isolate animal mitochondrial mutants for the first time, and to create heteroplasmic organisms containing two mitochondrial genotypes2,3. These advances make Drosophila a powerful system for mtDNA studies. Importantly, I showed that Drosophila mtDNA could undergo homologous recombination. Furthermore, I established a system to induce recombination at specific sites and select for progeny containing only the recombinant genome4. Thus, my work has demonstrated the existence of recombination in animal mitochondria, and opens up the possibility of developing a recombination system for functional mapping and manipulating animal mtDNA. Here I propose to 1) identify components of the mitochondrial recombination machinery by a candidate RNAi screen; 2) develop a recombination toolkit to map trait-associated mtDNA sequences/SNPs; and 3) build a site-directed mutagenesis system by establishing robust ways to deliver DNA into fly mitochondria. Given the essential functions of mitochondria and their involvement in incurable diseases, the genetic tools developed in this proposal will transform the field by making it possible to link mtDNA variations to phenotypic differences and introduce specific mutations into mtDNA for functional studies at organismal level. These advances will open many possibilities to accelerate our understanding on how mtDNA impacts health, disease and evolution.

Link to the ERC project webpage: themalab.co.uk

Keywords of the ERC project: mitochondrial DNA repair and maintenance

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
850405	**CHROMREP**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Aniek Janssen**
Host Institution:	Universitair Medisch Centrum Utrecht - NLD

Dissecting the chromatin response to DNA damage in silenced heterochromatin regions

Cells are continuously exposed to insults that can break or chemically modify their DNA. To protect the DNA, cells have acquired an arsenal of repair mechanisms. Proper repair of DNA damage is essential for organismal viability and disease prevention. What is often overlooked is the fact that the eukaryotic nucleus contains many different chromatin domains that can each influence the dynamic response to DNA damage. Different chromatin environments are defined by specific molecular and biophysical properties, which could necessitate distinct chromatin responses to ensure safe DNA damage repair.

The aim of this proposal is to understand how diverse chromatin domains, and in particular the dense heterochromatin environment, shape the dynamic chromatin response to DNA damage.

I recently developed locus-specific DNA damage systems that allow for in-depth analysis of chromatin domain-specific repair responses in Drosophila tissue. I will employ these systems and develop new ones to directly observe heterochromatin-specific dynamics and repair responses. I will combine these systems and state-of-the art chromatin analysis with high-resolution live imaging to dissect the DNA damage-associated heterochromatin changes to determine their function in repair -kinetics, -dynamics and -pathway choice.

Deciphering the chromatin dynamics that regulate DNA damage repair in heterochromatin will have broad conceptual implications for understanding the role of these dynamics in other essential nuclear processes, such as replication and transcription. More importantly, understanding how chromatin proteins promote repair will be important in determining how cancer-associated mutations in these chromatin proteins impact genetic instability in tumours in the long run.

Link to the ERC project webpage: aniekjanssen.org

Keywords of the ERC project: chromatin, dna repair, drosophila,

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
852786	**TYPEWIRE**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Amit Zeisel**
Host Institution:	Technion - Israel Institute Of Technology - ISR

Reconstructing wiring rules of in vivo neural networks using simultaneous single-cell connectomics and transcriptomics

The brain performs sophisticated functions and complex behaviours, orchestrated by highly specialized cells. Neurons are at the core of the nervous system's computational capabilities. In recent years, we and others have advanced single-cell RNAseq to reveal their extraordinary molecular diversity in transcriptome-based cell-type taxonomies. It is the unique combinations of circuits that these different neuronal types form – within a practically unlimited space of possible implementations – that encode the large functional repertoire of the nervous system. Although critical, little is known about the basic organizational principles of cells within the circuits – the 'wiring rules'. This highlights the conceptual challenge to measure connectivity on a systematic and synaptic, single-cell level. What is the topology of networks? What is the relation between network topology and function? How do cell types and gene expression determine wiring? Answering these questions will help resolve nervous system computation at the level of its cellular building blocks. The vision of this proposal is to provide and apply a novel approach that will allow us to investigate neuronal connectivity at large-scale. Two key requirements for such measurements are the ability to measure true synaptic connections, and obtain tens of thousands of datapoints. Further, the concept of cell types is crucial for addressing the connectivity problem, as it allows us to distinguish the network elements and thus assemble a global picture even from fragmented, partial measurements. For this purpose, we will combine transcriptomics and connectomics measurements at the single cell level.

The proposed project has enormous potential to systematically (re)address basic functional questions in neuroscience. It can expand our understanding of neural circuits to an unprecedented resolution, with conceivable impact on computational research, such as in vivo inspired neural networks and artificial intelligence.

Link to the ERC project webpage:

Keywords of the ERC project: Neuroscience, connectivity, cell types

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
853640	**PLANMod**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Omri Wurtzel**
Host Institution:	Tel Aviv University - ISR

Regulation of extreme plasticity in planarian stem cells by mRNA modifications

PlanaPioneering studies on post-transcriptional modifications of mRNA have revealed a hidden layer of regulatory complexity. The most abundant mRNA modification, N6-methyladenosine (m6A), regulates critical cellular processes and it is found in a huge diversity of Eukaryotes. Despite pivotal roles of m6A in development, only few animal models are available for m6A research. We poorly understand what cellular and intercellular factors modulate the RNA methylome, and how do changes in the cellular RNA methylome affect organism-level processes. There is an urgent need for innovative animal models. My primary objective is to establish an animal model for studying m6A regulation in multiple resolutions: molecular, cellular, and organismal, and use this system to uncover the interplay between of intercellular signaling and the dynamics of cellular mRNA modification. Planarians are free-living flatworms that can regenerate from any injury using a population of stem cells. Upon injury, planarian stem cells respond to extracellular injury signals and give rise to the missing tissues. Our preliminary data show that planarian stem cells require a functional m6A pathway for regeneration and tissue maintenance, raising the hypothesis that m6A regulates stem cell responses to extracellular signals. We propose to harness the power of planarians for (1) systematic studies of gene function in the context of cellular differentiation; (2) finding the molecular underpinnings of phenotypes associated with the m6A pathway; and (3) uncovering the interplay between injury signals, morphogens and stem cells that is required for regeneration. We will use multiple experimental approaches, including gene inhibition, sequencing and confocal microscopy to decode the contribution of organismal processes to mRNA modifications. Our proposal will lead to conceptual advances linking RNA-based regulation and cell signaling, and will provide infrastructure for studying other RNA-regulatory mechanisms.

Link to the ERC project webpage: wurtzellab.org

Keywords of the ERC project: regeneration, RNA modifications, model organisms, stem cells

Keywords that characterize the scientific profile of the potential visiting researcher/s: RNA biology, RNA modifications, chromatin structure

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Project ID:	Project Acronym:	Evaluation Panel:
948770	**DECIPHER**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Marnix Medema**
Host Institution:	Wageningen Universiteit - NLD

A computational framework to interpret the chemical language of the microbiome

Humans, animals and plants are covered in microbes. Such microbiomes have a major impact on the health of their hosts and have been linked to traits like growth promotion, stress resilience, and diseases. However, the mechanisms underlying microbiome-host interactions remain poorly understood. Recent studies have shown that microbiome-associated phenotypes are often mediated by specific molecules, a 'chemical language' that enables microbes to interact with each other and with the host. The biosynthesis of these molecules is encoded in metabolic gene clusters (MGCs) that are subject to frequent horizontal transfer and are therefore highly strain-specific.

Current computational methods for analysing microbiomes largely focus on comparative taxonomic analyses and generic metabolism, and overlook this complex "chemical dialog". Indeed, no adequate methods are available to systematically study the roles of MGCs in microbiomes. At the same time, metabolomics data from microbiomes are full of 'dark matter': unknown molecules that cannot be traced to their producers. Here, I propose to develop the first comprehensive computational framework to study the chemical language of the microbiome.

In the past years, I have developed technologies that lay the foundation for this ERC project, including automated identification of MGCs, grouping them into families and annotating them using reference data. With DECIPHER, I will move my research to the next level, by developing new algorithms to link MGCs to their metabolic products and to predict their molecular and ecological functions in microbiomes. I will then apply this new framework in a systematic study of microbiome- associated phenotypes in plants and humans. Together, the innovations proposed here will fill a key gap in the analysis of microbiome function and pave the way toward precision-engineering of microbiomes with specific metabolic capabilities for designer soils and microbiome-based therapies.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101018688	**bInDR**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Naama Barkai**
Host Institution:	Weizmann Institute Of Science - ISR

DNA binding specificity in-vivo

How transcription factors (TFs) bind rapidly at specific sites within large genomes remains a major mystery. Specificity is puzzling since TFs select a small fraction of their potential binding sites - short and highly abundant DNA motifs. Rapid detection of these selected sites is challenging due to the small motif size and the large number of non-specific sites within a genome. Despite extensive efforts, a unifying model accounting for these challenges, underlying the foundations of gene regulation, is still missing.

Our recent results revealed an unexpected role of long intrinsically disordered regions (IDRs) in determining the in-vivo binding specificity of TFs. Long IDRs are ubiquitous among eukaryotic TFs, but their potential role is largely unknown. By studying two budding yeast TFs, we found that in-vivo binding specificity depends on long (>500 residues) IDRs located outside the DNA binding domains (DBDs). Furthermore, IDRs direct TF binding to the selected set of promoters using multiple weak specificity determinants distributed throughout their entire sequence.

Our results suggest that TFs search for their binding sites through a two-tier process: Specificity determinants distributed within long IDRs direct TFs to broad promoter regions, allowing for subsequent localized search of the DBD for its short binding motif. We plan to establish this model by: (1) Defining the molecular basis of IDR-promoter recognition and its sequence recognition code, (2) Defining the dynamic profile of IDR-based DNA recognition, and (3) Elucidating the evolutionary implications of this novel recognition mode.

Through a combination of experiments, computation and theory, carried out by an interdisciplinary group of students, our study will establish a new paradigm that explains the efficiency and specificity of the search of TFs for their in-vivo binding targets, providing a new solution for a long-standing mystery.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101040914	**COVIDecode**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Mathias Munschauer**
Host Institution:	Helmholtz-Zentrum Fuer Infektionsforschung Gmbh - DEU

Interrogating RNA-protein interactions underlying SARS-CoV-2 infection and antiviral defense

The global COVID-19 pandemic underscores the need to better understand its causative agent, SARS-CoV-2, and the various other emerging viruses threatening human health. Like many human viruses, SARS-CoV-2 utilizes RNA as its replicated genetic material and its template for translating the virus's proteins. Ongoing research into SARS-CoV-2 and other RNA viruses has largely focused on understanding the function of their encoded proteins, revealing key roles in host cell entry, viral replication, and immune suppression. In contrast, little is known about the set of viral RNAs and how they interact with host machinery as part of a virus's replication cycle in infected cells. My group discovered a large collection of viral and host proteins that bind the genomic and subgenomic RNAs of SARS-CoV-2 during infection. This collection provides an excellent starting point to work toward the goal of my proposed ERC Starting Grant project: decoding how these interactions shape the viral RNA life cycle and contribute to antiviral defense mechanisms. My overarching hypothesis is that SARS-CoV-2 dynamically modulates RNA-protein interactions in the host to facilitate functions of genomic and subgenomic viral RNAs at different stages of the replication cycle. To test this hypothesis, I have devised three research objectives:

1) Decode mechanisms of host-mediated control over the life cycle of SARS-CoV-2 RNAs.
2) Map with temporal resolution which host cell proteins engage each SARS-CoV-2 RNA type.
3) Elucidate the role of host proteins that moonlight as RNA binders in SARS-CoV-2 infections.

If successful, this project will identify novel pro- and antiviral host factors in SARS-CoV-2 infections and reveal underlying RNA regulatory mechanisms. In turn, these insights will provide an RNA-centric view of viral infections and identify candidate factors and pathways as therapeutic targets to treat viral diseases.

Link to the ERC project webpage:

Keywords of the ERC project: SARS-CoV-2, RNA-binding proteins, RNA interactome, RNA virus, Proteomics, Systemsbiology

Keywords that characterize the scientific profile of the potential visiting researcher/s: RNA, RNA-binding proteins, virology

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Project ID:	Project Acronym:	Evaluation Panel:
101043132	**OMEGA**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Thomas Jacobs**
Host Institution:	Vib - BEL

Developing technologies to engineer plant genomes at the megabase scale

Genomics research combined with revolutionary genome editing tools has created new opportunities to explore fundamental aspects of biology and develop novel (bio)technologies for medicine, agriculture, and industry. The OMEGA project is designed to build on these developments by enabling Megabase-scale engineering of plant genomes. Experimentally-determined lists of essential genes have been crucial for such large-scale projects in other species but are currently unavailable in plants. Therefore, the OMEGA project needs to determine which plant genes are essential for growth and development. However, the standard technologies used to identify essential genes are limited by genetic interactions (e.g. redundancy, synthetic lethality). My group is developing multiplex CRISPR screens in plants to specifically overcome these limitations. The OMEGA project will use this capability to identify genome-wide essential genes and genetic interactions in Physcomitrium patens. This will be the first systematic genetic interaction screen in plants and will likely identify interactions conserved across the green lineage. The OMEGA project will also develop technologies to move, edit, and delete DNA at the Megabase scale. As proof-of-concept, I aim to reduce ~10% of the P. patens genome and remove all non-essential DNA from one chromosome. The SCRaMbLE system will be adapted for P. patens and used as an alternative approach to minimize chromosomes and also perform in planta directed evolution. Lastly, we will use a DNA assembly method developed in my lab to build biosynthetic pathways in vivo using modular DNA assembly methods. These tools will create opportunities to explore fundamental aspects of genomics, chromosomal biology and synthetic biology. The objectives of project OMEGA are necessarily ambitious as these technologies will allow us to perform controlled, Megabase-scale engineering projects in plant genomes not possible with the current generation of genome editing tools.

Link to the ERC project webpage:

Keywords of the ERC project: genome editing, CRISPR, genetic interactions, synthetic biology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101044320	**switchDecoding**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Tim Nicolai Siegel**
Host Institution:	Ludwig-Maximilians-Universitaet Muenchen - DEU

Decoding the path to cellular variation within pathogen populations

Heterogeneity amongst isogenic cells is pervasive throughout biology. Recently developed single-cell omics approaches are beginning to systematically reveal the repertoire of functionally distinct cell subpopulations within metazoan tissues. Pathogens frequently encounter changing and often hostile environments. To adapt to these challenges unicellular pathogen populations also exhibit a large degree of cell-to-cell heterogeneity, which often affects the outcome of infections. Yet, despite the importance of this cell-to-cell variation, very little is known about the mechanisms that control the level of heterogeneity in pathogen populations or why some isogenic populations are more heterogeneous than others. The goal of switchDecoding is to unveil the path to cellular variation. To this end I will go beyond identifying and describing new subpopulations of cells and elucidate the molecular pathways that establish them and modulate the level of cellular heterogeneity. As a model I will study the mechanism responsible for creating heterogeneity in surface antigen expression in the unicellular parasite Trypanosoma brucei. Antigenic variation is a widely employed strategy by evolutionarily divergent pathogens to evade the host immune response. Using a multidisciplinary approach, I will develop and combine single-cell multi-omics, lineage tracing and CRISPR-Cas-based genome manipulation strategies to characterize the processes, pathways and molecules regulating antigen switching in T. brucei. A better understanding of the mechanisms affecting the level of heterogeneity within a pathogen population will enable us to better predict how pathogens adapt to environmental challenges, including those that lead to the emergence of drug resistance. In the future this knowledge will enable the development of novel intervention strategies: drugs that modulate cell-to-cell heterogeneity to facilitate the clearance of infections.

Link to the ERC project webpage: http://siegel-lab.de

Keywords of the ERC project: temporal omics, lineage tracing, scRNA-seq, infectious diseases, antigenic variation

Keywords that characterize the scientific profile of the potential visiting researcher/s: experience in microfluidics, scRNA-seq, expension microscopy, raman microscopy or super resolution microscopy
interest in infectious diseases and gene expression

Project ID:	Project Acronym:	Evaluation Panel:
101045527	**bacRBP**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Cynthia Sharma**
Host Institution:	Julius-Maximilians Universitaet Wuerzburg - DEU

Exploring the expanding universe of RNA-binding proteins in bacteria

All organisms use diverse modes of cellular control as they cope with changing environments. Central to these processes are RNA-binding proteins (RBPs) that impact the stability, translation, or localization of bound RNAs. While RBPs typically have distinct RNA-binding domains, a growing number of proteins that lack these domains are found to interact with RNA as well. In prokaryotes, such unconventional RBPs remain largely unexplored, in part because methods for global RNA interactome capture (RIC) in bacteria are missing. My group recently made a breakthrough in developing a novel RIC approach for bacteria that relies on primary transcript capture (CoCAP). Our pilot study successfully captured known RBPs but also uncovered numerous new RBP candidates, including metabolic or cell division proteins. We also identified a pair of widespread KH-domain proteins (KhpA/B) with links to the RNA degradosome and cell division. This points towards a wealth of unexplored RBPs involved in cellular control in bacteria.

My ERC CoG proposal aims to explore the identity and functional diversity of novel RBPs in bacteria. My overarching hypothesis is that a vast, unexplored universe of unconventional RBPs exists in bacteria that play crucial roles in cellular physiology. I will tackle this through three objectives leveraging two model bacteria (Salmonella and Campylobacter) with different sets of canonical RBPs. I propose to:

1) Elucidate bacterial primary RBPomes during stress- and infection-relevant conditions.
2) Identify mechanisms and cellular functions of two widely conserved KH-domain RBPs.
3) Determine how cell division RBPs influence and are influenced by bound RNAs.

Our proposed work will provide a broadly applicable method for primary RBPome capture and vastly expand the set of bacterial RBPs. Their characterization in turn will reveal new layers of cellular control and establish new targets for industrial strain engineering and antimicrobial treatments.

Link to the ERC project webpage:

Keywords of the ERC project: RNA biology, microbiology, RNA biochemistry, RNA binding proteins, gene regulation, bacterial pathogens

Keywords that characterize the scientific profile of the potential visiting researcher/s: RNA biology, RNA biochemistry, molecular biology, microbiology

Project ID:	Project Acronym:	Evaluation Panel:
101054341	**GenRevo**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Stefan Mundlos**
Host Institution:	Charite - Universitaetsmedizin Berlin - DEU

Genetic Engineering of Regulatory Evolution

The regulation of genes is generally accepted to play a key role in shaping phenotypes. However, how regulatory sequence encodes complex morphological structures remains unsolved. This is due to our lack of understanding of how enhancers, promoters, and other regulatory components work together to control and fine-tune gene expression. As such, one of the major challenges of the post-genomic era is to uncover the sequence code that controls gene expression and, ultimately, the phenotype. In GenRevo, I propose to study the genomics of an extreme example of evolutionary adaption, the wings of bats, as a model system to identify and functionally dissect how sequence determines phenotype. Our approach involves the genetic re-engineering of bat regulatory sequence in mice and their functional dissection to identify the essential components that govern gene expression and phenotype.

Based on an already generated comprehensive data set from mouse and bat limb buds, we will detect, re-engineer and dissect intra- and interspecies differences in regulatory landscapes linked to batwing development. In particular, we will 1) determine what non-coding features are essential for maintenance and/or change in gene expression, 2) reconstitute bat-specific regulatory landscapes in mice by genome engineering synthetically produced large DNA sequences, 3) dissect how genomic changes translate into altered gene expression and phenotypes on cellular and regulatory level, and 4) create de novo designer regulatory landscapes that can be used as a testbed for experimental perturbations.

Collectively, GenRevo will produce ground-breaking knowledge in our understanding of how gene regulatory units work in vivo and how variants influence phenotypes. The possibility to re-engineer sequences in another species will spark a technological revolution in the functional analysis of mammalian genomes, particularly regarding the function of non-coding DNA in human diseases, traits, and evolution.

Link to the ERC project webpage: https://www.molgen.mpg.de/Development-and-Disease

Keywords of the ERC project: evolutionary genomics, bat wings, gene regulation, genome engineering

Keywords that characterize the scientific profile of the potential visiting researcher/s: molecular biology, bioinformatics, developmental biology, evolutionary genomics

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Project ID:	Project Acronym:	Evaluation Panel:
835243	**Sperm-Egg Phusion**	**LS3** Cellular, Developmental and Regenerative Biology

Principal Investigator:	**Dr Kodi Ravichandran**
Host Institution:	Vib - BEL

Unexpected connections between a phagocytic machinery and mammalian fertilization

Fertilization is essential for a species to survive. Mammalian sexual reproduction requires the fusion between the haploid gametes sperm and egg to create a new diploid organism. Although fertilization has been studied for decades, and despite the remarkable recent discoveries of Izumo (on sperm) and Juno (on oocytes) as a critical ligand:receptor pair, due to the structure of Izumo and Juno, it is clear that other players on both the sperm and the oocytes must be involved. While the focus of our laboratory over the years has been in understanding apoptotic cell clearance by phagocytes, we accidentally noted that viable, motile, and fertilization-competent sperm exposes phosphatidylserine (PtdSer). PtdSer is a phospholipid normally exposed during apoptosis and functions as an 'eat-me' signal for phagocytosis. Further, masking this PtdSer on sperm inhibits fertilization in vitro. Based on additional exciting preliminary data, in this ERC proposal, we will test the hypothesis that PtdSer on viable sperm and the complementary PtdSer receptors on oocytes are key players in mammalian fertilization. We will test this at a molecular, biochemical, cellular, functional, and genetic level. From the sperm perspective — we will ask how does PtdSer changes during sperm maturation, and what molecular mechanisms regulate the exposure of PtdSer on viable sperm. From the oocyte perspective — we will test the genetic relevance of different PtdSer receptors in fertilization. From the PtdSer perspective — we will test PtdSer induces novel signals within oocytes. By combining the tools and knowledge from field of phagocytosis with tools from spermatogenesis/fertilization, this proposal integrates fields that normally do not intersect. In summary, we believe that these studies are innovative, timely, and will identify new players involved in mammalian fertilization. We expect the results of these studies to have high relevance to both male and female reproductive health and fertility.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
835312	**PLASTINET**	**LS3** Cellular, Developmental and Regenerative Biology

Principal Investigator:	**Dr A Smith**
Host Institution:	The University Of Exeter - GBR

Plasticity of the Pluripotency Network

A few days after fertilisation mammalian embryos form a blastocyst comprised of three tissues; trophoblast and hypoblast are the forebears of extraembryonic structures, while naive epiblast cell are the pluripotent source of the embryo proper. Classical mouse embryological studies indicate that lineage potencies are determined concomitant with segregation of the three founder tissues. Textbook definitions of pluripotency thus exclude extraembryonic potential. Consistent with this paradigm, mouse embryonic stem cells are generally ineffective in producing trophoblast or hypoblast derivatives. However, we have discovered that human naïve pluripotent cells have high intrinsic competence for trophoblast formation. Furthermore, unlike in mouse, extraembryonic transcription factors are present in human epiblast in vivo. These findings challenge the dogma of early lineage restriction but may be compatible with the ancestral origin of pluripotency. We hypothesise that extraembryonic plasticity underlaid by entwined regulatory networks is the evolutionary template of pluripotency. Consequently, signal modulation to suppress extraembryonic specification may be crucial for capture of stem cells representative of naïve epiblast in most mammals. We will examine human and non-human primates, farm animals in which embryos undergo extended development before implantation, and a marsupial in which pluripotent cells are generated from the trophoblast. In a cross-disciplinary approach we will employ transcriptomics, embryo and stem cell experimentation, and formal computational modelling to uncover the core biological program moulded by evolution into different forms. We aim to establish hitherto elusive chimaera-competent embryonic stem cells from species of importance for research, biomedical applications and livestock improvement. We will obtain fresh insight into the molecular logic governing early development, lineage plasticity, pluripotent identity, and stem cell self-renewal.

Link to the ERC project webpage: https://lsi.exeter.ac.uk/groups/smith-group/

Keywords of the ERC project: Pluripotency, stem cells, livestock, non-human primates, early development, transcriptomics, gene regulatory networks

Keywords that characterize the scientific profile of the potential visiting researcher/s: Bioinformatics; single cell 'omics; molecular cell biology; embryology; reproductive biology; stem cell biology

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Project ID:	Project Acronym:	Evaluation Panel:
835322	**CENGIN**	**LS3** Cellular, Developmental and Regenerative Biology

Principal Investigator:	**Dr Pierre Gönczy**
Host Institution:	Ecole Polytechnique Federale De Lausanne - CHE

Deciphering and engineering centriole assembly

Deciphering and engineering the assembly of cellular organelles is a key pursuit in biology. The centriole is an evolutionarily conserved organelle well suited for this goal, and which is crucial for cell signaling, motility and division. The centriole exhibits a striking 9-fold radial symmetry of microtubules around a likewise symmetrical cartwheel containing stacked ring-bearing structures. Components essential for generating this remarkable architecture from alga to man have been identified. A next critical step is to engineer assays to probe the dynamics of centriole assembly with molecular precision to fully understand how these components together build a functional organelle. Our ambitious research proposal aims at taking groundbreaking steps in this direction through four specific aims:

1) Reconstituting cartwheel ring assembly dynamics. We will use high-speed AFM (HS-AFM) to dissect the biophysics of SAS-6 ring polymer dynamics at the root of cartwheel assembly. We will also use HS-AFM to analyze monobodies against SAS-6, as well as engineer surfaces and DNA origamis to further dissect ring assembly.

2) Deciphering ring stacking mechanisms. We will use cryo-ET to identify SAS-6 features that direct stacking of ring structures and set cartwheel height. Moreover, we will develop an HS-AFM stacking assay and a reconstituted stacking assay from human cells.

3) Understanding peripheral element contributions to centriole biogenesis. We will dissect the function of the peripheral centriole pinhead protein Cep135/Bld10p, as well as identify and likewise dissect peripheral A-C linker proteins. Furthermore, we will further engineer the HS-AFM assay to include such peripheral components.

4) Dissecting de novo centriole assembly mechanisms. We will dissect de novo centriole formation in human cells and water fern. We will also explore whether de novo formation involves a phase separation mechanism and repurpose the HS-AFM assay to probe de novo organelle biogenes

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
851080	**MYOCLEM**	**LS3** Cellular, Developmental and Regenerative Biology

Principal Investigator:	**Dr Ori Avinoam**
Host Institution:	Weizmann Institute Of Science - ISR

Elucidating the Molecular Mechanism of Myoblast Fusion in Vertebrates

Cell-to-cell fusion is a ubiquitous phenomenon essential for the physiological function of numerous tissues. A striking example is the fusion of myoblasts to form multinucleated myofibers during skeletal muscle development and regeneration. During myoblast fusion, membrane architecture must be radically remodeled. Yet, how membrane remodeling occurs on the molecular level is poorly understood as, until now, there was no approach available for visualizing dynamic changes in the cellular ultrastructure and the organization of the fusion machinery in situ.

To fill this gap, we have developed correlative light and 3D electron microscopy (CLEM) methods that allow us to identify fluorescent signals within EM samples with high sensitivity and subsequently localize the source of these signals with high precision. In this proposal, we will apply these methods in combination with live-cell imaging, biochemistry and cryo-electron tomography (ET) to deliver fundamental knowledge about the mechanism of myoblast fusion. Our specific aims are:

Aim 1: To resolve the molecular and ultrastructural events underlying cell fusion, by revealing how plasma membrane architecture is remodeled at sites of fusion using 3D EM.

Aim 2: To dissect the mechanism driving membrane remodeling during fusion, by visualizing how the fusion machinery assembles at sites of fusion and how its assembly is mirrored by changes in membrane shape, using biochemistry and live-cell imaging.

Aim 3: To determine the structure of the fusion machinery in situ, by using cryo-ET and subtomogram averaging.

Our synergetic experimental strategy will generate a quantitative, dynamic high-resolution view of the fusogenic synapse of vertebrate muscle, revealing how the fusion machinery remodels the plasma membrane at sites of fusion. These data are vital for deriving a biophysical model of myoblast fusion, understanding the general mechanism of cell fusion, and developing strategies to treat primary muscle diseases.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
852136	**LIP-ATG**	**LS3** Cellular, Developmental and Regenerative Biology

Principal Investigator:	**Dr Amelie Bernard**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

The missing link: how do membrane lipids interplay with ATG proteins to instruct plant autophagy

Autophagy is an intracellular catabolic process critical to eukaryotic life and indispensable for plant survival to drought, nutrient scarcity or pathogen attacks. Autophagy relies on the formation of specialized vesicles called autophagosomes (AP) which engulf and deliver cell components to the lytic vacuole. AP biogenesis is carried out by a group of dedicated proteins (named ATG) and hinges on intense remodelling events and on the remarkable capacity of an initial membrane, the phagophore, to assemble de novo, shape like a cup, expand while maintaining structure and function and re-shape to a complete vesicle. To date the molecular mechanisms underlying these events remain elusive. Research has focused on the role of autophagy proteins but, despite AP biogenesis being a membrane-based process, the fundamental contributions of lipids to AP membrane formation, identity and activities have been largely unexplored; in other words, when it comes to AP formation we are only looking at half of the picture.

I propose to address the fundamental question of how APs form and shape from a novel angle: by exploring how lipids' nature, dynamics and lateral heterogeneity instruct the phagophore structure, its protein composition and its functions. The project builds on our recent results and expands on strategies that we have developed, integrating proteomic/bioinformatic approaches, lipidomics and high-resolution 3D imaging. We will tackle 3 complementary objectives: 1) Reveal the dynamic lipid signature of the phagophore, 2) Elucidate the implication of lipids nature and repartition in the phagophore ultrastructure, 3) Decrypt the molecular mechanisms by which lipids interplay with ATG proteins to control autophagy activity and plant physiology. Overall the project will articulate an integrated vision of the molecular processes controlling autophagy and provide fundamental knowledge in our understanding of plant adaptive programs.

Link to the ERC project webpage:

Keywords of the ERC project: autophagy, lipid, membrane, plant

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
949500	**BehaEvoDevo**	**LS3** Cellular, Developmental and Regenerative Biology

Principal Investigator:	**Dr Nikolaos Konstantinides**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Evolution of neuronal cell types, development and circuitry in the insect visual system: breaking down behavioural evolution into its constituent elements

One of the holy grails of neuroscience is to understand how complex behaviours arise. However, surprisingly little is known about how behaviours evolve. My proposal will delve into Behavioural Evolution and Development (BehaEvoDevo) in an unbiased and comprehensive way using the insect visual system as a model. The visual system of Drosophila has been described extensively in terms of cell type composition, development, circuitry, and behaviour. My expertise in this system will be the springboard to address four fundamental questions: 1) How different is the cell type composition in the brains of different animals? 2) How do the mechanisms that are responsible for neuronal development evolve and how do they affect neuronal diversity? 3) What are the differences in the circuitry that underlies specific behaviours in different animals? 4) How do differences in neuronal composition, neuronal features, or circuitry drive different behaviours? I will combine cutting edge techniques, such as single-cell sequencing, with advanced genetic tools in Drosophila, and adapt innovative tools for genetic manipulation and circuit function in different non-model insects. I will compare how cell type composition, neuronal specification and differentiation, as well as circuitry, affect specific behaviours. I will examine phylogenetically diverse insects to generate a deep understanding of the mechanisms that are most important for the evolution of different behaviours. Moreover, I will identify fundamental principles about how developmental processes, such as neuronal specification and differentiation, evolve to control different behaviours. The cumulative results of this proposal will offer the first comprehensive assessment of the mechanisms that drive evolution of new behaviours across insects; it will also generate a blueprint for the community to compare their data in different clades of the phylogenetic tree as well as to different sensory modalities.

Link to the ERC project webpage:

Keywords of the ERC project: Comparative developmental neurobiology, drosophila, single-cell sequencing, evolution

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
950254	**MOVE_ME**	**LS3** Cellular, Developmental and Regenerative Biology

Principal Investigator:	**Dr Elias Barriga**
Host Institution:	Fundacao Calouste Gulbenkian - PRT

Mechanical and Electrical Guidance of Collective Cell Migration in vivo

Directional collective cell migration (dCCM) is key for cellular clusters to reach their target tissues in embryogenesis, tissue repair, and metastasis. Though cells interact with chemical and physical cues when migrating in vivo, the field has mostly focused on studying the chemical guidance (chemotaxis) of dCCM- and the role of physical cues is underappreciated. As chemotaxis is not sufficient to explain dCCM in native contexts, the mechanisms that guide dCCM in vivo remain unclear. Thus, our overall goal is to challenge the classic chemocentric view by addressing whether and how biophysical cues such as mechanical and electrical signals contribute to dCCM in vivo. To tackle this challenging aim, we will study durotaxis (mechanical guidance) and electrotaxis (electrical guidance) at two levels: i) Tissue level, to map mechanical and electrical properties in vivo and test their relative contribution to dCCM and ii) Cellular level, to explore the mechanisms by which cells respond and integrate these biophysical cues. To address this, we will take advantage of the innovative toolbox we developed to study mechanical and electrical cues in vivo. As dCCM occurs in different biological contexts, we propose to generalise our results by studying dCCM of Xenopus neural crest (NCs) in embryogenesis (WP1, WP2), and the migration of the recently discovered Regeneration Organizing Cells (ROCs) in Xenopus tail regeneration (WP3). Demonstrating durotaxis and electrotaxis in vivo has proven to be a challenging goal. Thus, we expect our research to be a breakthrough across fields, bringing new perspectives and tools to study the biophysics of dCCM in vivo for the first time. Finally, this proposal will open new research avenues for my lab and for the field, in which the interplay of biophysical and biochemical cues from the environment could be studied, paving the way to the formulation of a novel and more integrative view of dCCM, and other cell and developmental processes.

Link to the ERC project webpage:

Keywords of the ERC project: Mechanical and Electrical control of directed collective cell migration

Keywords that characterize the scientific profile of the potential visiting researcher/s: Xenopus, bioelectricity, mechanobiology, neural crest, regeneration organissing cells

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
950617	**NEUROSORTER**	**LS3** Cellular, Developmental and Regenerative Biology

Principal Investigator:	**Dr Ginny Farias**
Host Institution:	Universiteit Utrecht - NLD

Uncovering the machinery for the sorting of newly synthesized proteins into the axon

Neuronal development and function rely on the polarized distribution of organelles and transmembrane proteins (cargoes) across their somatodendritic and axonal domains. However, it is unknown how organelle organization regulates the polarized sorting of transmembrane proteins to ensure proper neuronal function.

The classical model for sorting of newly synthesized transmembrane proteins to the plasma membrane (PM) follows the biosynthetic pathway via the rough endoplasmic reticulum (ER) and Golgi, which are restricted to the somatodendritic domain in neurons. It is unclear whether this classical secretion pathway is the main route for cargo sorting into the axon or whether an alternative route to the axon is used for most axonal cargoes. Intriguingly, evidence indicates that cargoes can bypass the Golgi for their sorting to the axonal PM. However, the identity of an unconventional secretory pathway has not been demonstrated yet. Here, I propose that selective machinery, including the axonal ER and undefined intermediate compartments, allows local axonal cargo secretion.

Previously, I advanced our knowledge on Golgi-dependent sorting of somatodendritic cargoes and elucidated the mechanisms behind ER organization in neurons. Here, for the first time we will:

1) Identify the sorting routes for newly synthesized axonal proteins
2) Unravel the machinery required for Golgi-independent cargo sorting into the axon, and
3) Elucidate its impact on neuronal development and function

We will use high spatio-temporal resolution imaging and mass-spectrometry combined with novel strategies to control and track cargo secretion, as well as proximity-based labeling to identify key players in the newly identified machinery.

A broad spectrum of human diseases is associated to cargo Golgi-bypass. Neurons offer a unique advantage in spatial resolution to characterize this unconventional route, which could play a key role in human health and disease.

Link to the ERC project webpage:

Keywords of the ERC project: neurons, protein trafficking, endoplasmic reticulum, biosynthetic pathway

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101039531	**SyncyNucDiff**	**LS3** Cellular, Developmental and Regenerative Biology

Principal Investigator:	**Dr Minchul Kim**
Host Institution:	Institut National De La Sante Et De La Recherche Medicale (Inserm) - FRA

The biology of syncytial cells: Dissecting the mechanisms and functions of nuclear differentiation inside skeletal muscle syncytium

Due to their cellular anatomy, syncytial cells face many unique challenges that mono-nucleated cells do not. One of them is how syncytial cells organize gene expression among many nuclei in a shared cytoplasm. How such property is linked to their biological functions remains poorly understood. Using the skeletal muscle as a paradigm and single-nucleus transcriptomics, I recently uncovered previously unrecognized diversity and dynamics of myonuclear transcriptional programs. This conceptualized the syncytial muscle cell itself as an analog of multi-cellular tissue where individual nuclei are counterparts of differentiated cell types. My findings raise two important and unanswered questions. 1) How are the diverse nuclear identities specified and maintained? And 2) What are the functional contributions of the diverse nuclear subtypes in health and disease? I will first focus on the nuclei at the neuromuscular junction (NMJ) and myotendinous junction (MTJ), which are responsible for initiation of contraction and dissipation of contractile force, respectively. Despite their well-established functions, the mechanisms that specify or maintain them are sparsely understood. I will investigate how chromatin architecture and transcriptional regulators govern their identities. I will then characterize the upstream signalling pathways from motor neuron or tendon cells that activate the specific transcriptional programs. So far, genetic manipulation of myofibers have targeted entire muscle nuclei. To overcome this limit, I will develop tools that allow genetic manipulation in specific nuclear subtypes. Previous works had identified a new nuclear subtype associated with muscular dystrophy and a transient time window during postnatal development. I will characterize the function of these nuclei using a method that abolishes their transcriptional activities. The approaches to be developed here will pave the way to understanding the pathophysiology of syncytial cells in the future.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101039998	**UnderPressure**	**LS3** Cellular, Developmental and Regenerative Biology

Principal Investigator:	**Dr Morgan Delarue**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Elucidating the phenotypic convergence of proliferation reduction under growth-induced pressure

Growth-induced pressure necessarily emerges when a cell population, whichever the organism, proliferates in a 3D spatially-limited environment. Growth-induced pressure imposes physical constraints on cell physiology. A reduction of growth and division is observed in evolutionarily distant organisms such as bacteria, fungi, plants, or mammals. However, some cells are more capable of coping with these physical limitations and proliferate than others. This is in particular the case of cancer cells, for which growth-induced pressure participates in tumorigenesis and chemoresistance. Despite its importance, we are still at a loss to identify the basic sensing mechanisms associated with 3D proliferation under pressure.

It is notably unclear if the mechanical control of proliferation stems from specific signaling or is a consequence of associated changes in the physical properties of cells. The goal of UnderPressure is to elucidate the phenotypic convergence of the mechanical-control of cell proliferation. We hypothesize that a large part of proliferation reduction comes from the physical limits imposed by the obligatory increase of macromolecular crowding under 3D confinement. Crowding relates to the high fraction of macromolecules in the cell and has the potential to kinetically alter biochemical reactions. We expect crowding to limit key processes associated with growth and division, and to elicit specific signaling essential to circumvent these limitations.

Using unique microfluidic devices, we will investigate in bacteria, fungi, and mammalian cells how compressive forces physically limit growth and division and unravel the signaling pathways associated with the control of cell proliferation. We will mainly focus on crowding, investigate its consequences and its link with other physical properties such as membrane tension. We will use this knowledge to control cell proliferation in 3D compressed tumors, with the hope to notably reduce chemoresistance.

Link to the ERC project webpage: https://delarue-research.org

Keywords of the ERC project: microfluidics, mechanobiology, cancer, microbiology, cell growth, molecular crowding

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101042198	**HOT-AND-COLD**	**LS3** Cellular, Developmental and Regenerative Biology

Principal Investigator:	**Dr Petra Marhava**
Host Institution:	Sveriges Lantbruksuniversitet - SWE

How plants deal with heat and cold: Molecular mechanisms of auxin transport and signaling in response to temperature stress

Ambient temperature above or below a threshold can adversely affect plant growth and development, and even lead to death. The tightly regulated distribution of the hormone auxin throughout the plant body controls an impressive variety of developmental processes that tailor plant growth and morphology to environmental conditions. Although non-optimal ambient temperature can alter auxin transport, the precise nature of this alteration and the underlying molecular mechanisms remain enigmatic. Hence, the aim of HOT-AND-COLD is to dissect the molecular mechanisms involved in auxin transport and its downstream signaling upon temperature stress, down to the tissue and cell-type-specific level, focusing on the root of the model organism Arabidopsis thaliana. To achieve this aim, I will combine high-resolution imaging techniques integrated with a temperature-controlled stage system, mass-spectrometry-based phosphoproteomics, TRAP-seq and chemical screens in a multifaceted approach that has never been used for such a study in plant root systems. Using this approach, I expect to reveal: (i) the temperature-responsive phosphoproteome of membrane proteins; (ii) the link between changes in membrane fluidity and the dynamics of auxin transport components within the plasma membrane; (iii) cell-type-specific translatomes that orchestrate auxin transport upon temperature shock as well as in the gradual temperature stress response; and (iv) sensors and components of the signaling pathways controlling plant acclimation to temperature stress. Taken together, the fundamental knowledge obtained through this research will contribute to the mechanistic understanding of plant responses to the temperature variability that will accompany climate change. Such understanding is key for anticipating the impacts of climate variability on agricultural and natural ecosystems.

Link to the ERC project webpage:

Keywords of the ERC project: Arabidopsis, temperature stress, auxin transport, plasma membrane

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101043370	**RIBORESCUEPHAGY**	**LS3** Cellular, Developmental and Regenerative Biology

Principal Investigator:	**Dr Yasin Dagdas**
Host Institution:	Gregor-Mendel-Institut Für Molekulare Pflanzenbiologie Gmbh - AUT

How does autophagy rescue stalled ribosomes?

Multiple ribosomes simultaneously move along the mRNAs to translate the genes into proteins. Cellular stress triggers collisions of ribosomes and disrupts protein synthesis. Eukaryotes have evolved multi-tiered quality control mechanisms that monitor ribosomes and rescue them on collision. While much is known about the rescue of cytosolic ribosomes, how the cell rescues stalled endoplasmic reticulum bound (ER-bound) ribosomes remains unknown. We recently discovered that the stalling of ER-bound ribosomes induces autophagy, a major cellular degradation pathway. We discovered two autophagy receptors that are induced upon stalling of ER-bound ribosomes and these proteins are conserved between plants and humans. We also showed that ufmylation, an elusive posttranslational modification system regulates ER-bound ribosome stalling-induced autophagy. These two discoveries indicate that autophagy plays a major role in the maintenance of a functional ER-bound ribosome population. Based on these discoveries, I hypothesize that autophagy rescues stalled ER-bound ribosomes by selectively degrading harmful polypeptides and RNAs that clog the ribosomes during collisions. Here, I propose to define and characterize this conserved quality control mechanism. I will establish a suite of complementary methods in the model plants Arabidopsis thaliana and Marchantia polymorpha to explore the physiological significance of autophagy-mediated ribosomal rescue (RiboRescuePhagy) in complex multicellular organisms. In parallel, I will carry out unbiased genetic screens in human cell lines to discover the molecular components that mediate RiboRescuePhagy. Finally, I will perform structure-function analysis of a key ufmylation enzyme to untangle the connection between ufmylation and autophagy. At the completion of this project, we will have defined a new quality control mechanism that rescues stalled ER-bound ribosomes to maintain cellular homeostasis in eukaryotes.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101078291	**KaryodynEVO**	**LS3** Cellular, Developmental and Regenerative Biology

Principal Investigator:	**Dr Gautam Dey**
Host Institution:	EUROPEAN MOLECULAR BIOLOGY LABORATORY - DEU

Evolutionary principles of nuclear dynamics and remodelling

Every eukaryote has a nucleus, a double lipid membrane-bound compartment that encapsulates the genome, but almost every nucleus is different - in shape, size, molecular composition, spatial organisation, and dynamics through the cell cycle. Given its fundamental and universal functional roles in protecting the DNA and regulating the exchange of information and control machinery between genome and cytoplasm, one might ask the question: why are there so many ways to build and remodel a nucleus? Bringing together comparative genomics, phylogenetics, quantitative cell biology and experimental evolution in multiple microbial model systems drawn from across the eukaryotic tree, we set out to elucidate the genomic, biophysical and evolutionary factors that determine nuclear dynamics and remodelling - karyodynamics - within the context of cellular architecture and function. A comparative perspective driven by phylogenetics will enable us to separate universal principles of karyodynamics from species- and niche-specific adaptations, and dissect the reasons for the evolutionary and developmental plasticity that we observe experimentally. In turn, we can use these principles to infer, predict and validate phenotypes in novel and emerging model systems. Finally, a more comprehensive understanding of the mechanisms responsible for karyodynamic phenotypic diversity would allow us to reconstruct evolutionary trajectories all the way back to the origins of the nuclear compartment, a landmark event in the evolution of eukaryotes from an archaeal-bacterial symbiosis over 2 billion years ago.

Link to the ERC project webpage:

Keywords of the ERC project: evolutionary cell biology; nuclear organisation; cell division; mitosis; protists; phylogenetics; comparative genomics; emerging model systems

Keywords that characterize the scientific profile of the potential visiting researcher/s: mitosis; protists; phylogenetics; comparative genomics; emerging model systems

Project ID:	Project Acronym:	Evaluation Panel:
771431	**SympatimmunObesity**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Ana Domingos**
Host Institution:	The Chancellor, Masters And Scholars Of The University Of Oxford - GBR

Sympathetic and immune mechanisms underlying obesity

The era of molecular genetics has enabled the mechanistic dissection of brain circuits as well as the immune system in spectacular ways. However, the molecular and cellular organization of the sympathetic nervous system (SNS), which innervates all known organs, is essentially unexplored. In an attempt to push this frontier, we have recently uncovered a direct physical functional connection between the SNS and the adipose tissue. Further, we found this neuro-adipose junction to drive lipolysis and fat mass reduction (1). In this proposal we aim to define the molecular mechanisms that link SNS neurons, the immune system and the adipose tissue. A major entry point is our recent discovery of a novel population of Sympathetic Associated Macrophages (SAMs) that suppress the output of SNS. We propose to unravel their contribution to obesity in rodents (Aim 1) and in humans (Aim 2). Another major objective of this proposal is to establish a functional and molecular neuronanatomical map of the SNS, which defines subpopulations of neurons that specifically innervate fat (Aim 3). To achieve this, we will build molecular genetics tools for rapid non-invasive optocoustic visualization and functional probing of SNS circuits. A molecular and realistic atlas of the SNS will allow us to systematically access the functional anatomy of one of the most elusive tissues of the mammalian body and will form a blueprint upon which our neuroimmune mechanistic studies can be build. Our identification of the fundamental biological mechanisms that govern the neuro-adipose junction will set the stage for a new anti-obesity therapy that would circumvent the challenge of drug delivery to the brain, i.e. by targeting an excitatory drug directly to SAMs or sympathetic inputs in adipose tissue.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
819543	**MetaboSENS**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Ganna Panasyuk**
Host Institution:	Institut National De La Sante Et De La Recherche Medicale (Inserm) - FRA

Metabolic integration by nutrient SENSing

Nutrient sensing enables metabolic homeostasis by matching energy use with fuel availability. The vast body of knowledge on pro-anabolic nutrient sensors, such as insulin and class 1 phosphoinositol-3 kinase (PI3K) signalling exposed the missing links in molecular coordination of catabolism. The cellular catabolism relies on mitochondrial activities and on lysosomal pathway of autophagy, both paced by the biological clock. However, how pro-catabolic nutrient sensors synchronize these catabolic activities is not well understood. We discovered that class 3 PI3K, the only PI3K present in all eukaryotes, is essential for catabolic homeostasis in vivo, but the mechanisms of its metabolic functions are still lacking. We found novel roles for class 3 PI3K in metabolic adaptation to fasting and mitochondrial activity, beyond its established functions in autophagy and endosomal trafficking. These findings form the basis of our innovative interdisciplinary research program that will investigate the molecular bases of Metabolic integration in vivo by a nutrient SENSing pathway of class 3 PI3K (MetaboSENS). In the MetaboSENS research program, we seek to identify transcription factor networks and regulatory complexes of class 3 PI3K that serve its catabolic integrator function. We aim to reveal the physiological oscillation of class 3 PI3K signalling and its reciprocal impact on metabolic timekeeping. Finally, the MetaboSENS project will combine patient analyses and the medical expertise of my team to reveal, for the first time, genetic alterations in class 3 PI3K signalling in inborn metabolic disease. The new mechanisms that we discover may provide therapeutic targets that we will test in the pre-clinical models. Altogether, the MetaboSENS project will redefine our view of systemic catabolism.

Link to the ERC project webpage: www.panasyuklab.fr

Keywords of the ERC project: nutrient sensing, metabolic adaptation to nutrient stress, intergative physiology, PI3K signalling, gene expression control by metabolic pathways

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
852742	**PROTEOFIT**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Alexander Bartelt**
Host Institution:	Ludwig-Maximilians-Universitaet Muenchen - DEU

Adapting protein fate for muscle function and fitness

Muscle function is essential for motion, exercise, and shivering, whereas physical inactivity is causally related to reduced metabolic fitness in animal models and humans. A critical requirement for muscle function is that proteins are properly produced and, if necessary, degraded to adapt the proteome to meet metabolic demands. However, there is a fundamental, open gap in understanding how challenges to muscle proteostasis are sensed and how protein fate is subsequently adapted to enhance muscle function in exercise or, conversely, how it is compromised in obesity. I hypothesize that protein fate is highly adaptive and can be fine-tuned to promote proteostasis, the integrity of muscle cells, and metabolic health. Identifying novel key regulators of these mechanisms in muscle may hold great therapeutic promise for targeting metabolic fitness to combat obesity and associated disorders. In this innovative project I want to define new mechanisms of muscle adaptation in humans and preclinical mouse models, with the ultimate goal of using this knowledge to improve muscle function and fitness in obesity. I will identify exercise- and obesity-specific substrates of the proteasome by ubiquitomics in human and mouse muscle and define how the ubiquitination and turnover of these proteins dictates muscle cell function. In a complementary approach, I will use novel loss- and gain-of-function mouse models allowing for precise muscle-specific manipulation of Nfe2l1, an adaptive regulator of proteasomal protein degradation, to define the biological and therapeutic significance of this pathway for muscle function in exercise and obesity. In summary, this novel work will provide a transformative molecular understanding of muscle adaption to metabolic challenges and provide insight into how this translates into metabolic fitness and the development of obesity and associated disorders in humans.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
852761	**ONco-Energetics_OFF**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Mohamed Elgendy**
Host Institution:	Technische Universitaet Dresden - DEU

Dissection of Bioenergetic Plasticity of Tumors

Tumors reprogram their metabolism to fuel rapid growth. Glycolysis and oxidative phosphorylation "OXPHOS" are the main energy-producing pathways. For decades, metabolic reprogramming of tumors was perceived as only increased glycolysis (Warburg effect). This dogma has recently been revised as we started to realize the importance of OXPHOS in tumor metabolism. We are now entering a new era as metabolomics studies show that tumor metabolism is more heterogeneous than initially assumed. In the preparatory phase of this proposal, using an integrated transcriptional and metabolic profiling, a panel of cancer cell lines was first classified according to the bioenergetic pathway they predominantly utilize (glycolysis or OXPHOS). Second, the response of glycolytic and OXPHOS-dependent cells to the inhibition of their wired bioenergetic program was assessed. My findings show that regardless of their dependency at baseline, cancer cells can be collectively categorized according to their adaptability into "bioenergetically-committed" to one of the two pathways or "bioenergetically-plastic" cells which are able to switch from one to the other upon metabolic challenges. This proposal uses an integrated system approach to dissect the molecular signature, regulation and implications of bioenergetic plasticity. We will answer three key questions:
1-Why some cancer cells are bioenergetically-plastic while others are committed? What are the differences in metabolic machineries and oncogenic switches between both?
2-How heterogeneous tumor cell subpopulations are in terms of bioenergetic plasticity? Does metabolic crosstalk contribute to bioenergetic plasticity of tumors?
3-What are the implications of bioenergetic plasticity in drug resistance and metastasis and finally how to design approaches to target this plasticity?
Only handful drugs targeting tumor energetics have made it to clinical use. ONco-Energetics_OFF has a realistic and immediate translational potential.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/852761

Keywords of the ERC project: cancer metabolism, tumor, drug resistance, metastasis

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
866240	**EXPLOSIA**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Jacob Bentzon**
Host Institution:	Aarhus Universitet - DNK

EXpansion and Phenotype Loss Of SMCs In Atherosclerosis: Causal effects and therapeutic possibilities

Atherosclerosis is considered an inflammatory disease caused by the accumulation, modification and immune cell recognition of low-density lipoproteins in the arterial wall. Plaque macrophages are held to be the main drivers of disease activity, whereas smooth muscle cells (SMCs) have traditionally been considered protective by forming fibrous tissue that stabilises plaques from undergoing rupture and causing thrombosis.

In the present project, we challenge this dichotomous view of cellular villains and heroes in atherosclerosis. Using lineage tracking techniques in mice, we and others have uncovered a large population of SMCs in plaques, which has escaped detection because the cells completely lose conventional SMC phenotype. Strikingly, we have found that the entire plaque SMC population derives from only few founder SMCs that undergo massive clonal expansion and phenotypic modulation during lesion formation. We hypothesise that the balance between the different modulated SMC subtypes and the functions they carry are central to lesion progression.

In EXPLOSIA we will address this hypothesis in 3 steps. First, we will conduct a comparative analysis of clonal structure in mice, minipigs, and humans. Second, we will determine links between SMC subtypes, their gene expression programs, and atherosclerotic disease activity by combining single-cell transcriptomics with novel techniques to alter atherosclerotic disease activity in gene-modified mice and minipigs. Third, we will develop techniques for manipulating genes in modulated plaque SMCs and test the causal role of perturbing SMC subtypes and function for lesion progression.

The aim of the project is to answer the following key questions for a deeper understanding of atherosclerosis:

- What is the clonal architecture of SMCs in human atherosclerosis?
- What is the SMC gene expression signature of atherosclerotic disease activity?
- Can interventions targeting SMCs prevent dangerous lesion development?

Link to the ERC project webpage: bentzonlab.org

Keywords of the ERC project: Atherosclerosis, smooth muscle cells

Keywords that characterize the scientific profile of the potential visiting researcher/s: Cell biologist, bioinformatics, animal models

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
945674	**CancerAneuploidy**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Uri Ben-David**
Host Institution:	Tel Aviv University - ISR

Understanding and targeting the functional consequences of aneuploidy in cancer

Aneuploidy, an imbalanced number of chromosomes or chromosome arms, is a distinct feature of cancer. Recent years have seen conceptual, methodological and technical advances in the field of cancer aneuploidy research, but we are just beginning to scratch the surface of the underlying biology, and the potential vulnerabilities of aneuploid cancer cells remain under-explored. Cancer aneuploidy is therefore a biological enigma and a missed opportunity for cancer therapy. Identifying the "Achilles heels" of aneuploidy remains a holy grail of cancer research. However, current models of aneuploidy fail to fully recapitulate the cellular consequences of aneuploidy in cancer, thus compromising the identification of aneuploidy-induced cellular vulnerabilities. The time is ripe to tackle cancer aneuploidy with state-of-the-art genomic and functional approaches. In this project, I propose to address the following key questions: 1) What forces shape the evolution of aneuploidy in tumors? We will integrate in silico analyses of clinical data, in vitro modeling in isogenic human cell lines, and in vivo experiments in mice, to elucidate how various cellular contexts shape the tumor aneuploidy landscape. 2) What cellular vulnerabilities are induced by aneuploidy? We will combine isogenic cell lines with large-scale genetic and chemical perturbation screens, in order to identify, validate, and mechanistically dissect vulnerabilities induced by aneuploidy in human cancer cells. These research aims fall well within my unique expertise. I mapped various aneuploidy landscapes and developed innovative experimental and computational tools for studying cancer aneuploidy. A successful completion of the project will shed light on the context-dependent cellular consequences of aneuploidy in cancer and provide proof-of-concept for its potential targeting. Ultimately, identifying aneuploidy-specific vulnerabilities will pave the way for the therapeutic exploitation of this hallmark of cancer.

Link to the ERC project webpage:

Keywords of the ERC project: Cancer, Genetics, Chromosomes, Genomic instability

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
949017	**StopWaste**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Maria Rohm**
Host Institution:	Helmholtz Zentrum Muenchen Deutsches Forschungszentrum Fuer Gesundheit Und Umwelt Gmbh - DEU

Targeting the crosstalk of lipid and glucose metabolism to stop cancer-associated wasting

Cachexia is the deadly outcome of many late stage cancers. It is characterized by severe wasting of adipose tissue and muscle mass, cardiac dysfunction and systemic inflammation. To date, no prognostic biomarker or efficient treatment against wasting is available, and ultimately 30% of all patients with cancer will die of cachexia. Hence, we have the critical unmet and urgent medical need of developing novel biomarkers and treatment options.

Until now, research has focused on targeting either tumor-derived secreted proteins or specific aspects of organ dysfunction such as muscle atrophy. StopWaste builds on recent advances of my group in targeting adipose tissue malfunction in cachexia. My current data support the new concept that tumors activate futile substrate cycling in adipocytes, which leads to an energy crisis that drives systemic metabolic dysfunction. Interestingly, similar to obesity, perturbed adipose tissue in cachexia causes the increased release of bioreactive signaling lipids such as C16:0 ceramides which appear before any wasting occurs. My recently established state-of-the-art multi-omics workflow to trace substrate cycling paired with the functional and clinical readouts of cachexia present in my lab now enable me to identify the molecular origin of these cycles and their impact on systemic metabolism. Using my established cell culture systems and multiple cachexia mouse models as well as patient samples, I will investigate (1) the origin of the altered circulating lipids and their potential as early cachexia biomarkers, (2) if they derive from perturbed adipocytes by futile cycling, and (3) if they drive insulin resistance which, in combination with the as-yet unknown tumor-islet axis I have identified, aggravates catabolism by lack of insulin anabolic signaling. In summary, StopWaste addresses the interplay of glucose and lipid metabolic pathways that lead to cachexia, providing for the first time a holistic signature of wasting metabolism.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101001355	**BEHAVIOME**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Omry Koren**
Host Institution:	Bar Ilan University - ISR

Aggression and the Gut Microbiome

Aggression is one of the most important social behaviors in nature for procreation and survival. However, understanding the underlying pathways and networks leading to aggression remains a major challenge. Although there has been some progress deciphering genetic factors and neural mechanisms influencing aggression, the precise networks and environmental factors controlling aggression remain a mystery. In this proposal, we suggest the novel concept that host aggression may be regulated in part by the microbiota. We and others have recently linked the gut microbiota, the overall constellation of microorganisms residing within our gut, to behaviors such as risk taking, mating and sexual behavior, as well as hormone production, regulation, and secretion. Here, we aim to characterize the effects of antibiotics, germ-free animal models, and specific microbes on aggression in flies and mice. We further hypothesize that these processes are mediated by pheromones, bacterial and host gene products, and host brain hormones, and will therefore test the involvement of these factors. Considering the microbiota as a novel element regulating aggression is an audacious concept. However, we have demonstrated in a preliminary study that elimination of the gut microbiota significantly raises aggression levels in both D. melanogaster and in mice, thereby providing strong initial support for our hypothesis that the microbiota is involved in regulation of aggression. Outcomes of this research will lead to a better understanding of the effects of microbiota on behavior in model systems, and open new horizons in recognition of pathways linking microbiota, hormones and aggression

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101002599	**NICCA**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Reinier Boon**
Host Institution:	Stichting Vumc - NLD

Non-coding RNA and Intercellular Communication in Cardiac Ageing

Life expectancy in the European Union is rising and the prevalence of age-induced cardiovascular disease increases concomitantly. The main clinical presentation of age-induced cardiovascular disease is heart failure with preserved ejection fraction (HFpEF). HFpEF is a complex disease involving different cell types and mechanisms that contribute to impaired relaxation of cardiomyocytes. Currently there is no appropriate treatment for HFpEF. This proposal aims to better understand the molecular mechanisms behind intercellular communication and ageing that lead to HFpEF.

Long non-coding RNAs (lncRNAs) are emerging as novel key regulators of cellular functions and we hypothesize that lncRNAs contribute to ageing-induced cardiac dysfunction, including HFpEF. Preliminary experiments show that several long non-coding RNAs (lncRNAs) are differentially regulated during cardiac ageing, including the cardiomyocyte-enriched lncRNA Sarrah that is essential for cardiomyocyte survival. We propose to extensively characterize the role of Sarrah in HFpEF and to identify other lncRNAs that are involved in cardiac ageing. Importantly, we will focus those lncRNAs that are also affected in a cohort of human HFpEF patients. Furthermore, since disturbed intercellular communication is a hallmark of both ageing and HFpEF, we will identify lncRNAs that regulate endothelial cell-cardiomyocyte crosstalk. We will use state-of-the-art in vitro and in vivo models to assess cardiac ageing and function upon gain-of-function and loss-of-function of lncRNAs in a cell-type specific manner.

Understanding the role that Sarrah and other lncRNAs play in cardiac ageing and HFpEF will highlight novel potential therapeutic targets to attenuate age-induced cardiac dysfunction and will increase our knowledge of the underlying mechanisms controlling intercellular communication and cardiac function.

Link to the ERC project webpage:

Keywords of the ERC project: cardiovascular aging lncRNA HFpEF

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101002927	**ProtMechanics-Live**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Jorge Alegre-Cebollada**
Host Institution:	Fundacion Centro Nacional De Investigaciones Cardiovasculares Carlos Iii - ESP

Uncovering Protein Mechanics in Physiology and Disease

Protein mechanics is a key contributor to the form and function of biological systems by mechanisms that are just starting to be unraveled. An ensuing hypothesis is that alteration of protein mechanics can trigger disease, particularly in mechanical conditions such as cardiomyopathies in which primordial underlying molecular mechanisms remain elusive. Although tempting, this possibility has not been tested due to the absence of methods that can modulate the mechanics of proteins in vivo. My proposal aims to overcome technical barriers to scientific progress by establishing manipulation of protein mechanics in living cells and animals as a new research field. In aim 1, we will address current technological limitations through the generation of genetic, protein-engineering-based mechanical loss- and gain-of-function models to interfere acutely and reversibly with protein mechanics in living systems (mLOF and mGOF, respectively). We will apply these first-of-their-kind tools to the giant protein titin, a major contributor to the force-generating and sensing properties of cardiomyocytes with strong links with heart disease, and a workhorse protein that has been instrumental in the past to understand the biophysics of polypeptides under force. In aim 2, we will exploit cellular mLOF and mGOF to define how perturbations of titin mechanics result in altered cardiomyocyte force generation, mechanosensing, mechanotransduction, differentiation and proliferation. Leveraging on our cell studies, in aim 3 we will use murine mLOF and mGOF to shed light into the contribution of titin mechanics to the onset and progression of genetic and acquired cardiomyopathy. ProtMechanics-Live builds on our unique expertise in protein mechanics and engineering, biophysics, biochemistry and cardiovascular biology to enable investigation of mechanical proteins in their functionally relevant, physiological context

Link to the ERC project webpage: https://www.cnic.es/en/investigacion/molecular-mechanics-cardiovascular-system

Keywords of the ERC project: protein mechanics, cardiomyopathy, cardiomyocyte, titin, mechanobiology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101018670	**RETROFIT**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr George Kassiotis**
Host Institution:	The Francis Crick Institute Limited - GBR

Pinpointing novel molecular and cellular functions generated by retroelement onco-exaptation

Exaptation, the co-option of endogenous retroelements (EREs) for new molecular and cellular functions that confer a host fitness advantage, is a major force in evolution, but may also be exploited, through onco-exaptation, by tumour cells to promote the oncogenic process. There are over 4 million well-recognised and annotated individual ERE integrations in the human genome. However, their participation at the level of the more complex transcriptome is far less well understood and, therefore, the number of onco-exaptation events is likely vastly underestimated. To allow detection and quantitation of ERE transcription, we have recently de novo assembled the cancer transcriptome. This resulted in a doubling of the known transcriptome, particularly of unannotated or partially annotated transcripts derived from or overlapping with EREs. Here, we propose to utilise this extended view of ERE transcription as the framework for:

•building a genome-wide map of functionally validated ERE onco-exaptation events and

•pinpointing novel, targetable functions of EREs in immunity, cancer and their intersection

Although we identified thousands of novel ERE-overlapping transcripts in cancer, the majority are likely the consequence of transcriptional activation of normally silent EREs, with little or no impact on host cell function. Impactful and inconsequential ERE integrations will be distinguished based on a number of features, including association with cancer overall survival or response to immunotherapy, impact on adjacent gene function, evolutionary conservation and functional domain and folding predictions. Postulated function will ultimately be tested extensively in in vitro cancer cell lines, ex vivo cancer patient material and in vivo mouse cancer models, tailored to the relevant onco-exaptation event. The modification of existing gene function or the creation of new function by ERE onco-exaptation will undoubtedly uncover new targets and opportunities for cancer treatment.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101021078	**PLASTICAN**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Florian Greten**
Host Institution:	Chemotherapeutisches Forschungsinstitut Georg-Speyer-Haus Stiftung - DEU

Cell Plasticity in Metastatic Colorectal Cancer

Colorectal cancer (CRC) belongs to the most frequent tumor entities in both men and women. Although early detection and certain therapies have improved, the prognosis for patients with metastatic diseases is dismal and survival rates are below 10% at 5 years after diagnosis. Colorectal carcinogenesis is greatly dependent on the plasticity of both tumor cells as well as surrounding stromal cells within the tumor microenvironment. Among the latter, both T cells as well as mesenchymal cells substantially contribute to the survival prognosis. Importantly, mesenchymal cells are very heterogenous and various subtypes have been recently described in other tumor entities. Most likely these subtypes rather represent different activation states and have the capacity to interconvert, however, their precise functional role is unknown. Thus, a detailed mechanistic understanding about the cancer-stromal cross-talk as well as the stromal plasticity in CRC, particularly during late tumor stages and the relevance for metastasis development is lacking. Here we aim to perform well-defined hypothesis driven approaches to characterize the plasticity of both tumor and stromal cells and to develop innovative tools that will allow the functional analysis of distinct cell types in the stroma of primary tumors as well as in the pre-metastatic niche in the liver. This will be complemented by unbiased in vivo screens to identify novel pathways involved in plasticity of tumor epithelia and hepatocytes contributing to metastasis formation. Collectively, the combination of these comprehensive approaches that are based on sophisticated novel in vivo models as well as functional analysis of patient samples will ultimately aid the development of novel therapeutic strategies for late-stage CRC patients.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101040726	**DECODE-DKD**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Christoph Kuppe**
Host Institution:	Universitaetsklinikum Aachen - DEU

Decoding diabetic kidney disease

Diabetic kidney disease (DKD) is a rapidly growing worldwide health problem and represents one of the most serious threats in current medicine. DKD is the most common cause of chronic kidney disease (CKD) with 20% of DKD patients progressing to end-stage renal disease, which is associated with tremendously increased morbidity and mortality. The pathophysiology of DKD is complex, incompletely understood and the number of treatment options is low. The vision of DECODE-DKD is to utilize a patient-centric research approach to identify novel pathways and druggable targets in patients suffering from DKD. Concrete objectives are: (1) to establish a spatially resolved multi-omic landscape of human DKD; (2) to dissect and identify therapeutic pathways and signalling networks for novel drug target identification; (3) to incorporate patient-derived in-vitro models for target validation. It is envisaged that novel spatial and single-cell multi-omic technologies will generate a blueprint and predictive model of DKD. This unbiased map will serve to generate testable hypotheses with spatial and temporal coordinates at single-cell resolution. To identify disease-relevant pathways and novel drugable targets in-vitro and in-vivo genome editing approaches will be employed combined with high-throughput screens. In-vitro assays with human-derived kidney organoids will be used to screen potential compounds facilitating the development of novel therapeutics. This highly ambitious interdisciplinary proposal requires the expertise of biomedical engineers, computational biologists, biomedical researchers and physician-scientists. The generated knowledge and outcomes of DECODE-DKD will - alone and especially together - be truly transformative and provide an incremental step forward towards novel drug targets and precision medicine for the treatment of diabetic kidney disease using a systems medicine approach.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101040726

Keywords of the ERC project: Kidney, Single cell, Spatial transcriptomics, Computational Biology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101041331	**ElucidAge**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Joris Deelen**
Host Institution:	Max Planck Gesellschaft Zur Foerderung Der Wissenschaften E.V. - DEU

Elucidating and targeting the mechanisms encoded in the genome of long-lived individuals to improve healthy ageing

Advancing age is the major risk factor for many serious illnesses, including cancer, cardiovascular disease, and dementia. The rising number of older individuals is thus causing a major burden of ill health. However, individuals that reach an exceptional old age often seem to escape or delay age-related diseases, and part of this trait seems to be encoded in their genome. Hence, by studying the genome of long-lived individuals, we may be able to identify mechanisms that could be targeted for healthy ageing in the general population. My previous work suggests that large genome-wide association studies (GWAS) of long-lived individuals can be used to identify genetic variants involved in longevity. However, the common genetic variants thus far identified using GWAS only explain a minor part of the genetic component of longevity. This trait, therefore, may well be mainly determined by rare genetic variants, which can be detected using whole-genome or exome sequencing of long-lived families or exceptionally long-lived individuals. The aim of the proposed project is to establish the effect of genetic variants identified in genetic studies of long-lived individuals on general health and lifespan using cellular models and, subsequently, model organisms. To this end, I will use CRISPR/Cas9 gene editing to generate transgenic cell lines and mice that harbour genetic variants in candidate genes and pathways identified through GWAS and sequencing studies of long-lived families and individuals. I will subsequently use this information to create a high-throughput screening assay to identify compounds that can pharmacologically recapitulate the observed in vitro effects. As a proof-of-principle, I will start with functional characterisation of rare variants in genes involved in insulin/insulin-like growth factor 1 (IIS) and mammalian target of rapamycin (mTOR) signalling, given the well-known role of these networks in ageing in pre-clinical model organisms.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101041331

Keywords of the ERC project: Functional characterisation; Genetic variants; CRISPR/Cas9-based gene editing; Longevity; Lifespan; Healthspan; Model organisms

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101042738	**OralNiche**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Kai Kretzschmar**
Host Institution:	Universitaetsklinikum Wuerzburg - Klinikum Der Bayerischen Julius-Maximilians-Universitat - DEU

Dissecting the impact of epithelial stem cell niches on oral cancer heterogeneity

The oral epithelium is a unique tissue with a high degree of structural heterogeneity and distinct microenvironments (niches). However, the molecular mechanisms underlying the site-specific proliferation and differentiation of oral epithelial stem cells (OESCs) remain poorly understood. Oral squamous cell carcinoma (OSCC), one of the most common oral cancers, is a heterogeneous cancer type. Occurrences of metastatic lesions and treatment response differ from oral site to site, indicating a causal link to the heterogeneous nature of distinct OESC pools. In the OralNiche project, we will for the first time systematically and comprehensively characterise the OESC pools, dissect key mechanisms underlying oral epithelial site-specificity and define their contribution to OSCC heterogeneity. To achieve this, we will combine novel mouse models and patient material with cutting-edge methodology, including whole mount imaging, single-cell sequencing and organoids. Initially, we will profile the proliferative activities of OESCs and explore how stemness is regulated within defined niches in homeostasis, OSCC and chemotherapy-induced mucositis. Subsequently, we will functionally assess cellular cues that modulate stemness in the oral epithelia to generate a comprehensive single-cell atlas of OESCs and their cellular niches. Lastly, using OSCC patient material, we will validate key observations to define potential new biomarkers and therapeutic targets. In summary, this multidisciplinary approach will reveal how the distinct OESC pools maintain homeostasis, and how they respond to challenges, such as mucositis and OSCC. OralNiche will deliver new knowledge on the impact of tissue site-specificity on tumour heterogeneity and therapy response, which will have significant implications for OSCC patients. Moreover, the knowledge gained and the technological advances proposed will be applicable to other tissues and tumour types and thus provide a model approach in cancer research.

Link to the ERC project webpage: https://www.med.uni-wuerzburg.de/msnz/research-projects/junior-research-groups/kretzschmar-group/

Keywords of the ERC project: oral mucosa, oral cancer, tissue stem cells, lineage tracing, organoids, single-cell sequencing

Keywords that characterize the scientific profile of the potential visiting researcher/s: bioinformatics, single-cell sequencing, spatial transcriptomics, image analysis, oral cancer

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101043068	**SweetEggs**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Zita Carvalho-Santos**
Host Institution:	Instituto De Medicina Molecular - PRT

The impact of germline metabolic reprogramming on reproduction and physiology

Animals are composed of multiple tissues with different metabolic needs. During differentiation, the establishment of specific metabolic programs allows cells to acquire specialized functions. The nutrients that fuel these cell-specific metabolic pathways are obtained via the diet. In order to secure proper nutrient supply to these tissues, the central nervous system accesses their metabolic states, allowing the animal to mount behavioral strategies to adapt nutrient appetite. Our understanding of how cell-specific metabolic programs regulate animal physiology and behavior has been hindered by the lack of tractable experimental systems. Using Drosophila melanogaster I uncovered that the germline undergoes metabolic reprogramming, upregulating a specific carbohydrate metabolism branch, the pentose phosphate pathway (PPP) and that oogenesis progression requires the supply of dietary sugars, fueling this pathway. I further showed that the germline communicates its metabolic status to the fat body (FB), regulating the transcription of a satiety factor that acts on the brain to regulate sugar appetite. These findings represent a unique experimental platform, which I will use to study how cell-specific metabolic programs and nutrition regulate whole-animal animal physiology and fertility. I will: 1) identify the transcriptional factors regulating metabolic reprogramming in the germline; 2) test the requirement of specific PPP metabolites in germline cell functions and fertility; and 3) identify the molecules mediating the ovary-FB signaling axis and characterize their impact on FB transcriptional regulation, nutrient appetite, and fertility. Metabolic dysfunctions are known to result in many human conditions. This proposal will not only contribute to our understanding of how metabolism ensures reproduction, but will also help developing dietary interventions to tackle impactful human disorders including infertility.

Link to the ERC project webpage:

Keywords of the ERC project: cellular metabolism, germline, oogenesis, female fertility, Drosophila, inter-organ communication, nutrient appetite, diet

Keywords that characterize the scientific profile of the potential visiting researcher/s: Mathematician or physicist or computer scientist working in the intersaction with biology

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Project ID:	Project Acronym:	Evaluation Panel:
101055422	**EXPAND IT**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Diether Lambrechts**
Host Institution:	Vib - BEL

EXPANDing Immune Cells and their Tumor Antigens during checkpoint immunotherapy

Cancer immunotherapy using immune checkpoint blockade (ICB) has revolutionized the treatment of advanced-stage cancers. One of the major limitations of ICB is that durable responses are observed only in a subset of patients and in some specific cancer types. We recently analyzed tumor biopsies from breast cancer patients collected during ICB and indeed observed only in a subset of patients that tumor-infiltrating T-cells undergo rapid expansion when exposed to ICB. We characterized the gene expression programs underlying this expansion at single-cell level and realized that - although these expanding T-cells are the main executors of therapeutic response to ICB - several key questions regarding their function remain unanswered. First, we lack accurate knowledge about where in the heterogeneous tumor microenvironment (TME) and in which metabolic niches T-cell expansion occurs. Secondly, based on their TCR sequence we cannot predict upfront which T-cells will expand (or rather act as bystander T-cells), nor can we say to which tumor antigens these expanding T-cells are directed. Thirdly, it is not known which molecular events underlie the generation of the tumor antigens regulating T-cell expansion. Fourthly, we also observed an expansion of the B-cell repertoire and were left with similar questions as for expanding T-cells. For instance, where are expanding B-cells located, how do they interact with expanding T-cells, and do they perhaps even recognize the same tumor antigens. In EXPAND IT, we will use several innovative (single-cell) technologies to provide answers to these questions. These insights will much better characterize the mechanisms driving response to ICB, but will also provide important answers on how to sensitize patients not responding to ICB. Our findings could also contribute to the discovery of high-avidity anti-tumor TCRs that can be used in novel TCR-based cellular therapies.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101075607	**RiboID**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Daphna Nachmani**
Host Institution:	THE HEBREW UNIVERSITY OF JERUSALEM - ISR

Ribosome Heterogeneity as a Determinant of Cellular Identity in Hematopoiesis and Leukemia

Differentiation and acquisition of cell identity are fundamental processes in multi-cellular organisms. It is well established that chromatin and RNA mechanisms regulate cell fate determination. Mounting evidence from our lab and others, however, suggests that translation is an additional, until now underappreciated, determinant of cell fate. The importance of translation to differentiation can be gleaned from the hematopoietic system, where a prominent feature of human congenital syndromes, due to mutated ribosomes, is aberrant blood production. Crucially, these mutations lead to distinct cell-type-specific differentiation defects, rather than systemic failure. It remains unclear how congenital ("total-body") ribosomal mutations only affect particular differentiation paths and manifest in a cell-type-specific fashion. We hypothesize that cell-type-specific ribosomal composition—i.e., ribosome heterogeneity—results in cell-type-specific translation profiles, and therefore represents a crucial layer of gene regulation in cell-fate and differentiation. We will explore this hypothesis by pursuing three complementary objectives: (1) Systematically map ribosome heterogeneity and reveal its function in normal hematopoiesis and leukemia; (2) Determine how ribosome heterogeneity controls cell-type-specific translatomes and contributes to cellular transformation; and (3) Explore ribosome heterogeneity at single-cell resolution, using novel methodologies we will develop for simultaneous transcription and translatome interrogation. By combining cutting-edge sequencing techniques with extensive genetic manipulations in physiological settings, we will reveal cell-type-specific translation, controlled by cell-type-specific ribosomes, as major regulators of cell fate in health and disease. Understanding the mechanisms of cell-type-specific translation will provide a new paradigm for elucidating gene expression regulation and for revealing new mechanisms for human diseases.

Link to the ERC project webpage: https://www.nachmanilab.com/

Keywords of the ERC project: Cell identity, Hematopoietic stem cells, Translation, rRNA modifications

Keywords that characterize the scientific profile of the potential visiting researcher/s: single cell technologies, in-vivo hematological research

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Project ID:	Project Acronym:	Evaluation Panel:
786467	**MiCaBra**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Giovanni Marsicano**
Host Institution:	Institut National De La Sante Et De La Recherche Medicale (Inserm) - FRA

Mitochondrial Cannabinoid Receptors in the Brain

Brain activity critically depends on the high energetic support provided by mitochondria, the cell organelles transforming energy sources into molecularly usable ATP. The pathological effects of chronic mitochondrial dysfunctions in the brain are under scrutiny, but the impact of physiological modulation of mitochondrial activity on ongoing brain functions is almost unknown. Cannabinoid type-1 receptors (CB1) are amongst the G Protein-Coupled receptors (GPCR) expressed at highest levels in the brain, and they are key regulators of behaviour. We recently showed that CB1 receptors are present at brain mitochondrial membranes (mtCB1), where they regulate bioenergetic processes, thereby mediating amnesic effects of cannabinoids. Thus, the physiological roles of the brain endocannabinoid system formed by CB1 receptors and endogenous ligands, and the pharmacological effects of cannabinoid drugs (e.g. the psychotropic compound of the plant cannabis sativa, Δ9-tetrahydrocannabinol) partially rely on the regulation of brain mitochondrial activity. Using a bottom-up approach at micro-, meso- and macro-scale levels, MiCaBra will reveal cell biological features, signalling properties and behavioural impact of mtCB1 receptors in the brain. First, we will address the cell biology of mtCB1 receptors, determining the structural and molecular requirements for their mitochondrial trafficking. To define how this GPCR modulate mitochondrial activity and what are the functional consequences of these effects, we will study downstream intra-mitochondrial signalling of mtCB1 receptors and the eventual impact on cellular processes controlled by the organelle. Finally, we will tackle the role of mtCB1 receptors in the (endo)cannabinoid control of brain circuits and behaviour. Thus, MiCaBra has the ambitious aim to understand the impact of regulation of bioenergetic processes on ongoing brain functions, thereby determining a novel framework in the study of behavioural pathophysiology.

Link to the ERC project webpage:

Keywords of the ERC project: Mitochondria, brain, behavior, cannabinoid receptor, CB1

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
787157	**FunctionalProteomics**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Zoltan Nusser**
Host Institution:	Institute Of Experimental Medicine - Hungarian Academy Of Sciences - HUN

Proteomic fingerprinting of functionally characterized single synapses

Our astonishing cognitive abilities are the consequence of complex connectivity within our neuronal networks and the large functional diversity of excitable nerve cells and their synapses. Investigations over the past half a century revealed dramatic diversity in shape, size and functional properties among synapses established by distinct cell types in different brain regions and demonstrated that the functional differences are partly due to different molecular mechanisms. However, synaptic diversity is also observed among synapses established by molecularly and morphologically uniform presynaptic cells on molecularly and morphologically uniform postsynaptic cells. Our hypothesis is that quantitative molecular differences underlie the functional diversity of such synapses. We will focus on hippocampal CA1 pyramidal cell (PC) to mGluR1α+ O-LM cell synapses, which show remarkable functional and molecular heterogeneity. In vitro multiple cell patch-clamp recordings followed by quantal analysis will be performed to quantify well-defined biophysical properties of these synapses. The molecular composition of the functionally characterized single synapses will be determined following the development of a novel postembedding immunolocalization method. Correlations between the molecular content and functional properties will be established and genetic up- and downregulation of individual synaptic proteins will be conducted to reveal causal relationships. Finally, correlations of the activity history and the functional properties of the synapses will be established by performing in vivo two-photon Ca2+ imaging in head-fixed behaving animals followed by in vitro functional characterization of their synapses. Our results will reveal quantitative molecular fingerprints of functional properties, allowing us to render dynamic behaviour to billions of synapses when the connectome of the hippocampal circuit is created using array tomography.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
787450	**IN-Fo-trace-DG**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Marlene Bartos**
Host Institution:	Universitaetsklinikum Freiburg - DEU

Role of GABAergic interneurons in the formation of new memory traces in the Dentate Gyrus of behaving mice

Despite intensive study in the past on the problem of how information is processed in the brain to enable individual organisms to adapt to their continuously changing environment, little progress has been made on how new similar but discrete memory traces emerge in neuronal networks during learning. Current theories suggest that experience-dependent modifications in excitation-inhibition balance enable a selected group of neurons to form a new cell association during learning which represent the new memory trace. It was further proposed that particularly GABAergic inhibitory interneurons (INs) have a large impact on population activity in neuronal networks by means of their inhibitory output synapses. However, how cell associations emerge in space and time and how INs may contribute to this process is still largely unknown. This complex topic was so far difficult to address due to technical constraints. IN-Fo-Trace-DG aims to address this fundamental question in the dentate gyrus (DG), a brain structure essential for the acquisition of similar but discrete new memories. Based on our detailed knowledge on DG's cellular elements, their interconnectivity and our recently established molecular interference tools, we will first, visualize the spatial and temporal activity patterns of cell populations during spatial learning in a virtual-reality using 2-Photon imaging. Second, we will determine the role of IN recruitment and plasticity in assembly formation by optogenetic and molecular interference. Third, we will analyze changes in excitatory and inhibitory signals in granule cells (GCs), the principal cells in this brain area, and INs during learning using whole-cell recordings in vivo. Finally, we will examine whether adult-born GCs contribute differently to learning-associated population activity compared to mature ones in the adult DG. This innovative multi-disciplinary approach will provide new insights on the mechanisms of new memory formation in cortical networks.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
789128	**SENSATIONAL TETHERS**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Gary Lewin**
Host Institution:	Max Delbrueck Centrum Fuer Molekulare Medizin In Der Helmholtz-Gemeinschaft (Mdc) - DEU

Tethers for sensory mechanotransduction: from molecules to perception

Touch sensation is built upon the ability of sensory neurons to detect and transduce nanometer scale mechanical displacements. The underlying process has been termed mechanotransduction: the high sensitivity and speed of which is enabled by direct gating (opening) of ion channels by mechanical force. Force detection is functionally compartmentalized and only takes place at the peripheral endings of sensory neurons in vivo. Two molecules are known to be genetically necessary for touch in many sensory neurons, the force gated ion channel PIEZO2 and its modulator STOML3. However, mechanotransduction complexes in all touch receptors absolutely require tethering to the extracellular matrix for function. Tethering is dependent on large extracellular proteins that are sensitive to site-specific proteases. Here we will not only identify the nature of these tethers, but will develop technology to acutely and reversibly abolish tethers and other mechanotransducer components. We will use genome engineering to tag tether and mechanotranduction components in order to visualize and manipulate these proteins at their in vivo sites of action. By engineering de novo cleavage sites for site-specific proteases we will render tethers and ion channels newly sensitive to normally ineffective proteases in the skin. We will engineer mutations into candidate ion channels that dramatically alter biophysical properties to physiologcally “mark” function in vivo. Finally we will develop new behavioural paradigms in mice that allow us to measure touch perception from the forepaw. Psychometric curves for different vibrotactile tasks can then be precisely compared between humans and mice. Furthermore, the impact of acute and reversible manipulation of mechanotransduction on touch perception can be measured. Understanding how molecules assemble to function in a mechanotransduction complex in the skin will open up avenues to develop therapeutic strategies to modulate touch.

Link to the ERC project webpage:

Keywords of the ERC project: Molecular neurobiology, pain , touch, ion channels

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
802182	**Neurovulnerability**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Natalia Rodriguez-Muela**
Host Institution:	Deutsches Zentrum Fuer Neurodegenerative Erkrankungen Ev - DEU

Molecular mechanisms underlying selective neuronal death in motor neuron diseases

The mechanisms behind neuronal death in different motor neuron diseases (MND) remain unknown. These MNDs include the devastating spinal muscular atrophy (SMA) and amyotrophic lateral sclerosis (ALS). A fascinating question in neurodegeneration research is why mutations in ubiquitously expressed genes result in the selective death of a specific neuronal subtype. The ubiquitously expressed and conserved survival of motor neuron (SMN) protein receives its name because its deficit results in MN degeneration. However, SMN known functions -spliceosome assembly and axonal mRNA transport- do not explain the selective MN vulnerability.

Accumulation of intracellular aggregates in neurons is a hallmark of most neurodegenerative diseases. The lysosome-autophagy system is the main catabolic pathway for recycling of protein aggregates and damaged organelles, and its role as a quality control system is especially critical in neurons, due to their postmitotic and highly specialized nature. The hypothesis for this proposal is that SMN deficiency leads to a lysosome-autophagy dysfunction which results in a proteostatic failure, underlying MN degeneration. Furthermore, the existing heterogeneity in SMN protein levels across MN populations may determine their probability of survival.

To test these hypotheses we will use the CRISPR/Cas9 system to genetically engineer human control, SMA and ALS patient-derived iPSCs to generate isogenic and reporter lines that will allow us to study selective neuronal subtypes at a single-cell level. We will also follow an interdisciplinary approach using a SMA Drosophila model to identify new molecular pathways essential for SMN neuropathology. Altogether, my research proposal aims at untangling the molecular mechanisms underlying selective MN death. Our results will open up new directions of research into the molecular basis of neurodegeneration and will provide clues for the design of therapeutics targeting specific neuronal types or phases of MNDs.

Link to the ERC project webpage:

Keywords of the ERC project: Neuron, motor neuron, spinal cord, hiPSC, autophagy, lysosome, single cell omics

Keywords that characterize the scientific profile of the potential visiting researcher/s: neuroscience, neurodegeneration, stem cells, proteostasis

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
802371	**DisConn**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Alessandro Gozzi**
Host Institution:	Fondazione Istituto Italiano Di Tecnologia - ITA

Neural drivers of functional disconnectivity in brain disorders

A rapidly expanding approach to understanding neural organization is to map patterns of spontaneous neural activity as an index of functional communication and connectivity across brain regions. Fostered by the advent of neuroimaging methods like resting-state fMRI (rsfMRI), this approach has revealed that functional connectivity is almost invariably disrupted in severe psychiatric disorders, such as autism or schizophrenia. However, the neural basis of such functional disconnectivity remains mysterious. What drives brain-wide functional synchronization? And are there shared pathophysiological mechanisms leading to impaired large-scale neural coupling?

This project aims to elucidate the neural drivers of macroscale functional connectivity, as well as its breakdown in brain connectopathies. To achieve this goal, I propose a multi-scale perturbational approach to establish causal relationships between specific neural events and brain-wide functional connectivity via a novel combination of rsfMRI and advanced neural manipulations and recordings in the awake mouse.

By directionally silencing functional hubs as well as more peripheral cortical regions, I will provide a hierarchical description of spontaneous network organization that will uncover regional substrates vulnerable to network disruption. I will also manipulate physiologically-distinct excitatory or inhibitory populations to probe a unifying mechanistic link between excitatory/inhibitory imbalances and aberrant functional connectivity. Finally, to account for the hallmark co-occurrence of synaptic deficits and functional disconnectivity in developmental disorders, I will link cellular mechanisms of synaptic plasticity and learning to the generation of canonical and aberrant spontaneous activity patterns. These studies will pave the way to a back-translation of aberrant functional connectivity into interpretable neurophysiological events and models that can help understand, diagnose or treat brain disorders.

Link to the ERC project webpage: https://www.iit.it/it/web/functional-neuroimaging

Keywords of the ERC project: brain, MRI, connectivity, dynamics, mouse, chemogenetics, optogenetics

Keywords that characterize the scientific profile of the potential visiting researcher/s: neruocomputation, data analysis, neuroscience

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
818996	**DEVMEM**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Francesca Cacucci**
Host Institution:	University College London - GBR

Learning to remember: the development of the neural mechanisms supporting memory processing.

The ability to form and store memories allows organisms to learn from the past and imagine the future: it is a crucial mechanism underlying flexible and adaptive behaviour. The aim of this proposal is to identify the circuit mechanisms underlying our ability to learn and remember, by tracking the ontogenesis of memory processing. Importantly, we are not born with a fully functioning memory system: generally, adults cannot recollect any events from before their third birthday ('infantile amnesia'). There are several accounts as to the source of this mnemonic deficit, each placing emphasis on impairments of specific processes (encoding, consolidation, retrieval). However, a general weakness in the study of memory ontogeny is the lack of neural data describing the activity of memory-related circuits during development. To directly address this knowledge gap, we propose to study the ontogeny of brain-wide hippocampus-centred memory networks in the rat. We will study to which extent memory expression relies on spatial signalling, delineate the role of sleep in memory consolidation, determine how hippocampal planning-related neuronal activity influences memory processing, understand whether the rapid forgetting observed in development is due to interference, and explore interactions between the hippocampus, pre-frontal and striatal circuits in orchestrating memory emergence. We are best placed to deliver this ambitious experimental plan due to our extensive experience of in vivo recording in developing rats which we will couple with the application of recently emerged technologies (2-photon imaging, high density electrophysiology, chemogenetic manipulation of neural activity). As our studies of the development of hippocampal spatial representations have delivered powerful insights into their adult function, we expect the work outlined here to critically advance our understanding not only of development, but also of healthy memory processing in adulthood.

Link to the ERC project webpage:

Keywords of the ERC project: Cognition Memory Hippocampus Development

Keywords that characterize the scientific profile of the potential visiting researcher/s: Cognition Memory Hippocampus Development Computational Modelling

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Project ID:	Project Acronym:	Evaluation Panel:
833964	**REPLAY_DMN**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Francesco Battaglia**
Host Institution:	Stichting Radboud Universiteit - NLD

A theory of global memory systems

Spontaneous activity accounts for most of what the brain does and is likely to be key for information processing in the brain, but its function is still quite mysterious. Two key spontaneous activity processes are the Default Mode Network, a set of areas that are most markedly connected and active during behavioural idleness, and memory replay, the spontaneous reactivation of neural patterns occurring during experience.

I will test the hypothesis that the DMN plays a key role in memory replay processes. This theory, if confirmed, would bring important conceptual advances: to memory studies, as it would provide a mechanism supporting the formation and consolidation of complex memory representations. To the Default Mode Network field, as replay can be used as the "Rosetta Stone" to decipher the computations the DMN performs, moving beyond the connectivity, dynamics, and cognitive correlates, typical focus of DMN research.

I will explore this theory by an experimental study of spontaneous neural activity over the whole mouse cortex, going from large field-of-view 2-photon imaging and high-volume electrophysiology for the single neuron scale, to voltage sensitive imaging and electrocorticography, to resting state fMRI, in animals running memory tasks.

I will characterize the network dynamics and the encoding and replay of memories by quantifying conveyed information and assessing its nature (e.g. about simple percepts vs. complex events, remote vs. memories). I will also measure critical behaviour in these networks, and test whether neuronal avalanches, that occur in spontaneous activity, play a role in conveying information across distant brain areas.

I will model the consequences of these mechanisms for computation by formulating a machine learning based model of memory formation and consolidation, endowing a deep network with critical properties and memory replay.

Link to the ERC project webpage: https://neuronetmem.org

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
864164	**GridRepresentations**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Nikolai Axmacher**
Host Institution:	Ruhr-Universitaet Bochum - DEU

Neural mechanisms, functional roles and pathophysiological relevance of human grid cell-like representations

The entorhinal cortex contains grid cells, a major cell type underlying spatial navigation. At the same time, it is amongst the first areas of the brain to be affected by Alzheimer's disease (AD). In humans, grid cell-like representations (GCLRs) have been proposed as a network-level signature of grid cells that can be recorded non-invasively via functional magnetic resonance imaging (fMRI). I have recently demonstrated that there is a disruption of GCLRs in genetic AD risk carriers at young age, and suggested GCLRs as a novel biomarker for early disease processes in AD. However, the relationship between GCLRs at a network level and grid cells measured at the single-neuron level is still unknown, as is the pathophysiological relevance of the impaired GCLRs and of compensatory hyperactivity in other navigational systems. In the translational research program proposed here, I aim to unravel the cellular mechanisms, functional relevance, and pathological impact of grid cell-like representations in humans.

My specific objectives are to (1) provide the first validation of GCLRs, by directly relating GCLRs at the network level to single unit activity of individual neurons recorded via microelectrodes in epilepsy patients; (2) clarify the functional relevance of GCLRs and complementary navigational systems for spatial behavior via layer-resolved ultrahigh field (7T) fMRI; (3) determine whether impairments of GCLRs and compensatory recruitment of other navigational strategies are related to AD pathology, using tau- and amyloid-PET imaging in AD risk carriers; and (4) restore impaired GCLRs via a pharmacological intervention, which may constitute a novel therapeutic option for modifying early AD. These studies will provide the first detailed understanding of the neural mechanisms and functional role of grid cells in humans across several levels of brain organization and pave the way for novel diagnostic and therapeutic approaches to AD.

Link to the ERC project webpage:

Keywords of the ERC project: grid cells, Alzheimer's disease, spatial navigation, fMRI, 7T fMRI, intracranial EEG, oscillations, human single unit recordings, PET

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
865592	**GliomaSignals**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Gilles Huberfeld**
Host Institution:	Institut National De La Sante Et De La Recherche Medicale (Inserm) - FRA

Oncometabolitic control of tumor growth and epileptogenesis in IDH mutated gliomas: D2HG signaling mechanism.

Dysregulated growth processes of gliomas interact with pro-epileptic plasticity of brain circuits in such a way that the excitatory transmitter glutamate promotes autocrine tumor invasion as well as epileptic synchrony in surrounding cortical regions. Most low-grade gliomas are associated with mutations of Isocitrate DesHydrogenase (IDH) genes which lead to an excess of the oncometabolite D-2-Hydroxyglutarate (D2HG). With a structure mimicking glutamate, D2HG is thought to participate in both epileptogenic and oncologic processes. Importantly, while epileptic activity is accentuated, tumor prognosis is improved in affected people. My preliminary data now suggest a dual function for D2HG, acting as a glutamatergic agonist at high levels, but as an antagonist in the presence of glutamate. Solving this paradox will be a step forward in glioma science. The GliomasSignals project will examine the role of D2HG in the neurobiology of gliomas bringing electrophysiology concepts and tools to neuro-oncology, seeking to transform our understanding. It seeks to better understand how D2HG modulates glutamatergic signaling, affects neuronal excitability and tumor growth, and to detect the extent to which tumor infiltration colocalizes with epileptic remodeling. In vivo and in vitro work mostly on human tissue will aim at: 1- Map biomarkers of epileptic activity / tumor infiltration by cortical recordings during surgery using unique next generation Neurogrid electrodes. 2- Correlate D2HG levels, glutamate concentrations and tumor infiltration with recordings in peritumoral cortex at an unprecedented resolution. 3- Identify D2HG effects on glutamate signaling in human tissue slices producing epileptic activities and in a rodent model. 4- Explore D2HG long-term effects on epileptic activity and tumor growth / infiltration in co-cultures of tumors with surrounding peritumoral cortex by exploiting our unique capabilities for long-term human cortex organotypic cultures.

Link to the ERC project webpage:

Keywords of the ERC project: Glioma, epilepsy, human tissue, glutamate

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
865618	**MicroSynCom**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Martin Fuhrmann**
Host Institution:	Deutsches Zentrum Fuer Neurodegenerative Erkrankungen Ev - DEU

Mechanisms of Microglia Synapse Communication

Microglia are the resident tissue macrophages of the brain and represent cells of the innate immune system. Looking at microglia from the immunological perspective, much is known about their role during inflammatory processes, factors that activate them and how they response e.g by releasing cytokines to mount an inflammatory response. This response has been shown to be detrimental during disease processes and lead to pruning/loss of synapses, a task microglia carry out also during development. Although microglia obviously play an important role in synaptic pruning and loss, it remains an open question, whether microglia are involved in the process of synapse formation under physiologic conditions. Therefore, the main hypothesis of MicroSynCom is that microglia represent the mediator of synapse formation or linker between pre- and post-synapse: sensing neurotransmitter release at highly active pre-synaptic sites and actively orchestrating the formation of new spines from the dendrite. I propose to investigate and reveal the underlying mechanisms of this tripartite microglia synapse communication process. Therefore, we will use two-photon stimulated emission depletion microscopy (2P-STED), novel viral and genetically encoded sensors for neurotransmitters, as well as optogenetic and chemogenetic manipulation tools. These methods will be combined with behavior test in freely moving, but also head-fixed mice to visualize microglia mediated synapse formation in awake mice. This will allow us for the first time to visualize, investigate and reveal the mechanisms establishing this novel role of microglia as the mediator of synapse formation in life animals and relate it to physiologically relevant neuronal network rewiring.

Link to the ERC project webpage:

Keywords of the ERC project: microglia, synapses, in vivo imaging, super-resolution microscopy

Keywords that characterize the scientific profile of the potential visiting researcher/s: physicists with a degree in optics interested in brain research

Project ID:	Project Acronym:	Evaluation Panel:
865634	**PreSynPlast**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Stefan Hallermann**
Host Institution:	Universitaet Leipzig - DEU

Molecular mechanisms of presynaptic plasticity

The ambitious goal of this project is to reveal the molecular mechanisms of presynaptic plasticity in the vertebrate brain. Synaptic plasticity occurs in the form of alterations in both presynaptic neurotransmitter release and postsynaptic receptor function. However, due to technical reasons and in contrast to intensely studied postsynaptic plasticity, the presynaptic half of the brain's synaptic plasticity remains enigmatic. This is a crucial knowledge gap for our understanding of learning and memory.

My ambitious aim is therefore to uncover the molecular and biophysical mechanisms of presynaptic plasticity. Building on my strong track record in presynaptic research, my group made a technical breakthrough by establishing patch-clamp recordings from small nerve terminals of cultured neocortical neurons with unprecedented high resolution. In addition, we use an innovative super-resolution-microscopy approach resolving the rearrangement of proteins within the presynaptic neurotransmitter release site, which allows high-throughput screening of all major classes of synaptic genes for their involvement in presynaptic plasticity. To reveal the neuron- and plasticity-type specificity, the identified molecular pathways will be analysed in different types of neurons in culture and acute brain slices. Building on these unique abilities, I will also investigate physiological and pathophysiological modulations of presynaptic plasticity. Specifically, I will test the hypothesis that metabolic constraints regulate presynaptic plasticity and that the amyloid pathology of Alzheimer's disease impacts presynaptic plasticity.

Thus, for the first time in the history of neuroscience, neocortical nerve terminals can be investigated with direct electrophysiological recordings and super-resolution microscopy providing unprecedented spatial and temporal resolution for the analysis of presynaptic plasticity. The results could pave the way for new approaches treating neurological diseases.

Link to the ERC project webpage: https://physiologie.medizin.uni-leipzig.de/?en,id73

Keywords of the ERC project: Synaptic plasticity, presynaptic mechanisms

Keywords that characterize the scientific profile of the potential visiting researcher/s: Expertise in patch-clamp technique, two-photon calcium imaging, or super-resolution microscopy

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Project ID:	Project Acronym:	Evaluation Panel:
883746	**F-Addict**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Christian Luscher**
Host Institution:	Universite De Geneve - CHE

Convergence of positive and negative reinforcement in fentanyl addiction

F-Addict strives to unravel the neural circuits driving compulsion in fentanyl addiction. We ask the question how fentanyl causes fast transition from medical or recreational controlled drug use to compulsive consumption. About a third of opioid users eventually loose control, which increases the risk of death by overdose; a number that is even higher for fentanyl and definitely exceeds the transition observed with psychostimulants. The neural correlate of this difference remains elusive. We posit that repetitive withdrawal leads to strong negative reinforcement, which in conjunction with inherent positive reinforcement favors the transition to compulsion. F-Addict will uncover the synaptic processes and neuronal population activity leading to addiction in a mouse model of oral fentanyl self-administration. Much preliminary data implicate activity in the mesolimbic dopamine system and upstream subcortical regions (paraventricular thalamus/habenula/basolateral amygdala) in positive and negative reinforcement, respectively. In addition, top down control, in particular by the orbitofrontal cortex may drive compulsive drug use. The proposed project will harness advanced circuit investigations for an innovative, original perspective: how does positive and negative reinforcement in fentanyl addiction contrast with current circuit models of addiction that are based on psychostimulants? In a translational spirit, F-Addict will also examine the effects of oral substitution with methadone and buprenorphine, recognized therapies for opioid addiction. Much preliminary data provides proof of feasibility and principle. We are confident that our approach at the frontiers of modern neurosciences carries the potential for groundbreaking results to answer a timely question. Unraveling the neural basis of fentanyl addiction will enhance the molecular understanding of circuit modulation to shape future therapies facing the still growing opioid epidemic.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
885090	**HOLOVIS**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Valentina Emiliani**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Holographic control of visual circuits

The aim of this research program is to produce novel all-optical technologies to explore brain functions at the mesoscopic scale with cellular resolution opening a new phase in optogenetics that I named circuit optogenetics.

Revealing the neural codes supporting specific mammalian brain functions is a daunting task demanding to relate in vivo the individual activities of large numbers of neurons recorded jointly within collectives that form distinct nodes of a network and to perform precisely targeted and calibrated interventions in the spatiotemporal dynamics of neural circuits on the scale of naturalistic patterns of activity. Despite recent technical advances, these experiments remain out of reach because we lack a comprehensive approach for large-scale, multi-region, in depth, single cell and millisecond precise manipulation of neural circuits. HOLOVIS will tackle these limitations through the construction of an innovative paradigm combining optogenetics with cutting-edge technology of wave front shaping, compressed sensing, microendoscopy, wave-guide probes, laser developments and opsin engineering.

My lab has pioneered the use of wave front shaping for neuroscience and developed in the past years a number of new optical methods, for patterned optogenetic neuronal stimulation. Here, we will push forward this technology and first demonstrate the performances of these breakthrough systems to reveal how inter, intra-laminar and cortical/sub-cortical wiring construct and refine visual orientation selectivity in mice.

We will focus on the visual system of mice, whose input-output responses to controlled sensory stimulations have been characterized in decades of studies. However, we are persuaded that our approach can be used to reveal the connectivity rules that underlie specific patterns of activity of any neuronal circuit, thus defining the functional building blocks of distinct brain areas.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101001702	**BATSPEAK**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Sonja Vernes**
Host Institution:	The University Court Of The University Of St Andrews - GBR

Revealing the biological bases of speech and language by studying bat vocal learning

The overarching goal of BATSPEAK is to shed light on the biological origins of speech and language by analysing the molecular mechanisms and neural circuitry that support vocal learning in the bat, using tools that I have pioneered in this species.

Vocal learning is a fundamental building block of human spoken language and is a trait we share with few other animals. It has only been identified in 4 non-human mammal groups, of which bats are the only tractable model system in which the molecular and neural mechanisms can be addressed, thus providing a unique window onto the biological foundations from which human speech and language evolved.

BATSPEAK has 3 aims:

1. To identify the genomic markers of vocal learning allowing us to probe the molecular mechanisms that underlie mammalian vocal learning
2. To characterise neural mechanisms underlying mammalian vocal learning
3. To determine direct, causative contributions of molecular and neural mechanisms to mammalian vocal learning behaviour

This project will use bats as an exemplar species in which the molecular and neural mechanisms underlying mammalian vocal learning can be understood, and will contain 3 work packages:

WP1. Comparative evolutionary genomics, coupled with gene function and gene expression analyses, to identify the molecular mechanisms underlying vocal learning

WP2. Comparative neuroanatomy, electrophysiology, and transcriptomics to characterise a key neural circuit underlying vocal learning

WP3. Generation of transient transgenic bats to test hypotheses of the role of molecular and neural mechanisms in vocal learning behaviour

Understanding the bases of vocal learning in mammals will shed light on the biology underlying speech and language and provide a new mammalian model for the study of language related disorders.

Link to the ERC project webpage:

Keywords of the ERC project: genetics, neuroscience, behaviour, electrophysiology, transgenics, speech, bioacoustics

Keywords that characterize the scientific profile of the potential visiting researcher/s: electrophysiology, genetics, bioacoustics, bioinformatics, phylogenetics, evolution

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Project ID:	Project Acronym:	Evaluation Panel:
101002870	**EXPLORATOME**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Claire Wyart**
Host Institution:	Institut National De La Sante Et De La Recherche Medicale (Inserm) - FRA

Circuit mechanisms underlying sensory-evoked navigation

Life-threatening cues such as the scent of smoke or the taste of rotten food cause avoidance behavior in animals. In such situations, instantaneous integration of relevant sensory inputs by motor centers that guide navigation can be a matter of life and death. How is this sensorimotor integration achieved?
In vertebrates, it is known that motor command centers in the brainstem receive direct inputs from higher brain areas and cutaneous sensory pathways and in turn control the spinal circuits that drive locomotion. It is less well understood whether these brainstem command neurons are simple integrators relaying information, or whether they add a layer of integration to select locomotor action sequences. Because brainstem neurons are difficult to visualize and access in mammals, it has been challenging to measure their activity in moving animals as they respond to sensory cues. In contrast, larval zebrafish is a simpler vertebrate model in which optical technologies can be leveraged to visualise, record, and manipulate any and/or all brainstem neurons during locomotion.
This project will decode the neuronal computations of descending command neurons that integrate sensory inputs and elicit locomotor actions in freely-moving zebrafish larvae. To this end, my group has designed an unbiased method for segmenting locomotor action sequences from noisy behavioral data. Applied to robust assays where larvae navigate in chemical gradients, we are now in a unique position to link locomotor action sequences to the sensory landscape fish perceive. This original approach, together with innovative technologies pioneered in my lab, will reveal brainstem neuronal connectivity and roles in the selection of locomotor sequences.
The EXPLORATOME project will lead to models of circuit computations in the brainstem, a brain region historically-overlooked and with high potential for targeted electrical stimulations in patients with motor disorders.

Link to the ERC project webpage: https://wyartlab.org

Keywords of the ERC project: motor control, navigation, brainstem circuits, neuromodulation, noradrenaline, serotonine, dopamine, sensorimotor integration, recurrent networks, stochastic modelling, motor states, brain states, connectomics

Keywords that characterize the scientific profile of the potential visiting researcher/s: population imaging, connectomics, efference copy, sensory feedback, descending command, in vivo electrophysiology, modelling

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Project ID:	Project Acronym:	Evaluation Panel:
101003329	**PD-GUT**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Michela Deleidi**
Host Institution:	Deutsches Zentrum Fuer Neurodegenerative Erkrankungen Ev - DEU

Parkinson's disease: does it all start with gut inflammation?

Burgeoning evidence shows that Parkinson's disease (PD) involves the gut before affecting the brain, leading to the fascinating hypothesis that the gut might be the site of disease initiation. Remarkably, the gut origin of PD is still poorly understood. Multiple triggers could serve as a first insult: infections, dysbiosis, and inflammatory bowel diseases (IBDs). All these conditions ultimately converge on intestinal inflammation. Thus, an intriguing hypothesis is that PD is a systemic illness that originates from an inflammatory insult in the gut. This hypothesis is based on the observation that genetic traits relevant for both sporadic and familial PD also modulate immune responses to enteric pathogens and confer risk to IBDs. To dissect shared mechanisms among these seemingly unrelated diseases, I envision a multi- and interdisciplinary project with a unique integration of competences in neuroscience, immunology, and microbiology. Moving beyond the state of the art, I will combine patient stem cell-derived organoid, organ-on-a-chip, and single-cell sequencing approaches to decode the role of intestinal inflammation in PD and to identify new mediators of immune cell contributions to neurodegeneration. Specifically, I will i) mechanistically dissect cell type-specific host immune responses to intestinal pathogens and their link to PD; ii) establish complex human pluripotent stem cell-derived intestinal organoids to investigate intestinal inflammation; and ii) implement patient multiorganoid platforms to identify key players in the communication between the inflamed gut and the brain. Unveiling the critical steps that initiate PD may lead to a conceptual leap forward in our understanding of how the gut affects the brain in both health and disease. The novel methodologies that will be developed will also lay the foundations for future interventions aimed at targeting intestinal inflammation in enteric and neurological diseases.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency
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Project ID:	Project Acronym:	Evaluation Panel:
101039145	**InsulaBodyLoop**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Yoav Livneh**
Host Institution:	Weizmann Institute Of Science - ISR

The Insula-Body Loop for Neural Control of Gut Physiology

The brain and body are in a continuous dialog. Our brains constantly receive sensory information from within our body, as well as from the external environment, and then use it to regulate bodily function. Brain-body communication is essential for our physical and mental health, yet little is known about how it is achieved at the neurobiological level. A large corpus of work implicates the insular cortex as a central node in the brain's interoceptive network. Current models suggest that insular cortex integrates internal and external sensory information to regulate bodily physiology. Yet direct experimental evidence has been scarce. I propose a research program that focuses on the insular cortex as part of a dynamic loop with the gastrointestinal system, which regulates peripheral metabolic function and feeding behaviour. Two fundamental questions form the core of this proposal: (1) How do the sight, smell, and taste of a savoury dish, or a sweet dessert, enable our brains to predict the post-ingestive nutrients they will supply? (2) How are these predictions relayed to our body to pre-emptively prepare it for consumption, e.g., by inducing salivation and insulin release? To answer these questions we need to understand both cortical predictive computations, as well as peripheral physiology. I therefore propose to build on my expertise and use an inter-disciplinary approach, combining cutting-edge neuroscience and computational methods with recordings and optogenetic control of peripheral physiology. This will reveal: (1) how insular cortex represents internal sensations, (2) how insular cortex forms associations between internal and external sensory information, and (3) how these associations are relayed to the body to maintain homeostasis. This study will provide a conceptual and methodological foundation for future elucidation of how different internal sensory modalities act together within the brain-body loop to maintain our physical and emotional health.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101039706	**MOBY-FLY**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Bettina Schnell**
Host Institution:	Max Planck Gesellschaft Zur Foerderung Der Wissenschaften E.V. - DEU

Circuit mechanisms of behavioural variability in Drosophila flight.

While sensory systems report sensory input with high reliability, behavioural responses are inherently variable. How this variability arises and how behavioural decisions are formed, is not well understood in any organism. I will use the fruit fly Drosophila as a model system to study how a specific behaviour is initiated depending on external stimuli and behavioural state. During flight, flies change direction to avoid dangers or search for food with a fast turning response called saccade. This behaviour can be replicated in head-fixed flying flies, where saccades are measured as fast changes in wing stroke amplitude, which allows for simultaneous recordings of neuronal activity. However, the neuronal circuits underlying the execution of saccades in the fly brain are not known. Previously, I have discovered a descending neuron, whose activity is strongly correlated with saccadic turns during head-fixed flight. I will use novel anatomical tools and the available EM data sets to find the neurons, which provide input to this descending neuron and which control saccades. I will then record their activity using both 2-photon Calcium imaging of a genetically encoded indicator and whole-cell patch-clamp recordings during flight. At the same time, I will present a panel of multisensory stimuli, while monitoring turning behaviour. This will allow me to test under which stimulus conditions and internal states these neurons are active and whether their activity is more closely correlated with sensory input or behavioural output. To test for the contribution of these neurons to the execution of saccades, I will use genetic tools to manipulate their activity during tethered as well as free flight. This comprehensive approach will allow me to study, which neurons control saccadic turns and at which processing stage behavioural decisions are made and will provide general insights into how information is processed along the sensory-to-motor pathway and how behaviour is initiated.

Link to the ERC project webpage:

Keywords of the ERC project: neuroethology, decision making, Drosophila, Calcium imaging, flight behavior

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101039764	**NeuFRO**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Zohreh Hosseinzadeh**
Host Institution:	Universitaet Leipzig - DEU

Inducing functionality in retinal organoids with electrical activities derived from developing retina

Deriving mammalian retina from stem cells has had a large impact on the study of the biology of vision and is called organoid. Compared to in vivo retina, retinal organoids are far less functionally sophisticated in terms of their synapses, connectivity, discrimination between different light stimuli and their electrical action potentials. This project will overcome this functional constraint of retinal organoids by studying electrophysiological events-derived functional maturation of mouse retina during retinal development and then stimulating those events with the help of mathematical models in order to induce the same functionality in mouse and human retinal organoids. NeuFRO will achieve a resonance in the field by generating retinal organoids with the neuronal connectivity and the natural diversity of functions using interdisciplinary fields including electrophysiology, developmental biology, and computationally-derived electrical stimulation.
Initially, I will create a holistic roadmap of the electrical features of immature mouse retina during development that shows self-organization through electrophysiology. With milli- to nanometer imaging precision, electrical activities derived the circuit formation will be spatiotemporally documented. Then I will decode this space-time code of intrinsic electrical patterns and neuronal connectivity using an ambitious strategy incorporating Hodgkin-Huxley and linear-nonlinear models. Next, such electrical response models will be applied to immature retinal organoids (mouse and human) by an innovative 'sandwich' electrophysiology technique during the development in vitro. With this approach, I will induce naturalistic electrical features in the retinal organoid, allowing the functional neurons to wire and fire appropriately into retinal organoids, particularly visual circuits. This ground-breaking approach will advance techniques for generating functional human retina.

Link to the ERC project webpage:

Keywords of the ERC project: Retina, organoids, stem cells, computation

Keywords that characterize the scientific profile of the potential visiting researcher/s: Retina, neuroscience

Project ID:	Project Acronym:	Evaluation Panel:
101040378	**MESO_AG**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Ariel Gilad**
Host Institution:	The Hebrew University Of Jerusalem. - ISR

Mesoscale dissection of neuronal populations underlying cognition

The brain is responsible for cognition, broadly defined as thinking, by combining mental processes such as sensory integration, perception, and working memory. One of neuroscience's major challenges is understanding how the brain encodes cognition as a whole. The biggest obstacle to this goal is the complex nature of the brain, which contains billions of entangled neurons that form a dynamic, ever-changing network. We propose to use the mouse model to study cognitive processing streams across the brain. By applying a zoom-out/zoom-in approach, we first study cognition at the mesoscale level (i.e., the population level across many areas) and then zoom in and dissect a specific sub-population. Importantly, we focus on the dynamic brain-wide networks of different cognitive functions that are modulated within single trials and in each individual mouse. We hypothesize that cognitive functions are encoded at the mesoscale level in which information flexibly flows across many brain areas, but with certain motifs and rules. Each objective targets one processing stream and one cognitive function: streams within one cortical hemisphere during sensory integration, streams across cortical hemispheres transferring working memory, and streams between cortex and sub-cortex during perception. In each work package, we will train mice in cognitive behavioral paradigms, and perform a zoom-out/zoom-in protocol with the same mouse. First, we will implement a mesoscale approach (e.g., wide-field imaging and/or multi-fiber photometry) to outline the processing stream within the cognitive network. Second, we will zoom in to dissect a specific node or edge using multi-area two-photon microscopy, labeling techniques, and optogenetics. Importantly, these work packages are modulatory and with substantial overlaps, enabling us to obtain a brain-wide cognitive map that will aid in understanding cognition as a whole in both the healthy and the diseased brain.

Link to the ERC project webpage: https://medicine.ekmd.huji.ac.il/en/research/arielgi/Pages/default.aspx

Keywords of the ERC project: Mesoscale imaging; Brain-wide networks; Cognitive functions; Processing streams

Keywords that characterize the scientific profile of the potential visiting researcher/s: Molecular neuroscience; Neurological disorders; Computational neuroscience; Transcriptomics; RNAseq

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Project ID:	Project Acronym:	Evaluation Panel:
101040759	**SOFTCHIRP**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Alison Barker**
Host Institution:	Max Planck Gesellschaft Zur Foerderung Der Wissenschaften E.V. - DEU

Neural circuits for social communication

The main objective of this proposal is to understand how vocal communication is used to organize social groups and in turn how brain circuits have evolved to process social information encoded in vocal cues. The naked mole-rat, as one of only two eusocial mammals, is especially well-suited to this research question. Naked mole-rats form highly cooperative social units and like bees, wasps, and ants, live in multigenerational colonies under the control of a single breeding female, queen. In addition to their extreme cooperativity, these rodents are highly vocal with a repertoire (greater than 25 distinct vocalizations) comparable to that of non-human primates. I recently identified that naked mole-rat greeting calls, soft chirps, encode information about individual identity and are modulated to create distinct colony-specific dialects. Vocal dialects can be learned early in life and are influenced by social cues (i.e., the presence or absence of the queen). These features position the naked mole-rat as a promising, yet unexplored model for investigating the evolution of neural circuits for vocal communication, sociality and language. I will employ a combination of behavioral, computational, electrophysiological, molecular and in vivo imaging tools to investigate how: (i) social identity is encoded at the earliest stages of auditory processing within the naked mole-rat brain, (ii) how neural circuits for vocal production are shaped by auditory environments during development and finally (iii) how social interactions acting through transcriptomic and molecular mechanisms influence vocal behaviors. This work has the potential to not only expand our understanding of the neural architecture underling the sensory coding and production of vocalizations, but also to provide insights into complex social behaviors such as empathy and altruism.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101040951	**RADIOGUT**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Maria Rodriguez Aburto**
Host Institution:	University College Cork, National University Of Ireland, Cork - IRL

Radial Glia as Neurodevelopmental Mediators Of Gut Microbiota Signals

Increasing evidence points to the importance of gut microbiota in the aetiology of neurodevelopmental and neuropsychiatric conditions. However, the mechanisms and conduits through which microbiota influences brain development in the critical perinatal period, potentially leading to cognitive deficits in later life, remain largely unknown.

My hypothesis is that the dynamic early-life gut microbiota modulates the primary brain neural stem cells, the radial glia (RG), thereby sculpting the concurrently maturing neurodevelopmental trajectory. RG are in direct contact with cerebrospinal fluid (CSF), whose composition relies on a functional blood-CSF barrier (BCSFB) at the choroid plexus. BCSFB-RG interface is thus ideally positioned to receive peripheral circulating signals, such as those from gut microbiota. My preliminary data indicating alterations in RG dynamics and BCSFB integrity in neonatal mice with disrupted gut microbiota provides credence to my hypothesis. Building on this, RADIOGUT aims to mechanistically understand the interactions between gut microbiota, RG-led neurodevelopment and BCSFB function at molecular and cellular levels. To accomplish this, I will employ distinct models of early-life microbiota disruption in mice and assess the impact on RG and BCSFB using in vivo tracer imaging, ex vivo models combining explant cultures with microbial metabolites from a faecal fermenter, and an integrated multi-omics analysis. We will identify key microbial metabolites that operate at the BCSFB-RG interface, discern their signalling mechanisms and their potential to rescue RG-derived neurodevelopmental deficits as well as later life aberrant behaviours.

RADIOGUT will explore for the first time how RG can act as cellular sensors of microbial signals that modulate neurodevelopment. It will fill a large gap in the understanding of microbiota-gut-brain axis development and its communication code, as well as deliver tangible future translational value.

Link to the ERC project webpage: aburto-lab.org

Keywords of the ERC project: neurodevelopment, gut microbiota, radial glia, brain barriers, microbial metabolites, transcriptomics

Keywords that characterize the scientific profile of the potential visiting researcher/s: single cell transcriptomics, computational biology, metabolomics

Project ID:	Project Acronym:	Evaluation Panel:
101043584	**HUMANE**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Tarja Malm**
Host Institution:	Itä-Suomen Yliopisto - FIN

Window to the brain: a game changer in the discovery of human neuronal circuitry, cellular heterogenicity and biomarker profile indicative of early Alzheimer's disease -related pathology

The molecular mechanisms leading to Alzheimer's disease (AD) are poorly understood. This is due to lack of human tissue samples for research representing early changes of AD pathology. The accumulating pathology, including beta-amyloid and tau proteins, are manifested by concomitant neuroinflammatory reactions geared by malfunctional microglia. Microglia in the human and mouse AD brain exist in various subpopulations from which a specific, disease-associated microglia population is thought to be involved in AD pathogenesis. However, there is no evidence on whether and how these specific microglial subpopulations actually impair neuronal functions in human AD brain. I will now assess neuron-glia network activities and functions indicative of early AD pathology in humans. I hypothesize that early AD pathology selectively impairs neuronal circuits and that glial cells, especially specific microglia subpopulations, contribute to neuronal dysfunction and cognitive decline. These events contribute to a detectable vesicle-based biomarker profile in cerebrospinal fluid and blood prior the clinical disease. Due to early AD pathology present in a subpopulation of idiopathic normal pressure hydrocephalus (iNPH) patients, the brains of the iNPH patients offer a unique window to evaluate cellular and molecular events occurring during early AD. I combine a series of state-of-the art techniques to answer how and what glial cell subpopulations are associated with altered neuronal network activities at subcellular and spatial resolution in human brain impacted by early AD-related pathology. Novel methodologies established in my lab, knowhow and access to unique brain samples make me uniquely positioned to form a holistic view on how early AD-pathology impacts cellular functions at multiple levels. This will pinpoint novel molecular targets for further validation and new fluid biomarkers.

Link to the ERC project webpage:

Keywords of the ERC project: human brain biopsies, electrophysiology, multi electrode recordings, single cell sequencing, spatial transcriptomics, Alzheimer, microglia

Keywords that characterize the scientific profile of the potential visiting researcher/s: neurobiology, Alzheimer, electrophysiology, multi electrode recordings, single cell sequencing, data analysis

Project ID:	Project Acronym:	Evaluation Panel:
101044937	**TransNeuroFate**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Juliette Godin**
Host Institution:	Institut National De La Sante Et De La Recherche Medicale (Inserm) - FRA

Translational Control of Neuronal Fate and Identity

The cerebral cortex is a central structure of the mammalian brain, characterized by a remarkable diversity of neuronal types. Understanding the origin of the extraordinary neuronal diversity is fundamental to understand how cortical architecture and functions emerge during development and remains a critical challenge in cellular and molecular neurobiology.

While the efforts have been focused on transcriptional control, evidence for regulation at the translational level is emerging. I hypothesize that translational control, albeit overlooked, acts in a combinatorial fashion with transcriptional induction to regulate gene expression programs during cortical patterning. I have demonstrated an intimate functional link between cortical development and pools of mature transfer RNA (tRNAs), the major determinant of translation. I, therefore, propose to address how translational control, through the modulation of the availability of mature translationally competent tRNAs, fine-tunes gene expression programs during lineage progression, thereby regulating neuronal diversity. Studying this yet unexplored question should unravel a hitherto unrecognized level of neuronal fate identity determination in the cerebral cortex.

We will combine ribosome profiling, mRNA and tRNA deep sequencing, screening of genetic perturbation and gene manipulation in vivo in the mouse embryonic cortex to i) uncover the specific translational programs that influence neuronal lineages progression; ii) determine how tRNA repertoires (both at the transcriptional and post-transcriptional levels) are shaped to meet the specific translational needs of different cell types during corticogenesis and iii) validate the functional importance of fluctuation in mature tRNA content during cortical development.

This project should bring conceptual advances in the understanding of brain development mechanisms that could be instrumental to interpret the pathological mechanisms of neurodevelopmental disorders.

Link to the ERC project webpage:

Keywords of the ERC project: translation, neuronal diversity, cortical development, tRNAs, modification

Keywords that characterize the scientific profile of the potential visiting researcher/s: neurodevelopment, bioinformatics, molecular biologist

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Project ID:	Project Acronym:	Evaluation Panel:
101045253	**DEEPRETINA**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Olivier Marre**
Host Institution:	Institut National De La Sante Et De La Recherche Medicale (Inserm) - FRA

A perturbative approach to model retinal processing of natural scenes

A major goal of sensory neuroscience is to understand how sensory neurons process natural scenes. Models built from the responses of sensory neurons to simple stimuli do not generalize to predict how complex, natural scene are processed. Even as early as in the retina, this issue is not solved. Deep network models have been proposed to predict the responses of visual neurons to natural stimuli. However, they are still far from being a realistic model of the visual system. First, the sensitivity to perturbations of the stimulus can thus be very different for a deep network model and for our visual system. Second, it is not clear how the model components can be related to actual mechanisms in the brain. Our purpose is to understand how the retina processes natural scenes. We will follow an interdisciplinary approach where we will build realistic deep network models of retinal processing and test them in experiments. We will develop deep network models that can predict ganglion cell responses to natural stimuli, and map the components of these models to specific cell types in the retinal network. Our project is original because it will use two novel methods, that will be key to achieve our goal. The first one is a novel approach to characterize retinal function, where we will probe the selectivity of the retina to perturbations of natural stimuli. The second one is a novel tool based on 2-photon holographic stimulation to decompose the retinal circuit. They are tailored to address the specific issues of deep networks. Each ganglion cell has a receptive field center, the region of visual space whose stimulation evokes the strongest responses. Our project is divided in three parts. We will first understand how natural images are integrated inside the receptive field center. We will then ask how stimulation outside the receptive field center affects ganglion cell processing of natural images. Finally, we will focus on motion processing during natural scene stimulation.

Link to the ERC project webpage: http://oliviermarre.free.fr/

Keywords of the ERC project: retina ; computation neuroscience ; deep networks ; holography ; optogenetics

Keywords that characterize the scientific profile of the potential visiting researcher/s: retina ; computation neuroscience ; deep networks ; holography ; optogenetics

Project ID:	Project Acronym:	Evaluation Panel:
101054527	**elegansBrainBodyEnvi**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Manuel Zimmer**
Host Institution:	Universitaet Wien - AUT

Mechanisms and Functions of Brain- Body- Environment Interactions in C. elegans

Recent large-scaRecent large-scale neuronal activity recordings in awake, behaving animals revealed a new, unexpected neuroscientific principle: widespread neuronal activity patterns across the brain encode parameters of movement. Surprisingly, these brain-wide behavior representations even extend to areas that are implicated in the processing of sensory information (e.g., the visual cortex in mice). Thus, a large fraction of the brain's activity seems to be dedicated to representing the animals current, ongoing behavior. These observations have been made across the animal kingdom including worms, flies and mammals, suggesting a universal principle; however, the underlying mechanisms and functions remain unknown. In this proposal, we take advantage of the tractable model organism C. elegans to tackle this problem, combining brain-wide single cell resolution Ca2+-imaging in freely behaving animals with genetic circuit manipulation tools. It was previously recognized that the brain operates in a closed loop, actively sensing its body and its environment and making predictions of movement outcomes to optimally control behavior. Here, we propose to reconcile these long-standing concepts with the new observations of brain-wide behavior representations. Our core hypothesis is that sensory to motor transformation is a distributed process incorporating multiple functions like gain-control, re-afference prediction and predictive processing. Our team is at the forefront of scientific innovation and discoveries in this field, and we thereby are making substantial contributions to this currently ongoing paradigm shift in our understanding of how the brain operates. Studying these phenomena in worms offers a unique and timely opportunity to rapidly uncover the universal functions of brain wide behavioral representations. We therefore aim to make fundamental predictions and to formulate new working hypotheses for similar studies in larger model organisms with more complex brains.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101054886	**NeuRemodelBehavior**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Oren Schuldiner**
Host Institution:	Weizmann Institute Of Science - ISR

Sculpting circuits and behavior by developmental neuronal remodeling

Neuronal remodeling is a conserved strategy to refine neural circuits during development. Defects in remodeling have been associated with neuropsychiatric disorders, but direct mechanistic causality is lacking. Despite its fundamental significance, how remodeling of neuronal processes affects circuit architecture and function, and how this ultimately shapes behavior, is not only unknown, but also extremely challenging to study in complex organisms. Our lab is a world-leader in the molecular mechanisms of neuronal remodeling. We use the stereotypic remodeling of the Drosophila Mushroom Body (MB), a complex circuit within the fly brain, as powerful genetic model to study this question. Recently, we uncovered that MB remodeling is coordinated at the circuit level. Furthermore, we generated a detailed expression atlas of MB neurons during development, which highlighted genes and pathways mediating cell-cell interactions as prime remodeling regulators. Thus, our discoveries suggest that the time is ripe to take on the challenge of integrating the molecular, cellular, circuit and behavioral aspects of remodeling. The MB is a perfect system for this due to its well-characterized structure and function. To accomplish this goal, we will build upon our developmental expression atlas to identify molecules that mediate cell-cell interactions during remodeling (Obj 1). We will then investigate how specific genetic/cellular perturbations of remodeling impact overall circuit architecture and connectivity (Obj 2). Finally, taking a new direction for the lab, we will use behavioral readouts of MB function to understand how specific genetic perturbations of remodeling and connectivity affect circuit function and behavior (Obj 3). While each objective is independent and expected to yield high-impact discoveries by itself, it is their combined implementation that is expected to provide the first holistic picture of neuronal remodeling from molecules to cells, circuits and function.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
802899	**VIRUSES AND RNA**	**LS6** Immunity, Infection and Immunotherapy

Principal Investigator:	**Dr Troels Kasper Høyer Scheel**
Host Institution:	Kobenhavns Universitet - DNK

RNA regulation during viral infection

Viral infections are responsible for significant morbidity and mortality and frequency and impact of epidemics are expected to increase. Thorough understanding of basic virology is critical for informed development of prevention and control. Most systematic studies of virus-host interactions have focused on proteins, however, with recent methodological advances the intersecting fields of viral infection and RNA biology hold great promise for basic and therapeutic exploration. The goal of this application therefore is to discover and dissect RNA-based virus-host interactions and related regulatory mechanisms of gene expression.
Micro-RNAs (miRNAs) fine-tune gene expression by repressing mRNA targets. However, cellular miRNAs increase translation and replication of certain viruses. Thus, hepatitis C virus (HCV) critically depends on the liver specific miR-122, which emerged as a therapeutic target. Further, HCV sequesters enough miR-122 to indirectly regulate cellular gene expression. I hypothesize that this RNA-based mechanism contributes to virus induced liver cancer, and aim to address this using our recently developed rodent model for HCV infection (Aim 1). Better understanding of viral RNA (vRNA) interactions could significantly contribute to basic infection biology and novel therapeutics. I therefore aim to systematically identify vRNA interactions with other cellular RNAs and proteins (Aim 2). I expect to identify interactions of value for functional regulation and therapeutic targeting. I finally hypothesize that translation of certain cellular mRNAs – similarly to viruses – increase upon miRNA binding, and aim to systematically screen for such virus-like alternative regulation, with potential to change understanding of post-transcriptional regulation (Aim 3).
In conclusion, this high-risk high-gain project has potential to shape novel dogmas for virus and RNA biology and to identify novel RNA-based therapeutic targets; a promising upcoming field of discovery.

Link to the ERC project webpage:

Keywords of the ERC project: Virus RNA miRNA virus-host interactions

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
865105	**AimingT6SS**	**LS6** Immunity, Infection and Immunotherapy

Principal Investigator:	**Dr Marek Basler**
Host Institution:	Universitaet Basel - CHE

Mechanisms of dynamic localization of the bacterial Type 6 secretion system assembly

The Type 6 secretion system (T6SS) allows Gram-negative bacteria to deliver toxins into both eukaryotic and bacterial target cells and thus cause disease or kill competitors. T6SS is composed of four main parts: a membrane complex, a baseplate and a long spring-like sheath wrapped around an inner tube. Sheath contraction generates a large amount of energy to push the tube with associated toxins through the baseplate and membrane complex out of the cell. However, the reach of the T6SS tube is limited and thus a direct contact with the target membrane and precise positioning of T6SS assembly is required for protein translocation. In this proposal, we will unravel principles of spatial and temporal coordination of T6SS assembly that we have recently observed in several bacteria. We will study how Pseudomonas sense attacks from neighbouring bacteria to dynamically localize its T6SS to quickly retaliate. We will describe how Acinetobacter initiate and position T6SS assembly in response to peptidoglycan damage, changes in osmolarity and cell-cell interactions. We will identify the principles and the role of the polar assembly of T6SS in intracellular pathogens Francisella and Burkholderia. Using genetic and biochemical approaches, we will identify and characterize proteins interacting with the core components of T6SS and test their role in initiation and positioning of T6SS assembly. We will search for peptidoglycan remodelling enzymes required for T6SS assembly. We will use advanced microscopy techniques to describe dynamic localization of proteins upon T6SS activation to establish the order of their assembly. We will quantify how much T6SS aiming increases efficiency of protein delivery and T6SS function during bacterial competition and pathogenesis. Overall, we will unravel novel principles of spatial and temporal control of localization of protein complexes and show how this allows bacteria to quickly respond to external cues and interact with their environment.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
866222	**NICHEADAPT**	**LS6** Immunity, Infection and Immunotherapy

Principal Investigator:	**Dr Pamela Schnupf**
Host Institution:	Institut National De La Sante Et De La Recherche Medicale (Inserm) - FRA

Deciphering the niche adaptations of a gut commensal involved in educating the host immune system

The gut microbiota plays an integral part in driving the postnatal maturation of the gut immune system and in protecting the host from pathogens. The commensal segmented filamentous bacteria (SFB) plays a critical role in these processes through its intimate attachment to the ileal epithelium using a unique pointed tip structure on its unicellular 'infectious' particle. SFB induces a broad pro-inflammatory immune activation, and notably a striking induction of IgA and Th17 cell responses, that fosters pathogen resistance but can also exacerbate disease severity in a number of autoimmune models, making SFB an important microbe in health and disease. SFB is found in many vertebrate species, including humans, and SFB monocolonization has allowed a detail study of its immunostimulatory potential. However, the unique and complex life-cycle of SFB and SFB's interaction with the host has remained poorly understood due to a lack of in vitro culturing techniques. We recently overcame this hurdle by establishing the first in vitro SFB-host cell co-culturing system. Using this system, unicellular SFB were discovered to be flagellated and to stimulate TLR5 signaling, revealing a missing link of immunological importance in the SFB life-cycle. This important developmental stage will now be further characterized and its immunological consequence assessed using gnotobiology. State-of-the-art microscopy techniques will be employed to characterize in detail the SFB life-cycle and novel structures discovered during in vitro growth. Unicellular SFB surface proteins will be identified using mass spectrometry, localized on the bacterium and tested for their ability to mediate host cell attachment. In addition, next generation sequencing and transcriptomics will be used to assess SFB genome evolution and SFB niche constraints. Together, this work will lead to a detailed view of the SFB life-cycle and how SFB has adapted to its unique replicative niche at the epithelial surface.

Link to the ERC project webpage:

Keywords of the ERC project: microbiota, host-bacterial interaction, intestinal immunity, bacterial development

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
885435	**MAIT**	**LS6** Immunity, Infection and Immunotherapy

Principal Investigator:	**Dr Olivier Lantz**
Host Institution:	Institut Curie - FRA

Tissue repair functions of MAIT cells: integrating thymic pre-commitment and peripheral signals

Mucosal associated invariant T cells (MAITs) represent an abundant subset in humans with unique specificity for microbial metabolites. MAIT conservation along evolution indicates important, non-redundant functions. Despite changes in MAIT frequency and phenotype in several infectious and non-infectious diseases, their functions are still unclear. By contrast with mainstream CD4+ or CD8+ T cells, MAITs differentiate into effector cells during thymic development. How the differentiation program imparted in the thymus is modified by tissue and environmental cues to determine MAIT functions in tissues is not known. Our preliminary data support a new function for MAITs in boosting tissue repair in skin wound healing and flu infection. Thus, MAITs would either repair tissues or inflict tissue damage when fighting microbes according to the stage of the disease. To understand how and when the different MAIT functions are turned on and off in vivo we will study: 1) How is the thymic MAIT differentiation program modulated by tissue and environmental cues to determine the location and effector functions of MAITs in skin and lung at steady state? To this end we will develop new genetic methods to modify MAIT development or functions. 2) What are the effector functions of MAITs leading to protection during skin wound healing and flu infection? We will determine the cell types MAITs affect and identify the mediators secreted by MAIT cells. 3) What triggers MAIT protective effect? We will identify the drivers of MAIT activation and assess the requirement for cognate or non-cognate (cytokines) interactions. Wound healing of human skin explants will test the therapeutic potential of modulating MAIT activation. Our results will provide unique insight on the functions of MAIT cells with important implications for therapy of diseases in which MAIT triggering (or inhibition) could be beneficial (or deleterious) such as wounds or infections that damage tissues and thus require repair.

Link to the ERC project webpage:

Keywords of the ERC project: mait, T cell development, tissue repair, single cell transcriptomics

Keywords that characterize the scientific profile of the potential visiting researcher/s: immunologist

Project ID:	Project Acronym:	Evaluation Panel:
101053576	**VIRLUMINOUS**	**LS6** Immunity, Infection and Immunotherapy

Principal Investigator:	**Dr Frank Van Kuppeveld**
Host Institution:	Universiteit Utrecht - NLD

Illuminating the enteroviral life cycle

Enteroviruses are highly prevalent pathogens that have enormous clinical and socio-economic impact. Well-known examples are poliovirus, coxsackievirus, enterovirus-A71, enterovirus-D68, and rhinovirus. Although important insights have been obtained in the enteroviral life cycle, many important questions remain unanswered due to shortcomings of current imaging and biochemical methodologies. There is a high need for novel technologies that allow sensitive and real-time observation of the dynamics and localisation of viral RNA, viral proteins, and host factors at the single-cell level.

My long-term goal is to understand enterovirus replication and translate knowledge into the development of antiviral drugs. My lab has a long-standing track record and has made many important contributions to understanding the molecular mechanisms of enterovirus replication and the formation of viral replication organelles. Recently, we constructed a reporter virus that in combination with high-resolution microscopy allowed for the first time to visualize translation, and the regulation thereof, of single (entero)viral RNAs in living cells.

The goal of this project is to visualize and dissect the spatial and temporal regulation of different phases of the enterovirus life cycle. As a first step, novel recombinant reporter viruses for application in real-time imaging technologies will be developed. These viruses will be used to study viral RNA replication, virus assembly, and pre-lytic virus release in living cells. Moreover, they will be instrumental to study the structure and composition of the viral replication organelles and the associated replication complexes through advanced cryo-electron microscopy and tomography technologies, and proteomics/lipidomics analysis, respectively.

This project will lead to important new insights into the molecular interplay between enteroviruses and their hosts, which is essential for developing urgently needed antiviral drugs.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101054456	**Traitor-Viruses**	**LS6** Immunity, Infection and Immunotherapy

Principal Investigator:	**Dr Frank Kirchhoff**
Host Institution:	Universitaet Ulm - DEU

Traitor-virus-guided discovery of antiviral factors

Viruses may seem smart since they rapidly develop new skills to spread in humans. However, they are actually just masters of trial and error. Their short generation time, enormous reproduction and high variability allows viruses to try countless variations. A few of these will enhance viral spread and, in the worst case, enable viral pandemics. It is conceivable that viruses evolve to counteract those defence mechanisms that would otherwise be most effective against them. Usually, it is hard to assess why specific changes are advantageous. This is especially true for adaptations enabling viral pathogens to counteract innate antiviral factors because these cellular proteins and their viral antagonists are numerous and highly versatile. Here, I propose to combine the advantages of the revolutionary CRISPR/Cas9 technology with the enormous adaptive power of viruses to develop a novel approach allowing robust, specific and genome-wide unmasking of antiviral mechanisms. In principle, we will equip HIV-1 with genetic scissors to convert them into “traitor viruses” revealing their cellular opponents. To achieve this, we will generate libraries of replication-competent HIV-1 constructs expressing guide RNAs as genetic tools with the potential to inactivate every human gene in Cas9 expressing cells. Virus variants expressing guide RNAs eliminating antiviral genes will be selected by in vitro passaging and identified by next generation sequencing. Utilization of different viral backbones will allow the discovery of key defence factors against viral zoonoses and spread in humans. Finally, we will determine the antiviral spectrum and inducibility of innate antiviral factors to identify vulnerabilities of viral pathogens that can be exploited in preventive and therapeutic approaches. The project will establish and apply an innovative, highly versatile approach to uncover our antiviral defence mechanisms with the ultimate goal is to achieve better control of viral pathogens.

Link to the ERC project webpage:

Keywords of the ERC project: HIV, innate immunity, restriction factors

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
772635	**C-POS**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Richard Harding**
Host Institution:	King'S College London - GBR

Children's Palliative care Outcome Scale

Person-centred care is a core health value of modern health care. The overarching aim of C-POS (Children's Palliative care Outcome Scale) is to develop and validate a person-centred outcome measure for children, young people (CYP) and their families affected by life-limiting & life-threatening conditions (LLLTC). International systematic reviews, and clinical guides have highlighted that currently none exists. This novel study will draw together a unique multidisciplinary collaboration to pioneer new methods, enabling engagement in outcome measurement by a population currently neglected in research.

C-POS builds on an international program of work. The sequential mixed methods will collect substantive data through objectives to determine i) the primary concerns of CYP and their families affected by LLLTC & preferences to enable participation in ethical person-centred measurement (n=50); ii) view of clinicians and commissioners on optimal implementation methods (national Delphi study); iii) a systematic review of current data collection tools for CYP regardless of condition; iv) integration of objectives i-iii to develop a tool (C-POS) with face and content validity; v) cognitive interviews to determine interpretability (n=40); vi) longitudinal cohort of CYP and families to determine test-retest reliability, internal consistency, construct validity and responsiveness (n=151); vii) development of resources for routine implementation viii) translation and interpretation protocols for international adoption.

C-POS is an ambitious study that, for the first time, will enable measurement of person-centred outcomes of care. This will be a turning point in the scientific study of a hitherto neglected group.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/772635

Keywords of the ERC project: Children Paediatric Palliative Outcomes

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
818715	**SECRETE-HF**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Rudolf De Boer**
Host Institution:	Academisch Ziekenhuis Groningen - NLD

SECRETED FACTORS IN CARDIAC REMODELING PROVOKE TUMORIGENESIS AND END ORGAN DAMAGE IN HEART FAILURE

The objective of SECRETE-HF is to demonstrate the effects of secreted factors from failing hearts to explain the etiology of multimorbidity in heart failure (HF). The project focuses on two co-morbid patterns: 1) the emerging susceptibility of HF patients for incident cancer, 2) the more established co-morbid conditions of renal, liver and pulmonary disease in HF. The rationale is:

• HF treatment has improved, yet morbidity and mortality remain high, which can be attributed to co-morbid conditions rather than pump failure alone.

• HF treatment is heart-oriented, neglecting the systemic effects that come with HF, and the associated morbidity and mortality.

• Using innovative experimental approaches such as organ transplant models, target finding, and deep phenotyping of clinical databases I will dissect HF-derived effects on tumor growth and organ damage.

OBJECTIVES

1. To establish the effects of HF, due to different etiologies, using the state-of-the-art heart transplantation murine model with (spontaneous) formation of colon and renal tumors, and phenotype tumor growth, as well as the main HF-affected organs: kidney, liver and lungs.
2. Identification of the cardiac secretome using unbiased approaches.
3. Integrate the results and identify overlapping and diverse factors from different HF forms, and their consequences for tumor growth and kidney/liver/lung remodeling.
4. Validate discoveries in human cohorts with data on incident HF, cancer and organ function.
5. Create clinical algorithms to detect, monitor and act on extra-cardiac disease.

WORKPACKAGES

WP 1: Create HF, murine heart transplantation models; phenotype tumor growth and organ involvement.
WP 2: Explore the proteomic, metabolomic and extracellular vesicle profiles from HF subforms.
WP 3: Validate secreted factors in vitro and in vivo.
WP 4: Validate human relevance in large population-based cohorts with unique phenotyping.
WP 5: Describe added value of novel markers and design clinical

Link to the ERC project webpage: https://www.groningencardiology.com/nl/research/secrete-hf/

Keywords of the ERC project: cardio-oncology; heart failure; biomarkers

Keywords that characterize the scientific profile of the potential visiting researcher/s: cardio-oncology; heart failure; biomarkers

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
851231	**THERAUTISM**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Lucie Pellissier**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

New molecular targets and proof-of-concept therapies for Autism Spectrum Disorders

Autism is the major neurodevelopmental health public issue, affecting 1/100 child births worldwide. These disorders are diagnosed before the age of 3, based on behavioural cues: deficits in social interaction and communication as well as stereotyped and restrained behaviours. There is no medication to improve this condition. Most recent molecular targets identified within narrow frameworks (unspecific molecule, single tissue targeted, single disease model used) have failed in clinical trials. My first objective aims at thwarting this autism research gap, unravelling the common molecular and cellular dysfunctions underlying autism-related behaviours across several preclinical models and neuronal circuits. In particular, setting up translatomic analyses in these paradigms will identify and validate new molecular therapeutic targets. I recently deciphered one such molecular substrate, involving the loss of oxytocin transcripts in oxytocinergic axon terminals thus demonstrating the feasibility of this global approach. The second major objective of my project is to hijack the properties of a newly identified protein function to restore this new target and rescue social deficits in different preclinical models of autism. This would yield a novel and safe gene therapy vector which has never been explored before. Altogether, my research project will deliver strategic resources to the scientific and medical communities that will spur the development of new treatment options for autistic patients.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
864180	**QUANTUM**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Teun Bousema**
Host Institution:	Stichting Radboud Universitair Medisch Centrum - NLD

Quantifying the spread of P. falciparum malaria

Background: A major challenge for malaria elimination is its phenomenally efficient spread through sexual stage parasites (gametocytes). Many individuals in endemic settings harbour low but transmissible gametocyte densities. It is currently unclear how gametocyte density translates into the likelihood that an infected mosquito gives rise to secondary infections, who drive malaria transmission at population level and how anti-gametocyte immunity affects gametocyte production and infectivity.
I hypothesize that secondary infections can arise from low-density infections but that higher gametocyte densities result in comparatively more infectious mosquitoes and an increased number of secondary infections. I further hypothesize that malaria transmission efficiency and changes therein can only be accurately predicted if anti-gametocyte immunity is thoroughly understood and that the rapid loss of gametocyte immunity during effective control results in increased transmission efficiency.
Aims and approach: I will perform the first-ever direct assessment of numbers of malaria parasites ejected by mosquitoes in relation to natural gametocyte densities. Using novel genotyping approaches, longitudinal sampling of infections at unsurpassed resolution and state-of-the art analytical approaches, I will perform the most comprehensive molecular evaluation of malaria transmission in a real community ever performed. Lastly, I will quantify the impact of immune responses that reduce gametocyte density and infectivity by novel immune-profiling approaches and mathematical transmission models.
Importance and innovation: this project will profoundly improve understanding of the production and infectivity of gametocytes and the epidemiological impact of human immune responses that influence these processes. The work in different African settings will provide a major leap forward in understanding the human infectious reservoir for malaria and has direct implications for elimination

Link to the ERC project webpage:

Keywords of the ERC project: malaria, epidemiology, transmission, anopheles, immunity

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
866411	**CompHematoPathology**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Carsten Marr**
Host Institution:	Helmholtz Zentrum Muenchen Deutsches Forschungszentrum Fuer Gesundheit Und Umwelt Gmbh - DEU

Computational Hematopathology for Improved Diagnostics

Identifying hematologic malignancies still relies on the time-consuming and subjective visual assessment of images. Every day, cytologists and pathologists are confronted with rare diagnostic cells, ever-increasing image data, and heterogeneous disease manifestations. Although we understand blood better than any other human tissue, we are unable to quantitatively predict a patient's blood dynamics from a measurement. Diagnosis thus depends on rough staging schemes and the expertise and intuition of the clinician.

In my proposal, I address these challenges by establishing computational hematopathology, a combination of artificial intelligence algorithms and mathematical models that will boost the currently prevailing manual assessment. Based on my experience in using these methods for scrutinizing stem cell differentiation I will combine the power of deep learning and mathematical modeling with digitized and expertly annotated image data. My unique approach enables me to design and parametrize a data-driven model to predict hematopoietic dynamics in health and disease. Since the interpretation of digitized slides is becoming the clinical standard, novel algorithms for standardized disease classification and improved diagnosis are critically needed now.

This interdisciplinary project merges methods from digital pathology, machine learning, image processing, and mathematical modeling. ComHematoPathology will provide novel approaches and software tools for automated classification of hematopathology image data, allowing for reproducible and precise diagnosis at an unprecedented level. This will increase throughput and standardize the diagnosis of blood diseases and will thus improve the treatment of patients suffering from hematologic malignancies.

Link to the ERC project webpage:

Keywords of the ERC project: machine learning, single cell research, blood disease diagnostic, mechanistic modeling

Keywords that characterize the scientific profile of the potential visiting researcher/s: computer vision, mathematical modeling, multi-modal analysis, health AI

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
866504	**CANCER-RADIOMICS**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Hugo Aerts**
Host Institution:	Universiteit Maastricht - NLD

Deep Learning for Automated Quantification of Radiographic Tumor Phenotypes

Artificial Intelligence (AI), deep-learning in particular, is propelling the field of radiology forward at a rapid pace. In oncology, AI can characterize the radiomic phenotype of the entire tumor and provide a non-invasive window into the internal growth patterns of a cancer lesion. This is especially important for patients treated with immunotherapy as, despite the remarkable success of these novel therapies, the clinical benefit remains limited to a subset. As immunotherapy is expensive and could bring unnecessary toxicity there is a direct need to identify beneficial patients, but this remains difficult in clinical practice today. Radiomic biomarkers could address this, as, unlike biopsies that only represent a sample within the tumor, radiomics can depict a full picture of each cancer lesion with a single non-invasive examination. Previous work found significant connections between radiomic data, molecular pathways, and clinical outcomes. However, a direct link between radiomics and immunotherapy response has not yet been established. This project will address this problem by analyzing unique multicentre clinical data, including non-invasive imaging, clinical outcomes, and extensive biologic characterization, of over 3200 patients with lung or melanoma cancer. Specifically, I will develop deep-learning radiomic biomarkers to predict immunotherapy response using baseline (WP1) and follow-up imaging (WP2). I will also investigate if radiomics can characterize underlying biological factors, and, in turn, can be used to improve response predictions (WP3). Successful completion of this proposal will demonstrate the potential of radiomics to help physicians in selecting patients who will likely benefit from immunotherapy, while sparing this expensive and potentially toxic treatment for patients who don't. This work has implications for the use of imaging-based biomarkers in the clinic, as they can be applied noninvasively, repeatedly, and at low additional cost.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
882424	**IMPACT**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Burkhard Becher**
Host Institution:	Universitaet Zuerich - CHE

High-Dimensional single cell mapping of inflammatory disease signatures in monozygotic twins

Multiple Sclerosis (MS) is a chronic inflammatory disease, where immune cell invasion into the central nervous system causes immunopathology and neurological deficit. Although disease-modifying therapies dramatically reduce disease activity, they hold the potential for severe adverse effects while long-term disability prospects remain poor. Moreover, there is to date no biomarker for monitoring the disease activity and to guide therapy decisions. I propose that the key to identifying such biomarkers is to combine single-cell mapping of leukocytes across well-curated patient cohorts with unbiased machine-learning based data interrogation. Using such an approach, we have already delineated a disease signature in a helper T cell population specific for MS. However, the immune compartment of cross-sectional cohorts is influenced by the individual genetic make up, which masks disease-specific signals and hinders a more precise characterisation of involved immune cell populations. To eliminate genetic influences, I here propose in aim 1 to interrogate the immune compartment of a unique cohort of monozygotic twin pairs -discordant for MS- and deeply analyse peripheral blood lymphocytes by single-cell mass cytometry, combined TcR and single cell sequencing, and epigenetic profiling. aim 2 to develop representation-learning methods to account for the paired genetics of twins or longitudinal samples and to include clinical covariates into the high-dimensional data set. aim 3 to use well-defined patient samples of MS-like disorders (MS-Mimics) and longitudinal samples of patients undergoing disease-modifying therapy (e.g. B cell depletion, autologous stem cell transplant) using single-cell mass cytometry. Ultimately, the goal is to reduce the dimensionality of disease signature(s) towards a clinically translatable low-dimensional biomarker that could be identified and quantified by routine methods available in the clinics.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
949667	**CARsen**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Judith Feucht**
Host Institution:	Eberhard Karls Universitaet Tuebingen - DEU

Senolytic CAR T cells as novel therapeutic concept for solid tumors and senescence-associated diseases.

The adoptive transfer of T cells expressing CD19-directed chimeric antigen receptors (CARs) has yielded remarkable efficacy in patients with hematological B-cell malignancies. CARs are a class of synthetic receptors that reprogram T cell specificity, function and metabolism. Engineered T cells are applicable in principle to other cancers and diseases, but clinical success will critically depend on further progress to overcome current limitations such as antigenic heterogeneity or impaired T cell trafficking and function. We propose to develop CAR T cells targeting senescent cells as a novel therapeutic concept for cancer and senescence-associated diseases. Cellular senescence is a stress-response program characterized by stable cell cycle arrest that serves as a potent tumor-suppressive mechanism. Conversely, accumulation of senescent cells generates a chronic inflammatory milieu, which contributes to a plethora of pathologies, such as liver or lung fibrosis and can even promote tumor progression.

Our preliminary data demonstrate that CAR T cells can efficiently clear senescent cells, providing therapeutic benefit in a murine model of liver fibrosis. We thus firmly believe that senolytic CAR T cells have broad therapeutic potential. To this end, we will apply innovative engineering strategies to develop modular CAR designs tailored to senescence-specific requirements. We will determine safety and efficacy of senolytic CAR T cells in murine models of cellular senescence and solid tumors. Importantly, we will evaluate combined treatment approaches of senescence-inducing therapies with CAR T cells targeting senescent and proliferating tumor cells. Finally, we will investigate engineering tools to optimally direct senolytic CAR activity to mediate durable tumor regression.

This project combines two emerging concepts of anticancer therapies and goes beyond current applications of CAR therapies. The efforts may lead to promising new therapeutic avenues.

Link to the ERC project webpage:

Keywords of the ERC project: CAR T cells, senescence, immunotherapy for solid tutors and senescence-associated diseases

Keywords that characterize the scientific profile of the potential visiting researcher/s: background in molecular biology, immunology, oncology

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101001237	**I-PACE**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Matthijs Brouwer**
Host Institution:	Academisch Medisch Centrum Bij De Universiteit Van Amsterdam - NLD

Improving Prognosis by using innovative methods to diAgnose Causes of Encephalitis

Background: Encephalitis is a severe inflammation of the brain that can be caused by viruses, bacteria and other microorganisms, or autoimmune disease. The impact is high: the case fatality rate is 10-20% and half of patients have neurological deficits. Identifying the cause of encephalitis is essential for early initiation of therapy and thereby improves outcome.

The clinical challenge: Current diagnostics for encephalitis are insufficient. My prospective pilot study showed that the cause of encephalitis could be identified in only half of patients.

Aim: The aim of I-PACE is to improve the cause-specific diagnosis of encephalitis using innovative diagnostic methods.

Methods: I will use my encephalitis network of Dutch hospitals to study innovative diagnostic methods in 3000 patients with suspected encephalitis and validate the results in 2000 patients from Denmark, the UK and Zambia. I will collect clinical data, cerebrospinal fluid (CSF) and blood to enable state-of-the-art diagnostic studies and identify novel causes of encephalitis. First, I will perform virus discovery and DNA metagenomics sequencing to identify new infectious causes of encephalitis, combined with phage-display antibody sequencing. Second, I will perform CSF single cell gene expression studies to identify transcription patterns specific for the cause of encephalitis. Third, single cell immune profiling and anti-neuronal antibody detection assays will be used to identify new causes of autoimmune encephalitis. Finally, I will perform extensive metabolite and lipid analysis in the CSF to identify new biomarkers enabling a syndromic diagnosis to quickly differentiate between causes.

Impact: With I-PACE I aim to increase the proportion of patients with a cause-specific diagnosis of encephalitis from 50% to 80%, facilitating direct and targeted treatment to improve the prognosis. I will discover novel causes of infectious and autoimmune encephalitis, and provide insights in its pathophysiology.

Link to the ERC project webpage:

Keywords of the ERC project: Encephalitis, CSF examination, novel diagnostics, sequencing

Keywords that characterize the scientific profile of the potential visiting researcher/s: neurology, microbiology, interest in diagnostic testing/cohort studies

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101001791	**AIM.imaging.CKD**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Peter Boor**
Host Institution:	Universitaetsklinikum Aachen - DEU

AI-augmented, Multiscale Image-based Diagnostics of Chronic Kidney Disease

Chronic kidney disease (CKD) is a major global health problem, affecting 10% of the world population and projected to be the fifth major cause of death in 2040. CKD patients are one of the most complex and multi-morbid populations in internal medicine while at the same time having the least translational randomized clinical trials and limited treatment options. One of the major reasons for this is the lack of reproducible approaches specifically reflecting intrarenal pathological processes and disease activity. The overall goal of AIM.imaging.CKD is to specifically address this unmet need by developing, validating and integrating image-based diagnostics for CKD. The integration of broad interdisciplinary expertise will enable to develop a multiscale approach from nano- to micro- to macromorphological and molecular diagnostics. Specifically, the project will develop augmented full-spectrum ultrastructural ("nano") and histological ("micro") renal biopsy diagnostics, focusing on reproducible, quantitative nephropathological analyses and prediction of clinically relevant outcome parameters. The project will also explore macro-morphological and molecular imaging in CKD, focusing on translatable non-invasive approaches. The central feature will be the development of advanced, scalable and modular image analyses models utilizing artificial intelligence (AI), particularly machine and deep learning. Using preclinical testing and clinical validation, the main emphasis will be on accelerated or, whenever possible, direct implementation into the clinical practice. The integration of the above-mentioned tools and technologies provides a comprehensive multiscale and multiplex approach for improved diagnostics of CKD patients and facilitate future randomized clinical trials. At each level, and even more so when integrated, the results are expected to augment and transform image-based diagnostics of kidney diseases, and thereby lead to improved patient management and outcome.

Link to the ERC project webpage:

Keywords of the ERC project: deep learning, imaging, patholgo, multiscale image-based diagnostics, Kidney Diseases

Keywords that characterize the scientific profile of the potential visiting researcher/s: PhDs/MDs/PostDocs in various areas, including computer vision, data science and AI/DL development, imaging, experimental nephrology, molecular biology

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Project ID:	Project Acronym:	Evaluation Panel:
101020342	**TARGET**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Alberto Bardelli**
Host Institution:	Universita Degli Studi Di Torino - ITA

Targeting DNA repair pathways, sparking anti cancer immunity

This project will test for the first time the hypothesis that therapeutic inactivation of DNA repair pathways in cancer cells can be exploited for patient benefit by reawakening an anti-tumor immune response.
Genomic instability and molecular heterogeneity, which occur in cancer cells with DNA repair deficiencies, fuel tumour progression and are associated with poor outcome. An exception is represented by Mismatch repair (MMR) deficient cancers as these tumours are exceedingly genetically heterogeneous but show favourable prognosis and remarkable response to immunotherapy.
The molecular basis for the clinical outcome of MMR deficient cancers has long remained a mystery. Only recently it has become apparent that their biological properties are associated with increased levels of mutations, which unleash adaptive immunity and trigger immunosurveillance.
We have reported that when MMR is impaired, cancers cells grow in immune-deficient mice but are unable to do so in immune competent animals. MMR inactivation increased the mutational burden and led to dynamic mutational profiles, resulting in persistent renewal of neoantigens and engagements of antigen-specific T cells.
These data suggest an unprecedented high risk-high gain approach: the pharmacological blockade of proteins involved in DNA-repair as an anticancer therapy. This unconventional strategy builds on the concept that the immune system can identify and selectively target tumor cells carrying DNA alterations.
Using in vitro and in vivo functional assays we will systematically assess whether and how inactivation of DNA repair genes provokes an immune response and restrict cancer growth. Notably, TARGET will discover and develop inhibitors of MMR and other DNA repair proteins that induce tumor immunity.
The identification of DNA repair pathways which, when disabled, reawaken the immune system will provide transformative knowledge and could lead to the development of an entirely new class of anticancer drugs.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101021500	**LEGENDARE**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Fernando Rivadeneira**
Host Institution:	Erasmus Universitair Medisch Centrum Rotterdam - NLD

Leveraging genomic discoveries and skeletal phenotyping to improve osteoporosis patient care

Osteoporosis is a silent, systemic skeletal disease leading to fragility fracture. While the deleterious consequences for the individual, their families and society are well established, the causes of the disease remain elusive. Despite exhaustive clinical, epidemiological and genomic research, scarce understanding of the complex underlying disease mechanisms leading to bone fragility has hindered the improvement of clinical care. This LEGENDARE programme aims to implement a holistic integrative approach directed at discerning the underlying mechanistic pathways leading to bone fragility. The approach seeks translating genomic and imaging discoveries into meaningful clinical strategies to stratify risk; re-evaluate treatment indication; and ultimately, redefine (molecular) disease classification of patients with osteoporosis and other skeletal diseases. LEGENDARE will progress beyond the state-of-the-art by integrating genomic information from thousands of loci (genome regions) associated with musculoskeletal traits and other diseases, into "optimized" polygenic risk scores providing novel biological insight about skeletal disease. Skeletal research will be brought to a new level by enriching skeletal imaging with BIG DATA obtained with advanced whole-body EOS 3D X-rays. Approaching the whole skeleton as a unified organ will allow the unprecedented study of hidden relationships across bone compartments. Further, using artificial intelligence approaches, the complexity of the skeletal system will be modelled, integrating genomic, imaging and clinical data across epidemiological cohorts and patient settings. LEGENDARE will deliver knowledge on fundamental processes regulating skeletal fragility, unveiling new strategies for translational exploitation leading to improved clinical outcomes of osteoporosis patients. Discoveries will hold wider significance through potential spinoffs able to mitigate the societal impact of other diseases surging with bone fragility.

Link to the ERC project webpage:

Keywords of the ERC project: MUSCULOSKELETAL SYSTEM; GENOMICS; IMAGING; ARTIFICIAL INTELLIGENCE; MACHINE LEARNING

Keywords that characterize the scientific profile of the potential visiting researcher/s: COMPUTER SCIENTIST; BIOINFORMATICS; DATA SCIENTIST; GENETECIST

Project ID:	Project Acronym:	Evaluation Panel:
101021566	**ART-HEALTH**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Debbie Lawlor**
Host Institution:	University Of Bristol - GBR

Conception by artificial reproductive technologies and offspring health

Infertility affects 1 in 6 couples. With increasing numbers of artificial reproductive technology (ART) conceptions, understanding the effects of ART on maternal and offspring health has been designated a major research priority. Research to date has been highlighted as having limited quality and lacking methodological transparency. In ART-HEALTH we use a robust, systematic approach of triangulating different sources of evidence to address this.

work-package (WP) 1 will generate three new datasets with complementary sources of bias.

1. Birth cohort collaboration of 360,000 spontaneously conceived (SC) and 10,000 ART offspring. This will provide rich data on large numbers with ART offspring recruited, assessed and followed in identical ways to SC offspring.
2. Large ART cohort (5000 couples) with detailed information on treatments linked to a SC group that will have identical data collected from pregnancy to mid-childhood.
3. Large population record linkage of 200,000 contemporary ART births, 10,000 of their SC siblings and 400,000 general population SC births.

WP2 will triangulate evidence to determine the effects of ART on perinatal and offspring cardiometabolic health. It will compare results from the 3 datasets and updated systematic reviews, using conventional multivariable regression and within sibship analyses.

WP3 will analyse the datasets using Mendelian randomization, and multivariable regression in a counterfactual framework to explore pregnancy metabolomic mediation.

We will systematically and transparently assess risk of bias with each analytical method in each dataset and use bounds of causality and Bayesian approaches to integrate data.

PhD students, funded from elsewhere, will explore effects on parental and offspring mental health and cognitive function. In the final year we will work with colleagues in Brazil, Pakistan, a- ART is increasing

- Concerns about effects
- Evidence base limited
- Our objectives
- Why these will make a difference

Link to the ERC project webpage:

Keywords of the ERC project: Assisted reproductive technology, IVF, ICSI, fertility, offspring health

Keywords that characterize the scientific profile of the potential visiting researcher/s: Epidemiology, Statistics, Causal inference, Triangulation of evidence

Project ID:	Project Acronym:	Evaluation Panel:
101041118	**NanoBubbleBrain**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Tali Ilovitsh**
Host Institution:	Tel Aviv University - ISR

Low frequency nanobubbles-enhanced noninvasive transcranial ultrasound for brain cancer therapy

One of the worst diagnoses in oncology is a malignant brain tumor, with survival rates that are dismal. Noninvasive surgery can be achieved using histotripsy, a local, nonthermal ultrasound (US) surgical method that uses short, high-intensity?focused US energy to mechanically ablate deep tissues through cavitation, while leaving the surrounding heathy tissues unaffected. However, brain therapy histotripsy is currently limited due to the extremely high pressures that it requires. I propose to develop a breakthrough technology for the treatment of glioblastoma (GBM) using nanobubble (NB)-mediated transcranial histotripsy combined with blood?brain barrier (BBB) opening. NBs will be coupled with low-frequency US to remotely detonate cells in a manner that was not considered feasible in the past. As a result, low-energy, NB-mediated US surgery could be performed, reducing the required energy for standard US surgery by over an order of magnitude. While US widely utilizes microbubbles (MBs) for intravascular ultrasonography, MBs are too big to extravastate into the tumor. Unlike MBs, NBs have a sufficiently small size for accumulation in tumors; however, it was assumed that there is a trade-off between the bubble size and its ability to obtain significant bioeffects as a result of cavitation. My recent research revealed that when a bubble is excited well below its resonance frequency, its oscillations are significantly enhanced. Thus, I hypothesize that upon accumulation within the GBM tumor, and coupled with low-frequency excitation, NBs can be used as mechanical therapeutic warheads to remotely detonate cells with minimal off-target effects. For GBM treatment, NBs will be innovatively used for opening the BBB to allow tumor accumulation, followed by NB-mediated transcranial histotripsy. This research will provide a foundational understanding of NB oscillations as an innovative tool for cancer therapy and has the potential to revolutionize the field of brain therapy.

Link to the ERC project webpage:

Keywords of the ERC project: Ultrasound, Contrast agents, Nanobubbles, BBB opening, Histotripsy

Keywords that characterize the scientific profile of the potential visiting researcher/s: Ultrasound, Contrast agents, Nanobubbles, BBB opening, Histotripsy

Project ID:	Project Acronym:	Evaluation Panel:
101041677	**TRANSIT-ND**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Ahmad Aziz**
Host Institution:	Deutsches Zentrum Fuer Neurodegenerative Erkrankungen Ev - DEU

Tandem Repeats Associated with Neurogenomic Somatic Instability and Neurodegeneration

Dementia and other neurodegenerative diseases are among the leading causes of disability worldwide and have an immense societal impact due to lack of effective treatments. For developing better preventive and therapeutic strategies, it is essential to clarify their still largely elusive genetic basis and pathophysiology. Emerging insights from the study of rare hereditary repeat expansion disorders caused by elongations of repetitive DNA sequences ("tandem repeats" (TRs)) indicate that TRs could induce instability of neuronal DNA ("neurogenomic somatic instability"), and thereby instigate molecular changes that lead to neuronal degeneration. However, the role of highly prevalent TR variations or their somatic instability in the pathogenesis of common age-associated neurodegenerative diseases is unknown. Here, I aim to assess the role of TRs and their somatic instability in the pathogenesis of neuronal degeneration, the defining hallmark of all neurodegenerative diseases. To this end, I will 1) systematically identify TRs whose size or somatic instability are related to neuronal degeneration in the general population and/or disease severity in repeat expansion disorders, using an innovative approach combining "liquid biopsy" of neuronal tissue, high-throughput ultra-deep long-read DNA sequencing and ultrasensitive biomarkers of neuronal degeneration, 2) delineate the neuroanatomical pathways affected by TR somatic instability through comprehensive neuroimaging analyses, and 3) disentangle the underlying molecular and cellular mechanisms, using an extensive integrative multi-omics approach with experimental validation in neuronal cell lines and post-mortem human brain tissue. The wealth of unique insights from TRANSIT-ND could substantially increase our understanding of the pathogenesis of neuronal degeneration and provide shared targets for the prevention and treatment of a range of different neurodegenerative diseases that afflict millions of people globally.

Link to the ERC project webpage: www.dzne.de/aziz

Keywords of the ERC project: neurodegenerative diseases, genetics, functional genomics, Huntington disease, Parkinson disease, Alzheimer disease, bioinformatics

Keywords that characterize the scientific profile of the potential visiting researcher/s: bioinformatics, genetics, omics, neuroscience, neurology, neurodegenerative diseases

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101041730	**AIS-CaP**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Geert Litjens**
Host Institution:	Stichting Radboud Universitair Medisch Centrum - NLD

Interpretable Artificial Intelligence across Scales for Next-Generation Cancer Prognostics

Computation pathology has the potential to revolutionize cancer care and research, specifically through improving assessment of patient prognosis and treatment selection by applying advanced machine learning methods to digitized tissue sections, i.e. whole-slide images (WSIs). This will allow us to replace the current state-of-the-art of human-developed cancer grading systems. However, the field is currently hindered by significant knowledge gaps: we do not know how to effectively leverage both global and local information in WSIs, how to identify pan-cancer prognostic features, and how to make machine learning models explainable and interpretable. In this project, I will address these key knowledge gaps by building on the novel stochastic streaming gradient descent developed in my group. Specifically, I will integrate innovative multi-task and cross-task learning algorithms with SSGD. Furthermore, I will leverage the latest advances in self-supervision, self-attention and natural language processing to endow deep neural networks with unprecedented transparency and explainability. Last, the project will validate our developed methodology in the largest dataset of oncological WSIs in the world, and, for the first time, identify links between morphological prognostic features and genetic features. By publicly releasing all developed tools and data, the proposed project will have a scientific multiplier effect for the fields of oncology, computational pathology and machine learning. Specifically, the derived cancer-specific and pan-cancer biomarkers can be leveraged in clinical care and cancer research, the enhanced SSGD method for other tasks in computational pathology and our novel multi-task and explainability algorithms can impact other research areas in machine learning, such as remote sensing and self-driving cars.

Link to the ERC project webpage:

Keywords of the ERC project: artificial intelligence, computational pathology, machine learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: computer science, digital pathology, machine learning, computational pathology, medical imaging

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Project ID:	Project Acronym:	Evaluation Panel:
101043587	**RESISTANCEPROGRAMS**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Alexander Pietras**
Host Institution:	Lunds Universitet - SWE

Tumor recurrence and therapeutic resistance: exploring and exploiting the post-radiotherapy brain microenvironment for therapeutic opportunities in malignant brain tumors

Gliomas are the most common brain tumors and the highest-grade glioma, glioblastoma (GBM), is arguably the most aggressive tumor type, with no long-term survivors. Patients with GBM are treated with radiotherapy, chemotherapy, surgery, and tumor treating fields. Despite initial response all tumors recur as incurable lesions; there is an urgent need for novel therapeutic approaches for this patient group. The majority of GBMs recur within the treatment field receiving high-dose radiotherapy during treatment of the primary tumor; the recurrent tumor thus forms in an irradiated microenvironment. Despite the fact that it is the recurrent tumor that ultimately kills the patient and that the majority of new therapeutic agents for GBM are tested clinically in the recurrent setting, the majority of experimental models and clinical materials for drug discovery are based on primary disease. Recent advances established a central role for the tumor microenvironment in determining the therapeutic response of GBM cells, and our lab demonstrated that standard of care radiotherapy of the primary tumor can shape the microenvironment to generate tumor-supportive conditions in the recurrent tumor; These findings suggest that there is untapped potential in targeting the irradiated microenvironment. This proposal aims to explore and exploit the recurrent brain tumor microenvironment by i) consolidating the contribution of the irradiated brain tumor microenvironment to GBM resistance by integrating spatial transcriptomics, single cell RNA sequencing, and multiplexed immunohistochemistry from state-of-the-art murine and human models of GBM treatment and recurrence, and ii) discovering and targeting novel therapeutic targets unique to the post-radiotherapy brain tumor microenvironment by high-throughput phenotypic screening, with the ultimate goal of exploiting reversible stromal radiation responses and leverage novel therapeutic opportunities unique to the irradiated brain.

Link to the ERC project webpage:

Keywords of the ERC project: Glioblastoma; Tumor microenvironment; Tumor recurrence

Keywords that characterize the scientific profile of the potential visiting researcher/s: Spatial transcriptomics; Bioimage analysis; Single cell RNA sequencing

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Project ID:	Project Acronym:	Evaluation Panel:
101043848	**ARCHIMEDES**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Dario Greco**
Host Institution:	Tampereen Korkeakoulusaatio Sr - FIN

dAta-dRiven integrated approaches to CHemIcal safety assessMEnt and Drug dEvelopment

Traditional in vivo tesTraditional in vivo tests are hampering the development of new, safe and effective chemicals and drugs. If on one hand we need to ensure that dangerous chemicals do not emerge, on the other, we also need to promote rapid and sustainable innovation to successfully overcome the modern challenges of humankind. Toxicogenomics aims at clarifying the mechanism of action (MOA) of chemicals by using omics assays. The Adverse Outcome Pathways (AOP) concept is also emerging to contextualise toxicogenomics-derived MOA. Efforts are ongoing to anchor AOPs to molecular assays, but systematic embedding of AOP-derived in vitro tests and Integrated Approaches to Testing and Assessment (IATA) are still unestablished. At the same time, toxicogenomics-based evidence still struggles to gain regulatory acceptance. I aim to implement an integrated strategy based on state-of-the-art big data science, artificial intelligence (AI), toxicogenomics, molecular assays and cell technology via a novel Knowledge Graph approach. I will do so by developing the Toxicology Knowledge Graph (TKG), an innovative data platform where the currently fragmented knowledge in the field is going to be curated and integrated. The TKG will serve as a learning platform for artificial intelligence (AI) algorithms, which will be used to: 1) find new characteristics of chemicals/drugs; 2) infer associations between exposures and diseases; 3) select the most relevant cell lines to study specific phenotypes/chemical classes; 4) find the best genes to be used as reporters for specific AOPs; 5) define the applicability domain of computational, experimental and IATA models. I will also establish and validate regulatory-relevant high-throughput molecular assays to investigate the point of departure (PoD) of exposures. The ARCHIMEDES project will shift the paradigm of chemical and drug development, facilitating the emergence of new, smarter, greener, and more sustainable chemicals, drugs and materials.

Link to the ERC project webpage: https://www.researchgate.net/profile/Dario-Greco-2

Keywords of the ERC project: Toxicogenomics, data science, machine learning, graph learning, molecular biology, in vitro toxicology, cheminformatics, bionformatics

Keywords that characterize the scientific profile of the potential visiting researcher/s: Toxicogenomics, data science, machine learning, graph learning, molecular biology, in vitro toxicology, cheminformatics, bionformatics, HT sequencing, cell painting, knowledge graph

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Project ID:	Project Acronym:	Evaluation Panel:
101044779	**AIMIX**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Karim Lekadir**
Host Institution:	Universitat De Barcelona - ESP

Inclusive Artificial Intelligence for Accessible Medical Imaging Across Resource-Limited Settings

Artificial intelligence (AI) is widely regarded as one of the most promising and disruptive technologies for future healthcare. As AI algorithms such as deep neural networks are suited for the processing of large and complex datasets, radiology is the medical speciality that has seen some of the most important applications of AI in the recent years. However, despite these advances, a major limitation of current AI developments in medical imaging is that they have overwhelmingly, and almost entirely, targeted applications in high-income countries. There is a concern, if the current trend continues, that AI will increase the already pronounced inequalities in global health, in particular for resource-limited settings such as rural Africa, where the majority of the African population lives.

AIMIX will develop the first scientific framework for inclusive imaging AI in resource-limited settings. The project will greatly advance the current state-of-the-art, from existing AI methods mostly developed for high-income settings, towards new imaging AI algorithms that are fundamentally inclusive, i.e. (1) affordable for resource-limited clinical centres, (2) scalable to under-represented population groups, and (3) accessible to minimally trained clinical workers. Furthermore, AIMIX will investigate the socio-ethical principles and requirements that govern inclusive AI, and examine how they compare, conflict or complement those of trustworthy AI developed thus far in high-income settings. These innovations will be demonstrated for affordable and accessible AI-powered obstetric ultrasound screening by minimally trained clinicians such as midwives in rural Africa.

Ultimately, AIMIX's scientific breakthroughs will enhance the democratisation of imaging AI in resource-limited settings, which will result in an important social impact, by empowering local communities, promoting inclusion, and reducing disparities between populations from low- and high-income societies.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101044990	**BrainCRISPR**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Rachela Popovtzer**
Host Institution:	Bar Ilan University - ISR

In Vivo CRISPR-Based Nanoplatform for Gene Editing: A New Disruptive Avenue for Non-Invasive Treatment of Genetic Brain Diseases

Genetic brain diseases are among the most devastating and fatal diseases, typically having only palliative treatments and no cure. The revolutionary CRISPR/Cas gene editing technology provides a new horizon and enormous potential for treating such diseases. However, efficient and safe delivery of CRISPR machinery to diseased cells within the brain is one of the greatest challenges in medicine today. Here, I plan to expand far beyond the state-of-the-art, and propose a game-changer approach for this unmet need: A breakthrough nanoplatform, which will transform CRISPR into a clinically-relevant, non-invasive technology, enabling therapeutic genome editing in the brain. Our proof-of-concept results serve as the baseline of this pioneering research project, revealing the exceptional capabilities of insulin as a key to overcoming formidable brain and cell barriers. We will harness these unique abilities within the novel nanoplatform, and shuttle CRISPR machinery across the blood-brain barrier, transport it into deep brain regions, and mediate its successful entry into specific diseased brain cells, leading to highly effective gene editing. The nanoplatform will be designed to meet key criteria for non-invasive, safe and efficient delivery of CRISPR to the brain, while conferring a high degree of modularity and compositional heterogeneity - thus providing both universal and patient-specific components. The nanoplatform will be thoroughly investigated in primary brain cells, 3D organoids, and case-studies of monogenic brain disease models. This comprehensive research will culminate with a universal and modular BrainCRISPR nanoplatform, and delineate design principles for its precise tailoring to specific needs of different brain diseases. Overall, this research will provide in-depth fundamental knowledge and have a transformative effect on applying CRISPR in brain, whilst opening a wide array of possibilities with broader impact on genetic brain therapy and beyond.

Link to the ERC project webpage:

Keywords of the ERC project: nanoparticles drug delivery

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101045128	**iBack-epic**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Jan Kirschke**
Host Institution:	Klinikum Rechts Der Isar Der Technischen Universitat Munchen - DEU

Biomechanical modelling and computational imaging to identify different causes of back pain in large epidemiological studies

Chronic back pain is a major burden and source of disability worldwide. It is primarily attributed to different biomechanical factors, but can also have inflammatory, neurological or psychological causes. Clinical findings and conventional imaging cannot reliably distinguish different causes of back pain. In contrast, individual biomechanical models can quantify diverse (pathologic) loading patterns and thus could be used to distinguish different aetiologies of back pain, to better understand individual pathophysiology and guide preventive strategies.

During my recent ERC-StG “iBack”, I developed quantitative imaging methods and deep-learning based image processing to automatically generate a fully individualized biomechanical model of the thoracolumbar spine. Simultaneously, two large-scale epidemiologic studies collected clinical and high-resolution imaging data of the spine of more than 15,000 participants so far, aiming at more than 35,000 participants by mid 2022

The high-level objective of iBack-epic is to use such novel image analysis techniques to identify different biomechanical and inflammatory causes of back pain in study participants.

I will adopt and extend my recently developed deep-learning based spine labelling and segmentation algorithms to fully automatically calculate individual biomechanical, functional and morphometric parameters of the spine. In this large-scale population data, I will identify different biomechanical loading patterns, use quantitative image-based parameters to discriminate normal ageing from pathologic degeneration and identify pathological conditions that are linked to back pain or subsequent development of chronic back pain.

Such a differentiation – for the first time based on quantitative image data – will allow for a better understanding of the underlying pathophysiology of back pain, an improved risk stratification, a tailored investigation of genetic causes and thus will help to better guide preventive strategies.

Link to the ERC project webpage: https://www.neurokopfzentrum.med.tum.de/neuroradiologie/forschung_projekt_iback.html

Keywords of the ERC project: imaging, biomechanics, back pain

Keywords that characterize the scientific profile of the potential visiting researcher/s: Biomechanics, Finite element analyis, multi body simulation

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Project ID:	Project Acronym:	Evaluation Panel:
101045236	**DISSECT-HF**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Peter Van Der Meer**
Host Institution:	Academisch Ziekenhuis Groningen - NLD

Dynamic engIneered heart tiSsue to Study intEr-individual susCeptibily and improve Treatment of Heart Failure

The objective of DISSECT-HF is to generate engineered heart tissue (EHT) with the use of human induced pluripotent stem cells (hiPSC) from specific forms of heart failure (HF). It focusses on three etiologies of HF with a clear trigger and a large inter-individual susceptibility (pregnancy induced HF, anthracycline cardiotoxicity and PLN cardiomyopathy) to unravel common pathophysiological mechanisms involved in the development of HF. The rationale is: - Better understanding of molecular pathways leading to HF and knowledge about inter-individual susceptibility is needed to improve treatment. - For detection of changes on a molecular level cardiac tissue is needed. - Using innovative experimental approaches, such as dynamic loaded EHT (dyn-EHT), patient specific cells, unbiased target finding and deep phenotyping, I will dissect common disease pathways in the development of HF. SPECIFIC OBJECTIVES: 1. Construction of dyn-EHT from patient specific hiPSC derived cardiomyocytes, endothelial cells and fibroblasts. 2. Generation and deep-phenotyping of dyn-EHT from: A) Females with pregnancy induced HF (susceptible) and siblings with a normal pregnancy (resilience) B) Cancer patients with severe HF after anthracyclines (susceptibility) and patients who could resist high dose anthracyclines (resilience) C) Patients with an early PLN cardiomyopathy phenotype (susceptible) versus elderly asymptomatic PLN mutation carriers (resilience) 3. Identify overlapping and diverse factors. 4. Validate discoveries and apply in unique human cohorts with data on incident HF. WORKPACKAGES: WP1: Optimize construction of dyn-EHT from patient specific hiPSC. WP2: Phenotyping of dyn-EHT from the three HF etiologies focussing on susceptibility and resilience. WP3: Explore the transcriptome and proteome and apply a systems biology approach. WP4: Validate results and explore human relevance in a large cohort with unique phenotyping.

Link to the ERC project webpage: www.groningencardiology.com

Keywords of the ERC project: stem cells, tissue engineering, heart failure, cardiology

Keywords that characterize the scientific profile of the potential visiting researcher/s: translational scientist - MD - Biologist - Bio-engineering

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101054643	**EmergAI**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Johan Sundström**
Host Institution:	Uppsala Universitet - SWE

Enhancing emergency department safety, efficacy and cost-effectiveness by artificial intelligence

* Background: Emergency care costs are increasing in developed societies, both in rates of emergency department (ED) visits per person and in costs per visit, and are growing faster than other areas of healthcare spending. With limited and unstructured data, ED staff make quick decisions about probabilities for multiple diagnoses and risks. Both underestimation and overestimation of these probabilities lead to increased costs and patient harm. Hence, there is desperate need for clinical decision-support systems in the ED. * Aim: To develop a clinical decision support system for emergency medicine doctors, using sensor data, health records data and patient-reported data, validated in a randomized clinical trial, in order to improve the safety, efficacy and cost-effectiveness of emergency care. * Objectives: We will: Develop machine learning (ML)-powered diagnosis and risk prediction algorithms for common and dangerous conditions based on age, sex, presenting complaints, previous diagnoses, ECGs, and vital parameters; develop and validate a patient-centred technical platform for collecting, storing and sharing patient-reported data and three-dimensional symptom drawings; develop ML-powered diagnosis and risk prediction algorithms for common and dangerous conditions based on patient-reported data and symptom drawings; conduct a large-scale prospective ED data collection for internal and external validation of ML models using a common format for online applications and for further data collection; develop a Bayesian network-powered ED-based clinical decision support system that generates probabilities for diagnoses and 30-day mortality risks and suggestions for the most valuable next step, from data in multiple formats, with visual representation of probabilities, risks and uncertainties and Bayes factors for potential next steps; and conduct a randomized clinical trial investigating the usefulness, effectiveness and safety of the new decision support system.

Link to the ERC project webpage:

Keywords of the ERC project: machine learning; probabilistic modeling; Bayesian neural networks; emergency medicine; decision support

Keywords that characterize the scientific profile of the potential visiting researcher/s: civil engineer, data analyst, data scientist, statistician, mathematician

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
804569	**FIT2GO**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Claudia Bank**
Host Institution:	Universitaet Bern - CHE

A toolbox for fitness landscapes in evolution

A major challenge in evolutionary biology is to quantify the processes and mechanisms by which populations adapt to new environments. In particular, the role of epistasis, which is the genetic-background dependent effect of mutations, and the constraints it imposes on adaptation, has been contentious for decades. This question can be approached using the concept of a fitness landscape: a map of genotypes or phenotypes to fitness, which dictates the dynamics and the possible paths towards increased reproductive success. This analogy has inspired a large body of theoretical work, in which various models of fitness landscapes have been proposed and analysed. Only recently, novel experimental approaches and advances in sequencing technologies have provided us with large empirical fitness landscapes at impressive resolution, which call for the evaluation of the related theory.

The aim of this proposal is to build on the theory of fitness landscapes to quantify epistasis across levels of biological organization and across environments, and to study its impact on the population genetics of adaptation and hybridization. Each work package involves classical theoretical modelling, statistical inference and method development, and data analysis and interpretation; a combination of approaches for which my research group has strong expertise. In addition, we will perform experimental evolution in Escherichia coli and influenza to test hypotheses related to the change of fitness effects across environments, and to adaptation by means of highly epistatic mutations. We will specifically apply our methods to evaluate the potential for predicting routes to drug resistance in pathogens. The long-term goal lies in the development of a modeling and inference framework that utilizes fitness landscape theory to infer the ecological history of a genome, which may ultimately allow for a prediction of its future adaptive potential.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
819952	**Mari.Time**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Kristin Tessmar-Raible**
Host Institution:	Universitaet Wien - AUT

Dissecting the mechanistic basis of moon-controlled monthly timing mechanisms in marine environments

The correct timing of biological processes is crucial for organisms. The moon is an important timing cue for numerous marine species, ranging from brown and green algae to corals, worms and fishes. It acts either directly or via the synchronization of monthly (circalunar) inner clocks. Such lunar timing mechanisms typically control the gonadal maturation and behavioral changes associated with reproductive rhythms, including spectacular mass-spawning events. Despite their biological importance, the mechanisms underlying circalunar clocks, as well as their responses to naturalistic stimuli are unknown.

My lab has spearheaded research into the mechanisms underlying circalunar timing systems, establishing tools and resources for two well-suited, complementary animal models: Platynereis dumerilii and Clunio marinus. We unraveled first principles of the circalunar clock, e.g. its continuous function in the absence of oscillation of the daily (circadian) clock. Recent unpublished work revealed the first gene that functionally impacts on circalunar rhythms.

By capitalizing on these powerful tools and key findings, my lab is in a leading position to dissect the mechanisms of circalunar clocks and their interaction with other rhythms and the environment via three objectives:

(1) A reverse genetic approach to unravel how nocturnal light sets the phase of the monthly clock.

(2) A forward genetic screen to identify molecules involved in the circalunar clock, an experimental strategy that was the key to unravel the principles of animal circadian clocks.

(3) By growing animals in outside tanks and subjecting them to established analyses, we will test our lab-based results in more naturalistic conditions.

This project will substantially deepen our mechanistic insight into marine rhythms – ecologically important phenomena – and provide a first basis to predict how environmental changes might impact on timing systems of crucial importance to many marine species and likely beyond.

Link to the ERC project webpage: https://www.maxperutzlabs.ac.at/research/research-groups/tessmar

Keywords of the ERC project: chronobiology, lunar rhythms, marine, photoreceptor, clock, light, moon, hormones

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
832352	**EvolSexChrom**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Tatiana Giraud**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Testing new hypotheses on the evolution of sex-related chromosomes

The sex chromosomes of plants and animals often contain large non-recombining regions due to a stepwise cessation of recombination generating “evolutionary strata” of genetic differentiation. The reasons for the extension of recombination suppression beyond sex-determining genes remain unclear. Sexual antagonism, involving the linkage to sex-determining genes of alleles beneficial in only one sex, is the prevailing hypothesis, as this explanation is both theoretically plausible and attractive. However, decades of research have unearthed little evidence to support this hypothesis. Furthermore, I have shown that chromosomes involved in sexual compatibility in systems lacking male and female functions can nevertheless display a stepwise suppression of recombination beyond mating-compatibility genes. Thus, evolutionary strata can evolve without sexual antagonism. Alternative hypotheses, such as neutral rearrangements, epigenetic changes associated with transposable elements and the sheltering of deleterious alleles accumulating near non-recombining regions, must thus be seriously considered. I propose to use a synergic combination of different approaches and biological systems to refine and test these hypotheses, to broaden the theory of sex-related chromosome evolution, and, more generally, of the evolution of supergenes (linked allelic combinations). I will use mathematical modeling to test hypothesis plausibility and generate predictions. I will use comparative and population genomic approaches to test predictions, and an innovative experimental evolution approach with functional manipulations to assess the ability of the proposed mechanisms to generate strata. The EvolSexChrom project will challenge the current theory, opening up new avenues of research and potentially creating a paradigm shift in the dynamic research field focusing on the evolution of sex-related chromosomes and other supergenes, relevant to diverse traits and organisms.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
864287	**THRESHOLD**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Paul Kardol**
Host Institution:	Sveriges Lantbruksuniversitet - SWE

Thresholds and tipping points in ecosystem responses to global warming

Terrestrial ecosystems are important in providing key services to humankind, but under global warming the provisioning of such ecosystem services is at risk. However, there is little consensus on how the functioning of terrestrial ecosystems will change under projected scenarios of global warming, or when we will reach or surpass thresholds and tipping points. This is largely because most studies have failed to unravel ecosystem responses to increasing temperatures in terms of the underlying non-linear responses of plants, soil organisms, and their communities. Since plants and their associated soil organisms (i.e., pathogens, mutualists, and decomposers) can vary in their responses to temperature change, global warming may disrupt or decouple interactions among coexisting and co-evolved species. This may have unforeseen consequences for key ecosystem functions, such as carbon and nutrient cycling.

THRESHOLD will use a novel cross-disciplinary approach to advance our fundamental knowledge of how non-linear temperature responses transcend different levels of ecological organization. Specifically, this project aims to:

1) Establish a global network of forest-tundra and forest-alpine ecotone sites, to assess how responses of ecosystem carbon and nutrient cycling to global warming will be pushed across thresholds and tipping points.

2) Perform mesocosm experiments under different temperatures, to estimate how ecosystem process responses to global warming can be predicted from the reordering of plant and soil communities, as well as from the functional traits that they possess and express.

3) Reveal how community responses to warming and extreme temperatures can be predicted from the physiological responses of their component species.

To achieve these aims, this work will utilize a powerful approach that harnesses an array of cutting-edge tools, and it will advance our conceptual understanding in an area of urgent importance for ecology and society.

Link to the ERC project webpage:

Keywords of the ERC project: Thresholds, tipping points, temperature, global warming, plants, soils. microorganisms, soil biota, ecosystem responses, carbon cycling, forest-alpine ecotones

Keywords that characterize the scientific profile of the potential visiting researcher/s: Terrestrial ecology, soil ecology, microbial ecology, ecosystems, global warming

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Project ID:	Project Acronym:	Evaluation Panel:
865694	**DiversiPHI**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Bas E Dutilh**
Host Institution:	Friedrich-Schiller-Universitat Jena - DEU

Predicting the evolution of complex phage-host interactions

What determines if a phage can infect a host? This question arises as we work to understand the ecological roles of the hundreds of thousands of unknown viruses that I and others have discovered around the world. Phages are the most abundant life forms on Earth with important applications in medicine and biotechnology and far-ranging effects on microbial community functioning in all environments. Phage-host interactions (PHI) are an emergent trait that depends on the complex integration of factors like their taxonomic identity, the environment, and phage- and host-encoded proteins. With DiversiPHI, I propose a research program to unravel PHI by 1) measuring, 2) modelling, and 3) experimentally testing these diverse factors to develop a predictive understanding of host-range evolution.

I will first measure a range of evolutionary, ecological, and molecular factors contributing to PHI at high resolution using newly developed computational tools that exploit high-throughput datasets from thousands of natural environments around the world. Next, I will apply deep learning to integrate these measurements to simultaneously (i) quantify the relative importance and complex inter-dependencies of the different factors, and (ii) create a unique predictive model of host-range evolution. To complement these in silico predictions, I will develop an experimental evolution setup that tests the effect of the different PHI factors on host-range evolution in vitro.

Little is known about the abundant phages and their role in shaping our microbial world. DiversiPHI will vastly elevate this understanding and contribute new fundamental knowledge on how species-species interactions evolve in complex environments. Moreover, I will provide valuable new analysis tools to the community and consolidate my strong international reputation as a pioneering researcher in the cross-disciplinary field encompassing microbial ecology, virology, metagenomics, bioinformatics, and computer learning.

Link to the ERC project webpage: https://tbb.bio.uu.nl/dutilh/

Keywords of the ERC project: bacteriophage-host interaction, microbial/viral ecology, microbiome modelling

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
866530	**RuMinimum**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Itzhak Mizrahi**
Host Institution:	Ben-Gurion University Of The Negev - ISR

Reducing rumen complexity to its essential components to understand and modulate ecosystem structure and function

Ruminants represent a paradigmatic case of obligatory host-microbiome relationships. These animals require complex microbial communities to digest plant fibers. Which functions are essential and how the assembly of these functions impacts host physiology remain unknown. My goal is to understand the underlying aspects that allow the host and its microbes to coexist and to identify the essential requirements of this microbial community to sustain the life of the host. This proposal aims to address this ambitious and fundamental challenge. These efforts build on a unique research platform involving germ-free ruminant animals, modeling, genomics, metabolomics, as well as animal and microbial physiology, developed over nine years of experience working with animal microbiomes. To do so, I propose to identify the minimum rumen community (RuMinimum) using top-down and bottom-up approaches that will complement each other. Once defined, the RuMinimum will serve as a platform for experimenting and understanding how the ecosystem functions and supports the life of the host, and how to modulate it. We will specifically augment and decrease functional redundancy and richness at different edges of the trophic network and measure their impact on ecosystem function and host physiology. These endeavors will allow us to learn how to modulate host physiology towards better feed efficiency or lower methane production, which will have an immense environmental and agricultural impact. The results of this project will be relevant not only to ruminants but also to other gut ecosystems and anaerobic, carbon-degrading communities in general. Our research efforts will lead to new paradigms and concepts vis-a-vis microbial community assembly, the design of synthetic microbial communities, and host-microbiome interactions, with strong scientific and applicative potential.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
883621	**SoilResist**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Richard Bardgett**
Host Institution:	The University Of Manchester - GBR

Diversity, stability and functioning of the soil microbiome

A major challenge for advancing our understanding of the functional role of highly complex soil microbial communities is to systematically link changes in their structure and functioning to biogeochemical cycles under realistic scenarios of global change. This is a formidable challenge: not only does it require a step change in our understanding of the factors that shape soil microbial communities and their functioning, but also it requires new knowledge of the ecological and genetic mechanisms that underpin its stability, or ability to resist and recover from abiotic perturbations associated with global change. By embracing technological and theoretical developments in microbial ecology, SoilResist will make a major step forward in our understanding of the mechanisms that underpin the resistance and resilience of soil microbial communities and their functioning to natural and anthropogenic perturbations. Specifically, I seek to develop a novel mechanistic understanding of the factors that underpin the resistance and resilience of complex soil microbial communities and their functioning to different types of anthropogenic perturbations, and, for the first time, identity critical thresholds for abrupt transitions of microbial communities to alternative states and consequences for soil functioning. My overarching hypothesis is that the stability of microbial functions, in terms of their capacity to resist and recover from a pulse perturbation caused by climate extremes, is determined by microbial functional diversity, based on range and relative abundance of microbial traits. I also hypothesize that shifts in microbial functional diversity resulting from press perturbations erode the capacity of soil microbial communities to buffer climate-related pulse perturbations, rendering them more vulnerable to an abrupt transition to alternative taxonomic and functional state with negative consequences for soil functioning.

Link to the ERC project webpage:

Keywords of the ERC project: Soil, Microbial Communities, Stability, Climate Change

Keywords that characterize the scientific profile of the potential visiting researcher/s: soil microbial ecologist

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Project ID:	Project Acronym:	Evaluation Panel:
945026	**METASCALE**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Oleg Simakov**
Host Institution:	Universitaet Wien - AUT

Modes of genome evolution during major metazoan transitions

Our understanding of how genomic changes translate into organismal novelties is often confounded by the complexity of the underlying genome architecture. My previous studies revealed a complex interplay between several levels of genomic organization during major metazoan evolutionary transitions, ranging from modifications of regulatory elements to the gene order on the chromosomal scale. A major gap in our understanding is the extent to which those different genomic scales are evolutionarily linked and reflect an inherent functional property or mode of genome evolution. In this proposal, I focus on the emerging model system within the highly advanced clade of cephalopod molluscs, the Hawaiian bobtail squid Euprymna scolopes, to study how changes in the mode of metazoan genome evolution have yielded unique cephalopod innovations (e.g., the largest invertebrate brain). To address this question, I will (1) take a novel global pan-metazoan comparative genomics approach to test and reveal the extent of genomic character co-evolution, identifying, for the first time, modes of genome evolution. I will then (2) test whether co-evolving characters form inherent regulatory units in metazoan genomes by an in-depth characterization using emerging and available regulatory genomic data. Finally, using latest molecular approaches, I will (3) study the regulatory composition of co-evolving character units associated with cephalopod brain development and functionally test their organismal impact. This proposal will develop a novel and holistic approach to study genome evolution, constituting a departure from the previous analyses based on individual genomic characters. It will link genomic evolutionary units to their function, revealing the genomic changes behind major innovations (cephalopod brain). Finally, this project will develop predictive models that use evolutionary data to identify novel regulatory units aiding both biological and biomedical applications.

Link to the ERC project webpage:

Keywords of the ERC project: genomics, cephalopods, regulation, evolution

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
947921	**MAPAS**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Sara Varela**
Host Institution:	Universidad De Vigo - ESP

Mapping biodiversity cradles and graves

Diversity is the most important asset of life on Earth. Estimates indicate that there are more than 8 million species providing us food, well-being and health. Since Darwin and Mendel, we started to understand how diversity is selected and inherited. However, where and why biodiversity originates and vanishes are fundamental questions yet to be answered. Today, we are witnessing the 6th mass extinction and thus, to maintain high levels of biodiversity for future generations, we need to protect not only current biodiversity hotspots, but also evolutionary cradles of future biodiversity. Global biodiversity patterns have been studied by biogeographers and palaeontologists aiming to unveil general rules of life. But here, instead of focussing on patterns, I propose to focus on modelling and mapping processes through deep time (e.g. species origination and extinction). MAPAS aims to test the influence of different biotic and abiotic drivers in processes generating biodiversity, and answer theoretical and practical research questions involving where and why species originate, spread and vanish. MAPAS will pioneer the study of deep-time geographic diversification dynamics with an unprecedented time-frame. I plan to produce palaeoclimatic simulations for the entire Phanerozoic (the last 540 million years) and a ground-breaking spatially-explicit mechanistic model to generate the first maps of the geographical distribution of evolutive processes across deep time. The results of this decidedly ambitious project will open new horizons for research, bringing palaeontological, biogeographical and ecological schools together, and will provide important insights for conservation efforts.

Link to the ERC project webpage: https://paleobiogeography.org/

Keywords of the ERC project: macroecology, biogeography, GIS, spatial ecology

Keywords that characterize the scientific profile of the potential visiting researcher/s: GIS programmer, paleoclimatologist, paleontologist, macroecologist, biogeographer, computer scientist

Project ID:	Project Acronym:	Evaluation Panel:
948281	**SEA2LAND**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Rosa Fernández**
Host Institution:	Agencia Estatal Consejo Superior De Investigaciones Cientificas - ESP

Land animal evolution: genomic landmarks on the path to terrestrial life

All animals share a common origin: a marine one. To conquer land from marine environments, animals changed radically the way they breath, reproduce, move or smell. And they did it multiple times in the history of Earth, with terrestrial animals massively outnumbering aquatic ones. Understanding terrestrialization is therefore key to comprehending animal biodiversity and biological adaptation. Despite the relevance of such an episode, the genetic underpinnings orchestrating terrestrialization in animals are largely unexplored. The project will test the hypothesis that animals are equipped with a highly plastic 'terrestrialization genetic toolkit' that allowed their adaptation to the extreme environmental conditions in terrestrial ecosystems. We will focus on two pivotal questions: which genes facilitated life on land and how do they differ between aquatic and terrestrial animals?, and how did animals reshape their genomes to adapt to dry land? Moreover, we will study two case examples of critical processes common to all terrestrial animals -breathing and protection against UV light- to illuminate what molecular and biochemical changes allowed terrestrial animals to breathe and repair their DNA after UV light damage. To achieve this, we will (i) identify the gene repertoire orchestrating the extreme physiological and metabolic changes in aquatic and terrestrial lineages, (ii) characterize the dynamics of these genes to understand the role of gene loss, duplications and horizontal gene transfer, and (3) discover the adaptive mutations that led respiratory pigments and DNA repair proteins to gain their functions via molecular engineering techniques to resurrect their ancestral 'paleophenotypes'. This project will deliver fundamental insights into a core question in evolutionary biology: what shaped the land animal genetic toolkit. Furthermore, it will provide insights into the evolution of key proteins relevant to human health and industry.

Link to the ERC project webpage: www.metazomics.com

Keywords of the ERC project: Animal terrestrialization; Genomics; Transcriptomics; Proteomics; Protein engineering; Bioinformatics; Invertebrates

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
948465	**ROCKS-PARADOX**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Kjetil Lysne Voje**
Host Institution:	Universitetet I Oslo - NOR

Dissecting the paradox of stasis in evolutionary biology

There is something deeply disconcerting about the current state of knowledge on rates of morphological evolution across different timescales: Why do most species in the fossil record exhibit negligible morphological change when contemporary populations often respond rapidly to selection? The ROCKS-PARADOX project will address this fundamental question – known as the paradox of stasis – along mutually reinforcing lines of enquiry, by merging theory and data across paleontology and evolutionary biology. The prevalence of stasis and other patterns of change are hard to evaluate without knowledge of evolution on timescales unattainable by studies of contemporary populations (microevolution) and comparative species-data (macroevolution). The ROCKS-PARADOX project will address this by analyzing the world's largest collection of data on within-lineage evolution – spanning decadal to million-year timescales – using a statistical framework (developed by the project) where new and already established mathematical models of evolution are implemented. The ROCKS-PARADOX project also will conduct an unprecedented assessment of the effects of genetic constraints and evolvability on evolution beyond microevolutionary timescales. To do this, we will break new ground by estimating quantitative genetic parameters from fossil samples using machine-learning algorithms on a collection of 150,000 fossil clonal organisms (bryozoans) from a rich and highly-resolved stratigraphic section spanning 2.3 million years. The ROCKS-PARADOX project will bridge our current understanding of phenotypic evolution across timescales into a single cohesive theoretical framework, and open up new avenues for how fossil data can be collected and analyzed to inform questions within evolutionary biology. The project will develop new methodology with broad applications, including long-awaited tools for high-throughput phenotyping.

Link to the ERC project webpage:

Keywords of the ERC project: phenotypic evolution, microevolution, macroevolution, quantitative genetics, phylogenetic comparative methods

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101001341	**SELECTHAPLOID**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Simone Immler**
Host Institution:	University Of East Anglia - GBR

Testing the Evolutionary Consequences of Haploid Selection in Animals

Selection occurring during the haploid gametic phase of any sexually reproducing eukaryote may have far-reaching consequences for major biological processes. Selection acting on a haploid genome results in efficient removal of deleterious alleles and rapid fixation of beneficial alleles, which in turn affect adaptation, genetic load and the evolution of recombination rates. Despite their potential importance, we know surprisingly little about the genetic processes occurring during the time window after meiosis until the fusion of male and female pronuclei. This is particularly true for haploid selection in the gametes of predominantly diploid animals. Male gametes (sperm) are produced in vast numbers but only few fertilise eggs and therefore offer a strong opportunity for selection. A prevailing view that such haploid selection is of minimal consequence in animals has been recently overturned by evidence from our lab, which revealed strong links between sperm phenotype and offspring fitness, as well as sperm phenotype and its haploid genotype. The genetic mechanisms underlying these observations are currently poorly understood. In this project, I will tackle three key questions arising from these recent findings: i) How strong are purifying and positive selection during the haploid phase? ii) What are the mechanisms maintaining genetic variation in genes expressed during the haploid phase? iii) How does haploid selection affect the interaction between male and female gametes? By combining carefully designed innovative experimental approaches with cutting-edge single-cell genome and transcriptome sequencing technologies, this project will provide entirely novel insights into the process that is shared by all eukaryotic life. Findings from this project will illuminate not only the fields of evolutionary biology and genetics but far beyond into the areas of animal breeding and human reproduction.

Link to the ERC project webpage:

Keywords of the ERC project: genetics, reproduction, epigenetics, fertility, evolution

Keywords that characterize the scientific profile of the potential visiting researcher/s: genetics, reproduction, epigenetics, fertility, evolution

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Project ID:	Project Acronym:	Evaluation Panel:
101002644	**BEE-MOVE**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Mathieu Lihoreau**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Pollination ecology: how do bees move across the landscape and fashion plant reproduction?

How pollinators, such as bees, exploit plaHow pollinators, such as bees, exploit plant resources is a fundamental question in biology, with deep ecological, economical and societal consequences. When foraging on flowers, pollinators transfer pollen and mediate the reproduction of plants on which most animals (including us humans) rely on. Understanding the spatial foraging strategies and interactions of pollinators across the landscape is thus a critical scientific challenge to discover their influence on plant mating patterns and pollination efficiency. BEE-MOVE will use an interdisciplinary approach to mechanistically link pollinator movements to pollination efficiency at field scales, thereby crossing boundaries between research on pollinator behaviour and plant ecology. I will focus on two key pollinators worldwide: the buff-tailed bumblebee and the Western honey bee. 1) I will develop a new radar system to record and analyse the individual 3D movements of hundreds of bees foraging simultaneously. 2) I will use arrays of communicating radars and robotic plants to study how bees search and exploit food resources in field setups of several square kilometres, by manipulating key environmental factors such as the density of bees, the 3D distribution of plants, and the nutritional content of nectars and pollens. 3) From these observations, I will build computational agent-based models to investigate the influence of bee spatial strategies on pollination efficiency. Critical experiments will test model predictions in populations of natural plants. The dialogue between observations and simulations will create a positive feedback towards a robust, multi-level understanding of plant-pollinator interactions at the scale of landscapes. In addition to exploring entirely new grounds in pollination ecology, my results could be used to design practical interventions for conservation, sustainable agriculture and green development in the worrying context of pollinator declines.

Link to the ERC project webpage:

Keywords of the ERC project: animal behaviour, pollinator, foraging, radar tracking, modeling

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101002987	**ALIENIMPACTS**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Jane Catford**
Host Institution:	King'S College London - GBR

Predicting impacts of alien plant invasions on community diversity

The Anthropocene, the current geological epoch, is characterised by human-induced ecological changes, which have prompted a global biodiversity crisis. Human-introduced alien plants could help to offset native species loss, augmenting diversity and maintaining the services and capital that humans derive from nature. However, alien species that become invasive are themselves a key threat to biodiversity. Alien species thus presents a huge challenge for biodiversity conservation in the Anthropocene: should their arrival and establishment be inhibited or disregarded as they can potentially both exacerbate and ameliorate biodiversity loss? Coupling empirical and theoretical approaches, ALIENIMPACTS will directly address this challenge by developing an approach for accurately predicting impacts of alien plant invasions on plant community diversity and identifying the circumstances under which negative impacts will occur. Using temperate grasslands as a model system, ALIENIMPACTS will use innovative field experiments and global observations to systematically quantify – for the first time – how often, for how long, to what extent, under what conditions and in what ways alien plants can impact plant community diversity. ALIENIMPACTS will develop mechanistic niche models, validated with empirical data from grasslands in North America, Europe and Australia, that will enable realistic scenarios of invasion biodiversity impacts to be forecast, now and in the future. Developing empirically accurate mechanistic models that predict invasions and their biodiversity impact is a highly ambitious goal. Its achievement will mark a step-change in ecological theory and understanding, will inform environmental policy and management, and address a critical research challenge of the Anthropocene: how to conserve the biodiversity of plants – the dominant life form on earth – under global environmental change.

Link to the ERC project webpage: https://alienimpacts.com

Keywords of the ERC project: biodiversity; plant species; community diversity; alien invasion; non-native invasive species; community ecology

Keywords that characterize the scientific profile of the potential visiting researcher/s: theoretical ecology; community ecology; invasion ecology; mathematical biology; ecological modelling; chemical ecology; molecular ecology

Project ID:	Project Acronym:	Evaluation Panel:
101003296	**MyGardenOfTrees**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Katalin Csilléry**
Host Institution:	Eidgenossische Forschungsanstalt Wsl - CHE

A range-wide transplant experiment using participatory science and genomic prediction to assess local adaptation in forest trees

How organisms adapt to their environments is the most fundamental question in evolutionary biology and is of utmost importance given climate change threats. Identifying key traits involved in adaptations and understanding how they interact with each other, and with the environment, is a particularly urgent task for foundation and resource-production species, such as forest trees. Existing experiments assessing local adaptation lack scalability and predictability in natural environments, especially at the species range margins. Landscape genomics studies could reveal adaptive loci across environmental gradients, but they are hindered by the assumptions of a neutral model and the highly polygenic nature of most traits. To address these shortcomings, I will conduct a species range-wide transplant experiment using participatory science and genomics to (i) reveal major patterns and drivers of adaptation and (ii) to build a predictive model for selecting optimal seed sources for a given location that accounts for gene-environment interactions and demography. I will develop a participatory network of foresters as well as ordinary citizens, who will establish a large number (>2500) of micro gardens (4 to 36 m2). Seeds source populations of Fagus sylvatica and Abies alba, and their sister species, will be selected from across their ranges. To evaluate plant performance in novel climate conditions, garden locations will also cover locations beyond the species' current distribution range. Early survival and growth traits, which are under the highest selection pressure in trees, will be monitored and analyzed herein. An unprecedented nearly full factorial design transplant data set will be obtained using a genomic prediction (GP) model that exploits the genetic similarity between populations and the environmental similarity between garden locations. Finally, I will implement the GP model for forest managers to aid assisted migration decisions with evoluti

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: quantitative genetics, genomic selection, hybridization, spatial population genetics

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Project ID:	Project Acronym:	Evaluation Panel:
101020792	**PROTOEYE**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Gáspár Jekely**
Host Institution:	The University Of Exeter - GBR

From light detection to vision – revealing diversity of function of simple eyes and light-responsive behaviours to enlighten eye evolution

Complex animal eyes evolved many times independently from simpler forms. As already suggested by Darwin, the path to vision may have led from non-directional to directional light sensing and then to low-resolution spatial vision. Simple eyes in extant animals show a remarkable diversity of form and function and may hold the key to the origin of eyes and vision. We do not know why this diversity evolved when the organisms all respond to the same physical cue. Although we have a detailed molecular-centric view of eye evolution across animals, we lack corresponding knowledge of the physical mechanics and neuronal circuits coordinating the responses. PROTOEYE will study the diversity of simple non-visual and visual eyes and map the phase space of light-guided behaviours across animals. This will inform general principles of sensory system evolution and our understanding of the origin and evolution of eyes and visual circuits. The project will build on our long-term expertise in neural circuits and mechanistic photo-biology. We will study a range of aquatic invertebrates with distinct behavioural strategies, unified by the presence of simple eyes and non-visual photoreceptors. Instead of looking at eyes in isolation, we will investigate light responses from a whole-organism perspective focusing on circuits, behaviour and the biophysics of motion. In order to obtain entire neuronal circuits driving photic behaviours, we will use whole-body serial electron microscopy and connectomics. With laser ablation, we will explore strategies of light-seeking or light-avoidance behaviours. In high-throughput behavioural assays we will test navigation strategies and sensitivities to different wavelengths. With high-speed imaging and flow tracing, we will investigate how animal movement is shaped by light. This comparative and multi-disciplinary project will chart the functional diversity of simple eyes and provide a new framework for understanding the evolution of animal vision.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101039843	**CHIMERA**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Anouk Willemsen**
Host Institution:	Universitaet Wien - AUT

The sympatric lifestyle of giant viruses: contact tracing and fitness through mobile genetic elements

Giant viruses appear to be ubiquitous in soil and aquatic environments, infecting a wide range of protist hosts. As lytic viruses, they are important regulators in nutrient and energy cycles and key influencers of microbial community composition. The recent discovery of giant viruses challenged previous assumptions and blurred the sharp division between viruses and cellular life. Besides large particle sizes, giant viruses possess complex "chimeric" genomes, including genes that were likely acquired from their hosts and bacteria that parasitise the same hosts. Unique is the presence of prokaryotic-like mobile genetic elements (MGEs) that are speculated to aid giant viruses in defence against the host immune system or in direct competition for resources with other viruses or bacteria. Contrarily, bacteria may use MGEs to help the hosts counteract viral infections. Our current knowledge on the factors promoting giant virus diversity and maintenance of the virus-host balance in nature, are largely unknown. In the proposed project, I will investigate the role of MGEs in the evolution and ecology of giant viruses. I postulate that the presence of MGEs plays a crucial role in the competition between giant viruses and other parasites infecting the same hosts. Using co-infection experiments, as well as cutting-edge molecular, microscopy, and sequencing techniques, I will investigate viral competitive fitness as well as physical and molecular interactions between selected partners. By developing a highly specific giant virus genome editing tool, I will rigorously test whether MGEs can provide giant viruses with higher fitness. Moreover, I will combine cell sorting with metagenome analysis of two selected habitats, to unravel how MGEs are distributed in a natural ecosystem. My overarching goal is to elucidate the molecular dialogue between viruses, bacteria, and their hosts, and to use MGEs as a tool to trace the evolutionary history of this unique group of viruses.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101040311	**Mechano-Wolbachia**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Ewa Chrostek**
Host Institution:	Uniwersytet Jagiellonski - POL

Uncovering the mechanisms of action of an antiviral bacterium

Animals and microbes interact in intricate ways. Wolbachia, a common intracellular insect symbiont, can manipulate reproduction and protect hosts from viruses. Thus, Wolbachia is an asset in the control of insect-borne diseases. However, as Wolbachia cannot be cultured outside of host cells or genetically manipulated, the mechanisms of its antiviral phenotype remain poorly understood, and this inhibits wider exploitation.

I have been working to remedy these deficiencies, and now stand poised to discover the mechanisms of Wolbachia-conferred antiviral protection by answering the following questions:

1) Where does the protection originate? Up to now, mechanisms of protection have been studied in whole organisms, often lacking resolution, or in cultured cells, which lack emergent properties. I will identify tissues and cell types of the host where protection starts. To do this, I will: a) quantify titers of Wolbachia and virus at early time points post-viral infection in insect tissues, b) measure gene expression of host and microbes to identify candidates for further molecular characterisation, and c) test the extent of the utility of widely adopted, yet unvalidated, cell-culture models of antiviral protection.

2) Which Wolbachia genes effect protection? Wolbachia research has historically been impeded by a lack of tools to study gene function. Here, I will deploy antisense technology, which I have recently developed, to interrogate function of candidate Wolbachia genes in the native system. I will also engineer new methods to target Wolbachia genes and proteins, based on my data on cell-penetrating peptide-mediated delivery of bioactive cargo to Wolbachia.

This project has two major outcomes: it will uncover Wolbachia factors responsible for Wolbachia-conferred antiviral protection, and it will transform Wolbachia and symbiosis research by creating tools to study symbiont gene function.

Link to the ERC project webpage: https://echrostek.wixsite.com/website

Keywords of the ERC project: Wolbachia, virus, antiviral protection, molecular mechanisms

Keywords that characterize the scientific profile of the potential visiting researcher/s: intracellular bacteria, bacterial genetics, Drosophila genetics

Project ID:	Project Acronym:	Evaluation Panel:
101041354	**HOW2DOUBLE**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Polina Novikova**
Host Institution:	Max Planck Gesellschaft Zur Foerderung Der Wissenschaften E.V. - DEU

The basic principles of polyploidy in plants and animals

Many eukaryotes have more than two sets of chromosomes due to whole-genome duplication (WGD) and are called polyploids. WGDs explain many cases of speciation bursts and evolutionary inventions. Some evidence suggests an adaptive advantage of polyploids: the origins of many ancient WGDs correspond to the times of extreme climate change, and contemporary polyploids often occupy harsher environments compared to their ancestors. However, most new polyploids are not as lucky and rarely survive. To explain the cause, predict and manipulate this process, we need to understand the basic principles of polyploidy: (1) how it is triggered, (2) what enables the initial survival of newly formed polyploids, and (3) how they stabilize a population and become successful. My program will comprehensively cover all these aspects, from the functional and genetic levels to the evolutionary forces driving the entire process. I propose a cross-disciplinary approach to identify common polyploidy principles in plant and animal diploid-tetraploid species complexes: Arabidopsis lyrata, widespread plant in Northern Hemisphere, and Neobatrachus, burrowing frogs living in the Australian desert. The approach combines classic genetics with the latest genomics technologies and population genetics analysis of natural herbarium and museum collections across broad geographies. I will (1) expose genetic and environmental predispositions to polyploidy formation by mapping natural variation of the unreduced gametes rates; (2) reveal mechanics and genetics stabilizing meiosis in polyploids, comparing recombination and selection across ploidies; (3) uncover polyploid populations recovery processes after bottlenecks accompanying their origin by reconstructing introgression patterns. Deciphering the mechanisms leading to successful polyploidization across the plant and animal kingdoms will deliver groundbreaking advances relevant across biology, agriculture, and medicine.

Link to the ERC project webpage: https://www.novikovalab.org/

Keywords of the ERC project: polyploidy, meiosis, adaptation, unreduced gametes, introgression, population genetics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101041421	**PHAGECONTROL**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Anna Dragos**
Host Institution:	Univerza V Ljubljani - SVN

The evolution of host manipulation by bacteriophage.

The idea of parasite manipulation is well known in animal behaviour, with famous examples like the cordyceps ?zombie? fungus of ants. Yet, the most abundant and diverse parasites on earth do not target animals but rather bacteria. They are the bacteriophages, or phages. My hypothesis is that it is in phages that we will find the most important examples of parasite manipulation, examples that will help us both understand and control bacteria, and their impacts. I will focus on the recently-discovered Regulatory Switch (RS) phage, which reversibly excise and reintegrate into the bacterial chromosome to shift the host between different physiological states. I, and others, have shown that RS phages influence a wide variety of bacterial traits including sporulation, biofilm formation, mutation rates or bacteriocin production. However, we do not understand when, how or why these viruses cause such large changes to bacterial behavior. The goal of my project, therefore, is to understand how and why RS phage evolve as a new candidate model of parasite manipulation. Specifcally, I will answer: 1) When and how do RS phages alter host behavior? 2) What is the molecular basis for the effects of RS phage? 3) Why have RS phage evoved to change bacterial behaviours, and is there evidence of counter strategies in their bacterial hosts? I will work with the bacterium Bacillus subtilis, which is strongly affected by RS phage and a model organism, allowing me to employ the very latest molecular methods. My goal is to demonstrate that parasite manipulation is a major factor in the ecology and evolution of bacteria, whereby many bacteria are essentially puppets of their phage masters. Understanding how phage achieve this manipulation also has the potential for broad impacts in an era when the need to find new ways to control bacteria becomes ever greater.

Link to the ERC project webpage:

Keywords of the ERC project: phage, bacteria, Bacillus, lysogeny

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101042912	**BEE_GEMS**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Waldan Kwong**
Host Institution:	Fundacao Calouste Gulbenkian - PRT

Genetic factors Enabling Microbiome Symbioses: Bees as a natural model system

The gut microbiome is essential for the wellbeing of many animals including humans and bees. However, the genetic factors that enable stable, healthy microbiomes remain poorly understood. In particular, little is known about how different members of a gut microbial community communicate and interact with one another, both at the molecular level (which genes underlie the interactions) and the ecological level (how these genes are distributed across populations). Due to the complexity of most gut microbiomes, previous work in this field has largely been limited to in vitro studies using simplified, synthetic communities. In contrast, the core aim of this project is a systematic analysis of microbial interaction mechanisms at both the molecular and ecological levels. Unlike other systems, we can culture all members of the bee gut microbiome and have recently developed genetic tools for their manipulation. I will leverage these unique advantages, together with my expertise in social bees (honey bees, bumble bees) and microbial genetics, in an integrative approach to fulfil the project objectives. Work Package 1 will reveal the genes underlying pairwise intermicrobial interactions though unbiased in vitro and in vivo transcriptomics and proteomics. These genes, together with candidates I previously identified (secretion systems and toxin genes), will be investigated in detail using genetic and biochemical methods to uncover their mechanisms of action and novel functions. Work Package 2 will clarify how these interactions play out across populations by assessing variation of interaction genes with ecological factors (geography, host background), and by probing the evolutionary forces that lead to these variations. Our findings will contribute empirically to identifying the general principles behind microbiome assembly and function, which has broad implications across all fields where microbiomes play important roles including in agriculture, medicine, and biotechnology.

Link to the ERC project webpage:

Keywords of the ERC project: microbiology, genomics, host-microbe interactions, honey bee, symbiosis

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101044452	**BLOOMTOX**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Dedmer Van De Waal**
Host Institution:	Koninklijke Nederlandse Akademie Van Wetenschappen - Knaw - NLD

Global change impacts on cyanobacterial bloom toxicity

Harmful cyanobacterial blooms produce toxins that are a major threat to water quality and human health. Blooms increase with eutrophication and are expected to be amplified by climate change. Yet, we lack a mechanistic understanding on the toxicity of blooms, and their response to the complex interplay of multiple global change factors. Bloom toxicity is determined by a combination of mechanisms acting at different ecological scales, ranging from cyanobacterial biomass accumulation in the ecosystem, to the dominance of toxic species in the community, contribution of toxic genotypes in the population, and the amounts of toxins in cells. I will develop a fundamental understanding of bloom toxicity by revealing the combined effects of nutrients, elevated pCO2 and warming at each scale, and integrate these responses using a unique combination of ecological theory, technological advances, and methodological innovations. Specifically, I will use first principles to scale from cellular traits, like carbon and nutrient acquisition, cellular toxin synthesis and growth rates, to population and community dynamics. To enable rapid assessment of numerous cyanobacterial traits, I will set-up a high-throughput flow-cytometry pipeline. Also, I will develop a novel lab-on-a-chip experimental platform to allow massive parallel screening of key competitive traits in various phytoplankton species and cyanobacterial genotypes. To scale from these cellular traits to population and community interactions, I will study genotype selection and interspecific resource competition in state-of-the-art chemostats. I will further scale-up to natural communities in the field and in large-scale indoor mesocosms to assess global change impacts on the mechanisms underlying toxicity of (near) real-life blooms. With this unique combination of scaling approaches, I will provide a breakthrough in our mechanistic understanding on the toxicity of cyanobacterial blooms, and their response to global change.

Link to the ERC project webpage:

Keywords of the ERC project: Cyanobacteria, harmful algal blooms, eutrophication, climate change, phytoplankton, ecological stoichiometry

Keywords that characterize the scientific profile of the potential visiting researcher/s: Aquatic ecology, harmful algal blooms

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101044505	**PlastidOrigin**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Fabien Burki**
Host Institution:	Uppsala Universitet - SWE

Testing the paradigm of a single plastid origin in eukaryotes

Photosynthesis was acquired by eukaryotes through endosymbiosis with cyanobacteria, which resulted in new cellular organelles: the plastids. From the origin of plastids evolved the first eukaryotic algae, giving rise to land plants but also triggering the evolution of most photosynthetic eukaryotes by subsequent endosymbioses between these first algae and other eukaryotes. Thus, the origin of plastids profoundly changed the course of eukaryotic life by being the launching point that shaped the biological diversity of most primary producers. Despite this importance, our understanding of how plastids originated remains largely uncertain. The current paradigm describes this transformative event as a single primary endosymbiosis, but I argue here that critical data is lacking, notably from the vast hidden environmental diversity of microbes, to adequately test this hypothesis. In this project, I propose to gain insight into the origin of plastids by addressing the main questions: 1) What is the currently hidden diversity of high-ranked taxa related to primary photosynthetic lineages? 2) What are the feeding behaviors of these taxa and are they aplastidic? 3) Are some lineages genetically predisposed to establish plastids from the acquisition of foreign genes? 4) What was the composition, size, and origin of the ancestral primary plastid proteomes? To answer these questions, I will link third generation environmental sequencing, transcriptomics, and genomics to cell structure and behavior of novel key lineages related to primary algae, and produce crucially missing plastid proteomes to allow comprehensive comparative proteomic analysis. My project will not only have immediate implications on our understanding of the origin of plastids and more generally the fundamental process of endosymbiosis, but the approaches developed will be a test bed for future global studies aimed at understanding the evolution and ecology of the microbial majority of complex life.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101044975	**coralINT**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Maria Dornelas**
Host Institution:	Faculdade De Ciencias Da Universidade De Lisboa - PRT

Integrated Niche Theory: linking environmental, compositional and functional change on coral reefs

Idea: CoralINT aims to deliver the ability to predict spatio-temporal change in biodiversity and the consequences of this change for ecosystem function. To achieve this aim, I will develop an Integrated Niche Theory linking three niche concepts: Grinnell's niche (what a species needs), Elton's niche (what a species does) and niche construction (how the species function changes the environment). The key to this integration lies in how species are sorted along each of the niche axes (environmental gradients, functional rates and niche construction rates). I will map the dynamic implications of different types of bivariate sorting to the development of positive and negative feedback loops. This new theory will allow predicting the indirect consequences of selection on one axis to change along the other two axes. I will test INT with environmental, compositional, and functional data extracted from 3D maps of coral reefs and its coral inhabitants. Ground breaking features: CoralINT sits at the interface between theory development and cutting-edge empirical data. I anticipate coralINT will produce 3D maps for a total area of >26,600 m2 with mm scale resolution, distributed among 100 sites along a 2,000 km latitudinal gradient. Within these maps we will follow >100,000 coral colonies through time, measuring and inferring structural and demographic rates across >200 species and environmental variation in space and time. Working at organismal and ecosystem scales will enable coralINT to develop mechanistic understanding of the processes connecting environmental, compositional and functional change. Objectives: develop a new Integrated Niche Theory; quantify the effects of the environment on corals' distribution and functional rates; determine if function can be predicted from coral and reef structural traits; quantify the prevalence and evolutionary implications of coral niche construction. Feasibility:We have collected proof of concept data for each data type.

Link to the ERC project webpage:

Keywords of the ERC project: biodiversity community ecology coral reef theory

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101045015	**microTOUCH**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Nicola Segata**
Host Institution:	Universita Degli Studi Di Trento - ITA

Transmission of the human microbiome and its impact on health

The human microbiome is a key component of our own biology and has important biomedical applications, but while its composition has been studied in depth and linked with several lifestyle and disease factors, it is still highly unknown how its members are acquired, spread, and transmitted across hosts. Our preliminary results suggest that person-to-person microbiome transmission (MT) is extensive and shapes the microbiome according to host interaction networks, leading to the hypothesis that microbiome-linked diseases that are considered non-communicable are instead partially communicable. microTOUCH will (i) develop the methods needed to model MT in human populations from metagenomic sequencing, (ii) unravel the features of microbial transmissibility, and (iii) detail the contribution of MT to host conditions that are currently considered non-communicable. We will first empower metagenomics with the ability to track and model the transmission of known and unknown members of the microbiome, and will then apply these methods to specific case studies of MT in humans (children and adults) and non-human primates across diverse family, social, and interaction networks. Meta-analysis of MT integrating publicly available datasets will unravel the factors impacting MT the most and the degree of transmissibility of each microbiome member. Exploiting the large and deeply phenotyped metagenomic datasets available to the PI, microTOUCH will characterize the role of MT in shaping the connections between the gut/oral microbiome and (i) nutrition and cardiometabolic health, (ii) oral diseases, (iii) cancer and cancer immunotherapy, (iv) autism, and (v) the Westernization process. microTOUCH will advance our understanding of the epidemiological forces shaping the human microbiome and will link MT with host conditions and risk factors, thus enabling the development of biomedical strategies promoting or limiting the transmission of specific disease-associated microbiome components.

Link to the ERC project webpage: http://segatalab.cibio.unitn.it/

Keywords of the ERC project: metagenomics, microbiome, transmission, strains

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101052538	**NovoGenePop**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Mar Albà**
Host Institution:	Fundacio Institut Mar D Investigacions Mediques Imim - ESP

Deciphering de novo gene birth in populations

Genes are fundamental units of life and their origin has fascinated researchers since the beginning of the molecular era. Many of the studies on the formation of new genes in genomes have focused on gene duplication and subsequent divergence of the two gene copies. But, in recent years, we have learnt that genes can also arise de novo from previously non-genic sequences. The discovery of de novo genes has become possible by the sequencing of complete genomes and the comparison of gene sets between closely related species. Here we wish to test a novel hypothesis, we propose that de novo gene formation dynamics in populations results in substantial differences in gene content between individuals. If they exist, these differences would be not be visible by the current methods to study gene variation, which are based on the comparison of the sequences of each individual to a common set of reference genes. To test our hypothesis, we will need to develop novel computational approaches to first obtain an accurate representation of all transcripts and translated open reading frames in each individual, and then integrate the information at the population level. We propose to apply these methods to two very distinct biological systems, a large collection of Saccharomyces cerevisiae world isolates and a human lymphoblastoid cell line (LCL) panel. For this, we will collect and generate RNA (RNA-Seq) and ribosome profiling (Ribo-Seq) sequencing data. In order to identify de novo originated events occurred within populations, as opposed to phylogenetically conserved genes that have been lost in some individuals, we will also generate similar data from a set of closely related species in each of the two systems. Combined with genomics data, we will identify the spectrum of mutations associated with de novo gene birth with an unprecedented level of detail and uncover footprints of adaptation linked to the birth of new genes.

Link to the ERC project webpage: https://erc.easme-web.eu/?p=101052538#

Keywords of the ERC project: gene birth, evolution, ribosome profiling

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101053543	**VIBES**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Assaf Vardi**
Host Institution:	Weizmann Institute Of Science - ISR

The impact of the viral shunt and its metabolic landscape on microbial lifestyles and the flow of carbon during algal blooms

The fate of carbon in marine environments is influenced by associations between heterotrophic bacteria and phytoplankton, mediated by chemical communication and metabolic exchange. Deciphering the nature of these associations is critical given the impact of marine plankton on biogeochemical cycling and climate regulation. Viral infection is a prevalent mortality agent of algal blooms in the ocean, leading to massive release of biomass to the dissolved organic matter (DOM) pool, one of the largest global inventories of carbon. This process, termed the 'viral shunt', is a key ecosystem process, but remains unquantifiable and mechanistically enigmatic. Furthermore, the metabolic composition of the DOM released following viral infection (vDOM) and its role in shaping microbial communities are largely unknown. In the VIBES project, we will disentangle the complexity of the viral shunt, and elucidate its impact on microbial lifestyles (mutualism and pathogenicity) during algal bloom demise. We will generate experimental approaches to study these bacterial lifestyles, and uncover the chemical language that mediates them. Our expertise in marine microbial chemical ecology, using single-cell transcriptomics to quantify host-pathogen interactions, and metabolomics to identify the chemical signals that govern microbial interactions, will pave the way for unprecedented quantification of the viral shunt. We will investigate the molecular and metabolic basis of virus-derived microbial lifestyles and their consequence for the flow of carbon in the ocean, both under controlled lab-based experiments and during complex interactions in the ocean. We will investigate how microbial lifestyles that specialize on vDOM can determine the partitioning of carbon between the dissolved and particulate fractions, representing carbon cycling and export, respectively. Ultimately, VIBES will enable to evaluate the importance of microscale interactions to the cycling of carbon in the ocean.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101054307	**FishLEGs**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Craig Primmer**
Host Institution:	Helsingin Yliopisto - FIN

Life-history genes in fishes: bridging functional and evolutionary genetics for understanding life-history trait evolution

Life history is one of the most central concepts in biology. Numerous biological questions ultimately revolve around the causes and consequences of variation in reproduction and survival i.e. fitness. Tremendous effort has been put in establishing the causes and mechanisms for life history trait variation and trade-offs. But even in well studied model organisms, evolutionary genetic and functional genomic approaches are rarely combined, and thus the path from genotype to phenotype often remains a black box. A strategy to overcome this major hurdle has recently emerged, with the discovery of loci that explain exceptionally large proportions of the variation in various life history traits. These "life-history genes" offer new opportunities to study not just the why (evolution) but also the how (functional genetics) of life history trait variation. I will address critical outstanding questions by bridging functional and evolutionary genetics approaches to study multiple loci linked with life-history traits including age at maturity, migration timing and migration strategy in 3 fish species: Atlantic salmon, Rainbow trout/steelhead and Atlantic cod. The relatively simple genetic architecture of the traits, combined with the features of these species as model systems, offer a unique opportunity to finally reveal the genetic architectures, molecular mechanisms and ecological drivers that translate large-effect genotypes into adapted life history phenotypes, and examine how evolution shapes these processes. In FishLEGs I will:
i) characterize the molecular functions behind genotype-life history associations;
ii) elucidate life history trait reaction norms and evolution in variable environments and
iii) determine the strength of natural and sexual selection on life history traits, their sex specific effects, and model the evolutionary consequences.
Life history research also has societal relevance for health, sustainable fisheries, conservation and climate resilience.

Link to the ERC project webpage: http://www.helsinki.fi/evolution-conservation-and-genomics

Keywords of the ERC project: Evolution, conservation, genomics, salmon, ecology, life-history, genotype-phenotype map

Keywords that characterize the scientific profile of the potential visiting researcher/s: anything from functional genomics and population genetics to evolutionary ecology

Project ID:	Project Acronym:	Evaluation Panel:
101054718	**Xspect**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Mikkel Schierup**
Host Institution:	Aarhus Universitet - DNK

X-chromosome driven speciation through testes-expressed genes: comparative population genomics meets scRNA analysis in primates

Primate X chromosomes evolve extraordinary fast and are also tightly associated with the establishment of reproductive barriers between emerging species.

The hypothesis of this proposal is that genetic conflicts between the X chromosome and the rest of the genome during spermatogenesis cause rapid X chromosome evolution and build reproductive barriers. Genetic conflicts for transmission to haploid gametes, called meiotic drive, will cause non-adaptive evolution, which is expected to be countered by other genomic elements that will then be under selection. Such an arms race is expected to lead to a very rapid evolution of the X chromosome and a fast accumulation of incompatibilities between isolated populations, leading to speciation.

The goal of the project is to identify the underlying mechanisms and the genes responsible for meiotic drive using primates as the study system. A priori candidate processes include X-linked genes under repeated fast evolution with a focus on genes targeted by pachytene piRNAs and on ampliconic genes. Population genomics analysis will generate specific hypotheses that will then be tested by following expression of candidate genes during spermatogenesis through scRNAseq, and validate findings by ultrasensitive, in situ, staining of single transcripts and immunohistochemistry. Finally, the behaviour of key genes and processes will then be investigated in incipient speciation events.

Specifically, 850 individuals of 250 species of primates with full genome data will be analysed for candidate genes on the X chromosome. These genes will be investigated in large scale comparative scRNA sequencing analyses of >10,000 individual testicular cells from 14 primate species, including all great ape species, thus allowing expression trajectories through spermatogenesis to be inferred and followed up in functional experiments.

The success criterion is to report on primate speciation genes together with their biological mode of action.

Link to the ERC project webpage:

Keywords of the ERC project: primate spermatogenesis, scRNA sequencing, spatial transcriptomics, comparative genomics, meiotic drive, speciation

Keywords that characterize the scientific profile of the potential visiting researcher/s: scRNA transcriptomics labwork, bioinformatics, population genetics, evolutionary genetics

Project ID:	Project Acronym:	Evaluation Panel:
101055327	**HaplotypeStructure**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Nicholas Barton**
Host Institution:	Institute Of Science And Technology Austria - AUT

Understanding the evolution of continuous genomes

An organism's phenotype depends on a multitude of genetic variants, spread over a linear genome. This is widely understood, and yet in practice, has hardly been incorporated into population genetic analysis. Recent developments in theory, computation, and sequencing technology now make it possible to obtain and analyse whole haploid genomes on a large scale. This proposal is to develop and apply a theoretical analysis of genetic variation that is spread over continuous linear genomes. Theory and methods will be developed in close interaction with empirical data from artificial selection experiments and from an intensely studied hybrid zone in Antirrhinum; for both, we have a known pedigree, and phased whole-genome sequence. Population structure will be analysed by following blocks of genome through pedigrees, and across two-dimensional landscapes. Selection on discrete loci will be analysed by finding its effect on surrounding haplotypes, by analysing how favoured alleles become disentangled from heterogeneous backgrounds, and by seeing how haplotype blocks flow past selected clines. The contribution of variants that are spread across the genome to GWA, to selection response, and to hybrid zones will be modelled, and the overall effect of inherited fitness variance on haplotype structure will be determined. This work will establish a new framework for population genomics that goes beyond the current focus on individual loci. It will help bridge the distinct communities within genomics, quantitative genetics, and population genetics, which currently tackle these problems largely in isolation. The project will develop better tools for inferring selection and population structure from DNA sequence data, and more fundamentally, will give us a deeper understanding of how the abundant variation that is carried on linear genomes is shaped by evolution.

Link to the ERC project webpage: https://bartongroup.pages.ist.ac.at/

Keywords of the ERC project: evolutionary genomics, population genetics, quantitative genetics

Keywords that characterize the scientific profile of the potential visiting researcher/s: genomics, genetics, stochastic processes, applied probability

Project ID:	Project Acronym:	Evaluation Panel:
101076740	**STOIKOS**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Marcos Fernández-Martínez**
Host Institution:	Universitat de Barcelona - ESP

Elemental Ecology: towards an element-based functional ecology

Life on Earth, as we have known it for millennia, is at stake. Human activities are putting all kinds of ecosystems under increased stress because of land-use change and the alteration of the biogeochemical cycles of nitrogen (N), phosphorus (P) and carbon (C), thus inducing climate warming. Functionally diverse ecosystems are more productive and stable than less diverse ones, and biogeochemical changes affect both biodiversity and the elemental composition of organisms (their elementome), changing how they and their ecosystems function. It is, therefore, imperative to provide evidence about how the interactions between elementomes, biodiversity, and climate drive ecosystem functioning if we are to avoid the serious threat of reducing essential resources for life within the context of global change. STOIKOS will achieve an in-depth understanding of the interaction between elementomes and biodiversity in determining ecosystem functioning by introducing the concept of elemental diversity, and moving functional ecology from using functional traits to elementomes, an easy and universal way to compare all sort of organisms. STOIKOS will particularly test the hypothesis that community-weighted elementomes and elemental diversity explain ecosystem functioning better than functional traits and their diversity. STOIKOS will integrate data from observations (field campaigns), long-term monitoring sites, microcosm experiments and theoretical modelling to provide synergies amongst their outputs to build the foundations of an elemental-based ecology. This will allow STOIKOS' hypotheses to be tested at the individual, species and community/ecosystem scales using new and game-changing methodologies and study systems. The cutting-edge science of STOIKOS will not only provide the foundations of an elemental-based ecology, but will also deliver new ecological theory and methodological tools that will help us predict the future of ecosystems and assess the fragility of our biosphere.

Link to the ERC project webpage: not available yet, lab url instead: https://elemdiv.netlify.app/

Keywords of the ERC project: ecological stoichiometry, functional traits, biodiversity, ecosystem functioning, theoretical ecology

Keywords that characterize the scientific profile of the potential visiting researcher/s: data analyst, field work, theoretical ecologist, community ecologist, functional ecology

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Project ID:	Project Acronym:	Evaluation Panel:
802000	**RiboLife**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Hannes Mutschler**
Host Institution:	Technische Universitaet Dortmund - DEU

Resurrecting LUCA - Engineering of RNA-encoded Cellular Life Using Dual Evolution and Intergenomic Transplantation

Modern cellular life strictly depends on DNA as genetic material. However, a large body of evidence infers the existence of a previous, more primitive biology in which RNA also stored information in cellular entities. Recreating a living cellular fossil representing this transition from an ancient RNA world to modern DNA-based life would fundamentally advance our understanding of our biology's history, and enable us to explore its biological properties experimentally. However, the reengineering of existing molecular systems into a viable doppelganger of the Last Universal Common Ancestor (LUCA) or one of its precursors is extremely challenging.

I propose to use a novel, combined top-down and bottom-up approach to create a modern-day doppelganger of LUCA by engineering bacterial hybrids with core cellular functions encoded on RNA. Using Darwinian Evolution as driver, my team and I will prototype and refine synthetic RNA-replicons through alternating replication in both cell-free and intracellular environments. This "dual evolution" approach will shape increasingly complex RNA networks capable of encoding complex genetic information. Following this, we will use these networks to create information-rich RNA chromosomes, enabling the transfer of essential genomic information from DNA to RNA. Finally, we will address this intergenomic transplantation by combining a novel RNA-delivery strategy with iterative rounds of genome deletion and complementation using state-of-the art CRISPR-Cas9 assisted genome editing.

The proposed research will fundamentally advance synthetic biology, and could positively answer the transformative questions: Can we create, program and evolve life-like systems that can survive in both cell-free and intracellular environments? Can we use these entities to construct an alternative biology in which central cellular activities are encoded on genomes not made of DNA?

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: Synthetic Biology, RNA replication, RNA, Cell-free biology, Cell-free protein expression

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Project ID:	Project Acronym:	Evaluation Panel:
805094	**GRASP**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Charles Melnyk**
Host Institution:	Sveriges Lantbruksuniversitet - SWE

Overcoming plant graft incompatibility by modifying signalling and perception

For millennia, people have cut and joined together different plants through a process known as grafting. Plants tissues from different genotypes fuse, vasculature connects and a chimeric organism forms that combines desirable characteristics from different plants such as high yields or disease resistance. However, plants can only be grafted to closely related species and in some instances, they cannot be grafted to themselves. This phenomenon is referred to as graft incompatibility and the mechanistic basis is completely unknown. Our previous work on graft formation in Arabidopsis thaliana has uncovered genes that rapidly activate in grafted tissues to signal the presence of adjoining tissue and initiate a vascular reconnection process. These genes activate around the cut only during graft formation and present a powerful tool to screen large numbers of chemicals and genes that could promote tissue perception and vascular formation. With these sensors and our previously established grafting tools in the model plant Arabidopsis, we can address fundamental questions about grafting biology that have direct relevance to improving graft formation through:

1. Identifying genes required for the recognition response using forward and reverse genetic screens.
2. Determining and characterising signals that activate vascular induction using a chemical genetics screen.
3. Characterising the transcriptional basis for compatibility and incompatibility by analysing tissues and species that graft and comparing these to tissues and species that do not graft.
4. Overcoming graft incompatibility and improving graft formation by applying the knowledge obtained from the three previous objectives.

We thus aim to broaden our fundamental understanding of the processes associated with grafting including wound healing, vascular formation and tissue regeneration, while at the same time, use this information to improve graft formation and expand the range of grafted species.

Link to the ERC project webpage:

Keywords of the ERC project: Arabidopsis, grafting, regeneration, plants

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
819800	**BIONICbacteria**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Rob Lavigne**
Host Institution:	Katholieke Universiteit Leuven - BEL

Integrating a novel layer of synthetic biology tools in Pseudomonas, inspired by bacterial viruses

As nature's first bioengineers, bacteriophages have evolved to modify, adapt and control their bacterial hosts through billions of years of interactions. Indeed, like modern synthetic biologists aspire to do, bacteriophages already evade bacterial silencing of their xenogeneic DNA, subvert host gene expression, and co-opt both the central and peripheral metabolisms of their hosts. Studying these key insights from a molecular systems biology perspective, inspired us to develop these evolutionary fully-adapted phage mechanisms as a next-level layer of synthetic biology tools. Thus, BIONICbacteria will provide conceptual novel synthetic biology tools that allow direct manipulation of specific protein activity, post-translational modifications, RNA stability, and metabolite concentrations.

The goal of BIONICbacteria is to pioneer an unconventional way to perform synthetic biology, tapping an unlimited source of novel phage tools genetic circuits and phage modulators. To achieve these goals, we will apply and develop state-of-the-art technologies in molecular microbiology and focus on three principal aims:

(1) To exploit new phage-encoded genetic circuits as synthetic biology parts and as intricate biotechnological chassis.

(2) To build synthetic phage modulators (SPMs) as novel payloads to directly impact the bacterial metabolism in a targeted manner.

(3) To create designer bacteria by integrating SPMs-containing circuits into bacterial strains as proof-of-concepts for applications in industrial fermentations and vaccine design.

This proposed "plug-in" approach of evolutionary-adapted synthetic modules, will allow us to domesticate Pseudomonas strains in radically new ways. By building proofs-of-concept for applications in industrial fermentations and vaccine development, we address key problem in these areas with potentially high-gain solutions for society and industry.

Link to the ERC project webpage: https://www.biw.kuleuven.be/biosyst/a2h/LoGT/projects/erc-bionicbacteria/

Keywords of the ERC project: Pseudomonas, bacteriophage, synthetic biology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
834631	**DNA-DOCK**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Imre Berger**
Host Institution:	University Of Bristol - GBR

Precision Docking of Very Large DNA Cargos in Mammalian Genomes

Gene editing has developed at breath-taking speed. In particular CRISPR/Cas9 provides a tool-set thousands of researchers worldwide now utilize with unprecedented ease to edit genes, catalysing a broad range of biomedical and industrial applications. Gene synthesis technologies producing thousands of base pairs of synthetic DNA have become affordable. Current gene editing technology is highly effective for local, small genomic DNA edits and insertions. To unlock the full potential of this revolution, however, our capacities to disrupt or rewrite small local elements of code must be complemented by equal capacities to efficiently insert very large synthetic DNA cargos with a wide range of functions into genomic sites. Large designer cargos would carry multicomponent DNA circuitry including programmable and fine-tuneable functionalities, representing the vital interface between gene editing which is the state-of-the-art at present, and genome engineering, which is the future. This challenge remained largely unaddressed to date.

We aspire to resolve this bottleneck by creating ground-breaking, generally applicable, easy-to-use technology to enable docking of large DNA cargos with base pair precision and unparalleled efficiency into mammalian genomes. To achieve our ambitious goals, we will apply a whole array of sophisticated tools. We will unlock a small non-human virus to rational design, creating safe, flexible and easy-to-produce, large capacity DNA delivery nanodevices with unmatched transduction capability. We will exploit a range of techniques including Darwinian in vitro selection/evolution to accomplish unprecedented precision DNA integration efficiency into genomic sites. We will use parallelized DNA assembly methods to generate multifunctional circuits, to accelerate T cell engineering, resolving unmet needs. Once we accomplish our tasks, our technology has the potential to be exceptionally rewarding to the scientific, industrial and medical communities.

Link to the ERC project webpage:

Keywords of the ERC project: Genome engineering, synthetic virus-derived nanosystems, CRISPR/Cas, PRIME editing, DNA delivery, gene therapy

Keywords that characterize the scientific profile of the potential visiting researcher/s: CRISPR transposon technology, DNA delivery, synthetic biology, genome minimization

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Project ID:	Project Acronym:	Evaluation Panel:
849029	**EpigeneticScars**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Deborah Toiber**
Host Institution:	Ben-Gurion University Of The Negev - ISR

Understanding DSB repair from pathway choice to long term effects and their consequences.

DNA safekeeping is one of the most important functions of the cell. Since DNA damage occurs in the context of chromatin, it affects both the DNA itself, but also the epigenetic landscape. While the repair mechanism of the DNA has been extensively studied, questions abound regarding the restoration of the epigenetic landscape, and the long-term effects that damage leaves in the region. In this proposal I aim to address these questions using modified DSBs repair sensors from different pathways such as “homologous recombination” and “non-homologous end joining” to map the repair process. Our method will allow us to investigate the influence of the natural epigenetic landscape on pathway choice, the dynamic process of repair and the restoration of the region. Moreover, we will investigate whether certain repair processes leave long- lasting effects at the site of damage or even “epigenetic scars”. The advantage of our method is that it allows us to map each sensor repair time-line in an unbiased and high throughput manner over extended periods of time, even once the damage is already repaired. These questions are especially important for our understanding of ageing, and age-related diseases that are driven by DNA damage. Last, we will test the long-lasting effects of past damage in two different contexts: animal models of neurodegeneration, where DNA damage accumulates, and in the efficiency of reprograming to produce healthy induced pluripotent stem cells (IPCs).

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
850974	**MABSTER**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Andreas Laustsen**
Host Institution:	Danmarks Tekniske Universitet - DNK

Monoclonal Antibodies with Binding Sensitive To Environmental Regulation

Snakebite envenoming is a Neglected Tropical Disease (NTD) that each year affects 2.5 million victims and kills >100,000, unless they are treated with antivenom. Conventional antivenoms, derived from immunized animals, inflict serum sickness and anaphylaxis in patients, and are costly to manufacture. Monoclonal human antibodies with special toxin-binding properties that are sensitive towards regulation by their microenvironment (e.g. pH), which may be discovered using phage display selection, may solve this issue, providing significant societal impact by enabling the development of cost-effective antivenoms to victims in low and middle-income countries. In this project, phage display selection, high-density peptide microarray technology, and antibody engineering techniques will in three scientific objectives be harnessed in the pursuit of developing novel methodologies for discovery of therapeutic human monoclonal antibodies that are recyclable (can neutralize more than one snake toxin per antibody), broadly cross-reactive (can neutralize different types of snake toxins), and that are both broadly cross-reactive and recyclable at the same time. This will open up for entirely new ways of designing biotherapeutics against complex indications, such snakebite envenoming, but also cancer, infectious, and parasitic diseases, where the targets can be elusive due to hyper-mutability. The ERC Starting Grant offers a unique opportunity to consolidate me as an international key scientific researcher in this field of antibody discovery and NTDs. I have already independently led a research group in this area for 2 years, I have in-depth experience with toxin-targeted antibody discovery (my dr.tech dissertation similar to the German “habilitation” will be submitted during fall 2018), and I am already involved in high level policy in the field of snakebite envenoming via my role as a scientific advisor for the World Health Organization.

Link to the ERC project webpage: https://tropicalpharmacology.com

Keywords of the ERC project: antibodies, toxins, phage display, molecular biology, synthetic biology, protein science, antivenom, snakes, biochemistry, biophysics, antibody discovery

Keywords that characterize the scientific profile of the potential visiting researcher/s: antibodies, toxins, phage display, molecular biology, synthetic biology, protein science, antivenom, snakes, biochemistry, biophysics, antibody discovery

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Project ID:	Project Acronym:	Evaluation Panel:
864117	**nbPTMs**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Ivan Matic**
Host Institution:	Max Planck Gesellschaft Zur Foerderung Der Wissenschaften E.V. - DEU

A multifaceted platform for exploring nucleotide-based post-translational modifications

Nucleotide-based post-translational modifications (nbPTMs) play key roles in health and disease, from bacterial pathogenesis to cancer. However, technical challenges of these versatile, but chemically complex protein modifications have constrained our fundamental understanding of even the most intensely studied nbPTMs for decades. The overarching aim of this proposal is to establish, apply and disseminate a methodology to unveil novel types of nbPTMs and allow site-specific proteomic analyses. The conceptual innovation lies in a strategy for turning the complex chemical structures of nbPTMs from a challenge to an advantage. First, shared chemical moieties will be exploited to develop pan-specific enrichment of multiple nbPTMs. For this purpose, we will generate the first nbPTMs-specific antibodies by converting specific signalling proteins into biotechnology tools for chemoenzymatic synthesis of challenging peptide antigens (aim 1). Second, we will take advantage of the chemical lability of nbPTMs to analyse modified peptides using a nucleobase-targeted mass spectrometry approach (aim 2). The unbiased scope of our methodology will make possible the discovery of as yet unknown forms of nbPTMs (aim 3) and nbPTM site mapping throughout eukaryotic proteomes (aim 4). These new materials, methods, discoveries and datasets will be made publicly available to allow future investigations of nbPTMs by the scientific community. The new substrates, sites and nbPTMs will provide starting points for biological characterization (aim 5). Poised at the interface of biology and technology, this interdisciplinary research project has the potential to explore new territories within established biomedical fields and to contribute to the knowledge base for improved treatment of diseases.

Link to the ERC project webpage:

Keywords of the ERC project: ADP-ribosylation; proteomics; histones; PARP; nucleotide-based PTMs

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
865119	**PDPcardio**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Maja Banks-Köhn**
Host Institution:	Albert-Ludwigs-Universitaet Freiburg - DEU

Protein phosphatase 1-disrupting peptides: Scope and mechanism of action in the treatment of heart insufficiency

Protein phosphatase-1 (PP1) is a ubiquitously expressed enzyme known to dephosphorylate a large number of the phosphorylated serines and threonines. The catalytic subunit PP1c is bound to regulatory proteins in holoenzymes. These play specific and fundamental roles in physiological processes and pathologies. One key role lies in the regulation of important cardiac signaling pathways and calcium homoeostasis. Accordingly, deregulation of PP1 has been implicated in cardiac dysfunctions. Powerful tools to study PP1 biology are our own developed PP1-disrupting peptides (PDPs) that selectively release PP1c (bound to PDP: PDP–PP1c) activity in cells. Recently, we showed that PDP treatment counteracts kinase hyperactivity and seals the arrhythmogenic sarcoplasmic reticulum (SR)-calcium-leak in human heart failure tissue. Mechanistic data indicated that PDP–PP1c-mediated dephosphorylation of the ryanodine receptor type 2 (RyR2) is involved in this effect. Nevertheless, given the large amount of potential PP1 substrates, so far the scope of PDP action is unknown, and therefore the mechanisms underlying this beneficial and potentially therapeutic effect of the PDPs in heart failure are unclear and currently hard to investigate. PDPcardio will address these challenges by providing new chemical biology methodologies combined with proteomics approaches using PDPs to guide PP1c to its substrates and to identify PDP-mediated interactions of PP1. These strategies will enable identifying the scope of PDP action in general, and in particular they will be applied here in cardiomyocytes to study the effects of PDP–PP1c. The results will provide the basis to fine-tune targeting PP1 for the treatment of heart insufficiency. Furthermore, the principles and methods developed here will be applicable more generally for defining the interaction scope of target-bound ligands (drugs) as well as for using PP1 as tool in synthetic biology.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
883687	**MultiOrganelleDesign**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Edward Lemke**
Host Institution:	Johannes Gutenberg Universitaet Mainz - DEU

Multiple Designer Organelles for Expanded Eukaryotic life

The emergence of organelles dedicated to specific cellular functions drove the evolution of more complex eukaryotic organisms. We recently created membraneless organelles inside eukaryotic cells dedicated to orthogonal translation, which opened a new path to residue-specific protein engineering using genetic code expansion. We now want to design novel organelles into eukaryotes that will internally enact the entire central dogma of molecular biology. This will supplement the complex eukaryotic cell with an additional simple and easily tailored orthogonal machinery that can also facilitate transcription and replication. This will enable us to create eukaryotes that have more than four additional expanded genetic codes, and we will explore the functional space occupied by these novel living systems. The organelles will be enhanced to process specific signals to e.g. modify RNA or degrade specific proteins. Besides these curiosity-driven goals, specific applications will allow us to road test our technology. We will directly use these approaches to advance protein engineering in eukaryotes to create proteins and artificial peptide polymers having multiple, noncanonical functionalities suitable for diverse biotechnological applications and new bioinspired materials. We will also develop organelle design into a truly universal and powerful labeling method fully compatible with eukaryotic host cell physiology that has single-residue precision and goes way beyond the state-of-the-art of any fluorescent labeling technology. The approaches will be general and truly flexible in how translation can be tailored in terms of protein, RNA and codon choice, including sense codons and type of new functionalities. Progress made in recent decades has shown that protein design and engineering can revolutionize biology. We can only imagine what can be achieved with designed functional organelles inside eukaryotic cells and how they might enable the creation of new living systems.

Link to the ERC project webpage: www.lemkelab.com

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
948588	**hOssicle**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Paul Bourgine**
Host Institution:	Lunds Universitet - SWE

Bioengineering of human ossicles as advanced in vivo hematopoietic model

hOssicle aims at developing miniaturized human bone organs in mice to be used as advanced model of healthy and malignant human hematopoiesis.

In Europe, 80 million people are estimated to suffer from blood disorders. When at all existing, treatments are poorly effective: 92 % of new drugs successful in preclinical testing (animals and in vitro culture systems) fail in clinical trials. This urgently calls for the development of superior models, to refine our understanding of human hematopoiesis and better predict patient´ therapy efficacy.

My laboratory has developed unique human mesenchymal lines capable of forming “human ossicles” by recapitulation of endochondral ossification -the developmental process of bone formation. These ossicles form subcutaneously in mice and display a similar structure and function to native mouse bones, but rely on human mesenchymal cells reconstituting a complex bone marrow environment specifically supporting the development of human hematopoiesis.

hOssicle will offer the unprecedented custom engineering of human bones to understand the functional organization of its hematopoietic compartment. By genetic reprogramming of mesenchymal lines, I aim at controlling the molecular and cellular composition of the ossicles and study the corresponding impact on hematopoietic development. Finally, I envision the engineering of patient-specific ossicles with mesenchymal and leukemic blood cells from the same individual towards recapitulation of the disease setting. This will be a significant breakthrough, by offering the study of malignancy progression and drug-testing in a personalized in vivo context for cancer remission.

By combining principles of bone development & tissue engineering, hOssicle proposes an “organ engineering” approach applied to hematopoiesis. The implications run from the identification of key factors controlling the production of blood cell types to the personalized modelling of leukemia and test of therapies.

Link to the ERC project webpage: www.bourginelab.com

Keywords of the ERC project: hematopoiesis, bone marrow niche, mesenchymal cells, leukemia,

Keywords that characterize the scientific profile of the potential visiting researcher/s: stem cells, hematopoiesis, leukemia, transcriptomic, epigenetic

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
949080	**DEUSBIO**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Rodrigo Ledesma-Amaro**
Host Institution:	Imperial College Of Science, Technology And Medicine - GBR

Deciphering and Engineering the overlooked but Universal phenomenon of Subpopulations in BIOtechnology

Microbial bioproduction, despite being considered a paradigmatic sustainable alternative to petroleum-based chemistry, is often limited by low yields and productivities, which prevents commercialisation. It is generally known for all types of cells that genetically identical populations can form metabolically distinct subpopulations. This diversity strongly impairs bioproduction as the presence of low-producer or slow-grower cells reduces overall yields. However, the universal phenomenon of subpopulations emergence has been largely overlooked, especially in biotechnology, due to technical difficulties. Now, thanks to recent developments in single cell technologies, in molecular understanding of microbial communities and in synthetic biology tools, we can begin to address this widespread and impactful biological feature.

I propose to explore the emergence of subpopulations in yeast and understand their implications in metabolism and bioproduction using and developing cutting edge synthetic biology tools. I aim to use that knowledge to develop novel engineered strains that lack the presence of undesired subpopulations and then use such homogeneous populations for bioproduction. The homogenised production will be investigated in both, monocultures and microbial communities. In DEUSBIO, I will set up an innovative framework to maximise the biosynthesis of high value molecules, with high potential to overcome current limitations.

This project will shed light on the phenomenon of subpopulations, whose relevance goes beyond bioproduction, as for example, it has been associated with the origin of multicellularity. Increasing our knowledge about this matter will also have implications in biomedicine, as cell subpopulations are extremely important in the appearance of antimicrobial resistant, in cancer heterogeneity, and in microbiome complexity.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: metabolic engineering, yeast heterogeneity, single cell analysis

Project ID:	Project Acronym:	Evaluation Panel:
950050	**PREDICT-CARE**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Pedro Miguel Mena**
Host Institution:	Universita Degli Studi Di Parma. - ITA

Developing tools for the PREDICTion, at individual level, of the CArdiometabolic REsponse to the consumption of dietary (poly)phenols

The increased burden of cardiometabolic diseases is a major societal challenge worldwide. Plant-based diets, rich in bioactive compounds such as (poly)phenols, may promote cardiometabolic health. However, the preventive effects of these bioactives depend on the individual capacity to produce, and respond to, (poly)phenol metabolites. This heterogeneity in the individual response to the consumption of (poly)phenols is the main hindrance to exploit their potential for the prevention of cardiometabolic diseases through effective dietary strategies.

I aim to implement integrative tools for the prediction, at individual level, of the cardiometabolic response to the consumption of dietary (poly)phenols, taking into account inter-individual differences in both metabolism and health effects of these plant food bioactives. My vision is understanding the determinants leading to individual variability in the production of phenolic metabolites and driving cardiometabolic responsiveness to (poly)phenol consumption. I will be identifying comprehensive metabolic phenotypes (metabotypes) for main dietary (poly)phenols and the factors associated with their formation. Then, I will demonstrate the association between phenolic metabotypes and cardiometabolic health. Last, I will develop an integrative, high-throughput platform to identify phenolic metabotypes and to predict cardiometabolic responses to the consumption of dietary (poly)phenols considering individual's makeup.

PREDICT-CARE will develop new concepts, new methodologies and a new analytical platform. It relies on the integration of factors determining inter-individual variability, the deployment of translatable nutrition interventions, and the application of predictive modelling. PREDICT-CARE will lead to long-lasting breakthroughs and will build a new scenario in preventive, evidence-based, personalised nutrition strategies with these major dietary plant bioactives.

Link to the ERC project webpage: https://hnu.unipr.it/en/predict-care/

Keywords of the ERC project: nutrition, metabolomics, metaboypes, cardiometabolic response, multi-omics

Keywords that characterize the scientific profile of the potential visiting researcher/s: bioinformatic, biostatistics, data science, metabolomics, LC-IMS-HRMS

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Project ID:	Project Acronym:	Evaluation Panel:
101002044	**InCanTeSiMo**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Barbara Di Ventura**
Host Institution:	Albert-Ludwigs-Universitaet Freiburg - DEU

Intelligent cancer therapy with synthetic biology methods

With InCanTeSiMo I aim to realize local delivery and activation of cancer-defeating synthetic circuits. Despite the advent of immunotherapy as promising treatment against a number of cancers, surgery, radio- or chemotherapy, alone or in combination, remain the most common interventions. While surgery and radiotherapy are mainly targeted to the cancer itself, chemotherapy has a systemic mode of action, affecting both healthy as well as diseased cells. An innovative way to fight cancer would be the use of synthetic circuits sensing the status of the cell into which they are delivered and acting only in response to a detected diseased status. This type of cancer therapy lends itself well to personalization, as each patient's specific profile could be considered when designing the synthetic circuits. Since naked plasmid DNA cannot be simply released in the blood, the synthetic circuits must be encapsulated into protective vehicles, which should shield them from the immune system and accumulate them at the site of cancer. Moreover, to limit side effects due to the potential accumulation of the delivery vehicles in other body parts, it would be advantageous to locally activate the synthetic circuits with an external trigger, such as light. This would additionally allow activating the therapy at specific time points. This project comprises three major engineering efforts: 1) the establishment of cost-effective production of delivery vehicles able to specifically invade cancer cells; 2) the realization of new synthetic circuits functioning at the protein level that discern between healthy and cancer cells based on the amount of a metabolite and trigger apoptosis, or convert a pro-drug into the active drug, in the latter ones only; 3) the development of a novel red light-inducible protein-protein interaction tool.

Link to the ERC project webpage:

Keywords of the ERC project: synthetic biology; inteins; optogenetics; bacteria

Keywords that characterize the scientific profile of the potential visiting researcher/s: protein engineer; synthetic biologist

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Project ID:	Project Acronym:	Evaluation Panel:
101002085	**PERLIFE**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Maria Von Korff**
Host Institution:	Heinrich-Heine-Universitaet Duesseldorf - DEU

Engineering perennial barley

Today, annual crops account for more than 85% of the worldwide calorie consumption. Annual crops are sown and harvested within one growing season and therefore require annual tillage, and application of herbicides and fertilizers that cause land and water degradation. In contrast, perennial crops grow over many seasons, require low agricultural input and thereby hold great potential for sustainable production systems and climate change adaptation. However, current efforts to breed perennial cereals are hindered by hybridization barriers between annual crops and wild perennial relatives and the trade-off between longevity and seed yield.

PERLIFE pioneers the knowledge-based engineering of perennial traits in annual crops using the important annual crop barley as study system. This project will thus open entirely novel avenues for breeding perennial crops. PERLIFE capitalizes on 1) recent technical advances in high-throughput genome sequencing for the identification of genetic variants and 2) the novel genome-editing technology Crispr/CAS9 for the targeted transfer of genes between species. PERLIFE will isolate genetic variants promoting perennial growth using comparative genomics in annual and perennial wild relatives of barley. In interspecific crosses, we will dissect the interrelationship of longevity and seed yield and identify linked coding and regulatory variation. Based on this information, we will design and implement strategies for the targeted modification of longevity in barley using transgenic approaches and genome editing. The engineered genotypes will be trialled in environmental simulation chambers for longevity, stable seed yield and stress resistance to select the most successful engineering strategy. This ground-breaking work will provide a highly efficient approach for the generation of perennial cereals and will thus have a profound impact on sustainable food production in the face of climate change and a growing human population.

Link to the ERC project webpage:

Keywords of the ERC project: barley development genetics annual perennial growth

Keywords that characterize the scientific profile of the potential visiting researcher/s: plant biologist, geneticist, developmental biologist, evolutionary biologist

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101002646	**Switch2See**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Andre Stiel**
Host Institution:	Helmholtz Zentrum Muenchen Deutsches Forschungszentrum Fuer Gesundheit Und Umwelt Gmbh - DEU

Genetically encoded reporters and sensors for whole animal imaging using photo-modulated Optoacoustics

In vivo imaging of cellular localization and function and visualization of the chemicals that drive life are key challenges for biological research. Current methods limit our insight into this "bigger picture" to either a glimpse (low penetration and small field of view) or a coarse overview (low resolution).
Optoacoustic (OA) imaging has the physical means to overcome these limitations, but it lacks the necessary toolbox of genetically encoded reporters and sensors that allow specific probing of localizations and distributions. So far, all efforts to create such a toolbox were impeded by the strong tissue background inherent to OA. Recently, exploiting my longstanding expertise in reversibly switchable reporters I overcame this hurdle by introducing the concept of photo-modulation to OA. Switchable reporters allow modulation of the reporter signal to separate it from the background – making the latter virtually invisible ("Switch2See"). In parallel, the concept was used by a U.S. consortium in vivo, underpinning its validity.
Hence, now is the time to combine my expertise in switching, protein-engineering, sensors, and OA imaging to create a toolbox that will allow to follow cells over time, visualize their interactions, and image the distributions of chemicals – all on the scale of the whole live organism with resolutions of 20 - 150 µm. With Switch2See, I will lay the foundations by building dedicated screening infrastructure, use it to develop a range of reporters (multiplexing) and sensors, and develop algorithms to convert the photo-modulation patterns into images. I will demonstrate the revolutionary impact on whole-animal imaging by visualizing localization, dynamics and interaction of immune cells in the tumor micro-environment (TME) and visualize aspects of its chemical heterogeneity. Beyond cancer research, this will impact all questions requiring a "bigger picture" – from developmental processes over neurobiology to the functioning of the immune system.

Link to the ERC project webpage:

Keywords of the ERC project: Photochromic proteins, Photo/-Optoacoustics, Proteinengineering, Photophysics, Biosensors, AI, Imaging

Keywords that characterize the scientific profile of the potential visiting researcher/s: Proteinengineer OR/AND Chromophore bearing proteins expert OR/AND spectroscopy OR AI and time series image analysis

Project ID:	Project Acronym:	Evaluation Panel:
101020135	**LUNG-BIOREPAIR**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Luis Serrano**
Host Institution:	Fundacio Centre De Regulacio Genomica - ESP

Engineering a lung bacteria to treat idiopatic lung fibrosis and other non-infectious lung diseases

Lung diseases are a leading cause of mortality worldwide. Dysregulation of immunomodulatory molecules plays a key role in many pulmonary diseases, including lung cancer, idiopathic pulmonary fibrosis (IPF) and infections. In IPF acute or chronic inflammation results in senescence of the alveolar cells with telomere shortening and/or dysregulation of miRNAs. Modulating the immune response directly or its downstream repercussions could be a possible way to help treat lung diseases. Systemic treatment with immunomodulatory molecules however, can have several drawbacks and include toxic side effects in other organs, the need for continuous delivery and a high cost of production. Similarly, treating immunomodulatory repercussions such as telomere shortening or abnormal miRNA expression in target cells is not easy due to the lack of a technology that efficiently and specifically delivers RNA. Furthermore, viral transformation can result in toxicity and is associated with high costs. To circumvent these problems, we aim to engineer the genome-reduced lung bacterium Mycoplasma pneumoniae as a vector to locally express immunomodulatory proteins, and/or to deliver protein¬–RNA complexes into alveolar cells (Mycovector). M. pneumoniae does not have a cell wall, it directly releases secreted biomolecules into the medium, it does not recombine, it has a unique genetic code that prevents the transfer of genes to other bacteria and we have a non-pathogenic engineered version of it. To design this Mycovector, we will combine our experience in this organism with our know-how in protein design (http://foldxsuite.crg.eu/). We will use our Mycovector expressing different combinations of active biomolecules to treat bleomycin-induced IPF in mice. This project will not only offer new insights into the treatment of a currently incurable disease, but also show that bacterial chassis can be used in other organs different from the gut paving the way to other applications in human health.

Link to the ERC project webpage:

Keywords of the ERC project: synthetic biology, bacterial therapy, lung fibrosis

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101040437	**GLUTENOMICS**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Katharina Scherf**
Host Institution:	Karlsruher Institut Fuer Technologie - DEU

Tracking gluten immunoreactive peptides from the grain to the gut and beyond

Wheat is one of the pillars for nutrition security worldwide, but the prevalence of wheat-related disorders (WRD) is increasing. Taken together, coeliac disease, non-coeliac gluten sensitivity and wheat food allergy may affect up to 10% of European individuals. The causes for this increase are still unknown, but involve the intricate interaction of proteolytically resistant gluten immunoreactive peptides (GIP) from wheat, rye and barley, the human immune system and yet unknown adjuvants. Total GIP can be detected by immunoassays in human plasma, urine and faeces (biosamples) after gluten consumption, but the precise molecular structures have not been clarified so far, because specific analytical methods are missing.

The project GLUTENOMICS aims to elucidate the molecular structures of GIP in human biosamples and analyse factors determining their identities and quantities. I aim to achieve this using a combination of different approaches to overcome the analytical challenges by i) creating a comprehensive database of GIP and elucidating factors affecting gluten protein digestibility, ii) developing and validating proteomics methods to detect GIP in human biosamples and iii) establishing relations between the GIP profile of raw materials, foods and human biosamples. My central hypothesis is that gluten structure and content determine its digestibility which, in turn, leads to different GIP profiles in biosamples from healthy individuals and WRD patients.

The unique toolbox of methods that I will put in place will provide a fundamentally new understanding of how protein structures govern digestibility and how the resulting peptides pass through the human digestive system. My ambition is to use the findings to tailor grain-based foods towards better tolerability to prevent the initial onset of WRD. Beyond grains, GLUTENOMICS opens significant innovative potential to promote human health through systematically structured, isolated or designed dietary proteins.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101040901	**AVATar**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Robert Ohlendorf**
Host Institution:	Technische Universitaet Muenchen - DEU

Engineering vasoactive probes for brain-wide imaging of molecular signaling

Brain function depends on spatiotemporally defined brain-wide signaling via molecules such as neurotransmitters. No current technology can measure signaling molecules throughout the brain with sufficient spatial and temporal resolution in living mammals. This poses a major roadblock for understanding how molecular neuronal communication coordinates whole-brain function.

Magnetic resonance imaging (MRI) currently provides the highest brain-wide resolution. Dynamic imaging of blood flow and oxygenation in the finely arborized vasculature, so-called functional MRI (fMRI), is the only method that can visualize whole-brain function in mammals and humans. However, MRI is inherently insensitive, which precludes it from accessing molecular signaling that occurs at (sub)micromolar concentrations and fMRI cannot resolve neurotransmitter signaling underlying measured hemodynamic signals.

I previously designed protein-based vasoactive sensors, named AVATar, that directly cause hemodynamic signals in fMRI in response to target molecules at low nanomolar doses, without using radioactive or metallic components. They can be genetically encoded and also pave the way for noninvasive brain delivery through the vasculature, critical for translational applications in primates and humans.

Here, I will combine my expertise in synthetic biology and in vivo molecular imaging to develop my proof-of-concept work into a robust preclinical neuroimaging method along three objectives:

1) Engineering AVATars that convert neurotransmitter signaling into hemodynamic signals.

2) Brain delivery via non-invasive routes.

3) Application for fMRI of brain-wide neurotransmitter signaling in rodents.

My project will provide neurotransmitter-sensing AVATars to turn fMRI into molecular fMRI and bridge the long-standing gap between molecular nuclear imaging and functional hemodynamic imaging. AVATars will visualize how brain-wide molecular signaling dynamics shape healthy and pathological brain function.

Link to the ERC project webpage:

Keywords of the ERC project: Molecular Biology, Protein Engineering, Molecular Imaging, fMRI

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101041729	**LEAPHY**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Astrid Avellan**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Unravelling the behaviour of inorganic (nano)phases in leaves to optimize the foliar delivery of sustainable agrochemicals

Population growth and the expected-to-increase (a)biotic stresses due to climate change are putting the agro-ecosystems under pressure. The dependence on inorganic agrochemicals (IAs) for fertilization and plant protection will lead to an increase in their use. Yet, current IAs do not efficiently reach their target. They lead to waste of resources, pollutions, and environmental degradations. Foliar application of nanostructures is one of the proposed solutions to optimize IAs in order to better protect crops, but also their agro-ecosystem. Nano-IAs can exhibit reduced leaf leaching and increased bioavailability, allowing to strictly applying the right dose of IA at the right time. However, the lack of knowledge on IA behaviour at the leaf interface hinders our ability to predict optimized nanostructures. The LEAPHY project aims to establish a rationale for the design of such nano-IAs. Model nano-IAs with controlled morphologies and surface properties will be designed and exposed to isolated plant cells or model leaves characterized for their surface characteristics and interfacial functional groups. The pathways and associated rates of uptake, transformations, and in planta behaviour will be quantified. These results will be used to establish a predictive modelling framework for the biological and chemical interactions that govern IA adhesion, uptake, and translocation from leaves to other plant tissues. This knowledge will be leveraged to design and test bio- and geo-inspired copper-based fertilizers and pesticides with improved delivery. The team's expertise in tuning (in)organic reactivity at plant interfaces and studying the resulting interactions and speciation changes is the backbone of LEAPHY's state-of-the-art experimental strategy. This project will be a cornerstone in implementing solutions to contribute moving forward a better, safer rationale for foliar phytoprotection and fertilization strategies.

Link to the ERC project webpage: https://www.get.omp.eu/recherche/projets-scientifiques/erc-leaphy-unravelling-the-behaviour-of-inorganic-nanophases-in-leaves-to-optimize-the-foliar-delivery-of-sustainable-agrochemicals-2022-2026-pi-astrid-avellan/

Keywords of the ERC project: Foliar uptake, nanomaterials, agriculture

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101044399	**3Dwheat**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Moussa Benhamed**
Host Institution:	Universite Paris Cite - FRA

3Dwheat, A 3 Dimensional functional genomics approach to identify hidden targets controlling heat stress and priming in wheat

In the global warming era, heat stress is a major threat for both yield stability and yield increase. Plants have evolved a variety of sophisticated mechanisms to adapt to challenging environments. Epigenetic regulations allow them to dynamically reprogram their transcription machinery to adapt to an ever-changing environment. Both histone marks and the 3D organization of the chromatin are instrumental for this coordinated regulation of gene expression according to environmental cues. Yet, the overwhelming majority of available data on chromatin dynamics in response to stress has been obtained in Arabidopsis, and cannot be directly transferred to crops. Due to the expansion of NGS technologies, we are currently facing a change of paradigm, empowering the development of genome-wide approaches on crops.

In this project we focus on wheat. Wheat is the 1st cereal worldwide for trade, and the demand is expected to increase by 60% by 2050. My main objective is a thorough understanding of the priming for heat stress resistance in wheat. To this end, I propose to develop a new tri-dimensional (D) functional genomics approach, integrating epigenomic (1D), transcriptomic (2D) and chromatin architecture (3D) data to elucidate the molecular basis for priming in wheat.

Moreover, this project will go beyond addressing the challenge of deciphering epigenetic regulatory processes underlying priming. It also includes the development of innovative tools for novel breeding strategies that will harness epigenetic variability in addition to genetic diversity. We propose to generate a new generation of molecular markers that do not rely on DNA sequence polymorphisms, and that can be readily used in traditional breeding programs as such, or as complementary tools for efficient QTL introgression. Such markers will be used to tag new traits, to follow a new generation of alleles as well as to unveil new types of genetic diversity in existing collections of germplasms.

Link to the ERC project webpage:

Keywords of the ERC project: Chromatin biology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101053857	**STEADY**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Wilfried Weber**
Host Institution:	Albert-Ludwigs-Universitaet Freiburg - DEU

Engineering homeostasis into living materials

Engineered Living Materials (ELMs) are dynamically emerging at the intersection of synthetic biology and materials sciences and are providing solutions in a rapidly growing number of application fields. Current areas of application comprise, for example, biomedicine, textiles, sensors, soft robotics, electronics, or construction materials. From a conceptual point of view, ELMs provide the opportunity of endowing materials with properties and functions long sought for in materials sciences, such as adaptivity and interactivity, evolvability, hierarchical design, self-reproduction, energy harvesting from the environment, synthesis from renewable resources, as well as biodegradability. Despite intensive research, however, a key defining property of life is largely missing in ELMs, that is homeostasis. Homeostasis is the ability of a system to maintain an inner steady state despite external fluctuations that impact this state. For example, mammals maintain a constant body temperature despite varying external temperatures. In STEADY, we will develop and test the concept of engineering homeostasis into living materials. To this aim, we will develop three genetically encoded modules, (i) a sensor to sense the actual state of a specific mechanical property of the material, (ii) a controller to process the sensor signal, and (iii) an actuator, that, based on the controller's output, steers the material towards the setpoint. The design of the homeostatic system will be highly modular, so that the sensor and actuator can be adapted in order to maintain homeostasis for other properties or functions of the material. The tools developed here are not restricted to ELMs but may also be used to confer homeostasis to polymer-based soft materials with regard to maintaining a desired feature. Thus, STEADY will open novel opportunities for engineering materials to be robust and resilient to changing environmental conditions.

Link to the ERC project webpage: https://www.bioss.uni-freiburg.de/groups/synthetic-biology/intro/

Keywords of the ERC project: Synthetic Biology, engineered living materials, optogenetics

Keywords that characterize the scientific profile of the potential visiting researcher/s: biomaterials, synthetic biology, optogenetics, mammalian cell technology, living materials

Project ID:	Project Acronym:	Evaluation Panel:
101054658	**PeroxyZyme**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Frank Hollmann**
Host Institution:	Technische Universiteit Delft - NLD

Practical oxyfunctionalisation biocatalysts by engineering monooxygenases into peroxyzymes.

Chemistry is far away from being a mature science: many desirable transformations are still out of scope. One important example is the selective (oxy)functionalisation of non-activated C-H bonds, which still represents a dream reaction of organic chemistry. This is because balancing high reactivity (needed for the activation of inert C-H bonds) with selectivity is difficult to achieve. Enzymes, specifically monooxygenases, are catalysts that principally solve this challenge.

Monooxygenases, however, are not practical catalysts for organic chemistry. This is because they have evolved to enable the survival of their host organisms and not to suit the needs of organic chemists. In particular the complex molecular architecture of monooxygenases (necessitating O2, stoichiometric reductants and additional catalytic components) together with mechanistic challenges arising from their complex molecular architecture impede their chemistry-wide application.

PeroxyZyme aims at solving these issues and establish evolved monooxygenases (peroxyzymes) as practical catalysts for organic chemistry. Peroxyzymes will be able to function with simple hydrogen peroxide rather than via the natural, albeit complex and vulnerable electron transport chains. This fundamental change in the monooxygenases' catalytic mechanisms will be achieved by a mechanism-driven and experimentally validated semi-rational engineering approach. Evolved peroxyzymes will be characterised using up-to date (ultra)fast spectroscopy identifying catalytic bottlenecks and possible inactivation mechanisms. This molecular understanding will provide the basis for further improvement of first generation peroxyzymes. The practical usefulness of evolved peroxyzymes will be demonstrated on preparative-scale by using them in non-aqueous reaction media enabling high product concentrations and space-time yields.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: biocatalysis, oxidation, oxyfunctionalisation

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Project ID:	Project Acronym:	Evaluation Panel:
770936	**NewtonStrat**	**PE1** Mathematics

Principal Investigator:	**Dr Eva Viehmann**
Host Institution:	Westfaelische Wilhelms-Universitaet Muenster - DEU

Newton strata - geometry and representations

The Langlands programme is a far-reaching web of conjectural or proven correspondences joining the fields of representation theory and of number theory. It is one of the centerpieces of arithmetic geometry, and has in the past decades produced many spectacular breakthroughs, for example the proof of Fermat's Last Theorem by Taylor and Wiles.

The most successful approach to prove instances of Langlands' conjectures is via algebraic geometry, by studying suitable moduli spaces such as Shimura varieties. Their cohomology carries actions both of a linear algebraic group (such as GLn) and a Galois group associated with the number field one is studying. A central tool in the study of the arithmetic properties of these moduli spaces is the Newton stratification, a natural decomposition based on the moduli description of the space. Recently the theory of Newton strata has seen two major new developments: Representation-theoretic methods and results have been successfully established to describe their geometry and cohomology. Furthermore, an adic version of the Newton stratification has been defined and is already of prime importance in new approaches within the Langlands programme.

This project aims at uniting these two novel developments to obtain new results in both contexts with direct applications to the Langlands programme, as well as a close relationship and dictionary between the classical and the adic stratifications. It is subdivided into three parts which mutually benefit from each other: Firstly we investigate the geometry of Newton strata in loop groups and Shimura varieties, and representations in their cohomology. Secondly, we study corresponding geometric and cohomological properties of adic Newton strata. Finally, we establish closer ties between the two contexts. Here we want to obtain analogues to results on one side for the other, but more importantly aim at a direct comparison that explains the similar behaviour directly.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
802689	**CURVATURE**	**PE1** Mathematics

Principal Investigator:	**Dr Andrea Mondino**
Host Institution:	The Chancellor, Masters And Scholars Of The University Of Oxford - GBR

Optimal transport techniques in the geometric analysis of spaces with curvature bounds

The unifying goal of the CURVATURE project is to develop new strategies and tools in order to attack fundamental questions in the theory of smooth and non-smooth spaces satisfying (mainly Ricci or sectional) curvature restrictions/bounds. The program involves analysis and geometry, with strong connections to probability and mathematical physics. The problems will be attacked by an innovative merging of geometric analysis and optimal transport techniques that already enabled the PI to solve important open questions in the field. The project is composed of three inter-connected themes: Theme I investigates the structure of non smooth spaces with Ricci curvature bounded below and their link with Alexandrov geometry. The goal of this theme is two-fold: on the one hand get a refined structural picture of non-smooth spaces with Ricci curvature lower bounds (e.g. size of the singular set, existence of a well defined dimension), on the other hand apply the new methods to make progress in a long-standing conjecture relating an Alexandrov space with its boundary. Theme II aims to achieve a unified treatment of geometric and functional inequalities for both smooth and non-smooth, finite and infinite dimensional spaces satisfying Ricci curvature lower bounds. This approach will be used also to establish new theorems for smooth Riemannian manifolds (e.g. quantitative versions of the Levy-Gromov isoperimetric inequality) and make progress on the fundamental Pansu's Conjecture about isoperimetry in the Heisenberg space. Theme III will investigate optimal transport in a Lorentzian setting, where the Ricci curvature plays a key role in Einstein's equations of general relativity. The ultimate goal is to get a weak formulation of Einstein's equations in a singular setting. The three themes together will yield a unique unifying insight of smooth and non-smooth structures with the potential to shape the field for many years to come.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
850930	**FIBRING**	**PE1** Mathematics

Principal Investigator:	**Dr Dawid Kielak**
Host Institution:	The Chancellor, Masters And Scholars Of The University Of Oxford - GBR

Fibring of manifolds and groups

The study of manifolds that fibre over the circle has a long and exciting history at the core of modern manifold topology, starting with Farrell's work on the problem in high ('surgery') dimensions, and running through the celebrated work of Stallings and Thurston in dimension 3, to Agol's 2013 solution of Thurston's virtual fibring conjecture. Parallel developments in group theory have placed the study of Bieri-Neumann-Strebel (BNS) invariants, which emerged in the 1980s, at the heart of the subject; these invariants describe when a group fibres, i.e. admits a map onto Z with finitely generated kernel. In the research outlined here a powerful new set of algebraic invariants - agrarian polytopes - will be used to establish a new frontier in the theory of fibring. The main goal is to achieve a complete description of all possible fibrings over the circle for aspherical manifolds in surgery dimensions.

An agrarian polytope is a subset of the vector space H_1(X;R), where X is a group or a manifold. It is defined in the novel framework of agrarian invariants that I am developing, a theory that has already borne remarkable fruit. The theory provides algebraic counterparts to the (analytic) L2-invariants that have proved so powerful in geometric topology, group theory and global analysis over the last four decades.

The primary focus of the research proposed here lies in establishing new deep connections between the algebra of group rings and their completions, and global properties of aspherical manifolds and groups. Three further goals of the proposal are: to develop the theory of agrarian invariants in positive characteristic; to show that agrarian invariants are profinitely rigid; to apply the new technology to the study of dynamical zeta functions. Each of these goals promises a breakthrough in its respective domain.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
865751	**RandomMultiScales**	**PE1** Mathematics

Principal Investigator:	**Dr Daniel Peterseim**
Host Institution:	Universitaet Augsburg - DEU

Computational Random Multiscale Problems

Geometrically or statistically heterogeneous microstructures and high physical contrast are the key to astonishing physical phenomena such as invisibility cloaking with metamaterials or the localization of quantum waves in disordered media. Due to the complex experimental observation of such processes, numerical simulation has very high potential for their understanding and control. However, the underlying mathematical models of random partial differential equations are characterized by a complex interplay of effects on many non-separable or even a continuum of characteristic scales. The attempt to resolve them in a direct numerical simulation easily exceeds today's computing resources by multiple orders of magnitude. The simulation of physical phenomena from multiscale models, hence, requires a new generation of computational multiscale methods that accounts for randomness and disorder in a hierarchical and adaptive fashion.

This proposal concerns the design and numerical analysis of such methods. The main goals are connected to fundamental mathematical and algorithmic challenges at the intersection of multiscale modeling and simulation, uncertainty quantification and computational physics:

(A) Numerical stochastic homogenization beyond stationarity and ergodicity,

(B) Uncertainty quantification in truly high-dimensional parameter space,

(C) Computational multiscale scattering in random heterogeneous media,

(D) Numerical prediction of Anderson localization and quantum phase transitions.

These objectives base upon recent breakthroughs of deterministic numerical homogenization beyond periodicity and scale separation and its deep links to seemingly unrelated theories ranging all the way from domain decomposition to information games and their Bayesian interpretation. It is this surprising nexus of classical and probabilistic numerics that clears the way to the envisioned new computational paradigm for multiscale problems at randomness and disorder.

Link to the ERC project webpage: https://www.uni-augsburg.de/de/fakultaet/mntf/math/prof/numa/erc-consolidator-grant/

Keywords of the ERC project: Numerical Analysis, Scientific Computing

Keywords that characterize the scientific profile of the potential visiting researcher/s: Numerical Analysis, Scientific Computing

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
882971	**GeoScape**	**PE1** Mathematics

Principal Investigator:	**Dr Janos Pach**
Host Institution:	Magyar Tudomanyos Akademia Renyi Alfred Matematikai Kutatointezet - HUN

From Geometry to Combinatorics and Back: Escaping the Curse of Dimensionality

Combinatorics is a fundamental mathematical discipline whose study has experienced unprecedented growth during the past few decades. Its rapid development can be partially explained by spectacular applications of extremal combinatorics in additive number theory, information theory, theoretical computer science, and elsewhere. Asymptotic results in extremal and probabilistic combinatorics have proved to be powerful tools in the structural and algorithmic analysis of huge networks such as the internet graph, brain maps, social networks, and integrated circuits. We have deep, well developed algebraic, topological, and probabilistic techniques to tackle some basic problems of modern combinatorics, but many classic Ramsey-, Turán-, and Szemerédi-type questions remained open.

The main goal of the proposed work is to attack some hard problems for large classes of graphs and hypergraphs arising in geometric, algebraic, and practical applications. These structures escape the "curse of dimensionality": they can be embedded in a bounded-dimensional space, or they have small VC-dimension, or a short algebraic description. The work of the principal investigator, his collaborators and students has played a significant role in the introduction of modern combinatorial tools in geometry. In the present project, he aims to explore the reverse direction: to develop and apply geometric techniques to settle important special cases of notoriously difficult combinatorial problems on (1) bounded degree semi-algebraic graphs and hypergraphs, (2) graphs and hypergraph of bounded VC-dimension, (3) ordered graphs, 0-1 matrices, and graphs embedded in the plane or in other surfaces. Progress on the problems described in the proposal is expected to lead closer to the solution of some classical problems such as the Erdős-Hajnal conjecture, the Danzer-Rogers conjecture, the Schur-Erdős problem, and to the development of improved algorithms for clustering and property testing in huge graphs.

Link to the ERC project webpage: https://users.renyi.hu/~pach/geoscape/

Keywords of the ERC project: discrete geometry

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
883363	**Nonlocal-CPD**	**PE1** Mathematics

Principal Investigator:	**Dr Jose A. Carrillo**
Host Institution:	The Chancellor, Masters And Scholars Of The University Of Oxford - GBR

Nonlocal PDEs for Complex Particle Dynamics: Phase Transitions, Patterns and Synchronization

This proposal focuses on the development of new mathematical tools to analyse theoretical, numerical and modelling aspects of novel applications of nonlinear nonlocal aggregation-diffusion equations in Mathematical Biology and in classical problems of kinetic theory. Among the numerous areas of applications of kinetic modelling in Mathematical Biology, we will concentrate on phenomena identified, at the modelling stage, as systems involving a large number of "individuals" showing "collective behaviour" and how to obtain "averaged" information from them. Individuals behavior can be modelled via stochastic/deterministic ODEs from which one obtains mesoscopic/macroscopic descriptions based on mean-field PDEs leading to continuum mechanics, hydrodynamic and/or kinetic systems. Understanding the interplay between the interaction behaviour (nonlocal, nonlinear), the diffusion (nonlinear), the transport phenomena, and the synchronization is my main mathematical goal.

The proposed research is centred on developing tools underpinning the analysis of long time asymptotics, phase transitions, stability of patterns, consensus and clustering, and qualitative properties of these models. On the other hand, designing numerical schemes to accurately solve these models is key not only to understand theoretical issues but also crucial in applications. We will focus on the important case of the Landau equation with applications in weakly nonlinear plasmas by means of the gradient flow techniques. On the other hand, we showcase our tools in patterns and consensus by focusing on zebra fish patterning formation, as example of spontaneous self-organisation processes in developmental biology, and grid cells for navigation in mammals, as prototype for the synchronization of neural networks. This project connects with other areas of current interest in science and technology such as agent-based models in engineering: global optimization, clustering, and social sciences.

Link to the ERC project webpage: https://people.maths.ox.ac.uk/carrillo/ResearchGroup/index.html

Keywords of the ERC project: Analysis, Numerics and Mathematical modelling with PDE

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101020009	**TameHodge**	**PE1** Mathematics

Principal Investigator:	**Dr Bruno Klingler**
Host Institution:	Humboldt-Universitat Zu Berlin - DEU

Tame geometry and transcendence in Hodge theory

Hodge theory, as developed by Deligne and Griffiths, is the main tool for analyzing the geometry and arithmetic of complex algebraic varieties, that is, solution sets of algebraic equations over the complex numbers. It occupies a central position in mathematics through its relations to differential geometry, algebraic geometry, differential equations and number theory. It is an essential fact that at heart, Hodge theory is NOT algebraic. On the other hand, some of the deepest conjectures in mathematics (the Hodge conjecture and the Grothendieck period conjecture) suggest that this transcendence is severely constrained.

Recent work of myself and others suggests that tame geometry, whose idea was introduced by Grothendieck in the 1980s, is the natural setting for understanding these constraints. Tame geometry, developed by model-theorist as o-minimal geometry, has for prototype real semi-algebraic geometry, but is much richer. As a spectacular application of tame geometry, Bakker, Tsimerman and I recently reproved a famous result of Cattani-Deligne-Kaplan, often considered as the most serious evidence for the Hodge conjecture: the algebraicity of Hodge loci.

I propose to lead a group at HU Berlin to explore this striking new connection between tame geometry and Hodge theory, with three axes: (I) attack the arithmetic of periods coming from the moduli space of abelian differentials; this opens a completely new perspective on this space cherished by dynamicists; (II) attack some fundamental questions for general variations of Hodge structures: fields of definition of Hodge loci (related to the conjecture that Hodge classes are absolute Hodge classes); atypical intersections, for instance for families of Calabi- Yau varieties; Ax-Schanuel conjecture for mixed period maps and for Hodge bundles; (III) attack Simpson's « Standard conjecture » for local systems through the tame geometry of the non-abelian Hodge correspondence.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: Hodge theory, algebraic geometry, arithmetic geometry

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101039794	**CHORAL**	**PE1** Mathematics

Principal Investigator:	**Dr Jean Barbier**
Host Institution:	United Nations Educational Scientific And Cultural Organization - FRA

Computational Hardness Of RepresentAtion Learning

Rich internal representations of complex data are crucial to the predictive power of neural networks. Unfortunately, current statistical analyses are restricted to over-simplified networks, whose representations (i.e., weight matrices) are either random, and/or project the data in comparatively very large or very low dimensional spaces; in many applications the situation is very different. The modelisation of realistic data is another issue. There is an urgent need to reconcile theory and practice.

Based on a synergy of the mathematical physics of spin glasses, matrix-models from physics, and information and random matrix theory, CHORAL's statistical framework will delimit computational gaps in the learning, from structured data, of much more realistic models of neural networks. These gaps will quantify the discrepancy between:

(i) the statistical cost of learning good representations, i.e., the minimal amount of training data required to reach a satisfactory predictive performance;

(ii) the cost of efficiency, i.e., the amount of data needed when learning using tractable algorithms, such as approximate message-passing and noisy gradient descents.

Comparing these costs will quantify when learning is computationally hard or not.

To achieve this, CHORAL will first focus on dictionary learning, another essential task of representation learning, and then move on to multi-layer neural networks, which can be thought of as concatenated dictionary learning problems.

CHORAL's ambitious program, by defining benchmarks for algorithms used in virtually all fields of science and technology will have a direct practical impact. Equally important will be its conceptual impact: the study of information processing systems has become a major source of inspiration for mathematics.

Link to the ERC project webpage:

Keywords of the ERC project: high-dimensional statistics, statistical physics of disordered systems, spin glasses, inference, theoretical machine learning, neural networks, matrix factorization, random matrix theory, information theory, phase transitions

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101041040	**SAMPDE**	**PE1** Mathematics

Principal Investigator:	**Dr Giovanni S. Alberti**
Host Institution:	Universita Degli Studi Di Genova - ITA

Sample complexity for inverse problems in PDE

This project will develop a mathematical theory of sample complexity, i.e. of finite measurements, for inverse problems in partial differential equations (PDE). Inverse problems are ubiquitous in science and engineering, and appear when a quantity has to be reconstructed from indirect measurements. Whenever physics plays a crucial role in the description of an inverse problem, the mathematical model is based on a PDE. Many imaging modalities belong to this category, including ultrasonography, electrical impedance tomography and photoacoustic tomography. Many different PDE appear, depending on the physical domain. Currently, there is a substantial gap between theory and practice: all theoretical results require infinitely many measurements, while in all applied studies and practical implementations, only a finite number of measurements are taken. We argue that this gap is crucial, since the number of measurements is usually not very large, and has important consequences, regarding the choice of measurements, the priors on the unknown and the reconstruction algorithms. Many safe and effective modalities have had very limited use due to low reconstruction quality. Within a multidisciplinary approach, by combining methods from PDE theory, numerical analysis, signal processing, compressed sensing and machine learning, we will bridge this gap by developing a theory of sample complexity for inverse problems in PDE. This will allow for the deriving of a new mathematical theory of inverse problems for PDE under realistic assumptions, which will impact the implementation of many modalities, guiding the choice of priors and measurements. Consequently, emerging imaging modalities will become closer to actual usage. As a by-product, we will also derive new compressed sensing results which are valid for a general class of problems, including nonlinear and ill-posed, and sparsity constraints. Collaborations with experts in the relevant fields will ensure the project's success.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101044249	**RAMBAS**	**PE1** Mathematics

Principal Investigator:	**Dr Phan Thanh Nam**
Host Institution:	Ludwig-Maximilians-Universitaet Muenchen - DEU

Rigorous Approximations for Many-Body Quantum Systems

From first principles of quantum mechanics, physical properties of many-body quantum systems are usually encoded into Schr\"odinger equations. However, since the complexity of the Schr\"odinger equations grows so fast with the number of particles, it is generally impossible to solve them by current numerical techniques.
Therefore, in practice approximate theories are often applied, which focus only on some collective behaviors of the systems in question.
The corroboration of such effective models largely depends on mathematical methods. The overall goal of RAMBAS is to justify key effective approximations used in many-body quantum physics, including the mean-field, quasi-free, and random-phase approximations, as well as to derive subtle corrections in critical regimes.
Building on my unique expertise in mathematical physics, I will 1) develop general techniques to understand corrections to the mean-field and Bogoliubov approximations for dilute Bose gases, 2) introduce rigorous bosonization methods and combine them with existing techniques from the theory of Bose gases to understand Fermi gases, and 3) employ the bosonization structure of Fermi gases to study the many-body quantum dynamics in long time scales, thus deriving quantum kinetic equations.
By applying and suitably inventing mathematical techniques from functional analysis, spectral theory, calculus of variations and partial differential equations, RAMBAS will take standard approximations of quantum systems to the next level, with special focus on those particularly challenging situations where the particle correlation plays a central role but is yet not adequately addressed. RAMBAS will thereby provide the physics community with crucial mathematical tools, which are at the same time rigorous and applicable.

Link to the ERC project webpage:

Keywords of the ERC project: Mathematical physics, many-body quantum mechanics, spectral theory, partial differential equations

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
803740	**NEXT**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Julia Even**
Host Institution:	Rijksuniversiteit Groningen - NLD

Neutron-rich, EXotic, heavy nuclei produced in multi-nucleon Transfer reactions

The heaviest element which has been found in nature is uranium with 92 protons. So far, the elements up to atomic number 118 (oganesson) have been discovered in the laboratory. All transuranium elements are radioactive and their production rates decrease with increasing number of protons. An Island of Stability, where the nuclei have relatively long half-lives, is predicted at the neutron number 182 and, depending on the theoretical model, at the proton number 114, 120 or 126. Current experimental techniques do not allow to go so far to the neutron-rich side close to the Island of Stability.

The observation of gravitational waves as well as electromagnetic waves originating from a neutron star merger has been published on October 16, 2017 and is a first proof of the nucleosynthesis of heavy elements in the r-process. It still remains an open question if superheavy nuclei have been formed in our universe. To answer these questions, we need insight into the nuclear properties of the heaviest elements and how these properties evolve when one moves toward to the neutron-rich side on the nuclear chart.

In the NEXT project, I will set out to discover new, Neutron-rich, EXotic heavy nuclei using multi-nucleon Transfer reactions. I will measure their masses and, thus, pin down the ground state properties of these nuclei. These studies provide insight into the evolution of nuclear shells in the heavy element region. Furthermore, I will measure the fission half-lives of these isotopes. In order to realize the NEXT project, I will built a novel spectrometer, which is a combination of a solenoid separator and Multi-Reflection Time-of-Flight Mass Spectrometer.

The broad experience in heavy element research and mass measurements that I have acquired over the years, and the unique infrastructure at my home institute that houses the AGOR accelerator, makes it so that I am ideally placed to start and lead the NEXT project.

Link to the ERC project webpage:

Keywords of the ERC project: neutron-rich nuclei, solenoid separator, mass spectrometry, multinucleon transfer reaction

Keywords that characterize the scientific profile of the potential visiting researcher/s: experimental physics, nuclear theory, precision mass measurements

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
832219	**ANDLICA**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Robin Kaiser**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Anderson Localization of Light by Cold Atoms

I propose to use large clouds of cold Ytterbium atoms to observe Anderson localization of light in three dimensions, which has challenged theoreticians and experimentalists for many decades.
After the prediction by Anderson of a disorder-induced conductor to insulator transition for electrons, light has been proposed as ideal non interacting waves to explore coherent transport properties in the absence of interactions. The development in experiments and theory over the past several years have shown a route towards the experimental realization of this phase transition.
Previous studies on Anderson localization of light using semiconductor powders or dielectric particles have shown that intrinsic material properties, such as absorption or inelastic scattering of light, need to be taken into account in the interpretation of experimental signatures of Anderson localization. Laser-cooled clouds of atoms avoid the problems of samples used so far to study Anderson localization of light. Ab initio theoretical models, available for cold Ytterbium atoms, have shown that the mere high spatial density of the scattering sample is not sufficient to allow for Anderson localization of photons in three dimensions, but that an additional magnetic field or additional disorder on the level shifts can induce a phase transition in three dimensions.
The role of disorder in atom-light interactions has important consequences for the next generation of high precision atomic clocks and quantum memories. By connecting the mesoscopic physics approach to quantum optics and cooperative scattering, this project will allow better control of cold atoms as building blocks of future quantum technologies. Time-resolved transport experiments will connect super- and subradiant assisted transmission with the extended and localized eigenstates of the system.
Having pioneered studies on weak localization and cooperative scattering enables me to diagnostic strong localization of light by cold atoms.

Link to the ERC project webpage: https://inphyni.univ-cotedazur.eu/sites/cold-atoms/research/andlica-1

Keywords of the ERC project: Cold atoms, Anderson Localisation

Keywords that characterize the scientific profile of the potential visiting researcher/s: cold atom expert, theory on localisation

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
835105	**YoctoLHC**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Carlos Salgado**
Host Institution:	Universidade De Santiago De Compostela - ESP

Yoctosecond imaging of QCD collectivity using jet observables

QCD is the only sector of the Standard Model where the exploration of the first levels of complexity, built from fundamental interactions at the quantum level, is experimentally feasible. An outstanding example is the thermalised state of QCD matter formed when heavy atomic nuclei are smashed in particle colliders. Systematic experimental studies, carried out in the last two decades, overwhelmingly support the picture of a deconfined state of matter, which behaves as a nearly perfect fluid, formed in a very short time, less than 5 yoctoseconds. The mechanism that so efficiently brings the initial out-of-equilibrium state into a thermalised system is, however, largely unknown. Most surprisingly, LHC experiments have found that collisions of small systems, i.e. proton-proton or proton-lead, seem to indicate the presence of a tiny drop of this fluid in events with a large number of produced particles. These systems have sizes of 1 fm or less, or time-scales of less than 3 ys. To add to the puzzle, jet quenching, the modifications of jet properties due to interactions with the medium, has not been observed in these small systems, while jet quenching and thermalisation are expected to be controlled by the same dynamics. Present experimental tools have limited sensitivity to the actual process of thermalisation. To solve these long-standing questions we propose, as a completely novel strategy, using jet observables to directly access the first yoctoseconds of the collision. This strategy needs developments well beyond the state-of-the-art in three subjects: i) novel theoretical descriptions of the initial stages of the collision — the first 5 ys; ii) jet quenching theory for yoctosecond precision, with new techniques to couple the jet to the surrounding matter and novel parton shower evolution; and iii) jet quenching tools for the 2020's, where completely novel jet observables will be devised with a focus on determining the initial stages of the collision.

Link to the ERC project webpage: http://igfae.usc.es/yoctolhc

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
851780	**NanoEP**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Ido Kaminer**
Host Institution:	Technion - Israel Institute Of Technology - ISR

Enabling Novel Electron-Polariton Physics with Nanophotonic Platforms

Light-matter interactions are highly limited by strict fundamental rules. The commonly used dipole approximation enforces selection rules that prohibit many electronic transitions due to the mismatch between the wavelength of light and the scale of its emitter (e.g., atom, molecule, quantum dot). This mismatch even prevents access to many other light-matter interactions such as spin-flip transitions and multiphoton spontaneous emission.

In the past four years, I have shown theoretically and experimentally how extreme confinement of light enables transitions that are otherwise forbidden. For example, transforming an unobservable multiphoton emission to be the dominant transition. The key to accessing such transitions is using nano-confined 2D plasmons or phonon-polaritons.

I propose to go beyond my recent work and to study conventionally-forbidden light-matter interactions of free electrons, which have never been explored before. I will do this by utilizing polaritons in nanophotonic structures and in settings of 2D materials. Using both theory and experiments with an ultrafast transmission electron microscope (UEM), my group will develop and observe novel concepts of light emission such as double spontaneous emission of a polariton paired with a high energy photon. We will attempt to realize ultrastrong electron-polariton coupling in new systems, pushing the classical and quantum boundaries of electron-photon energy conversion that limit the efficiency of a wide range of processes.

This project will challenge limits in electron-polariton interactions to enable novel polariton phenomena in nanostructures and settings of 2D materials.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
865844	**BINGO**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Claudia Nones**
Host Institution:	Commissariat A L Energie Atomique Et Aux Energies Alternatives - FRA

Bi-Isotope 0n2b Next Generation Observatory

BINGO will set the grounds for a large-scale bolometric experiment searching for neutrinoless double beta decay with a background index of about 10-5 counts/(keV kg y) and with very high energy resolution – of the order of 1.5‰ – in the region of interest. These features will enable a search for lepton number violation with unprecedented sensitivity. The BINGO approach can lead to the demonstration of the Majorana nature of neutrino even in the unfavourable case of direct ordering of neutrino masses.

BINGO is based on luminescent bolometers for the rejection of the dominant alpha surface background. It will focus on two extremely promising isotopes – 100Mo and 130Te – that have complementary merits and deserve to be both considered for future large-scale searches.

The project will bring three original ingredients to the well-established technology of hybrid heat-light bolometers: i) the light-detector sensitivity will be increased by an order of magnitude thanks to Neganov-Luke amplification; (ii) a revolutionary detector assembly will reduce the total surface radioactivity contribution by at least one order of magnitude; (iii) for the first time in an array of macrobolometers, an internal active shield, based on ultrapure ZnWO4 scintillators with bolometric light readout, will suppress the external gamma background. These challenging technologies will be extensively tested in a two-isotope demonstrator, dubbed MINI-BINGO, which will be located in an underground laboratory in a dedicated cryogenic infrastructure built with ERC funds.

The BINGO approach can be implemented in the next-generation search CUPID, a proposed follow up of the CUORE experiment. BINGO can improve dramatically the sensitivity of CUPID, using two isotopes at the same time and providing the demonstration of its background goal. Subsequently, the intrinsic modularity of the bolometric technique would make sensible to proceed to further expansions, capable of penetrating the direct-ordering band.

Link to the ERC project webpage: http://www.bingo-neutrino.eu/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
884715	**NECTAR**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Beatriz Jurado**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Nuclear rEaCTions At storage Rings

Obtaining reliable cross sections for neutron-induced reactions on unstable nuclei is a highly important task and a major challenge. These data are essential for nuclear astrophysics -since most of the heavy elements in the Universe are produced by neutron-induced reactions in stars- and for applications in nuclear technology. However, their measurement is very complicated as both projectile and target are radioactive. The most promising way to infer these cross sections is to use surrogate reactions in inverse kinematics, where the nucleus formed in the neutron-induced reaction of interest is produced by a reaction involving a radioactive heavy-ion beam and a stable, light target nucleus. The decay probabilities (for fission, neutron and gamma-ray emission) of the nucleus produced by the surrogate reaction provide precious information to constrain models and enable much more accurate predictions of the desired neutron cross sections.
Yet, the use of surrogate reactions is hampered by the numerous long-standing target issues. I propose to solve them by combining surrogate reactions with the unique possibilities at ion storage rings. In a storage ring heavy radioactive ions revolve at high frequency passing repeatedly through an electron cooler, which will greatly improve the beam quality and restore it after each passage of the beam through the internal gas-jet serving as ultra-thin, windowless target. This way, decay probabilities can be measured with unrivaled accuracy.
NECTAR aims to develop a detection system based on cutting-edge technology and a new method to measure accurate decay probabilities of radioactive nuclei at the CRYRING storage ring of the GSI/FAIR facility. The extreme vacuum conditions of the ring put severe constraints on the detection setup. I propose original, even revolutionary options to overcome these issues like the use of solar cells. Thus, NECTAR will be the seed of a new generation of nuclear-reaction experiments with unstable beams.

Link to the ERC project webpage: https://www.lp2ib.in2p3.fr/nucleaire/nex/erc-nectar/

Keywords of the ERC project: Experimental nuclear physics, nuclear reactions, heavy-ion storage rings, innovative detection systems, solar cells, nuclear fission

Keywords that characterize the scientific profile of the potential visiting researcher/s: Experimental nuclear physicist interested in the development of cutting edge technology for conducting unique experiments at heavy-ion storage rings

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
884719	**FAIME**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Peter Križan**
Host Institution:	Institut Jozef Stefan - SVN

Flavour Anomalies with advanced particle Identification MEthods

In the proposed research, precision measurements of rare processes involving heavy quarks and leptons will be used to search for new phenomena beyond the Standard Model, popularly known as New Physics. This research at the intensity frontier is complementary to searches at the highest achievable energies carried out at the LHC proton-proton collider. Indications of very interesting discrepancies have recently been observed by three experiments (LHCb, BaBar, and Belle) between their results and predictions of the Standard Model in certain classes of decays of B mesons, which involve leptons in the final state. The proposed project will address these issues by using large event samples collected with the Belle II detector at a new electron-positron collider, SuperKEKB. By investigating a broad range of selected rare decays of B and D, the project will attempt to provide a definite answer on the violation of Lepton Flavour Universality, one of the cornerstones of our current understanding of the interactions among the elementary particles. Based on the results of these studies, the final stages of the project will be devoted to possible explanations and to studies of transitions that would be based on related new physics phenomena.
Within the proposed research programme, novel, highly advanced identification methods for charged particles will also be developed. They will be of crucial importance to suppress backgrounds arising from other, much more abundant decays in measurements of rare processes where the sensitivity to a possible contribution of New Physics is largest. The proposed research will strongly benefit from the fact that the same group that contributed substantially to the physics programme, concept, design, and construction of the detector, will also carry out the development of novel analysis methods, their calibration and optimization for individual reactions.

Link to the ERC project webpage: https://faime.ijs.si/

Keywords of the ERC project: particle physics, flavour physics, rare decays of B and D mesons and tau leptons, identification of charged particles, Cherenkov detectors

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
884900	**QPAP**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Anne L'Huillier**
Host Institution:	Lunds Universitet - SWE

Quantum Physics with Attosecond Pulses

This project lies at the crossing of attosecond science, photoionization of atoms and molecules and quantum optics. Progress in the performances of the attosecond sources, in particular regarding repetition rate, now enables us to perform photoionization studies of atoms and molecules using advanced coincidence/three dimensional momentum techniques. Adding an additional dimension, the phase, which is accessible by attosecond interferometric techniques, we will able to follow in time the quantum properties of the studied processes.

The aim of the present application is to perform quantum optics experiments, not with photons as in conventional quantum optics, but with electron wave-packets created by absorption of attosecond light pulses. Our objectives are

- to characterize and study in the time domain the quantum coherence of attosecond electron wavepackets,
- to control quantum interferences of electron wavepackets using a small number of attosecond pulses and
- to create and follow in time entangled two-electron attosecond wavepackets.

The experiments will use advanced laser systems, attosecond sources and electron detectors. A unique 200-kHz repetition rate laser system based on optical parametric chirped pulse amplification technology, combined with an efficient attosecond source and a three-dimensional momentum electron detector will open the door to attosecond experiments where the kinematics of the light-matter interaction can be recorded.

The success in achieving the above objectives will not only lead to a major leap forward in attosecond science and atomic and molecular physics in general; it might shed new lights in fundamental quantum physics, given the originality of the studied systems, attosecond electron wave packets and the versatility of the tools, providing four dimensional information (momentum and time) for multiple particles.

Link to the ERC project webpage: 884900

Keywords of the ERC project: attosecond science

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
948254	**DISCOVERHEP**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Steven Schramm**
Host Institution:	Universite De Geneve - CHE

Turning noise into data: a discovery strategy for new weakly-interacting physics

The ATLAS and CMS Experiments at the Large Hadron Collider (LHC) have done an excellent job in searching for new high-energy physics, pushing out to energy scales which have never before been studied. In contrast, low-energy physics has only been studied in specific contexts at the LHC, and remains largely uncovered in the search for new physics. Despite the main focus being on the high-energy regime, it is entirely possible that new physics is instead hiding in the low-energy regime, and it was not observed in previous collider physics experiments due to being rarely produced.

In the context of the DISCOVERHEP project, I will lead a group in the search for new physics in the largely-uncovered low-energy regime. The project will exploit the very-high LHC beam intensity to turn "noise", in the form of traditionally unwanted and ignored additional simultaneous proton-proton collisions, into a currently-untapped wealth of useful low-energy physics data. This novel approach thereby opens up the possibility of conducting high-sensitivity searches for low-energy physics at the LHC.

This massive low-energy physics dataset will be used to enable the project goals, in the form of searches for new low-energy weakly-interacting physics conducted using the ATLAS Detector. Three different search strategies, sensitive to different types of new physics, are considered: two types of direct searches for new light particles such as potential mediators between the Standard Model and Dark Matter, and one generic search for new low-energy physics using anomaly detection techniques. These searches will dramatically extend the sensitivity of ATLAS to new low-energy physics, thus expanding the ATLAS physics program and potentially leading the way towards new discoveries.

Link to the ERC project webpage:

Keywords of the ERC project: Particle physics; hadronic physics; searches for new physics; jets; machine learning; anomaly detection

Keywords that characterize the scientific profile of the potential visiting researcher/s: Particle physics; hadronic physics; searches for new physics; jets; machine learning; anomaly detection

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
948689	**AxionDM**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Manuel Meyer**
Host Institution:	Universitaet Hamburg - DEU

Searching for axion and axion-like-particle dark matter in the laboratory and with high-energy astrophysical observations

The nature of dark matter, which makes up more than 80% of the Universe's matter content, remains unknown. Light axions and axion-like particles (ALPs) are well motivated dark-matter candidates that could be detected through their oscillations into photons in the presence of magnetic fields. Here, complementary laboratory and astrophysical searches for dark-matter axions and ALPs are proposed that will cover more than 10 orders of magnitude of possible axion and ALP masses.

The astrophysical searches will focus on high-energy gamma-ray observations with the Fermi Large Area Telescope as well as current and future imaging air Cherenkov telescopes. Photon-ALP oscillations would cause features in the spectra of distant galaxies as well as gamma-ray bursts from core-collapse supernovae. Axion and ALP decay would also increase the opacity of the Universe for gamma rays. These signals will be searched for through novel comparisons of gamma-ray data and model predictions.

The laboratory searches will focus on contributions to the Any Light Particle Search (ALPS II) and International Axion Observatory (IAXO) experiments. New analysis and simulation frameworks, as well as trigger concepts, will be developed in order to significantly improve the background rejection for the Transition Edge Sensor (TES) detector employed in the ALPS experiment. These improvements could pave the way for an ALP detection in the laboratory with first data runs at the ALPS II experiment planned in 2021. Monte Carlo simulations will be used to assess whether TES detectors can achieve the low background rates required for IAXO. Such high energy resolution detectors could help to precisely measure the axion/ALP mass through mass-dependent spectral features.

Through an unprecedented investigation of axion and ALP signatures and by enhancing the sensitivity of future laboratory experiments, the proposed research will discover or rule out so-far unprobed dark-matter axions and ALPs.

Link to the ERC project webpage: axion-alp-dm.github.io/

Keywords of the ERC project: dark matter, particle physics experiment, astroparticle physics, axions

Keywords that characterize the scientific profile of the potential visiting researcher/s: particle physics experiment, data analysis, quantum sensors

Project ID:	Project Acronym:	Evaluation Panel:
101001561	**LISA**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Kathrin Wimmer**
Host Institution:	Gsi Helmholtzzentrum Fur Schwerionenforschung Gmbh - DEU

LIfetime measurements with Solid Active targets

The coexistence of single-particle and collective degrees of freedom in atomic nuclei gives rise to various exotic phenomena. In nuclei with very asymmetric proton-to-neutron ratios, the strong nuclear interaction drives shell evolution which alters the orbital spacing, and in some cases even the ordering present in stable nuclei. In the absence of large gaps between orbitals, nuclei can take on non-spherical shapes and their excitations proceed through coherent and collective motion of many nucleons. Where and how collectivity emerges from the single-particle dynamics of protons and neutrons is an open question in nuclear structure physics that will be addressed with LISA in a unique way.

The aim of the LISA (LIfetime measurements with Solid Active targets) project is to develop a novel method for lifetime measurements in atomic nuclei. Lifetimes probe the collectivity of a nucleus through its electromagnetic transition properties. The experimental approach is based on active solid targets and will dramatically enhance the scope of measurements of excited-state lifetimes and thus transition probabilities achievable in exotic nuclei. Coupled to state-of-the-art gamma-ray tracking detectors such as AGATA, this novel instrument will overcome the present challenges of lifetimes measurements with low-intensity beams of unstable nuclei.

LISA will exploit the unique capabilities of FAIR, the future European fragmentation facility set to deliver the most exotic and highest intensity radioactive ion beams. LISA will greatly expand the physics program for nuclear structure studies at FAIR. Through the measurements made possible by LISA, our understanding of key aspects of single-particle and collective structures and their interplay will become much more developed. The results will have significant impact on the theoretical descriptions and modeling of atomic nuclei making their predictions more reliable.

Link to the ERC project webpage: https://web-docs.gsi.de/~kwimmer/

Keywords of the ERC project: Nuclear structure, nuclear astrophysics, structure of exotic nuclei

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101002107	**NEWSPIN**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Darrick Chang**
Host Institution:	Institut De Ciencies Fotoniques, Fundacio Privada - ESP

A New Spin on Quantum Atom-Light Interactions

A central goal of quantum optics is to realize efficient, controlled quantum interfaces between atoms and photons. Such interfaces enable broad applications from quantum information processing to quantum nonlinear optics to metrology, and also open a route toward creating exotic quantum states of light and matter. Today, our major paradigm for realizing an efficient interface is based upon the concept of collective enhancement, where using a large number of atoms creates an enhanced coupling to a preferred optical mode over undesired emission into other directions. However, our known error bounds for applications decrease very slowly as a function of system resources, such as the optical depth, thus posing a great challenge for future technologies.

In NEWSPIN, we propose a remarkable new way forward, based upon the realization that these conventional error bounds are derived without accounting for multiple scattering and wave interference between emitting atoms. We aim to establish that interference in light emission is in fact a much more powerful resource than the level that we currently exploit it. In particular, beyond the usual collective enhancement, it can simultaneously enable a much stronger collective suppression of emission into undesired directions, and which can yield exponentially better error bounds than was previously known.

Underlying this powerful paradigm shift will be the development of a quantum many-body theory of multiple scattering involving photons and atoms, which takes advantage of state-of-the-art tools from condensed matter physics. Beyond robust new routes toward applications, our theory will also reveal exotic new quantum phenomena and lead to new insights into fundamental questions in optics, such as the physical limits to how large the refractive index of an optical material can be. In total, we anticipate that NEWSPIN could greatly enrich our understanding of atom-light interactions and their realm of possibilities.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101002107

Keywords of the ERC project: quantum optics, atom-light interactions, collective phenomena, atom arrays, many-body dynamics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101019987	**FunClocks**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Piet Schmidt**
Host Institution:	Physikalisch-Technische Bundesanstalt - DEU

Testing Fundamental Physics with Highly Charged Ion Clocks

Precision spectroscopy of highly charged ions (HCI) provides insight into atomic systems in which electrons are highly correlated, strongly relativistic, and experience strong internal fields. Thus, HCI are excellent systems to probe and refine our understanding of physics under these extreme conditions. They are the most sensitive known atomic species to probe for possible changes in fundamental constants and offer advantageous properties to study coupling of hypothetical dark matter fields to normal matter. For these applications, high-precision optical spectroscopy of HCI is required. In the past, the spectroscopic resolution of optical transitions in HCI was limited by Doppler-broadening to hundreds of megahertz. We have recently demonstrated the first hertz-level laser spectroscopy of an optical fine-structure transition in highly charged argon using sympathetic cooling and quantum logic with a co-trapped logic ion in a Paul trap, improving the spectroscopic precision by nine orders of magnitude compared to the previous state-of-the-art. Here, we propose to further develop quantum techniques for controlling HCI and to push spectroscopic resolution in order to realise next generation optical clocks based on promising reference transitions in HCI. We will employ these novel types of optical clocks to advance our understanding of atomic structure and to probe for physics beyond the standard model. Sub hertz-level isotope shift spectroscopy of highly charged calcium ions will be performed to improve current bounds on hypothetical fifth forces that couple neutrons and electrons. Furthermore, we will perform optical clock-type spectroscopy on HCI that offer up to a 20-fold higher sensitivity to a possible change in the fine-structure constant and a non-gravitational coupling between dark matter and normal matter than existing clocks. Through frequency comparisons with other clocks, we will improve bounds on these new physics effects.

Link to the ERC project webpage: https://www.quantummetrology.de/eqm/research/

Keywords of the ERC project: optical clocks, frequency metrology, quantum logic spectroscopy, trapped ions, highly charged ions

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101020842	**EUSTRONG**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Achim Schwenk**
Host Institution:	Technische Universitaet Darmstadt - DEU

Exploring the Universe through Strong Interactions

The ERC project EUSTRONG will enable major breakthroughs in understanding strong interactions in nuclei and neutron stars, and where strong interactions are essential in dark matter direct detection and neutrino physics. Recently, great progress has been made in constraining the nuclear equation of state from nuclear physics combined with neutron star observations and the neutron star merger GW170817. At the same time, ab initio calculations of nuclei using chiral effective field theory (EFT) interactions have reached nuclei with up to 100 nucleons. These successes are based in parts on developments in my past ERC Starting Grant. Taking these to the next level, we will explore the equation of state with the goal to provide first constraints directly on dense matter interactions from astrophysics, including from new NASA NICER observations. This will enable us to answer which microscopic interactions are consistent with astrophysical observations, or where there are tensions. To this end, we will develop the equation of state to high densities using Fermi liquid theory, and explore new degrees of freedom at intermediate densities. The second work package will advance the ab initio frontier to key heavy nuclei including full uncertainty quantification. This will be realized by developing eigenvector continuation and tensor network methods to the ab initio in-medium similarity renormalization group. Another milestone will explore EFTs and novel power countings for nuclei. This will open new horizons in the physics of nuclei, with global ab initio predictions of nuclear masses for r-process simulations. The third work package will derive ab initio nuclear responses for dark matter direct detection and coherent neutrino scattering, where a reliable understanding of strong interaction effects is crucial. Moreover, universal correlations and EFTs will be explored to predict nuclear matrix elements for neutrino physics.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101040024	**BHHQG**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Thomas Mertens**
Host Institution:	Universiteit Gent - BEL

Black Hole Horizons in Quantum Gravity

The project "Black Hole Horizons in Quantum Gravity" aims for an in-depth investigation of black holes and the information paradox in the context of quantum gravity. Due to the recent breakthroughs in astronomy, these exotic objects have moved from the purely theoretical realm to being abundant in our physical universe. Surprisingly, our theoretical understanding of them is insufficient to even in principle understand their horizons and what happens behind them. Our approach to tackle these questions is to combine a lower-dimensional approach with holography as a guide. Within this framework, substantial breakthroughs were made in the Sachdev-Ye-Kitaev models, and their low-energy gravitational description in terms of Jackiw-Teitelboim gravity. This model is exactly solvable to a large degree, and many important lessons on black hole physics and quantum gravity can be studied quantitatively and exactly.
Our goals within this project span across two lines.
Firstly, we will apply quantum gravitational results on the Jackiw-Teitelboim gravity model to address aspects of the black hole information puzzle in a quantitative way and probe the deep questions on black hole horizons largely building on our detailed knowledge of this model. In particular, we will calculate correlation functions of local infalling bulk observables, and assess the effect of quantum gravitational corrections to evaporation. Secondly, it is vital to investigate the universality of the set of techniques and methods we use in Jackiw-Teitelboim gravity. We will do this by pursuing several roads simultaneously (dilaton gravity models, 2d string theory, the original Sachdev-Ye-Kitaev model, supersymmetric models and 3d pure gravity). Armed with these results, we will extrapolate to higher dimension and in particular to our physical universe making contact with the first objective.

Link to the ERC project webpage:

Keywords of the ERC project: Black holes, quantum gravity, holography

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101042399	**QuESADILLA**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Tim Bartley**
Host Institution:	Universitaet Paderborn - DEU

Quantum Engineering of Superconducting Array Detectors In Low-Light Applications

Optical measurements are fundamental to experimental science and observations of nature. At the single photon level, superconducting nanowire single-photon detectors (SNSPDs) are well-established as the gold standard in measurement, due to their near-unit efficiency, negligible noise and ultrafast response. Building SNSPD arrays and simultaneously extracting intensity, spectral and spatial resolution from a device at the single photon level will revolutionise astronomical measurements, spectrometry in chemistry and life sciences, and quantum imaging. Key to unlocking this potential is to marry concepts from detector tomography with robust high-yield detector fabrication, the integration of complementary optical technologies and low heat-load scalable readout schemes. QuESADILLA tackles these challenges head-on, with a series of experiments demonstrating the groundbreaking potential of quantum detector engineering. In contrast to engineering quantum states of light for metrology, QuESADILLA will shift that paradigm by engineering the quantum mechanical response of the detector itself. QuESADILLA introduces the concepts of a modal decomposition of the positive operator valued measure (POVM), and quantum-enhanced POVM engineering in low-light applications. To do so, arrays of SNSPDs in combination with lithographically-written etalons and dielectric coatings will be developed, in concert with state-of-the-art scalable approaches to large scale quantum tomography. QuESADILLA will exceed the state of the art in many areas: performing the first modal decomposition of detector tomography and the largest tomographic reconstruction of a quantum detector; the first demonstration of quantum detector engineering using nonclassical ancilla states; the first demonstration of etalon array reconstructive spectrometry with single photons; and exploit the fastest electronic shutter speed of any optical sensor to enable the highest dynamic range detection of continuous illumination.

Link to the ERC project webpage:

Keywords of the ERC project: Single Photon Detector Arrays; Superconducting Single Photon Detectors; Photon Counting; Quantum Optics; Cryogenic Electronics

Keywords that characterize the scientific profile of the potential visiting researcher/s: A researcher with a background in physics or electrical engineering with an interest and/or expertise in single photon counting with superconducting detectors, and associated control electronics.

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101044443	**NLO-DM**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Josef Pradler**
Host Institution:	Oesterreichische Akademie Der Wissenschaften - AUT

New Light On Dark Matter

Collisions of dark matter (DM) particles with nuclei or with themselves can be accompanied by the prompt production of (dark) Bremsstrahlung quanta or, in matter, by the emission of electrons. The latter is called the Migdal effect, and the former adds a dissipative process to DM self-interactions. Focusing on light, sub-GeV DM candidates, we will advance two fields of central interest to the particle physics community: the direct detection of DM in the laboratory and the DM-assisted formation of structure in the Universe. The first goal is to put recent ideas of prompt photon and electron production in DM-nuclear scattering on firm and undisputable grounds. We do so by new detailed theoretical calculations for the target compounds of direct detection experiments and by devising experimental verification schemes through Standard Model analogs. The results will pioneer how we understand signal formation in DM searches and clarify the reach of state-of-the-art and future DM direct detection experiments. The second goal is to give self-interacting DM with dissipative channels an exact theory embedding. We will provide a new formulation of the Bremsstrahlung process that is exact to all orders in the colliding particle-pair interaction and spans all kinematic situations: soft- and hard-emission, quantum, and semi-classical. The results will apply broadly: from the Standard Model, to particle dark matter, to primordial black hole relics. Astrophysical implications and observational signatures will be established. The findings of these works will increase our chances of discovering DM in the laboratory and the skies and bring us closer in our quest to unravel its non-gravitational nature.

Link to the ERC project webpage:

Keywords of the ERC project: Dark Matter, Astrophysics, Dark Matter Direct Detection, Self-Interacting Dark Matter

Keywords that characterize the scientific profile of the potential visiting researcher/s: low threshold detectors & condensed matter theorist OR N-body simulations & halo structure

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101053159	**RAVE**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Rosario Fazio**
Host Institution:	United Nations Educational Scientific And Cultural Organization - FRA

UnRAVElling the dynamics of many-body open systems: Collective dynamics of quantum trajectories

With the flourishing of quantum information processing, the study of open quantum system dynamics has become of paramount importance for the ultimate success of quantum technologies. The phenomenology becomes increasingly rich when decoherence and dissipation arise in quantum systems with many degrees of freedom, leading to a flurry of different phases of matter. RAVE is devoted to the study of collective phenomena in synthetic, many-body open quantum systems through investigation of the dynamics of quantum trajectories. Following the dynamics at the level of its trajectories will capture features that are washed out by looking at averaged observables, i.e. in the density matrix. RAVE will show that there are collective phenomena visible only in the dynamics of single trajectories, and propose experimental schemes to observe them. This will lead to a new classification of phases in quantum many-body open systems and help clarify the relations between entanglement, correlations and non-equilibrium thermodynamics. In those cases where the steady-state phase breaks time-translational invariance, RAVE will contribute to unify apparently different concepts such as synchronisation and time-crystals. The statistics associated with the behaviour of quantum jumps in many-body systems is also important for characterizing the quality and performance of quantum information processing protocols. To address the key questions posed by the project, RAVE will develop a promising new methodology based on replicas and use it to design open system quantum simulators able to provide information at the level of single trajectories. RAVE is a highly interdisciplinary programme which will have significant impact in the fields of condensed matter, statistical physics, quantum information and stochastic thermodynamics.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101053168	**NEUTRINOSHOT**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Elisa Resconi**
Host Institution:	Technische Universitaet Muenchen - DEU

Why a new neutrino telescope? Because we can.

For over a century, ultra-high energy cosmic rays (CR) have been observed by scientists, but their energy and place of production remain a mystery. At very high energies, neutrinos generated by CR carry messages from, e.g., the verge of supermassive black holes, but here our understanding is limited. Tracking neutrinos offers a way to trace the origin of the highest energetic particles in the universe. The stumbling block is that neutrinos, the ghost particles, are notoriously tough to detect. A target of at least a Gigaton of natural transparent material, like water or ice, must be instrumented to collect neutrinos from the cosmos. Currently, only IceCube Neutrino Observatory at the South Pole has the exposure to detect very high-energy neutrinos beyond Earth's atmosphere. More and larger telescopes are needed to advance on this promising, rich path of fundamental discoveries in astro and particle physics. The objectives of NEUTRINOSHOT are to significantly advance the development of telescopes that detect far beyond the reach of IceCube, and make the exploration of cosmic accelerators more affordable. This can only be achieved with multi-cubic-kilometre (km) neutrino telescopes, currently limited by the scalability of technology to volumes beyond the cubic km. To this end, the lead researcher has identified the optimum testing location and established a scientific relationship with Ocean Networks Canada (ONC) to pioneer this global network as a testbed infrastructure for first case testing, deployment, and use of a new multi-line array neutrino telescope capable of functioning in extreme deep sea environmental conditions with improved sensitivities by orders of magnitude. This project will detect the first neutrinos in the Pacific Ocean and give neutrino astronomy a new "shot" to bring science a major step closer to revealing the hidden parts of our universe.

Link to the ERC project webpage:

Keywords of the ERC project: Astronomy, Neutrinos, Instrumentation, Data Science

Keywords that characterize the scientific profile of the potential visiting researcher/s: Programming, Statistics and Data Science, Machine Learning, Astronomy

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101055120	**ESSCEvNS**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Juan Collar**
Host Institution:	Fundacion Donostia International Physics Center - ESP

Beyond the Standard Model: Coherent Neutrino Scattering at the European Spallation Source

Coherent Elastic Neutrino-Nucleus Scattering (CEvNS), a recently discovered process of neutrino interaction, provides numerous opportunities to search for physics beyond the Standard Model (SM). The CEvNS cross-section, much larger than for any other coupling, results in a dramatic miniaturization of neutrino detectors. However, the faint signals generated (few-keV nuclear recoils, NRs) require advanced detector technologies. The unprecedented neutrino flux from the upcoming European Spallation Source (ESS) provides the opportunity for a definitive exploration of all phenomenological applications of CEvNS.

The centerpiece of this proposal is the development of a new CEvNS detector technology, cryogenic undoped CsI scintillators monitored by innovative sensors (the largest avalanche photodiodes produced to date), in combination with state-of-the-art waveshifters (nanostructured organosilicon luminophores). An array of seven CsI crystals at the ESS, operating at 80 K and adding up to just 32 kg, will provide an exceptionally-high signal rate of 12,000 CEvNS events per year, significantly surpassing the sensitivity of ton-scale detectors at present-day spallation sources. The signal output per energy deposited in this new hybrid device is the highest ever achieved with scintillators: this provides a sensitivity to the lowest NR energies expected from CEvNS, for which deviations from the SM are most evident.

This combination of detector technology and neutrino source will achieve the best foreseeable sensitivity to new particle and nuclear physics via CEvNS. A first investigation of the response of high-pressure xenon detectors to low-energy NRs will also be performed. For reasons of nuclear structure, CsI and Xe are essentially identical in their response to CEvNS. However, the technologies and their expected systematics are entirely different. Their simultaneous use at the ESS will provide a unique, robust confirmation of any signatures of new physics encountered.

Link to the ERC project webpage:

Keywords of the ERC project: neutrino

Keywords that characterize the scientific profile of the potential visiting researcher/s: experimentalist, neutrino

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
771346	**ISCQuM**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Fabrizio Carbone**
Host Institution:	Ecole Polytechnique Federale De Lausanne - CHE

Imaging, Spectroscopy and Control of Quantum states in advanced Materials

Atomic confinement in 2D materials, topological protection in strong spin-orbit coupling systems or chiral magnets, all result in spin/charge textured states of matter. For example skyrmions, a whirling distribution of spins, behave as individual particles which controlled creation/annihilation/motion is of great importance in spintronics. To achieve control over skyrmions, or more generally over the constituents of disordered elastic media (vortices in superconductors, domain walls in magnets to name a few), the fundamental interplay between short-range and long-range interactions, influenced by topological protection, disorder and confinement, has to be understood and manipulated. This project aims at controlling with electromagnetic pulses a handful of charges and spins in nanostructured materials to be filmed with nm/fs resolution by time-resolved Transmission Electron Microscopy. I propose to image and shape confined electromagnetic fields (plasmons) in nanostructured novel materials. With this ability, we will implement/demonstrate the ultrafast writing and erasing of individual skyrmions in topological magnets. These experiments will enable the fundamental investigation of defects in topological networks and possibly seed new ideas for application in ultradense and ultrafast data storage devices. Similarly, pinning of vortices in type II superconductors will be controlled by light and imaged, gaining new insights into out of equilibrium superconductivity. In my laboratory, shaping and filming plasmonic fields down to the nm-fs scales have been demonstrated, as well as laser-writing and imaging skyrmions in nanostructures. ISCQuM will allow implementing crucial advances: i) extending our photoexcitation to the far-infrared for creating few-cycles electromagnetic pulses and exciting structural or electronic collective modes; ii) upgrading our detection to higher sensitivity and spatial resolution, extending our ability to image spin and charge distributions.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
801847	**WIREDETECT**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Jesper Wallentin**
Host Institution:	Lunds Universitet - SWE

High resolution X-ray detectors based on nanowire arrays

In this project I will develop ultra-high resolution X-ray detectors based on semiconductor nanowires, whose spatial resolution will be radically better than the current state of the art. In X-ray detectors the primary X-ray absorption induces a cascade of secondary electrons and photons which are measured at the front or back of the detector, but during the long transport to the point of detection these can spread orthogonally to the optical axis. This limits the resolution in present bulk detectors.

My novel concept is to create a nanostructured detector based on an array of semiconductor nanowires, which will confine and physically prevent spreading of the secondary electrons and photons. In a nanowire array, the pixel size is the diameter of the nanowire, which can be as low as 10 nm, while the nanowires can be as long as the X-ray absorption length. The very high aspect ratio of nanowires allows detectors with simultaneously very high spatial resolution and sensitivity. I will investigate both direct detectors and scintillators, in which the secondary electrons and photons are detected, respectively.

The objective is to create detectors based on arrays of 10 nm-diameter nanowires. Time- and temperature resolved measurements will be used to improve understanding of the X-ray physics in these nanodevices, with strong quantum confinement of electrons and phonons and high surface to volume ratio. I will test the detectors within an imaging project targeting the neural connectome, and compare the nanowire detectors with commercial ones. This novel detector concept could revolutionize high-resolution imaging of samples on the nanoscale, maintaining the unique ability of X-rays to study samples in realistic conditions: DNA within live cells, the strained channel in single operational transistors or individual nanoparticles in a charging battery. High resolution detectors could also be employed in X-ray spectroscopy and diffraction.

Link to the ERC project webpage: https://www.sljus.lu.se/staff/jesper-wallentin/

Keywords of the ERC project: perovskite, X-ray, detector, nani

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
811234	**ENFORCE**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Pietro Tierno**
Host Institution:	Universitat De Barcelona - ESP

ENgineering FrustratiOn in aRtificial Colloidal icEs: degeneracy, exotic lattices and 3D states

Geometric frustration, namely the impossibility of satisfying competing interactions on a lattice, has recently become a topic of considerable interest as it engenders emergent, fundamentally new phenomena and holds the exciting promise of delivering a new class of nanoscale devices based on the motion of magnetic charges. With ENFORCE, I propose to realize two and three dimensional artificial colloidal ices and investigate the fascinating manybody physics of geometric frustration in these mesoscopic structures. I will use these soft matter systems to engineer novel frustrated states through independent control of the single particle positions, lattice topology and collective magnetic coupling. The three project work packages (WPs) will present increasing levels of complexity, challenge and ambition: (i) In WP1, I will demonstrate a way to restore the residual entropy in the square ice, a fundamental longstanding problem in the field. Furthermore, I will miniaturize the square and the honeycomb geometries and investigate the dynamics of thermally excited topological defects and the formation of grain boundaries. (ii) In WP2, I will decimate both lattices and realize mixed coordination geometries, where the similarity between the colloidal and spin ice systems breaks down. I will then develop a novel annealing protocol based on the simultaneous system visualization and magnetic actuation control. (iii) In WP3, I will realize a three dimensional artificial colloidal ice, in which interacting ferromagnetic inclusions will be located in the voids of an inverse opal, and arranged to form the FCC or the pyrochlore lattices. External fields will be used to align, bias and stir these magnetic inclusions while monitoring in situ their orientation and dynamics via laser scanning confocal microscopy. ENFORCE will exploit the accessible time and length scales of the colloidal ice to shed new light on the exciting and interdisciplinary field of geometric frustration.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
818751	**MesoPhone**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Edward Laird**
Host Institution:	Lancaster University - GBR

Vibrating carbon nanotubes for probing quantum systems at the mesoscale

Many fascinating quantum behaviours occur on a scale that is intermediate between individual particles and large ensembles. It is on this mesoscopic scale that collective properties, including quantum decoherence, start to emerge.

This project will use vibrating carbon nanotubes – like guitar strings just a micrometre long – as mechanical probes in this intermediate regime. Nanotubes are ideal to explore this region experimentally, because they can be isolated from thermal noise; they are deflected by tiny forces; and they are small enough that quantum jitter significantly affects their behaviour. To take advantage of these properties, I will integrate nanotube resonators into electromechanical circuits that allow sensitive measurements at very low temperature.

First, I will study the motional decoherence of the nanotube itself, by using it as the test particle in a new kind of quantum interferometer. This experiment works by integrating the nanotube into a superconducting qubit, and will represent a test of quantum superposition on a larger mass scale than ever before. It will answer a longstanding question of physics: can a moving object, containing millions of particles, exist in a superposition of states?

Second, I will use the nanotube device as a tool to study superfluid helium 3 – the mysterious state of matter that may emulate the interacting quantum fields of the early universe. By measuring an immersed nanotube viscometer, I will be able to measure the behaviour of superfluid excitations on a scale where bulk superfluidity begins to break down.

Third, I will add to the device a nanomagnet on nanotube springs, creating an ultra-sensitive magnetic force sensor. This offers a way to perform nuclear magnetic resonance on a chip, ultimately creating a microscopy tool that could image for example single viruses.

Link to the ERC project webpage: http://wp.lancs.ac.uk/laird-group/

Keywords of the ERC project: Nanotubes, superfluids, nanomechanics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
819823	**Piko**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Suliana Manley**
Host Institution:	Ecole Polytechnique Federale De Lausanne - CHE

Revealing the adaptive internal organization and dynamics of bacteria and mitochondria

Bacteria cells appear to be less complex than our own cells -- yet they are better able to survive harsh conditions. Typically ~1 micron in size, they lack motor proteins; thus, they rely on fluctuations for intracellular transport. Bacteria in the environment often face starvation and exist in a non-proliferating quiescent state, which promotes antibiotic resistance and virulence. Entering quiescence, the bacterial cytoplasm displays signatures of the colloidal glass transition, with increasingly slow and heterogeneous diffusion. Also important for fitness during starvation is the formation of storage granules up to hundreds of nanometers in size. The complex state behavior of the bacterial cytoplasm is therefore important for their survival, but the physical nature of each of these processes is poorly understood. Our own cells are typically tens of microns in size and contain organelles including mitochondria, which originated from ancient bacterial endosymbionts. But little is known about the transport properties of the mitochondrial matrix, or how it responds to changes in mitochondrial membrane potential or energy production.

The goal of this project is to elucidate the organization and dynamics of the bacterial cytoplasm and the mitochondrial matrix. A major obstacle to studying the interior of bacteria and mitochondria is the relevant length scales, which lie below the diffraction limit. Furthermore, to observe and quantify their adaptive response, many cells must be measured. Our strategy to overcome both of these technical challenges is to use high-throughput super-resolution fluorescence microscopy. We have developed new microscopes, capable of capturing thousands of super-resolved cells in each experiment. We propose to translate these developments to dynamic structured illumination and long-term molecular tracking. Broadly applicable, this will also enable the quantitative study of the subcellular properties of single bacteria cells or mitochondria.

Link to the ERC project webpage:

Keywords of the ERC project: superresolution microscopy
physics of living systems
mitochondrial dynamics
bacterial division

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
833895	**PrISMoID**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Ullrich Steiner**
Host Institution:	Universite De Fribourg - CHE

Photonic Structural Materials with Controlled Disorder

Structural colour reflected by photonic materials is typically attributed to highly ordered nanostructures with periodicities on the 100-nm length scale. When investigating structural colour in animals and plants, it is however becoming increasingly evident that brilliant photonic colour can also arise from seemingly disordered morphologies. This is surprising as uncontrolled disorder in photonic materials usually severely degrades their colour response. While some recent theories exist, the emergence of structural colour from disordered morphologies is fundamentally not understood. It is clear however that these disordered morphologies must possess "hidden correlations", which enable the formation of a photonic band gap.
This project will uncover the design rules that underlie disordered photonic morphologies, thereby contributing to the fundamental understanding of photonic materials. The project has a strong nature-inspired component, but will go beyond the examination of natural photonic materials. WP1 and WP2 will examine 3D and 2D disordered photonic morphologies in animals and plants, respectively. The structural analysis of these materials will uncover hidden correlations in seemingly random morphologies. WP2 and WP3 will manufacture materials that implement these correlations to recreate the optical signatures of the biological model organisms. This will test the statistical analysis of WP1 and WP2 and shed light on the \textit{in vivo} synthesis of the disordered photonic morphologies. WP4 ties WP1-WP3 together by performing optical experiments and computer simulations. By analysing both the far- and near-field results of the simulations and comparing them with the structural correlations and optical experiments, the four WPs will not only provide a fundamental understanding of the interplay of structural correlations with optical interference in disordered materials, it will also establish design rules allowing their facile manufacture.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
853368	**Corr-NEQM**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Arijeet Pal**
Host Institution:	University College London - GBR

Correlated Non-Equilibrium Quantum Matter: Fundamentals and Applications to Nanoscale Systems

Non-equilibrium states of matter occur in a wide range of systems. From microscopic scales of atoms and electrons to stars and galaxies in the universe. These phenomena have observable effects measurable by humans. In many of these systems the laws of thermodynamics do not apply. In spite of the ubiquity of non-equilibrium states, their universal understanding is still rudimentary. A general description of out of equilibrium states is of fundamental importance and can potentially spur technological innovation. Therefore, non-equilibrium systems host a family of questions which can be a source of knowledge and benefit to humankind.
In this proposal I will tackle several open problems on correlated non-equilibrium quantum states in condensed matter physics. The remarkable twin discoveries of many-body localization (MBL) and time crystals have opened a new paradigm for non-equilibrium matter where an interacting quantum system violates the laws of equilibrium thermodynamics. By amalgamating tools and ideas from quantum information science, I will theoretically investigate these phenomena in regimes which are thus far unexplored. It will shed new light on MBL in higher dimensions and effect of long range interactions, a common feature in many physical systems. I will explicate the formation of discrete time crystals, a new phase of matter with broken time-translational symmetry, in dissipative systems. Until recently, MBL was considered to be an essential ingredient for time-crystallinity. The project will unravel the underlying principles of dissipative time crystals and the crossover from their semi-classical realization to the purely quantum effect protected by MBL. I will also predict smoking-gun signatures of these phenomena which are testable in semiconductor nanostructures. An answer to these vital questions will provide a deeper understanding of fundamental physics and may open new avenues for spatio-temporal control of entanglement in many-body quantum states.

Link to the ERC project webpage:

Keywords of the ERC project: Non-equilibrium dynamics, quantum information, many-body localization, time crystals, open quantum systems, quantum simulation, quantum circuits

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
853387	**Ph.D.**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Serim Kayacan Ilday**
Host Institution:	Bilkent Universitesi Ulusal Nanoteknoloji Arastirma Merkezi - Unam - TUR

Phase map of dynamic, adaptive colloidal crystals far from equilibrium

We recently reported the first observation of dynamic adaptive colloidal crystals exhibiting characteristics similar to those commonly associated with living organisms: self-replication, self-healing, adaptation, competition, motility. Here, I propose to do the first experiments to clarify precisely how dynamic adaptive behavior arises far from equilibrium and how to control it. The key to both is a fundamental question at the heart of condensed matter, statistical and nonlinear physics: When far from equilibrium, in the presence of fluctuations and faced with multiple steady states with small energy differences, how does a system evolve? Specifically, my objectives are (1) to form crystals with periodic and aperiodic patterns, e.g. 2D Bravais lattices, quasicrystals, using passive identical particles, (2) to quantify their formation energies through the effective temperature of Brownian particles, (3) to identify the conditions for emergence and control of adaptive behavior. Then, I will draw a complete phase map of these dynamic adaptive colloidal crystals using fitness landscapes to characterize each pattern. I will further ask to what extent this control is extendable down to the few-nm scale, where fluctuations are even stronger and if and how these findings change when using nonidentical, in size or shape, but still passive particles. My system comprises quasi-2D-confined pure-polystyrene 500-nm spheres suspended in water. An energy flux to drive the system far from equilibrium and sustain it there is supplied by an ultrafast laser. My method exploits only three physical tenets, nonlinearity, fluctuations and positive/negative feedback mechanisms acting on identical passive particles, yet generates extremely rich emergent dynamics. A full understanding of how such dynamics arise from so few basic ingredients will advance our understanding of complex systems in addition to numerous practical applications to self-assembly, microfluidics, nanoscience and biology.

Link to the ERC project webpage: https://staff.bilkent.edu.tr/serim/

Keywords of the ERC project: Soft condensed matter, nonlinear, nonequilibrium physics

Keywords that characterize the scientific profile of the potential visiting researcher/s: Soft condensed matter, nonlinear, nonequilibrium physics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
865840	**QS2DM**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Patrick Maletinsky**
Host Institution:	Universitaet Basel - CHE

Quantum sensing of two-dimensional magnets

Van der Waals (vdW) materials are layered compounds that can be readily exfoliated down to the monolayer limit. Magnetic order has recently been observed in such atomic monolayers. This milestone discovery could launch a new era in nano-magnetism, in, which the exceptional cleanliness and tunability of these truly two-dimensional magnets may enable fundamental discoveries and novel technologies based on atomic-scale functional magnetic elements.

Direct, quantitative sensing of nanoscale properties of these systems is a key ingredient for further progress. My group has recently demonstrated their power through the first nanoscale imaging of magnetism in atomic-scale vdW magnets. This major advance was enabled by quantitative, nanoscale magnetometry with a single spin - a unique quantum technology, which I have pioneered.

I propose to leverage this progress to bring groundbreaking advances to the field of vdW magnetism. Non-collinear, engineered spin textures, such as Skyrmions of helimagnetism, offer a current frontier that I will address, with possibly far-reaching impact for the field of spintronics. I will further harness the high-frequency sensing capabilities of our quantum sensors to address microwave-domain spin-waves in vdW magnets. This completely uncharted domain offers insight into still poorly understood spin interactions and has technological potential through the field of "vdW magnonics", which I plan to establish.

This challenging project combines advanced materials engineering with an emerging, and highly promising quantum sensing technology. It is thereby highly interdisciplinary and goes well beyond the state-of-the-art in the fields of vdW magnetism and quantum-sensing. I will thereby further strengthen Europe's position at the forefront of these flourishing research areas. My project requires a commitment of several years, a team of two graduate students and two postdoctoral fellows, and significant investment in instrumentation.

Link to the ERC project webpage: www.quantum-sensing.ch

Keywords of the ERC project: Quantum sensing; van der Waals magnets; Quantum Engineering; Cryogenics; Scanning probe microscopy; Diamond; NV centers

Keywords that characterize the scientific profile of the potential visiting researcher/s: Quantum sensing; van der Waals magnets; Quantum Engineering; Cryogenics; Scanning probe microscopy; Diamond; NV centers

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
883684	**LoopingDNA**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Cees Dekker**
Host Institution:	Technische Universiteit Delft - NLD

Bottom up biophysics approach to resolve the looping structure of chromosomes

How is DNA spatially organized in our cells? What are the mechanisms that shape chromosomes and how does their 3D architecture direct their function? Recent years have shown that the spatial structure of the genome is of pivotal importance for its biological function. Yet, the basic physics of the formation and regulation of its 3D structure has remained unclear. This proposal aims to understand the fundamental structure of chromosomes using a bottom up biophysics approach, from looping at the single-molecule level to higher levels of complexity. We focus on so-called SMC protein complexes (SMC = Structural Maintenance of Chromosomes). These ring-shaped proteins are a unique new type of molecular motors that can extrude large loops of DNA that are thought to be the basis of chromosome structure. Our group's recent breakthrough discovery of the looping motor function of condensin SMC paved the way to now answer major open questions, such as the motor mechanism of SMCs; how SMCs handle realistic chromosomal fibers loaded with DNA-binding proteins; how looping relates to gene expression; and whether it is evolutionary conserved from bacteria to man. By answering these questions using single-molecule assays, we will resolve the basic mechanics of the SMC-induced looping of DNA. We will extend this to even build a chromosome from the bottom up, in a 'genome-in-a-box' approach where we will take genome-length bare DNA and add SMC protein complexes and other DNA-processing proteins. Such a well-controlled bottom-up approach – which to our knowledge is unique – can be expected to generate a radically new understanding of the physical forces and protein systems that shape chromosomes. We are confident that our powerful single-molecule biophysics tools, in collaboration with working with the world's best biochemists, will enable to disentangle the fundamental looping architecture of chromosomes that is so essential to all of life.

Link to the ERC project webpage: https://ceesdekkerlab.nl

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
947918	**TAP**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Davide Michieletto**
Host Institution:	The University Of Edinburgh - GBR

Topologically Active Polymers

Synthetic and biological polymers are everywhere, they make up a wide range of materials, from every-day plastics to living cell. The study of how polymers behave in solution is a well-established research field that allows the informed design of commercial products, from plastics to rocket propellant. Most of the polymers used in everyday applications have a fixed structure that cannot be changed in time and this assumption lies at the heart of classic polymer physics. In this project, I propose to shift this paradigm by considering polymers whose architecture can be modified in time via topological operations that cut and glue the polymers' backbone at the expense of energy. Polymers undergoing these operations can dynamically and selectively alter their architecture or topology and I thus name them "topologically active polymers" (TAPs). This project is inspired by the facts that the DNA in every living entity is constantly topologically altered in time to fulfil a range of basic functions (e.g. cell division) and that DNA is increasingly employed as a building block for responsive and multifunctional materials. I propose to computationally design and explore generic systems of TAPs and then experimentally realise them as solutions of DNA functionalised by special classes of ATP-consuming proteins. These active complex fluids are expected to display unconventional behaviours intimately linked to the accessible space of topologies, their dynamic morphology and non-equilibrium kinetics. For instance, they are expected to selectively respond to the concentration of certain proteins, e.g. Topoisomerase, that are enriched in cancer cells. Given the fundamental importance of polymer science and the ubiquity of topology-altering proteins in vivo, this exciting bottom-up project will not only open a new area of fundamental research with potential far-reaching applications but will also shed new light into the workings of certain vitally important classes of proteins.

Link to the ERC project webpage: https://www2.ph.ed.ac.uk/~dmichiel/

Keywords of the ERC project: Topological Polymers; DNA biophysics; nanotechnology; rheology

Keywords that characterize the scientific profile of the potential visiting researcher/s: microfluidics; biopolymers; single molecule DNA;

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
948243	**AQE2D**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Bruno Schuler**
Host Institution:	Eidgenossische Materialprufungs- Und Forschungsanstalt - CHE

Atomic Quantum Emitters in 2D Frameworks

The ability to create and control connected quantum states established the advent of quantum information technologies (Q-IT). Manipulation of the electron spin associated with colour centres in solid state crystals is one of the pillar technologies that could eventually push Q-IT beyond cryogenic environments. Exploitation of the full potential of these atomic qubit systems is, however, hampered by two key challenges: the lack of atomistic insights into their properties, and the ability to place them with the required fidelity and atomic spatial precision.

Here I propose to converge recent breakthrough developments in the synthetic control of two-dimensional (2D) materials and ultra-fast, single-atom resolving probes to overcome these challenges. Specifically, I will develop a platform for electro-optically addressable spin qubits (Atomic Quantum Emitters, AQEs) in 2D materials based on atomic dopants in transition metal dichalcogenide (TMD) monolayers and molecular spin systems in 2D covalent organic frameworks (2D-COFs). These systems will provide an ideal platform to generate AQEs by chemical design, to control the mesoscopic environment averting variability between emitters, to achieve atomically precise spatial placement, to identify and eliminate decoherence channels, and to develop high-fidelity scalable pumping schemes.

The proposed construction of a spin-polarized ultrafast THz scanning probe microscope with optical detection capabilities will enable the direct correlation of structural, electronic, magnetic, and optical properties of individual AQEs with simultaneous atomic spatial resolution and picosecond time resolution. This will open new frontiers in the spatio-temporal characterization and control of solid-state AQE systems.

The atomically precise engineering of 2D quantum materials and unprecedented microscopic insights into AQEs bear transformative potential for the field of quantum sensing, communication and information processing.

Link to the ERC project webpage: https://www.empa.ch/web/s205/2d-quantum-materials

Keywords of the ERC project: Quantum Nanoscience, THz-STM, 2D Materials, Quantum Emitter

Keywords that characterize the scientific profile of the potential visiting researcher/s: Scanning Probe Microscopy, Ultrafast Optics, THz, Ultrahigh Vacuum

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
948895	**MetElOne**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Ross Howie**
Host Institution:	The University Of Edinburgh - GBR

The Metallization Conditions of Element One

Element number one, hydrogen, is the simplest and most abundant element in the universe. The relative abundance is reflected in the gas giant Jupiter, where under extreme pressures and temperatures, hydrogen exists in a dense metallic fluid state. In 1935, it was predicted that such a metallic state could also be realised at considerably lower temperatures, whereby the quantum molecular solid would dissociate under compression into an atomic metal. With the development of modern quantum mechanics, this metallic state of hydrogen is now expected to exhibit a whole host of fascinating properties at high pressure, from room temperature superconductivity, to a novel superfluid liquid ground state. The pursuit of these phenomena has been the principal scientific driver in high-pressure research and inspires many from interdisciplinary fields of science. In the eight decades that have passed since the initial prediction, there has been a vast amount of interesting phenomena discovered experimentally. Breakthroughs in diamond anvil experiments in the past five years have led to the discovery of two novel solid phases, suggesting that we are tantalizingly close to the metallization conditions, but at the limit of what can be currently achieved. For now, the metallic state remains elusive. I propose a novel hydrogen research program that will combine complex diamond sculpting, time resolved spectroscopy and novel fast compression techniques to extend the pressures achievable in static compression experiments. Using these state-of-the art diagnostics, I will explore the phase diagram and pinpoint the P-T conditions at which hydrogen becomes metallic in the solid and fluid states. With my experience in ultra-high pressure studies of hydrogen, together with resources unmatched anywhere else, the project promises to resolve many outstanding questions surrounding one of the most fundamental unsolved problems in condensed matter physics: the metallization of element one.

Link to the ERC project webpage:

Keywords of the ERC project: High Pressure Research, Hydrogen

Keywords that characterize the scientific profile of the potential visiting researcher/s: High Pressure Researcher

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
948986	**QFAST**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr María José Martínez Pérez**
Host Institution:	Agencia Estatal Consejo Superior De Investigaciones Cientificas - ESP

Quantum Fast Spin dynamics addressed by High-Tc superconducting circuits

Nanoscopic spin excitations in confined geometries open a wide range of opportunities both for fundamental investigations and for applications. However, quantum magnetization dynamics in nanomagnets are still largely unexplored, especially when it comes to non-homogeneous spin configurations. QFaST is aimed at filling this gap by investigating quantum properties of magnetic vortices stabilized in low-damping ferromagnetic microdiscs at millikelvin temperatures. The project will be built upon quantum nanocircuits based on the high critical temperature superconductor YBa2Cu3O7 (YBCO) in the form of nano Superconducting Quantum Interference Devices (nanoSQUIDs) and coplanar waveguide resonators. On the one hand, quantum spin dynamics from quaistatic up to nanosecond timescales will be addressed with few Bohr magnetons-sensitivity and 100 nm spatial-resolution by implementing a broadband on-chip YBCO-nanoSQUID microscope. This will be combined with the possibility of locally probing and controlling the temperature of the sample and sending radiofrequency pulses. Among other issues, such facility will allow studying zero-point vacuum fluctuations of vortex gyration. On the other hand, the physics of vortex gyration will be addressed by quantum cavity electrodynamics. The first step towards this goal will be the experimental realization of vortex-photon hybrid states using YBCO resonators. Such achievement entails the exchange of vortex and photon populations in the form of Rabi oscillations. Based on this, strong coupling of high order vortex modes and cavity photons will be explored putting emphasis in the possibility of transducing single photons into coherent spin-waves. These studies will open new opportunities for future research, e.g., to transduce between microwave and optical photons or to manipulate and detect single quanta of vortex gyration, which are relevant for quantum information applications and detection of dark matter.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
949052	**MAGNEPIC**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Can Onur Avci**
Host Institution:	Agencia Estatal Consejo Superior De Investigaciones Cientificas - ESP

Magnetic Insulators: An Enabling Platform for Innovative Spintronic Concepts

New approaches to write, read, and process data are required in order to improve the sustainability of computer technologies. Spintronics offers attractive solutions to these problems. Today, however, the majority of spintronic devices and research efforts rely on a limited set of materials, mostly magnetic conductors. Here I propose to challenge this conventional approach and place magnetic insulators at the core of spintronics by exploiting their advantages over conducting magnets.

Magnetic conductors are ubiquitous in spintronics due to their ability to generate and detect spin currents by electrical means. However, we now know that nonmagnetic materials with large spin-orbit coupling can efficiently convert charge currents into spin currents with de-coupled directions. This key feature enables spin current injection into virtually any material, including magnetic insulators where charge currents cannot propagate but spin currents can.

The aim of this project is to bridge the long-established knowledge on magnetic insulators with today's expertise on spintronics and measurement techniques. I will exploit the highly tunable properties of magnetic insulators to achieve efficient magnetization control by electrical means in various schemes.

First, I will optimize the current-induced spin-orbit torque control of magnetization in magnetic insulators, a widely used methods in ferromagnetic conductors, but little explored in the context of insulators.

Second, I will devise a new electrical method to induce localized spin-flop transitions and harness the magnonic spin currents generated in this process.

Third, I will explore the possibilities of dynamically controlling the magnetic properties of insulators by proximity coupling and electric gating.

Overall, MAGNEPIC will provide breakthrough knowledge of magnetic insulators for spintronics and demonstrate fast, energy-efficient, and innovative device concepts for magnetic data manipulation beyond the state-of-the art.

Link to the ERC project webpage: https://magnepic.icmab.es/

Keywords of the ERC project: Spintronics, Magnetic Insulators, Electrical control of magnetization, Memory devices,

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101001267	**MAPEI**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Giovanni Volpe**
Host Institution:	Goeteborgs Universitet - SWE

Microscopic Active Particles with Embodied Intelligence

Over billions of years of evolution, motile organisms have developed complex strategies to survive and thrive. These strategies integrate three components: sensors, actuators, and information processing. In the last two decades, active-matter research has tried to replicate the evolutionary success of microorganisms in artificial systems. Researchers have replicated the actuators by developing artificial active particles that extract energy from their environment to perform mechanical work and, to a lesser extent, the sensors, by making these active particles adjust their motion properties to physical cues. However, these artificial particles are still largely incapable of autonomous information processing, which is limiting the scientific insight and technological applications of active matter. The main challenges are: 1. Make active particles capable of autonomous information processing. 2. Optimize the behavioral strategies of individual active particles. 3. Optimize the interactions between active particles. Drawing inspiration from Nature, this project will take the next steps in the evolution of artificial active matter systems by endowing them with embodied intelligence and autonomous information processing abilities. Specifically, it will: 1. Realize microscopic active particles with embodied intelligence (microbots). 2. Use embodied intelligence to achieve optimal behaviors for the microbots. 3. Use embodied intelligence to engineer interactions between microbots. I will achieve this by combining my background in mesoscopic physics and microfabrication with machine learning, a new research direction that offers radically different and complementary opportunities. This project will provide scientific insight into far-from-equilibrium physics and lay the foundations for ground-breaking applications empowered by microbots that are able to autonomously sense and react to their microscopic environment.

Link to the ERC project webpage: http://softmatterlab.org

Keywords of the ERC project: deep learning, active matter

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101001290	**3DNANOMAG**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Amalio Fernández-Pacheco**
Host Institution:	Agencia Estatal Consejo Superior De Investigaciones Cientificas - ESP

Three-dimensional nanoscale magnetic structures

Three-dimensional (3D) nanomagnets, with unconventional spin and topological properties, are very promising systems for the future development of greener, more capable, multi-functional technologies. However, the significant experimental challenges associated with the fabrication and probing of 3D nanoscale geometries and spin configurations, have restricted most studies to date in this field, to either computational and theoretical works, or experiments in simple 3D geometries that do not fully exploit the potential of moving to three dimensions.

Making use of recently-developed 3D nano-printing and magneto-optical tools, the 3DNANOMAG project will carry out first experimental investigations in ultra-advanced nanomagnetic systems with a variety of complex 3D geometries, multi-layered materials and chiral spin configurations. These techniques will be combined with state-of-the-art magnetic microscopy and simulations, in collaboration with worldwide experts.

The project will study 3D nanowire conduits, where the magnetic state and propagation properties of domain walls and skyrmionic textures will be tailored via symmetry-breaking nano-curvature effects, leading to ground-breaking investigations in 3D spintronic devices. In addition, new types of topologically non-trivial spin textures and localised magnetic defects will be realised via the pioneering exploitation of 3D geometrical effects in multi-strand nanowires with strong interwire coupling.

To carry out the project, 2.6M€ are requested, which will be employed to form a research team working for 60 months, use of microscopy facilities and the purchase of nanofabrication equipment specially designed for the investigation of 3D nanostructures.

Link to the ERC project webpage: https://sites.google.com/view/amaliofernandezpacheco/

Keywords of the ERC project: magnetism, spintronics, nanotechnology, 3D nanofabrication

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101002392	**InfAct**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Yael Roichman**
Host Institution:	Tel Aviv University - ISR

Active matter information machines

The relation between information and thermodynamics remains a fundamental thought-provoking issue since the days of Maxwell. The most effective platforms used to explore this relation are information machines: processes that convert measured information about a system to extractable work. A crucial question that goes beyond the currently explored regime in the field is how information machines perform out of equilibrium, namely when not in equilibrium with a thermal bath. This is the general scenario of relevance to biological systems and stands at the focus of this proposal.

Our recent result, showing how temporal correlations affect the efficiency of information engines (PRL 2018), demonstrates our ability to manipulate, track, and analyze particle motion in order to address such outstanding questions experimentally. We propose to realize and study three new information engines with increasing complexity: (1) a microscopic engine that converts information to osmotic pressure, (2) a macroscopic engine that converts information to pressure, and (3) a mobile engine converting local information to directed motion. The proposed engines are unique in that they harvest work from active systems, not necessarily coupled to a heat bath, and include many particles. By measuring work and information directly, we will be able to test the validity of the generalized second law of thermodynamics and the Jarzynski fluctuation theorem in active matter systems with feedback and control loops.

Providing essential, precise and detailed experimental observations in a field in which they are lacking will pave the way toward the extension of stochastic thermodynamics to active systems. Unraveling the mechanisms that govern conversion of information to useful work will benefit far-reaching applications. These include macroscopic and microscopic biomimetic robots and machines made of an ensemble of simple agents, analogous to natural phenomena such as cargo transport in ant colonies

Link to the ERC project webpage:

Keywords of the ERC project: Experimental statistical physics, Information engines, Active matter

Keywords that characterize the scientific profile of the potential visiting researcher/s: statistical physics, active matter

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101020445	**2D-Liquid**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Aleksandra Radenovic**
Host Institution:	Ecole Polytechnique Federale De Lausanne - CHE

2D material interactions with liquids probed with nanoscopy tools

In this project, we will introduce a myriad of nanoscopy techniques to investigate the liquid-solid interactions taking advantage of either engineered defects or defects already hosted in 2D materials. We will address the pertinent question on the mechanism of reactivity of 2D materials with aqueous electrolytes at ambient conditions and the role of the defects on the dynamics of interfacial charges. At the start of the project, we will explore defects hosted in two classes of 2D materials: hexagonal boron nitride (h-BN) and transition metal dichalcogenides (TMDs). Our plans are to define strategies to extend defect imaging combined with other characterization approaches to a multitude of 2D materials. In parallel, we will explore the role of interfacial liquid taking advantage of novel nanofluidic platforms termed angstrom slits that will allow fine-tuning the balance between 2D and 3D liquid. To control defect density in 2D materials, we will use approaches based on focused ion beam irradiation with Xenon and Helium ions

We will adapt and develop different nanoscopy tools such as single-molecule localization microscopy (SMLM), single-particle tracking, Point Accumulation for Imaging in Nanoscale Topography (PAINT) Minimal Emission Fluxes Microscopy MINFLUX and Scanning Ion Conductance Microscopy (SICM). All nanoscopy modalities used in 2D-LIQUID project can operate in –situ under ambient conditions and are compatible with the probing of defect chemistry, charge dynamics in different pH environments, and under different solvents or solvent mixtures. We believe that obtained insights regarding the role of defects in dynamics of the surface charges will shed light on the water and ion transport through nanopores, nanotubes but also ultimately narrow angstrom. Our findings will propel the development of nanofluidics, biosensing, energy harvesting, molecular separation and other nanoscale technologies that exploit liquid 2D-material interfaces.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101039103	**EMetBrown**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Thomas Salez**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Brownian Motion near Soft Interfaces

Soft and wet contacts are ubiquitous across scales from geology to physiology and are crucial for engineering. Furthermore, many processes of physics and biology at small scales are governed by the mobility of microscopic entities in soft and confined environments, with the aim of reaching specific targets. Interestingly, an emergent elastohydrodynamic (EHD) lift force was theoretically predicted recently for an immersed object moving near an elastic wall. An active community, including the PI, has started to explore this striking effect with various deterministic models and experiments, showing its relevance for nanoscale and biomimetic systems. In this context, and moving beyond the deterministic, the PI's central claim is that such EHD effects can be spontaneously triggered by thermal fluctuations. The result would be an original migration scenario in complex and confined environments – with enormous implications. However, studies are scarce on the topic. The ambition of EMetBrown is thus to address this challenge at the interface between two mature fields, by solving a fundamental problem involving both continuum and statistical mechanics: Brownian motion near soft interfaces. The three objectives are to reveal, explore and harvest the signatures of such motion, paving the way towards the future design of methods for particle transport, surface patterning, confined reactions and nanorheology. These objectives will be reached using a combination of experiments, theory and numerics, domains in which the PI has extensive experience. EMetBrown involves three core experimental setups (free colloids, optical trapping and atomic-force microscopy), three core theoretical models (soft lubrication, stochastic theory and Langevin simulations) and three exploratory tools (microfluidics, suspension rheometry and molecular dynamics). These complementary methods will be employed through four work packages covering various viscous, hard, soft materials, as well as applied flow.

Link to the ERC project webpage: https://www.loma.cnrs.fr/thomas-salez/

Keywords of the ERC project: Brownian motion, soft materials, confined flows, interfaces, colloids, dispersion, microfluidics, membranes, capillarity

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101040651	**SuperCorr**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Mathias Scheurer**
Host Institution:	Universitaet Innsbruck - AUT

Understanding, Engineering, and Probing Correlated Many-Body Physics in Superlattices of Graphene and Beyond

Exploring the plethora of possibilities provided by solid-state systems to realize exotic many-body phases is not only motivated by fundamental questions but also by potential quantum technological applications. In both cases, it is important to have control over the properties of the system in order to engineer the phase of interest, to have a clear theoretical understanding of the microscopic physics, and to be able to probe it. In this regard, superlattice systems have recently brought many exciting results: e.g., the moire lattice that emerges when two layers of graphene are twisted induces correlated phenomena, akin to high-temperature superconductors. Furthermore, artificially arranged atoms on surfaces have become popular tools to design electronic bands. SuperCorr will explore the vast set of possibilities provided by these tunable systems to engineer novel correlated many-body physics, propose ways to probe it, and advance our understanding of the complex phase diagrams of quantum matter.

More specifically, we will address key questions related to several different graphene moire systems, such as the origin and form of superconductivity, its relation to the correlated insulator, the interplay of topological obstructions and correlations, and the microscopics of their nematic phases. We will work on the impact of spin-orbit coupling and on a theoretical description of twist-angle disorder, viewing inhomogeneities as a blessing in disguise that can also be used to probe and realize interesting physics. Finally, we will develop a theoretical framework for the design of atom arrangements on the surface of complex host materials, in order to create or simulate a quantum many-body system on demand. To this end, we will employ and further extend a variety of analytical and numerical methods of many-body physics and field theory, and combine it, in some projects, with machine-learning techniques, while keeping a close connection to experiment.

Link to the ERC project webpage:

Keywords of the ERC project: condensed matter, graphene, superlattices, correlations, many-body physics, superconductivity, magnetism, spin liquids, topology, machine learning in physics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101041443	**MOUNTAIN**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Pascal Gehring**
Host Institution:	Universite Catholique De Louvain - BEL

Molecular Quantum Heat Engines

Heat engines are an integral part of our daily lives. They power cars or produce electricity by converting heat into work. Increasing their efficiency is very difficult and only marginal improvements have been achieved over the last decades. Thus, to reach the ambitious climate goals, it is necessary to go beyond conventional technologies. Atom-sized systems where quantum mechanical effects come into play could enable this: theory predicts that their efficiency can be boosted beyond the classical limits imposed by thermodynamics. However, so far, this has not been tested in practice due to a lack of suitable model systems.

I propose to build a molecular heat engine of only a few atoms in size, with such high control over its structure and properties that these predictions can finally be tested. The engine's quantum properties will be robust at experimentally accessible temperatures, its coupling to the environment will be controllable, and electrical transport through it will be quantum coherent. I seek to exploit the full gamut of their physical properties to boost efficiency, including spin entropy and vibrational coupling.

Practically, I will 1) implement a scanning probe setup into a dilution refrigerator, 2) fabricate single-molecule junctions with micro-heaters and ultra-sensitive superconducting thermometers, and 3) perform and interpret caloric experiments on single molecules at unprecedented precision.

The results will teach us about the fundamental properties of atom-scale quantum systems and heat flowing through single molecules. It will inspire new ways to increase the performance of thermoelectric applications such as waste heat harvesters, nanoscale spot-cooling devices, or even thermal rectifiers and transistors.

I am one of the forerunners in molecular thermoelectrics, with extensive hands-on experience in material sciences, nanotechnology, and mesoscopic physics. This multidisciplinary background is needed to make this ambitious project a success.

Link to the ERC project webpage: www.gehring-lab.com

Keywords of the ERC project: Molecular electronics; nanoscale physics; thermal transport; nanoelectronics; heat engines

Keywords that characterize the scientific profile of the potential visiting researcher/s: experimental physics; cryogenics; device fabrication; quantum transport experiments

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101042439	**CoSpiN**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Philipp Pirro**
Host Institution:	Technische Universitaet Kaiserslautern - DEU

Coherent Spintronic Networks for Neuromorphic Computing

Neuromorphic computing uses networks of artificial neurons highly interconnected by artificial synapses to perform vast data processing tasks with unmatched efficiency, as needed, for instance, for pattern recognition or autonomous driving tasks. The synaptic connections play a paramount role to create better hardware realizations of these networks. However, it is very complex to realize large interconnectivity by electronic circuitry. COSPIN overcomes this connectivity constraint by using the eigen-excitations of the magnetic system - the spin waves - to connect state-of-the-art artificial neurons based on spintronic auto-oscillators. COSPIN'S main goal is to create and experimentally validate innovative physical building blocks for a novel nano-scaled, all-spintronic network structure which incorporates all necessary properties for neuromorphic computing including high nonlinearity, interconnectivity and reprogrammability. By design, COSPIN works at the boundary between oscillator-based computing and wave-based computing. It uses interference, frequency-multiplexing, and time-modulation techniques as well as spin-wave amplification to significantly increase the connectivity between neurons. Reprogramming of the network is implemented by a direct physical link to magnetic memory solutions as well as by reconfiguring spin-wave circuits. By using coherent wave interference and nonlinear wave interaction, COSPIN paves the way for novel coupling phenomena for complex artificial neural networks far beyond the state-of-the-art of current hardware realizations. Using cutting-edge micromagnetic simulations enhanced by inverse design methods, the artificial networks will be designed and tested prior to their nano-fabrication. Experimental investigations will be mainly carried out using micro-focus Brillouin light scattering. This allows for local investigation of the individual neurons and synapses, and significantly simplifies the interpretation of the network dynamics.

Link to the ERC project webpage: https://www.physik.uni-kl.de/pirro/

Keywords of the ERC project: spin waves, spintronics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101044526	**MAWiCS**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Mathias Weiler**
Host Institution:	Technische Universitaet Kaiserslautern - DEU

Magneto-Acoustic Waves in Complex Spin Systems

Spintronic devices perform information storage and processing based on the spin degree of freedom. Materials with complex magnetic order, such as ferrimagnets, antiferromagnets and chiral magnets are promising candidates for next-generation spintronic devices with ultrafast speed, enhanced robustness and unique functionalities. However, several fundamental obstacles prevent their efficient control with established approaches based on magnetic fields and electrical currents.

MAWiCS will overcome these obstacles by introducing the magneto-acoustic control of magnetization in these complex spin systems. The advantage of MAWiCS' approach is based on the following hypotheses: Microwave frequency phonons can excite and control antiferromagnetic spin waves and magnetic skyrmions lattices with high efficiency. The uniaxial magnetic anisotropy induced by magneto-acoustic interactions can be used for full modulation of antiferromagnetic resonance frequencies. Magneto-acoustic waves can propagate in topologically protected skyrmion lattice edge-states with reduced magnetic damping.

MAWiCS will develop innovative experimental approaches to take advantage of symmetry, topology and exchange-enhancement effects for highly efficient control of spin dynamics in complex spin systems. Consequently, MAWiCS' results will allow for the first time to:

1) Generate nanoscale spin waves from acoustic pulses in ferrimagnets and antiferromagnets.
2) Control skyrmions by acoustic lattices and realize nanoscale topological acoustics
3) Excite and detect antiferromagnetic spin waves by acoustic two-tone modulation

MAWiCS' results will pave the way for the technological realization of magneto-acoustic spintronic devices, enable antiferromagnetic magnonics and realize topological magnon transport. Ultimately, MAWiCS will thus pioneer a new class of information technology concepts that do not only offer increased performance but also novel functionalities.

Link to the ERC project webpage: https://www.physik.uni-kl.de/en/weiler/research/mawics

Keywords of the ERC project: surface acoustic wave, skyrmion, antiferromagnet, magnon, phonon

Keywords that characterize the scientific profile of the potential visiting researcher/s: magnetization dynamics,micromagnetics, magneto-optics, microwave spectroscopy, Brillouin Light Scattering, magnet cryostat, chiral magnet, antiferromagnet, surface acoustic wave

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Project ID:	Project Acronym:	Evaluation Panel:
101044657	**T-Higgs**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Stefan Kaiser**
Host Institution:	Technische Universitaet Dresden - DEU

Phase-resolved THz-Higgs Spectroscopy on Superconductors

T-Higgs develops “Higgs Spectroscopy” as novel tool to probe the order parameter in superconductors. It will allow unprecedented insights into the structure and dynamics of the condensate and shine new light onto the physics of unconventional superconductors. In particular high temperature superconductivity calls for new probes to reveal its pairing mechanism. T-Higgs can also be applied to intriguing phenomena like light-induced superconductivity, superconductivity in “twisttronics” or under extreme conditions matching the ongoing importance of superconductivity in quantum materials.

T-Higgs is a high-field phase-resolved non-linear THz spectroscopy on order parameter excitations of the superconducting ground state itself, the Higgs oscillations. Probing the internal structure of the condensed Cooper pairs this reveals not only the symmetry of the order parameter but also couplings of the condensate to external modes and their interplay with superconductivity.

T-Higgs has three parts. WP1 will develop the full method and perform Higgs spectroscopy on unconventional superconductors: In particular a systematic study of high-Tc cuprates. In their complicated phase diagram T-Higgs will explore the role of the intertwined orders in the pairing mechanism and trigger new ideas on their theoretical description. WP2 will focus on the aspect of light induced-superconductivity controlled by ultra-short light pulses. It transiently probes the non-equilibrium states via the time dependent Higgs modes in the light induced state. Not only will this allow to discriminate light-induced superconductivity from perfect conductors but also gain insight into the mechanism behind the buildup and decay of superconducting coherence. WP3 will explore the possibilities of Higgs spectroscopy to be extended to momentum space via time resolved ARPES as well as into extreme regimes like external pressure and strain.

Link to the ERC project webpage:

Keywords of the ERC project: superconductivity, THz, optics, ultrashort pulse lasers, high harmonics generation

Keywords that characterize the scientific profile of the potential visiting researcher/s: optics, lasers, spectroscopy, time resolved probes, correlated quantum materials

Project ID:	Project Acronym:	Evaluation Panel:
101045089	**T-Recs**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Norberto Daniel Lanzillotti Kimura**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Tunable and Reconfigurable Nanoacoustics

In solid-state physics, all the properties determined by the atoms' position are susceptible to be modified by acoustic phonons. Acoustic phonons are usually seen as a primary source of unwanted effects in electronics, optoelectronics, and quantum technologies based on solid-state platforms. This project proposes a series of tunable nanodevices where acoustic-phonons constitute, instead, a central resource to unveil wavelength conversion phenomena, transfer information, and simulate systems difficult or impossible to study in optics and electronics.

The current trend in nanophononics is to engineer acoustic nanodevices to shape the local acoustic density of states, tailor the light-matter interaction, or enhance the interactions with other systems based on static and predetermined fixed-function nanostructures. This project takes a radically different direction by incorporating responsive materials that change their elastic properties under external stimuli. GeSbTe compounds and vanadium dioxide present phase transitions that can be triggered thermally, optically, or electrically and have associated ultrafast changes in their elastic properties. These materials, widely used in active photonics and electronics, will be integrated into nanophononic semiconductor and oxide-based resonators working in the GHz-THz range.

The project is organized around three major challenges: i) To develop hybrid tunable acoustic-phonon resonators and transducers based on materials presenting structural phase transitions. ii) To develop reconfigurable nanophononic lattices (i.e. artificial graphene) formed by coupled resonators. And iii) To demonstrate novel acoustic-phonon wavelength conversion phenomena, simulate time-dependent Hamiltonians, and develop dynamical acoustic phonon devices. Using dynamical structures to control acoustic phonons in the GHz-THz range will enable a new dimension in the solid-state physics toolbox.

Link to the ERC project webpage:

Keywords of the ERC project: nanomechanics, phase transitions, phonons, nanophononics, nanoacoustics, pump probe, optomechanics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101045468	**SynthNuc**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Jan Brugues**
Host Institution:	Max Planck Gesellschaft Zur Foerderung Der Wissenschaften E.V. - DEU

Understanding emergent physical properties of chromatin using synthetic nuclei

The main aim of this proposal is to resolve how the physics of molecular-scale activities result in the emergent material properties of chromatin and how those contribute to chromatin organization and function. Mounting evidence suggests that the material properties of chromatin regulate essential nuclear processes. Chromatin has been studied with two disconnected approaches; pure in vitro studies, perfectly suited for careful biophysical measurements on single DNA molecules but lacking the complexity of a cell, or intact cell measurements, with limited access to measure material properties and small-scale chromatin dynamics. The physical properties of chromatin, however, are emergent and result from the molecular activities that are in turn regulated by those properties. As a consequence, it is crucial to establish new experimental assays that connect these two scales and levels of complexity. Here, I will bridge the gap in scales and biochemistry between pure in vitro assays and measurements in intact cells by reconstituting chromatin processes in Xenopus laevis egg extracts across scales. I will combine quantitative microscopy, optical tweezer measurements, and theory to biophysically characterize the self-organization of protein-DNA co-condensation and loop extrusion and single chromatin molecules of increasing complexity. To bridge the microscopic and the macroscopic scales, I will assemble synthetic nuclei made of pre-engineered DNA sequences, which allows for exquisite control of DNA length, amount, and chromatin activities. In combination with microrheology, micropipette aspiration, and magnetic tweezers, I will unravel how the collective behavior of chromatin activities gives rise to the emergence of large-scale material properties of chromatin. This project will provide a physical description of the material state of chromatin across scales and contribute to reveal the basic physical principles that govern nuclear organization and function.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101054860	**SUPERMINT**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Stuart Parkin**
Host Institution:	Max Planck Gesellschaft Zur Foerderung Der Wissenschaften E.V. - DEU

Interplay between Chirality, Spin Textures and Superconductivity at Manufactured Interfaces

Memories that operate at cryogenic temperatures are urgently needed to realize advanced quantum and superconducting computing systems that will enable more efficient and scalable computing systems beyond today's reach. SUPERMINT proposes to combine the latest advances in superconductivity and spintronics to build a novel SUPERTRACK cryogenic memory, that is high performance, non-volatile and that needs very low energy for its operation. A major objective will be to demonstrate the generation and use of triplet supercurrents, that are dissipation-less, but which carry spin-angular momentum, to move chiral domain walls in magnetic racetracks. A second major objective will be to explore the origin and utilize our recent discovery of a non-reciprocal Josephson diode effect, to build a novel device to detect magnetic fields and thereby "read" magnetic domain walls for SUPERTRACK. These objectives will be met by exploring and designing "manufactured interfaces" or MINTs that combine superconducting and magnetic ultra-thin layers using an advanced complex of thin film deposition systems that I have constructed over the past 5 years. To achieve these objectives, fundamental breakthroughs are needed in the preparation of MINTs with high-quality interfaces. A wide-ranging exploration of MINTs formed from superconducting layers with chiral antiferromagnets, homo-chiral layers of chiral compounds, especially from the B20 family of materials, and geometrical chiral structures will be undertaken. In addition, the concept of obstructed atomic insulators that we have recently developed will be used to identify novel interfaces of insulating materials that are metallic and, thereby, to explore the possibility of making these superconducting by pairing electrons via chiral antiferromagnetic fluctuations in adjacent layers.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: SPINTRONICS, Racetrack, cryogenic memory, triplet superconductivity, supercurrent, Josesphon Diode

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Project ID:	Project Acronym:	Evaluation Panel:
786707	**FunMagResBeacons**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Malcolm Levitt**
Host Institution:	University Of Southampton - GBR

Functionalized Magnetic Resonance Beacons for Enhanced Spectroscopy and Imaging

This project will develop and demonstrate molecular agents called functional magnetic resonance beacons (fMRBs). These will provide a new set of versatile spectroscopic tools for the spatially resolved study of chemistry, biochemistry, diffusion, flow and percolation inside opaque objects. The fMRB agents support hyperpolarized nuclear spin order, which generates enormously enhanced nuclear magnetic resonance (NMR) signals. The agents are designed to maintain such order for long times (between 5 minutes and several hours) in ambient temperature solution, enabling their transport deep inside opaque objects. The molecules are functionalized, so that they "light up" in an NMR or magnetic resonance imaging (MRI) experiment, upon triggering by specific chemical signals or physical conditions (sensory functionality), and may also to bind to selected molecular targets (binding functionality). One set of proposed realisations possesses "lock-and-key" functionality, meaning that the hyperpolarized nuclear spin order is "locked" into a form which is invisible in the NMR spectrometer, but which may be "unlocked" at any chosen time by applying a suitable radiofrequency pulse sequence. The following molecular moieties are proposed as storage modules: (1) molecular cages, such as functionalized C60 fullerenes, encapsulating noble gas atoms such as 3He; (2) spin clusters supporting long-lived states, such as pairs of 13C or 15N nuclei, in shielded molecular environments. The sensory moieties include tailored peptide sequences, which may be activated by the presence of particular proteases, while binding modules include moieties such as biotin. The agents are designed to be conveniently transportable in a hyperpolarized state. Potential long-term applications include in vivo molecular imaging by MRI.

Link to the ERC project webpage:

Keywords of the ERC project: NMR, nuclear magnetic resonance, hyperpolarization

Keywords that characterize the scientific profile of the potential visiting researcher/s: NMR

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
818064	**GEMS**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Chiara Cappelli**
Host Institution:	Scuola Normale Superiore Di Pisa - ITA

General Embedding Models for Spectroscopy

Recently, there has been a paradigmatic shift in experimental molecular spectroscopy, with new methods focusing on the study of molecules embedded within complex supramolecular/nanostructured aggregates. In the past, molecular spectroscopy has benefitted from the synergistic developments of accurate and cost-effective computational protocols for the simulation of a wide variety of spectroscopies. These methods, however, have been limited to isolated molecules or systems in solution, therefore are inadequate to describe the spectroscopy of complex nanostructured systems. The aim of GEMS is to bridge this gap, and to provide a coherent theoretical description and cost-effective computational tools for the simulation of spectra of molecules interacting with metal nano-particles, metal nanoaggregates and graphene sheets.

To this end, I will develop a novel frequency-dependent multilayer Quantum Mechanical (QM)/Molecular Mechanics (MM) embedding approach, general enough to be extendable to spectroscopic signals by using the machinery of quantum chemistry and able to treat any kind of plasmonic external environment by resorting to the same theoretical framework, but introducing its specificities through an accurate modelling and parametrization of the classical portion. The model will be interfaced with widely used computational chemistry software packages, so to maximize its use by the scientific community, and especially by non-specialists.

As pilot applications, GEMS will study the Surface-Enhanced Raman (SERS) spectra of systems that have found applications in the biosensor field, SERS of organic molecules in subnanometre junctions, enhanced infrared (IR) spectra of oligopeptides adsorbed on graphene, Graphene Enhanced Raman Scattering (GERS) of organic dyes, and the transmission of stereochemical response from a chiral analyte to an achiral molecule in the vicinity of a plasmon resonance of an achiral metallic nanostructure, as measured by Raman Optical Activity-ROA

Link to the ERC project webpage: https://gems.sns.it

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
818266	**LactaDiff**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Julien Valette**
Host Institution:	Commissariat A L Energie Atomique Et Aux Energies Alternatives - FRA

Assessing cellular compartmentation of brain lactate using diffusion MR spectroscopy in vivo

The idea has emerged that compartmentation of brain lactate, i.e. its distribution between different cell types and the extracellular space, plays a critical role in neurotransmission and brain plasticity. Dysregulations of lactate metabolism have also been reported in neurodegenerative diseases such as Alzheimer's disease. However, these notions remain challenged, and even fundamental mechanisms such as the astrocyte-to-neuron lactate shuttle, whereby astrocytes are supposed to export lactate to neurons to sustain neuronal energy needs, are still fiercely debated. This is largely due the lack of tools to evaluate cell-specific compartmentation of lactate in the living brain, in particular in Humans.

In this project, we will develop new nuclear magnetic resonance spectroscopy techniques to non-invasively measure lactate diffusion, including in cortical regions. We will then take advantage of the unique ability of these methods to differentiate between metabolites diffusing in different environments, based on diffusion properties imposed by the microstructure, to quantify lactate in the extracellular space and, most importantly, in neurons and astrocytes. After validation in rodent models, these methods will be transposed on a clinical MRI system at ultra-high magnetic field, to gain unprecedented access to lactate compartmentation in the Human brain and its modifications during brain activity, plasticity, and in Alzheimer's disease. This will open a new research field for magnetic resonance spectroscopy in vivo.

Link to the ERC project webpage:

Keywords of the ERC project: Brain; lactate; MRI; spectroscopy; diffusion; metabolism; MRS

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
832703	**CONTROL**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Klaas Wynne**
Host Institution:	University Of Glasgow - GBR

Laser control over crystal nucleation

The CONTROL programme I propose here is a five-year programme of frontier research to develop a novel platform for the manipulation of phase transitions, crystal nucleation, and polymorph control based on a novel optical-tweezing technique and plasmonics. About 20 years ago, it was shown that lasers can nucleate crystals in super-saturated solution and might even be able to select the polymorph that crystallises. However, no theoretical model was found explaining the results and little progress was made.

In a recent publication (Nat. Chem. 10, 506 (2018)), we showed that laser-induced nucleation can be understood in terms of the harnessing of concentration fluctuations near a liquid–liquid critical point using optical tweezing. This breakthrough opens the way to a research programme with risky, ambitious, and ground-breaking long-term aims: full control over crystal nucleation including chirality and polymorphism.

New optical and microscopic techniques will be developed to allow laser manipulation on a massively parallel scale and chiral nucleation using twisted light. Systematically characterising and manipulating the phase behaviour of mixtures, will allow the use of the optical-tweezing effect to effectively control the crystallisation of small molecules, peptides, proteins, and polymers. Exploiting nanostructures will allow parallelisation on a vast scale and fine control over chirality and polymorph selection through plasmonic tweezing. Even partial success in the five years of the programme will lead to fundamental new insights and technological breakthroughs. These breakthroughs will be exploited for future commercial applications towards the end of the project.

Link to the ERC project webpage:

Keywords of the ERC project: crystal nucleation, amorphous intermediates, supercooling, glass transition, optical tweezing, Raman spectroscopy

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
848668	**RadSpec**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Joshua Baraban**
Host Institution:	Ben-Gurion University Of The Negev - ISR

A New Strategy for Vibronic Spectroscopy of Radicals

This proposal aims to develop a novel strategy for high resolution vibronic spectroscopy of radicals, with unprecedented sensitivity, specificity, and applicability. The proposed scheme will provide answers to longstanding quantum mechanical questions about non-adiabatic dynamics, and, in combination with a unique, recently developed transparent microreactor source of reactive molecules, enable the pursuit of unknown reactive intermediates.

Radicals and transient reactive intermediates are centrally important to chemistry but notoriously difficult to study. The proposer has recently led several successful experimental and theoretical efforts directed at molecules and transition states thought to be extremely difficult if not impossible to characterize. Here we propose to launch a revolutionary approach to spectroscopy of these important species, exploiting a key insight into dissociation dynamics on top of elements of state of the art laser spectroscopy techniques in the infrared, ultraviolet, and vacuum ultraviolet to forge a new universal method. It possesses the high sensitivity and mass selectivity of ion detection, while simultaneously being multidimensional and fully rovibronic in scope to extract the maximum possible information about coupled nuclear and electronic dynamics.

We anticipate that this advance will also be of great interest and utility to a broad swath of researchers in related fields, such as combustion, atmospheric chemistry, and surface science, who require the ability to track rare but reactive species. The nitrate and cyclopentadienyl radicals will initially be targeted as particularly important examples, and we also plan to hunt for as yet unobserved reactive intermediates using our new spectroscopic scheme alongside the flexibility of our molecular source to rationally explore chemical phase space.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
850764	**TACCAMA**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Barbara Lechner**
Host Institution:	Technische Universitaet Muenchen - DEU

Atomic-Scale Motion Picture: Taming Cluster Catalysts at the Abyss of Meta-Stability

From fine chemical synthesis over combustion control to electrode design – the majority of chemical reactions rely on catalysts to improve energy and material efficiency. Yet, the atomic-scale processes underlying a catalytic reaction at elevated pressures are far less well-understood than one might expect. Indeed, the successful optimization of industrial catalysts is typically achieved by 'trial and error'. If we precisely understood the correlation between catalyst dynamics and activity, we could instead design stable, yet intrinsically dynamic (i.e. structurally fluxional) catalysts, drastically reduce our waste of noble metals by using only the most active particles and replace rare and toxic materials.
This project constitutes a fundamental and systematic investigation of heterogeneous catalysis in action. My aim is to map the pressure and temperature range in which supported particle catalysts are stable, and correlate particle size and support morphology with dynamics and stability. To do so, I will combine my experience with surface dynamics studies, video-rate scanning tunneling microscopy (STM), ambient pressure (AP) surface science and cluster research. State-of-the-art video-rate APSTM will enable me to observe catalyst dynamics such as sintering, adsorbate spillover onto the support, dynamic structural fluxionality of clusters and support roughening as a function of reactant partial pressure and temperature. The novelty of this project lies in the direct observation of catalyst particles, defined to the exact number of atoms, under realistic reaction conditions in order to tune reactivity by controlling their dynamics and stability on structurally and electronically optimized oxide supports. AP X-ray photoelectron spectroscopy (APXPS) will supply complementary information about chemical changes occurring in cluster and support. The knowledge gained will contribute to the targeted design of more active and efficient catalysts for specific applications.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
850850	**HEIST**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Søren Bredmose Bredmose Simonsen**
Host Institution:	Danmarks Tekniske Universitet - DNK

High-temperature Electrochemical Impedance Spectroscopy Transmission electron microscopy on energy materials

The great challenge for humankind is to mitigate climate changes by replacing fossil fuels with renewables. We will have to store excess energy produced by solar and wind power for usage in dark and calm weather. Excess energy can be stored electrochemically by high-temperature electrolysis cells as they have the potential to store vast amounts of electrical energy by conversion to chemical fuels. Solid oxide electrolysis cell (SOEC) technology is well known and proven, but not price competitive with storage of fossil fuels.

To drive the SOEC research towards a breakthrough, it is critical to determine relations between electrochemical activity and structure/composition in the cells. Electrochemical impedance spectroscopy (EIS) is a very powerful method for determining the contribution from processes in the cell to the overall activity. EIS cannot show structure/composition which is offered by transmission electron microscopy (TEM). Conventional TEM, however, does not offer insight into active cells, but only post mortem analysis.

High-temperature electrochemical TEM is extremely challenging because this requires a) that hard and brittle ceramic cells are thinned to electron transparency (ca. 100 nm), b) that the cells are carefully designed to allow for characterization of the layer interfaces, and c) that the cells are characterized during exposure of i) reactive gasses, ii) electrical potentials and iii) temperatures up to ca. 800 °C.

The aim of HEIST is to cover step a) to c), i.e. to transform TEM into an electrochemical lab for high-temperature electrochemical experiments including EIS. HEIST will give us “live” images of nanostructures and composition during operation of the electrochemical cells and thus disclose structure-activity relations. This is important, because the structures of nanomaterials will transform depending on the electrochemical environment, and post mortem analysis does not offer a correct representation of the active nanostructures.

Link to the ERC project webpage: http://www.heist-project.eu/

Keywords of the ERC project: TEM, SOEC, SOFC, FIB

Keywords that characterize the scientific profile of the potential visiting researcher/s: TEM, SOEC, SOFC, FIB

Project ID:	Project Acronym:	Evaluation Panel:
851154	**ULTRAIMAGE**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Giulia Fulvia Mancini**
Host Institution:	Universita Degli Studi Di Pavia - ITA

Advanced EUV/soft X-ray microscopy in the ultrafast regime: imaging functionality of nanomaterials across length scales

Imaging charge, spin, and energy flow in functional materials when hit by a light pulse, is a current grand challenge in nanotechnology relevant to a host of systems including photovoltaics, optoelectronic and spin devices. The design of such materials relies critically on the availability of accurate characterisation tools of how light-induced function and performance are related to nano-to-mesoscale electronic and lattice structural properties.

To address this challenge, ULTRAIMAGE will introduce ground-breaking capabilities in microscopy of nanomaterials, providing access to their far-from-equilibrium states, with resolution on nanometer-to-Ångstrom length and femtosecond time scales. Key to this advance is the combination of extreme ultraviolet (EUV) to soft X-ray tabletop coherent light sources with a technique for coherent diffractive imaging called ptychography, in which multiple diffraction patterns from overlapping fields of view are processed by iterative algorithms to recover amplitude and phase images of sample and beam, separately.

Nanoscale movies of the sample's impulsive response, irradiated by ultrafast laser pulses, will be obtained with extremely high fidelity and in a non-destructive approach, with sub-20nm transverse resolution, 0.5Å axial precision, and ≈10fs temporal resolution. Each movie frame will be characterized by amplitude and phase images of the sample, with exquisite quantitative contrast to material composition, and to its topography.

ULTRAIMAGE will introduce a world-class tabletop facility for ultrafast ptychography with coherent short-wavelength EUV light, which will enable the understanding with unprecedented detail of fundamental nanoscale behaviour, vital to a better design of energy-efficient next generation devices.

Link to the ERC project webpage: https://luxem.unipv.it/research/

Keywords of the ERC project: MICROSOCPY, ULTRAFAST, NANOPARTICLES

Keywords that characterize the scientific profile of the potential visiting researcher/s: ULTRAFAST LASER SCIENCE, COLLOIDAL NANOPARTICLE ASSEMBLIES

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
851421	**POLYQUANT**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Edit Matyus**
Host Institution:	Eötvös Loránd Tudományegyetem - HUN

Theoretical developments for precision spectroscopy of polyatomic and polyelectronic molecules

I propose research for an increasingly accurate quantum mechanical computation of small molecular systems including non-adiabatic, relativistic, and radiative effects. The computed rovibronic energy intervals will be directly comparable with high-resolution and precision spectroscopy measurements. The accuracy goal for theory (and experiment) is more than six-orders of magnitude tighter than the usual chemical accuracy defined to be on the order of 1 kcal/mol. The rovibronic eigenstates obtained from effective non-adiabatic, relativistic-radiative Hamiltonians to be developed will provide the most fundamental and most detailed quantum dynamical fingerprint of the molecular system, and as a complete database they are necessary for the simulation of a variety of molecular phenomena including ultrafast laser-molecule interactions.

Link to the ERC project webpage: www.compchem.hu

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
852208	**123STABLE**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Nejc Hodnik**
Host Institution:	Kemijski Institut - SVN

Towards Nanostructured Electrocatalysts with Superior Stability

In the last decades, significant progress has been made on understanding and controlling solid/liquid electrochemical interfaces at atomic levels. As the principles guiding the activity of electrochemical reactions are quite well established (structure-activity relationships), the fundamentals of stability are still poorly understood (structure-stability relationships). 123STABLE proposes to employ (1) identical location, (2) online monitoring and (3) modeling of noble metals based nanoparticles changes with the state-of-the-art electron microscopy equipment and online dissolution and evolution analytics using electrochemical flow cell coupled to online mass spectrometers. Projects unique methodology approach with picogram sensitivity levels, in combination with sub-atomic scale microscopy insights and simulations, promises novel atomistic insights into the corrosion and reconstruction of noble metals in electrochemical environments. This unique approach is based on observations of the same nanoparticles before and after electrochemical treatment where weak and stable atomic features and events can be recognized, followed, understood and finally utilized. Upon (1) doping, (2) decoration and/or (3) other synthetic modification of nanoparticles like a change in size and shape further stabilization is envisioned. For instance, blockage of nanoparticle vulnerable defected sites like steps or kinks by more noble metal could stop or significantly slow down their degradation.
The 123STABLE project will feature platinum- and iridium-based nanostructures as a model system to introduce a unique “123” approach, as they still possess the best electrocatalytic properties for the future electrification of society through the Hydrogen economy. However, their electrochemical stability is still not sufficient. Coupled with the fact that their supply is hindered by extremely scarce, rare and uneven geological distribution, the increase in their stability is of immense importance.

Link to the ERC project webpage:

Keywords of the ERC project: electrocatalysis, platinum, iridium, nanoparticles, oxygen reduction reaction, oxygen evolution reaction, synthesis, characterization, TEM, SEM

Keywords that characterize the scientific profile of the potential visiting researcher/s: synthesis, characterization, electrosynthesis, electrolyzers, fuel cells

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
864625	**ConTROL**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Koen Vandewal**
Host Institution:	Universiteit Hasselt - BEL

Charge-TRansfer states for high-performance Organic eLectronics

Thin films comprising a blend of electron donating (D) and electron accepting (A) molecules are ubiquitous in organic electronic devices. At the D-A interfaces, intermolecular charge-transfer (CT) states form, in which an electron is transferred from D to A. Electrical doping (p- and n-type) involves ground-state CT from dopant to host and results in increased conductivities of the host organic semiconductor. Furthermore, the performances of organic solar cells, photodetectors and light emitting diodes depend crucially on D-A interfaces where the CT state is an excited state, mediating between photons and free charge carriers. New applications of intermolecular CT states, such as transparent conductors, artificial synapses, biosensors, organic persistent luminescent materials and low cost narrowband near-infrared sensors have emerged in the past years, and there is clearly potential for additional innovation. However, current progress is hampered by a lack of understanding of the fundamental properties of intermolecular CT states and their decay and dissociation mechanisms. ConTROL aims to fill this knowledge gap and link device performance to molecular parameters of D-A interfaces. Electro-optical properties will be tuned by molecular design and appropriate D-A selection, as well as by weak and strong interactions with the opto-electronic device's optical cavity. The knowledge generated will not merely result in improved performance of existing organic electronic devices, but new avenues and novel exciting applications of intermolecular CT states will be demonstrated.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
865590	**Programmable Matter**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Artem Mishchenko**
Host Institution:	The University Of Manchester - GBR

New materials enabled by programmable two-dimensional chemical reactions across van der Waals gap

Chemical reactions between solids are fundamental in areas as diverse as catalysis, information storage, pharmaceuticals, electronics manufacturing, advanced ceramics, and solar energy, to name just a few. Controlling the spatial extent of solid-state reactions at the nanoscale will enable development of materials, programmed on an atomic level, which will facilitate many emerging applications like bioinspired smart batteries and artificial synapses for future neuromorphic electronics. However, currently, there are no chemistry methods which allow precise spatial control at the nanoscale, limiting progress towards the programmable matter. Here I propose a completely new way to create novel materials using two-dimensional (2D) chemical reactions at the atomically-defined interfaces between crystalline solids. Usually, reactions between macroscopic solids are hindered as their large dimensions prevent placing them close enough to each other to support chemical transformations. Thus, just a few years ago, the task of placing two atomically flat crystals within angstrom proximity of each other, to initiate chemical interactions between them, was impossible to realise. This situation has changed dramatically with the advent of van der Waals technology - disassembly of various layered crystals into individual atom- or molecule-thick layers followed by a highly-controlled reassembly of these layers into artificial heterostructures. Building on our recent progress in van der Waals technology, I aim to realise interplanar chemical reactions between highly-crystalline solids in precisely controllable conditions using temperature, electric and magnetic fields, light, sound, pressure, and mechanical forces as means of control. Using digital control of 2D chemistry, mechanics, and electronics at the nanoscale, I and my team will develop programmable matter that actively responds to external and internal stimuli by adjusting their properties on an atomic level.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
866559	**NANOVR**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr David Glowacki**
Host Institution:	Universidade De Santiago De Compostela - ESP

Nanoscale Design using Virtual Reality

As molecular scientists have made progress in their ability to engineer and design the structure of mo-lecular systems at the nano-scale, a new fundamental challenge has emerged: namely, our ability to un-derstand and engineer molecular dynamics (MD) and flexibility. This limits our ability to carry out effi-cient molecular engineering in a range of important areas, including enzymatic catalysis, ligand-protein kinetics, and molecular signalling. In principle, MD simulations offer an excellent tool for furnishing microscopic insight into the fundamental dynamical and kinetic processes driving important molecular processes. However, the potential energy surfaces which characterize complex nano architectures have an extremely high dimensionality, making the exploration of structural dynamics a challenge; simula-tions tend to get trapped in metastable states, making it difficult to explore important transition path-ways. Drawing on the state-of-the-art in high performance computing [HPC] and virtual reality [VR], NanoVR will develop a new paradigm for undertaking nano-scale design, engineering, and analysis, through a synergistic combination of human design insight on the one hand and computational automation on the other. We will develop an intuitive open-source framework which enables molecular scientists to use VR-enabled interactive MD for guiding the automatic calculation of free energies along dynamical pathways in complex systems. We will highlight the power of this approach by applying it to under-stand enzyme-catalysed peptide macrocyclization, as well as the key protein-ligand interactions re-sponsible for emerging drug resistant strains of influenza. In so doing, we will advance fundamental new microscopic insight into molecular conformational dynamics, and grow a thriving user & develop-er community across both academia and industry committed to accelerating molecular design across important domains spanning biochemistry, materials chemistry, & catalysis.

Link to the ERC project webpage: https://www.intangiblerealitieslab.org/

Keywords of the ERC project: virtual reality, molecular dynamics, computer graphics, scientific simulation, gamified science, high performance computing

Keywords that characterize the scientific profile of the potential visiting researcher/s: virtual reality, computer graphics, human computer interaction, scientific simulation, molecular dynamics

Project ID:	Project Acronym:	Evaluation Panel:
883631	**DynaMo**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Hans-Jürgen Butt**
Host Institution:	Max Planck Gesellschaft Zur Foerderung Der Wissenschaften E.V. - DEU

Dynamic charging at moving contact lines

Water drops sliding over hydrophobic surfaces can lead to surface charging. In contrast to charging caused by friction between two solid phases, drop slide electrification is largely unexplored. Slide electrification has been consistently reported, but results are difficult to reproduce. No theory or quantitative explanation currently exists. One reason for the lack of quantitative understanding is that the deposition of charge is a non-equilibrium effect and depends essentially on microscopic processes at the contact line. Slide electrification is relevant for the friction of drops and possible corrosion due to ions deposited on surfaces. It has potential as a means of power generation.

Based on a recently developed lateral adhesion force apparatus (DAFI) and a new theoretical approach to describe slide electrification, we aim for a fundamental understanding of charge separation at sliding drops. Thus we plan to

- identify important parameters for slide electrification (surface chemistry, substrate material, thickness, slide distance, velocity, drop rate, pH value, salt, atmosphere), and
- construct a fast, inverted Reflectance Interference Microscope (RIM) to image the movement of the sliding contact line with unprecedented temporal and spatial resolution. RIM will be combined with DAFI and electronics to detect charge transfer.
- Experiments using macroscopic drops will be complemented by moving micron-sized drops (<1 pL) over surfaces using a liquid probe microscope and simultaneously measuring the charge transfer.
- Based on the microscopic processes identified above we develop a theory to predict charge transfer.

Using this fundamental understanding, we will explore the potential of slide electrification for electric energy generation. Our objectives are to design a nano- and microstructured surface, which provides maximal power output, and build small scale devices to generate electric energy.

Link to the ERC project webpage: https://sites.mpip-mainz.mpg.de/dynamo/

Keywords of the ERC project: Wetting, contact angle, tribocharging

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
948426	**3DX-FLASH**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Pablo Villanueva Perez**
Host Institution:	Lunds Universitet - SWE

Probing MHz processes in 3D with X-ray microscopy

I aim to develop an X-ray imaging technique capable of filming processes in 3D, with a temporal resolution several orders of magnitude faster than up-to-date 3D X-ray imaging techniques.
The unique penetration power of X-rays allows us to study systems in their native environment. This property has led to the development of X-ray microtomography (µCT). µCT acquires 3D information, which determines the functionality and mechanical properties of nature, by rotating a sample with respect to the X-ray source. µCT is a crucial tool for several scientific disciplines such as physics, biology, and chemistry.
Over the last decade, µCT has become a technique capable of not only recording 3D information but also filming dynamical processes. Several breakthroughs have made this possible: i) intense X-ray sources (synchrotron light sources), ii) efficient and fast X-ray detectors, and iii) fast 3D reconstruction algorithms. Despite all of these developments, the acquisition protocols remain unchanged, i.e., the sample is only rotated faster. This fast rotation introduces forces which may alter the studied dynamics and ultimately limit the achievable temporal resolution.
My project is to establish an X-ray microscope that avoids the sample rotation, obtaining 3D information from a single X-ray flash by splitting it into nine-angularly resolved beams which illuminate the sample simultaneously. This approach, when implemented at intense X-ray sources such as synchrotron light sources and X-ray free-electron lasers, will allow the filming of natural processes with micrometer to nanometer resolution and resolve dynamics from microseconds to femtoseconds. To demonstrate its capabilities, I will study fundamental processes in cellulose fibers, a renewable biomaterial, which can replace fossil-based materials, such as plastics. This technique will open up the possibility to film dynamics in 3D to answer questions coming from industry and natural sciences at rates not accessible today.

Link to the ERC project webpage:

Keywords of the ERC project: X-ray imaging, 3D, 3D, synchrotron radiation, X-ray free-electron lasers

Keywords that characterize the scientific profile of the potential visiting researcher/s: X-ray imaging, deep-learning, X-ray free-electron lasers, synchrotron radiation

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Project ID:	Project Acronym:	Evaluation Panel:
948525	**HILTRAC**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Julia Lehman**
Host Institution:	The University Of Birmingham - GBR

Highly Instrumented Low Temperature Reaction Chamber

In this project, I will build, optimize, and apply a Highly Instrumented Low Temperature Reaction Chamber (HILTRAC) to study organosulfur chemical reactions. This chamber is the first of its kind to couple a uniform supersonic flow (USF) capable of achieving a wide range of cold temperatures (30 – 250 K) with the unique detection capabilities of an infrared direct frequency comb spectrometer (DFCS). The combination of DFCS with two additional detection methods (laser-induced fluorescence and time-of-flight mass spectrometry) will make HILTRAC a highly versatile instrument, with sufficient sensitivity and selectivity to measure very low concentrations of molecules in a gas phase chemical reaction. The spectrally broadband and high resolution frequency comb laser enables both reactants and products to be identified and monitored simultaneously as a function of reaction time. For the first time, a single instrument will have the ability to collect multiplexed information on temperature-dependent reaction kinetics, product identification, and product branching ratios. This will set a new benchmark for what should be considered a more complete understanding of the way a reaction progresses. As a first target for the newly commissioned HILTRAC, I will study three different organosulfur reactions relevant to chemical environments ranging from the interstellar medium to biological systems. There is very little information about organosulfur reactions in general and especially at low temperatures due to experimental challenges which the USF is able overcome. By using the combined power of the HILTRAC detection methods and the temperature controlled environment, with supporting quantum chemical calculations and reaction kinetics simulations, I will be able to draw conclusions about the reaction potential energy surfaces which govern the branching to reaction products. This in turn will allow predictive abilities beyond achievable experimental conditions.

Link to the ERC project webpage:

Keywords of the ERC project: astrochemistry, laser spectroscopy, mass spectrometry, cold chemistry

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
949012	**DeepProton**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Chao Zhang**
Host Institution:	Uppsala Universitet - SWE

Deep multi-scale modelling of electrified metal oxide nanostructures

One promising solution toward a sustainable society and a green economy One promising solution toward a sustainable society and a green economy is to use metal oxide-based materials. Metal oxides are a class of inorganic materials that have various energy and environmental applications such as heterogeneous catalyst, fuel cell, lithium-ion battery, supercapacitor, water treatment and antimicrobial application. Most metal oxides are synthesized as nanostructures which leads to unique properties and reduced economical costs. The very properties that make the metal oxide nanostructures attractive and indispensable in modern science and technology also cause an issue for the environment and human safety. In both the functioning and the degradation of metal oxide nanostructures, aqueous interface plays a vital role. The metal oxide-aqueous solution aqueous interface is electrified in working conditions due to acid-base chemistry and composed of protonic electric double layer. Given the importance of metal oxide surfaces in practical applications, surprisingly little is known about the relation between atomic structure of protonic double layer and the interfacial reactivity. This is largely due to the fact that our knowledge is mostly based on macroscopic observations such as current and concentration in electrochemistry and microscopic information of protonic double layer is difficult to be obtained in experiments. Therefore, developing a novel deep-learning empowered multi-scale modelling framework and providing a revolutionizing understanding at microscopic level of the functioning and degradation of electrified metal oxide nanostructures are the aims of this proposal. The outcome of this project will not only lead to the knowledge discovery about the impact of protonic electric double layer on porous metal oxide-based supercapacitors and on the degradation of metal oxide nanoparticles, but it will also propose useful design principles for synthesis and fabrication.

Link to the ERC project webpage: https://tec-group.github.io

Keywords of the ERC project: Electrochemical Interfaces; Atomistic Simulation; Machine Learning

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
950625	**HiPeR-F**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Matic Lozinsek**
Host Institution:	Institut Jozef Stefan - SVN

Challenging the Oxidation-State Limitations of the Periodic Table via High-Pressure Fluorine Chemistry

The HiPeR-F project aims to establish a new frontier research direction – high-pressure fluorine chemistry, by method development and a merger of two highly specialised and experimentally demanding fields, namely high-pressure experiments in diamond anvil cell and inorganic fluorine chemistry. Fluorine under high pressure represents a breakthrough testing environment for challenging the oxidation-state limitations of the elements in the periodic table. Tantalizing theoretical indications have been provided recently for the existence of compounds with elements displaying unusual and exotic formal oxidation states, and even the possibility of the inner electronic shell involvement in chemical bonding. However, extreme conditions of very high pressure (in GPa range) and extreme chemical reactivity (fluorine) are required and this is currently limited to in silico investigations. Experiment lags substantially behind the theory. The experimental verification of exciting computational predictions is of paramount importance and will be pursued in HiPeR-F. Compounds targeted are at the edge of existence and are eminently difficult to synthesise, but are also of significant interest to the scientific community at large. Some of the notoriously elusive compounds, with elements in exotic oxidation states, whose syntheses could become possible by high-pressure fluorochemistry include: CsF_3, CsF_5, $Cs^+[F_5]^-$, BaF_4, KrF_4, HgF_4, XeF_8, IrF_8, OsF_7, FeF_4, AuF, AuF_6. Novel compounds obtained in high-pressure experiments could exhibit unusual electronic structures and thus exotic physical properties. Some of these high-pressure materials might be metastable and hence possibly technologically useful, much as diamonds. High-pressure fluorochemistry thus represents a genuine new direction in modern chemistry with exciting possibilities and would enable a frontier research that would significantly advance our understanding of many facets of chemistry.

Link to the ERC project webpage: https://eccl.ijs.si/

Keywords of the ERC project: inorganic chemistry, fluorine, crystallography, high pressure, extreme conditions, coordination chemistry, bonding, X-ray diffraction

Keywords that characterize the scientific profile of the potential visiting researcher/s: inorganic chemistry, fluorine, crystallography, high pressure, extreme conditions, coordination chemistry, bonding, X-ray diffraction

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Project ID:	Project Acronym:	Evaluation Panel:
101001854	**SIMONANO2**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Andreas Dahlin**
Host Institution:	Chalmers Tekniska Hoegskola Ab - SWE

Single Molecule Analysis in Nanoscale Reaction Chambers

Single Molecule Analysis in Nanoscale Reaction Chambers

Imagine that you would measure the average eye color of the population in Sweden. Clearly it would not say much about the colors of the eyes of the inhabitants. To obtain this information, one must of course study them individually. The same holds true for complex biological molecules, especially proteins, which may exist in many different configurations that cannot be resolved in an ensemble measurement. Heterogeneities in biomolecular structure and function limit our understanding of biology. To advance further it is vital that we study biomolecules individually. For proteins this is highly challenging since it must be done in a non-invasive manner under conditions similar to their native environment.

The SIMONANO project aims to develop a new platform for single molecule analysis which provides essential advantages. Proteins will be controllably loaded into solid nanoscale chambers, thereby eliminating the need of field gradient forces or surface immobilization. Furthermore, the proteins are entrapped at physiological conditions and small ligands can still access them quickly. Most importantly, the content is regulated on the single molecule level, i.e. proteins can be controllably loaded one at a time and different types of proteins can be introduced sequentially. Advanced (but established) fluorescence microscopy techniques will be used to detect the proteins and analyze their reactions.

The possibility to reliably entrap any desired number of proteins under physiological conditions and study their reactions will provide great scientific advancements in the life sciences. Once developed in this project, the nanoscale reaction chambers can become a tool used by biologists worldwide, which will advance our understanding of life on the molecular level. This will in turn lead to new applications in biotechnology and medicine.

Link to the ERC project webpage: www.adahlin.com

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101021166	**GAS-WAT**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Lars Pettersson**
Host Institution:	Stockholms Universitet - SWE

Gases in Water

Is there “hidden” structure in normal liquid water? Do nanoscopic structural heterogeneities in ambient water exist and affect solution chemistry? In this project we will focus on structural fluctuations in simulations of liquid water as observed through the enhancement of the isothermal compressibility. From both experiment and theory a two-state picture of water is emerging with fluctuations between high- (HDL) and low-density (LDL) local structures. The structure of these is unknown. Moreover, present simulation models require a pressure shift of one thousand atmospheres to reproduce the experimental compressibility maximum at ambient pressure. We propose to develop a unique description of the liquid that extends to take into account that the water molecule exists in two forms, ortho and para, with different rotational properties. We will use Argon dissolved in water as discrete probe of the LDL local environments in high-resolution EXAFS measurements to discern their structure in combination. Finally, in a two-state picture with LDL structures providing “pockets of stability” for dissolved oxygen, the question arises how fish entice the oxygen to leave the water and enter the gills. We will carry out a combined experimental X-ray spectroscopic and theoretical modeling study of water in polyelectrolyte and polysaccharide models of the mucous layer found outside lamella of fish gills and specifically determine how water structure there differs from the bulk. Has Nature through evolution found a way to restructure the water to enhance exchange of gases?

Link to the ERC project webpage:

Keywords of the ERC project: Water structure, Theoretical X-ray spectroscopy, Nuclear quantum effects, EXAFS, Oxygen in water, Fish gills, Force-field development, MD simulations

Keywords that characterize the scientific profile of the potential visiting researcher/s: See above

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101039746	**WEPOF**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Laerte Patera**
Host Institution:	Universitaet Innsbruck - AUT

Watching Excitons in Photoactive Organic Frameworks

One of the most urgent challenges our society is facing nowadays is the development of an energy economy based on renewable resources. A fascinating approach is artificial photosynthesis, where solar energy is exploited to produce chemical fuels out of carbon dioxide, water, and sunlight.

While recent technological advances are bringing us closer to the goal of developing efficient light-harvesting platforms, a fundamental gap about the atomic-scale mechanisms remains to be filled. Understanding the atomistic details of the processes involved is of tremendous importance to drive a rational design of photoactive materials. Relevant questions include: how do electrical charges move upon light absorption? How does the atomic structure influence the ability to harvest light? Why do some materials work better than others? Answering to questions as these represents an extraordinary demanding task, since excitons, the most fundamental light-induced excitations, composed of bound electron-hole pairs, are only transient short-lived entities occurring in complex materials.

The WEPOF project aims at enabling the direct experimental observation of excitons in photoactive covalent organic frameworks, providing a fundamental understanding of photoexcited states in energy materials. While the structural complexity of organic frameworks will be tackled by individuating elementary functional units, allowing rationalizing their structure-function relations, the development of unique scanning probe microscopy methods will enable to watch excitons on their relevant length- and timescales.

The understanding of excitonic processes will allow steering the design of photoactive materials with improved energy conversion efficiency, providing a conceptual framework for next-generation material platforms for artificial photosynthesis.

Link to the ERC project webpage:

Keywords of the ERC project: scanning probe microscopy, excitons, organic frameworks

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101040193	**COSAS**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Sara Barja Martinez**
Host Institution:	Universidad Del Pais Vasco/ Euskal Herriko Unibertsitatea - ESP

Controlling Oxygen Selectivity at the Atomic Scale

Developing new materials with optimized catalytic properties is a crucial challenge towards sustainable energy production. In order to achieve this long-standing goal, fundamental understanding of the processes taking place at the electrode-electrolyte interface is vital. Progress here requires a comprehensive atomic-scale picture of the fundamental chemical and catalytic properties of surfaces, in connection to their macroscopic catalytic performance. This knowledge remains hindered due to the complexity of real catalytic systems and the lack of experimental techniques that can provide information of the catalytic process from single-molecule interaction to operando conditions.

The project COSAS focuses on the electrochemical water oxidation to hydrogen peroxide and seawater electrolysis. It proposes an atomistic study of the electrode-electrolyte surface to unveil the key parameters for selective activation of alternative reaction paths for water oxidation. The experimental approach of the project represents a novel quasi-in situ electrochemical characterization (near ambient pressure x-ray photoemission spectroscopy), combined with atomic-scale access to the electronic structure (scanning tunnelling microscopy and spectroscopy) on the very same sample. The project will study thin films of transition metal oxides as model systems for exploring structure-function relationships, while presenting catalytic relevance for oxygen related reactions. The unique methodology of the project promises novel atomistic insight in the mechanism behind complex reactions with multiple intermediates, unveiling key parameters that can guide the design of active and selective electrocatalysts for cost-effective water electrolysis.

Link to the ERC project webpage:

Keywords of the ERC project: green electrochemistry, atomic scale, surface science, in situ characterization

Keywords that characterize the scientific profile of the potential visiting researcher/s: surface electrochemistry, ultra high vacuum, x-ray photoemission spectroscopy, intrumental development

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101040480	**LACRIDO**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Ha Vinh Lam Nguyen**
Host Institution:	Universite Paris Xii Val De Marne - FRA

Laser Activated Chemistry of Reactive Intermediates: Direct Observation in the jet

The goal of LACRIDO is to lock reactive intermediates of a fast reaction by freezing them through Joules-Thompson expansion in the molecular jet, then precisely determine their three-dimensional (3D) structures by chirped-pulse microwave spectroscopy to capture all species marking the reaction mechanism.
LACRIDO comprises two stages. The first stage focuses on the detection of van der Waals complexes of the educts through their 3D structures encoded in the microwave spectra. New results of the lower-risk first stage will pave the way to the higher risk-high gain second stage where reactive intermediates are formed by laser activation; adiabatically frozen and locked in the collision-free zone of the molecular jet where the rotational temperature is close to the absolute zero-point; then captured exploiting the strength of microwave spectroscopy in its specificity of conformation-sensitive detection unrivalled by any other type of spectroscopy and chemical methods.
The first reaction chosen as key target is Diels-Alder, one of the most classic and important reactions in chemistry. Backed up by the Hueckel theory, Diels-Alder is theoretically described to be a single-step reaction, but details on the reaction course through the van der Waals complex of the educts have never been demonstrated experimentally and will be explored by LACRIDO, giving the final answer for an old, traditional question. The second experimental stage targets the atmospherically important reaction of isoprene with hydroxyl (OH) radical. Its reaction mechanism is extremely diverse with many steps and possible pathways to different stable products. Though lacking experimental evidence, previous studies proposed that the reaction passes through two radical intermediates, each in a cis and a trans configuration. Capturing these short-lived intermediates and determining their 3D structures would give the decisive proof, directly extracted from experiments, on the reaction paths actually taken.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101040669	**Interfaces at Work**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Christoph Baeumer**
Host Institution:	Universiteit Twente - NLD

Interface-sensitive Spectroscopy of Atomically-defined Solid/Liquid Interfaces Under Operating Conditions

Charge-transfer reactions are key not only to the way that nature fuels life in photosynthesis but also in synthesizing sustainable fuels like hydrogen. Charge transfer occurs at interfaces with an applied potential, yet almost all our understanding of electrocatalytic activity trends comes from the bulk material properties in the as-prepared state. We still lack interface-sensitive spectroscopy tools that can probe the composition and electronic structure under reaction conditions. Only with such interface-sensitive operando information can we fully understand the underlying reaction mechanisms and devise strategies for efficient energy conversion and storage.

In Interfaces at Work, I will overcome these limitations by developing novel interface-sensitive operando X-ray spectroscopies combined with model electrochemical surfaces with atomic-layer compositional control, merging the fields of surface science and liquid electrochemistry. My aim is to fully visualize the physico-chemical properties of the solid/liquid interface under operating conditions. Specifically, I will develop a new laboratory-based, multicolour operando “meniscus XPS” (X-ray photoelectron spectroscopy) and transform the recently invented “membrane XPS” by making it accessible to the relevant electrochemical materials using these materials themselves as new membranes. I will apply these novel techniques to electrocatalyst and pseudocapacitor model systems based on epitaxial oxide thin films and 2D carbides.

Ultimately, the proposed approach will allow me to track the surface and subsurface properties under applied potential to shed light on the electrochemical mechanisms. The operando insights will result in design rules for efficient energy conversion and storage on the chemical and electronic properties of a true electrochemically active surface under operating conditions rather than the as-prepared bulk. This will help our transition towards sustainability.

Link to the ERC project webpage:

Keywords of the ERC project: operando spectroscopy, electrocatalysis, oxygen evolution reaction, oxide thin films, MXenes

Keywords that characterize the scientific profile of the potential visiting researcher/s: XPS, electrochemistry

Project ID:	Project Acronym:	Evaluation Panel:
101041933	**KI-NET**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Giulio Ragazzon**
Host Institution:	Centre International De Recherche Aux Frontieres De La Chimie - FRA

Energy transduction in KInetically asymmetric catalytic NETworks

Endergonic processes are central to Life. They are achieved by enzymes, that change conformation during their catalytic cycle. Thus, biological non-equilibrium processes are catalysis-driven. The realization of catalysis-driven processes in artificial systems proved challenging. It remains limited to synthetically demanding interlocked structures, which were upgraded with catalytic features affecting ring sliding motion.

With KI-NET, I want to develop a general biomimetic strategy enabling endergonic processes driven by chemical catalysis. I plan to invert the current approach by introducing defined conformational freedom into simple catalytic units.

KI-NET scientific objectives go beyond state of the art in chemically-driven non-equilibrium systems, with the aim to:

(i) establish an unconventional theoretical approach based on “effective transition states”, that guides experiments and reveals common underlying principles for catalysis-driven processes and chemical oscillations;

(ii) realize endergonic conformation changes powered by catalytic processes, including ATP hydrolysis;

(iii) promote endergonic assembly reactions, that will reveal how energy consumption directs chemical adaptation;

(iv) realize an artificial synthase: a catalyst that harvests energy from one reaction and uses it to drive a different one.

I will implement a theory-guided experimental approach at the interface between systems chemistry and molecular machines. Leveraging my broad chemistry background, I will address questions that expand towards physics – in terms of formalizing models – and biology – in terms of operating systems to be imitated and unraveled.

Realizing KI-NET allows overcoming thermodynamic boundaries. Unforeseen opportunities become possible in material science and energy management, such as the realization of artificial mitochondria. Indeed, KI-NET pioneers a largely unexplored area of science at the roots of dissipative systems, complex phenomena, and – ultimately, Life.

Link to the ERC project webpage: https://ragazzonlab.isis.unistra.fr/

Keywords of the ERC project: non-equilibrium systems, self-assembly, chemical catalysis, nonlinear systems, axial chirality

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101042403	**BiFOLDOME**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Miguel Mompean**
Host Institution:	Agencia Estatal Consejo Superior De Investigaciones Cientificas - ESP

BiFoldome: Homo- and Hetero-typic Interactions in Assembled Foldomes

Self-assembly is a fundamental foundation of life, but what about co-assembly? The main goal of BiFOLDOME is to decipher co-assembly to understand self-assembly. Amyloids were assumed to be assembled by one type of protein, but our recent elucidation of the first 1:1 hetero-amyloid structure (the RIPK1-RIPK3 necrosome core) suggests that amyloids composed of two distinct proteins playing key roles in health and disease may be common. In fact, a viral protein (M45) can displace one partner (RIPK1) to form a distinct 1:1 hetero-amyloid (M45-RIPK3). Taking a leaf from the viral playbook, this means that for a given self-assembling sequence there may be a mating sequence driving the preferential 1:1 co-assembly of the two. Thus, understanding what drives the preferential formation of co-assembled forms over conventional self-assembled species will afford an entirely new vision on assembly processes transversal to all fields of knowledge. BiFOLDOME is organized around three different levels of complexity: (1) characterizing the formation, structure and energetics of representative paradigms of 1:1 co-assembled amyloids using solution and solid-state NMR spectroscopies, and energy calculations, featuring novel technical innovations that we will develop. This will provide the basis for self-assembly by delivering a firm understanding of co-assembly. (2) Applying the fundamental knowledge from (1) to the manipulation of self-assembled, disease-associated proteins using the powerful concept of 1:1 co-assembly. (3) Going beyond the state of the art by developing a new methodology to study the assembly of biomolecular condensates. The approach, which I call “optoNMR”, will enable controlled, light-triggered self- and co-assembly of proteins within the NMR tube, opening new avenues to discern between alternative hypotheses for condensate formation and hardening in real-time and at high resolution, or for sensitive detection using hyperpolarization schemes.

Link to the ERC project webpage:

Keywords of the ERC project: NMR; amyloid; SSNMR: solid-state NMR; fluorescence; assembly; protein; dynamics; relaxation dispersion; DEST; CPMG; spin dynamics

Keywords that characterize the scientific profile of the potential visiting researcher/s: NMR; amyloid; SSNMR: solid-state NMR; fluorescence; assembly; protein; dynamics; relaxation dispersion; DEST; CPMG; spin dynamics

Project ID:	Project Acronym:	Evaluation Panel:
101042989	**QuantMol**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Michal Tomza**
Host Institution:	Uniwersytet Warszawski - POL

Ultracold polyatomic molecules for controlled chemistry and precision physics

Ultracold atoms have been successfully used in quantum simulations and precision measurements. Molecules possess a richer internal structure promising new applications. However, only relatively simple molecules have been produced and employed at ultralow temperatures. This project aims to understand and harness the increasing complexity of ultracold polyatomic molecules to probe the fundamentals of chemistry and physics.
We will extend the range of ultracold polyatomic molecules and their applications in controlled chemistry and precision spectroscopy. We will propose and theoretically investigate two paths: 1) association of ultracold deeply-bound diatomic molecules into ultracold weakly-bound polyatomic molecules and 2) direct cooling deeply-bound polyatomic molecules carefully selected and manipulated with electromagnetic fields. The first approach will build on established atomic techniques, which we will extend to molecular systems. The second one will employ strong fields, short pulses, and structural modifications to engineer closed transitions suitable for laser cooling. We will combine and develop novel electronic structure and quantum scattering methods enhanced by machine learning and high-performance computing. Next, we will study new applications exploiting features emerging from single-molecule and coherent control, conical intersections, and non-trivial electronic states and geometries absent in simpler systems. Applications will range from quantum-controlled chemical reactions and molecular dynamics to precision measurements of fundamental constants and their spatio-temporal variation.
The realization of the project will push cold chemistry into the quantum realm and bring unprecedented complexity to ultracold physics, thus, give new insights into the physical basis of chemistry and the fundamental laws of nature. A unique experience of the PI in both quantum chemistry and ultracold atomic physics will be instrumental in achieving these goals.

Link to the ERC project webpage: http://quantmol.uw.edu.pl

Keywords of the ERC project: Ultracold polyatomic molecules, controlled chemistry, precision physics

Keywords that characterize the scientific profile of the potential visiting researcher/s: Ultracold molecules, ultracold atoms, ultracold collisions

Project ID:	Project Acronym:	Evaluation Panel:
101043272	**HyBOP**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Ali Hassanali**
Host Institution:	United Nations Educational Scientific And Cultural Organization - FRA

Hydrogen Bond Networks as Optical Probes

Fluorescence takes place throughout the natural world. Most conventional chemical wisdom proposes that in organic entities, fluorescence occurs in conjugated systems, such as in the aromatics. However, in biological settings, the interaction of light with matter occurs in media built up of dense networks of hydrogen bonds. Recent experiments suggest that it is possible to observe fluorescence from these networks too. This could open the possibility of designing hydrogen-bond networks with enhanced fluorescence, offering enormous fundamental and practical potential.

The overarching goal of HyBOP is to decipher, using advanced computer simulations, the exotic optical properties of hydrogen-bond networks and to harness them as probes of water-mediated forces. To achieve this, HyBOP will tackle the following challenges:1) Establish the ground rules for creating fluorescent hydrogen-bond networks in biological materials. 2) Understand how to drive the electrons and nuclei of water networks into regimes where they can fluoresce. 3) Use the optical behaviour of these networks to probe hydrophobic forces in nature.

To uncover the complex chemistry of hydrogen-bond network fluorescence, and guide the discovery of new fluorophores, we will deploy state of the art electronic excited-state molecular dynamics in combination with machine-learning techniques. This will provide HyBOP with ground-breaking knowledge which will lay a theoretical framework to motivate development of new experimental probes of hydrophobicity.

HyBOP seeks to bring hydrogen-bond networks to the forefront of chemistry in their use as optical probes; by laying the theoretical ground-work for designing non-invasive fluorophores in biophysics, opening up a new window into the origins of autofluorescence in medical diagnostics and finally, provoking frontier electron and nuclear spectroscopy, HyBOP will have a spill-over effect and build new synergies across several branches of the physical sciences.

Link to the ERC project webpage:

Keywords of the ERC project: Computational Chemistry, Hydrogen Bond Networks, Fluorescence, Data Science

Keywords that characterize the scientific profile of the potential visiting researcher/s: Advanced Researcher: Postdoc or PhD

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101043617	**SunFlower**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Csaba Janáky**
Host Institution:	Szegedi Tudomanyegyetem - HUN

Photoelectrosynthetic processes in continuous-flow under concentrated sunlight: combining efficiency with selectivity

To be the first CO2-neutral continent by 2050, Europe needs to develop and implement disruptive new technologies, based on scientific breakthroughs. In this regard, utilization of CO2 and organic waste as feedstock to generate valuable products will play a key role in turning the chemical industry on a more sustainable, circular path. In the SunFlower project, we are going to demonstrate that two high-value processes (CO2 or CO reduction and glycerol oxidation will be studied first) can be synergistically coupled to produce chemicals (such as ethylene and lactic acid) and fuels, using novel photoelectrode assemblies (both photocathodes and photoanodes), original photoelectrochemical (PEC) device architectures, and automated processes. The SunFlower project is based on the following three hypotheses:

1. Proper engineering of continuous-flow PEC cells operating under concentrated sunlight will allow current densities similar to the electrochemical (EC) methods.
2. One semiconductor alone can supply the necessary energy input for bias-free operation of PEC cells, while generating two high-value products.
3. PEC methods can provide superior selectivity compared to their EC counterparts, even at high current density operation (as the current density and potential can be decoupled).

To validate our hypotheses, we are going to use for the first time:

- The pairing of two high-value generating redox processes (none of them being H2 or O2 evolution).
- Concentrated sunlight (which has only been used for water-splitting so far).
- Custom-designed and developed PEC cells, elaborating on the photo-gas diffusion electrode concept.
- Machine learning, based on the broad dataset collected by the sensors built in the PEC system, optimizing the performance at a system level.

The proposed combination of these novel approaches will be of groundbreaking nature, therefore, it opens a whole new arena of solar energy conversion.

Link to the ERC project webpage:

Keywords of the ERC project: Solar Fuels, photoelectrochemistry, energy conversion, glycerol oxidation, CO2 reduction

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101043676	**DYONCON**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Lars Heinke**
Host Institution:	Karlsruher Institut Fuer Technologie - DEU

Dynamic Ions under Nano-Confinement for Porous Membranes with Ultrafast Gas Permeation Control

Transport phenomena of molecules and ions inside porous materials are paramount in various fields, ranging from energy storage and transformation to molecular separation. In advanced energy storage devices, like supercapacitors and batteries, ions are confined in small pores. Nanoconfinement effects change the ion properties and enhance the performance, vital for saving resources and energy. So far, the static properties of nanoconfined ions are thoroughly studied but there is little known about the dynamic properties of ions in nanopores, mainly attributed to the lack of suitable experimental model systems.

In DYONCON, the dynamic properties of nanoconfined ions will be explored by using well-defined, tunable model systems. This is realized by combining two exclusive material classes: ionic liquids, ILs, which are room-temperature molten salts of organic molecules, and films of metal-organic frameworks, MOFs. MOF films provide the variable, crystalline, scaffold-like container for the ion confinement. An applied electric field will act on the nanoconfined ILs, causing its directed movements. Controlling the dynamic properties of the nanoconfined ions will lead to myriad advances of safety and efficiency concerns, including enhanced charging rates of energy storage devices.

In a radical new approach, DYONCON will also show that nanoconfined ions provide unprecedented functionalities. Based on the functional uniformity of IL@MOF membranes, the nano-level control of the confined ions will be used to regulate macroscopic gas fluxes with ultrafast switching rates, orders of magnitude faster than conventional gas valves.

DYONCON aims to enhance the potentials of electrochemical technologies in energy storage, in sensors and in iontronics. The benefits of DYONCON will not only impact the improvement of speed, quality and control in existing technologies, but it will change the way we look at mobile confined ions and launch us into new methods of using nanomaterials.

Link to the ERC project webpage:

Keywords of the ERC project: Ionic liquids, metal-organci frameworks, dynamics under confinement

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101044764	**CHIRAL**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Willem Noorduin**
Host Institution:	Stichting Nederlandse Wetenschappelijk Onderzoek Instituten - NLD

Crystals of single chirality via non-equilibrium routes

The molecular building blocks of life are of only one handedness. Consequently, pharmaceuticals and other bioactive molecules also need to be of one handedness. When such enantiomers crystallize in separate crystals, isolation of the desired handedness is relatively straightforward. Unfortunately, most enantiomers (90-95%) are thermodynamically more stable as racemic compounds with both enantiomers in the crystallographic unit cell, which impedes any such separations. There are currently no methods to systematically overcome this major bottleneck, thus hindering simple routes towards many essential enantiopure molecules. This proposal is aimed at overcoming this fundamental challenge by establishing new principles to turn racemic compounds into molecules of a desired handedness by liberating them from their thermodynamic constraints. To achieve this ambitious goal, we introduce a revolutionary new approach: manipulating the stability of crystals by subjecting mixtures of crystals to non-equilibrium conditions. Building upon our preliminary work, we hypothesize that growth/dissolution rates can be manipulated by selecting crystallization conditions such that the thermodynamically stable racemic compound is converted into the desired enantiomer. To achieve this ambitious goal, the main objectives of this proposal are to: (i) demonstrate the proof-of-principle, (ii) identify the essential parameters, and (iii) understand the mechanism behind this methodology. The results of this ERC Consolidator will hold direct relevance for our fundamental understanding of non-equilibrium conditions in reactive crystallizations, and the outcomes of this research will immediately impact our ability to produce molecules of single handedness. Ultimately, this breakthrough holds the potential to disrupt the pharmaceutical industry by offering versatile, sustainable, and simple routes towards essential enantiomerically pure building blocks that are crucial in our daily lives.

Link to the ERC project webpage:

Keywords of the ERC project: chirality, crystallization, self-organisation

Keywords that characterize the scientific profile of the potential visiting researcher/s: chirality, crystallization, self-organisation, synthesis, optics

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Project ID:	Project Acronym:	Evaluation Panel:
101054846	**FastTrack**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Niek Van Hulst**
Host Institution:	Institut De Ciencies Fotoniques, Fundacio Privada - ESP

Photons and Electrons on the Move

The conversion of sunlight photons to electrons is the essence of the natural photosynthesis that powers life. Dedicated antennas funnel the sun's energy towards reaction centres. Amazingly, nature reaches almost perfect photon-to-electron conversion efficiency, while it regulates down at high light level for protection and survival.

How does nature dynamically re-organize the membrane architecture, its packing, order, diffusion, on light stress? Which pathways are taken to charge separation? What is the role of fluctuations, coherences, color and vibrations?

My group recently succeeded in first detection of the fs spectral progression of a single exciton, the nanoscale tracking of electron transport and reveal energy disorder of a single photosynthetic complex. These pioneering results, together with our expertise in fs pulse control and nanoimaging, set the grounds to now address photosynthetic light-to-charge transfer in real nanospace and ultrafast. Specific objectives are:

Energy transport on the nanoscale: tracking spatiotemporal membrane transport by super-resolved transient optical microscopy and nanophotonic light localization: to reveal disorder and quantify diffusion.

Light to charge: photo-current detection of the energy flow: by ultrafast photo-thermoelectric graphene and photo-electrochemical detection I will probe charge separation of the reaction center directly, quantify rate and efficiency.

Multidimensional spectra on the nanoscale: by collinear 2D spectroscopic imaging with photocurrent and fluorescence detection, I will map the development of the energy landscape, at special membrane spots, ultimately on a single complex.

Functional imaging: visualize the dynamic light-response of the membrane architecture, the changes in packing density, (dis)order, diffusion and pathways to charge separation.

The novel tool-set of FastTrack and the insights on nature's energy strategies are directly relevant for artificial photosynthesis and solar technology.

Link to the ERC project webpage: TBD by ERC

Keywords of the ERC project: Photosynthetic complex, Energy transfer efficiency, Transient microscopy, Light-harvesting membrane,
Membrane transport, Nanoscale imaging, Reaction center, Exciton diffusion, Multi-dimensional spectroscopy, Electrochemistry, Graphene photo-detection, A

Keywords that characterize the scientific profile of the potential visiting researcher/s: Physical and Analytical Chemical Sciences; Physical chemistry of biological systems;

Project ID:	Project Acronym:	Evaluation Panel:
101075996	**GlycoX**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Kelvin Anggara**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DEU

Imaging Single Glycoconjugates

GlycoX aims to develop single molecule analytical methods to address the challenge of elucidating glycoconjugate structures. Glycoconjugates are glycans (a.k.a carbohydrates) that are attached to another biomolecules such as proteins or lipids. Glycoconjugates are essential to all living organisms, carrying out key cell-cell communication roles in immune system or in microbial infection. Glycoconjugates are found in all biological systems and yet, when compared to proteins or nucleotides, very little is known about their structures and how they lead to their biochemical properties or how they can be exploited in therapeutics. Efforts to reveal their structures by ensemble averaged approaches, whether primary structures (sequences) or secondary structures (conformations), have been severely hampered by the high complexity and flexibility of glycans.

GlycoX addresses this challenge by direct imaging of single glycoconjugate molecules, devoid of any ensemble averaging. To this end, glycoconjugate ions generated from electrospray ionization are soft landed on surface and imaged one-at-a-time by scanning probe microscopy in vacuo. The Project proposes the use of direct imaging (1) to identify the glycoforms of any glycoconjugates (i.e. variants of a specific glyconjugate that possess different glycan primary structures), (2) to sequence any glycan residues in any glycoconjugates, and (3) to determine the conformations of any glycoconjugates. The Project plans to focus on glycoconjugates that are intractable by present analytical methods, many of which are central in immune system, in microbial infection, and in emerging diagnostics, drugs, and vaccines. These works have far reaching impacts: shedding light into the language used by cells to communicate and by pathogens to infect; creating new opportunities in glycan-based therapeutics; as well as opening new frontiers in single molecule analytical chemistry of biomolecules.

Link to the ERC project webpage: https://anggara.science/

Keywords of the ERC project: Single molecule imaging, Reaction dynamics, Glycoscience, Density Functional Theory, Physical Analytical Chemistry

Keywords that characterize the scientific profile of the potential visiting researcher/s: Native electrospray, Ion optics design, Conformation search, Biochemistry, Inorganic chemistry, Computational chemistry

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Project ID:	Project Acronym:	Evaluation Panel:
772462	**ProLiCell**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Julien Gautrot**
Host Institution:	Queen Mary And Westfield College, University Of London - GBR

Engineered Protein Nanosheets at Liquid-Liquid Interfaces for Stem Cell Expansion, Sorting and Tissue Engineering

A long standing dogma in the field of cell-based technologies is that bulk mechanical properties of solid substrates are essential to enable cell spreading, proliferation and fate decision. The use of solid materials to culture adherent cells constitutes an important hurdle for the scale up, automation and speed up of cell culture and recovery. Our recent results show that bulk solid substrates are not necessary to promote cell adhesion, growth and fate regulation as adherent stem cells spread and proliferate readily at the surface of ultra-soft materials, even liquids. In such cases, cell adhesion is enabled by the formation of a mechanically strong layer (nanosheet) of proteins at the interface between the oil (liquid substrate) and aqueous medium. This key discovery opens the door to the engineering of protein nanosheets enabling the use of liquid, free-flowing substrates sustaining cell adhesion, expansion, isolation and recovery.

ProLiCell will design the biochemical and mechanical properties of extracellular matrix (ECM) protein nanosheets that can sustain the formation of adhesion protein complexes and support cell proliferation and culture on materials with very weak bulk mechanical properties (liquids). The engineered ECM nanosheets will be applied to: 1. the design of 3D bioreactors based on emulsions, for the culture of stem cells; 2. the formation of stem cell sheets at oil-water interfaces for tissue engineering; 3. the isolation and purification of stem cells using emulsions presenting antibody-adsorbed interfaces. ProLiCell will provide fundamental insights into ECM nanosheet design and advance our understanding of the mechanisms via which cells adhering to such interfaces sense and respond to nanoscale cues. Such fundamental understanding will enable liquid-liquid platforms to transform stem cell technologies by borrowing a wider range of processing and manufacturing concepts to the field of Chemical Engineering.

Link to the ERC project webpage: http://biointerfaces.qmul.ac.uk/prolicell/

Keywords of the ERC project: Biomaterials, interfaces, nanomaterials, biotechnology, stem cells

Keywords that characterize the scientific profile of the potential visiting researcher/s: Interface, surface, polymers, soft matter

Project ID:	Project Acronym:	Evaluation Panel:
804106	**ReverseAndCat**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Pawel Dydio**
Host Institution:	Centre International De Recherche Aux Frontieres De La Chimie - FRA

Reversible Creation of Non-Inherent Reactivity Patterns in Catalytic Organic Synthesis

Current methods in organic synthesis only enable reactions at the most reactive bonds or at bonds predisposed by specific directing groups. Consequently, many less reactive bonds, including numerous C-H and C-C bonds, cannot be functionalized, enormously limiting the scope of possible transformations. To overcome these limitations, I propose Reverse&Cat, a revolutionary strategy using a novel method to change the reactivity pattern of molecules. This strategy combines the dynamic equilibrium mediated by the first catalyst and a functionalization reaction catalyzed by the second catalyst. The originality of the transformation stems from exploiting three simultaneous processes: (i) the dynamic exchange of one functional group (FG) for another FG that modulates the reactivity of the substrate; (ii) the functionalization of the temporarily activated bond; and (iii) the restoration of the initial FG. In essence, the processes (i) and (iii) – the components of the dynamic equilibrium – realize the novel concept of the temporary creation of non-inherent reactivity of a substrate.
The program is divided in three phases, which will establish the full potential of the strategy. In phase A, I will develop a set of new reactions enabled by the bi-catalytic systems. I will exploit two types of reversible reactions: (1) reversible oxidation of alcohols, which delivers temporarily activated aldehydes/ketones, with the distinct reactivity of their C-H bonds; and (2) reversible retro-hydrofunctionalization of nitriles or their analogues, which delivers temporarily activated alkenes, containing allylic C-H and C=C bonds. In phase B, I will conduct detailed mechanistic studies to gain the mechanistic understanding and enable further rational development. In phase C, I will establish the utility of this new strategy in practical organic synthesis. Overall, the strategy will open a new dimension of reactivity, with prospective applications in production of fine-chemicals and materials.

Link to the ERC project webpage: https://dydiolab.com/complex-networks-of-reactions-a-new-way-to-improve-the-efficiency-and-capacity-of-organic-synthesis/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
816268	**F-ELEMENT_ARCHITECT**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr David Mills**
Host Institution:	The University Of Manchester - GBR

Building Precise Molecular Architectures to Unlock Remarkable f-Element Properties

The astonishing properties of the f-elements have been exploited in numerous consumer technologies, despite their fundamental chemistry being poorly developed. It is now crucial to address this issue to provide the necessary insights to develop future applications. Design criteria exist to build f-element complexes with maximised physical attributes. This adventurous proposal targets the synthesis and thorough analysis of two complementary molecular f-element architectures that 1) optimise magnetic properties and 2) stabilise unusual oxidation states.

In Part 1, we target highly axial f-element complexes that lack equatorial ligand interactions. These molecules can exhibit maximised single-molecule magnet properties, including magnetic hysteresis, a memory effect and as a prerequisite of data storage, at liquid nitrogen temperatures. This is the necessary first step towards achieving high-density molecular data storage without expensive liquid helium cooling and future commercial applications.

In Part 2, we target trigonal f-element complexes that lack axial ligand interactions. These are optimal ligand fields for the stabilisation of low oxidation states, thus we aim for rare lanthanide/actinide(II) and unprecedented lanthanide/actinide(I) complexes. These compounds are ideal candidates for unique measurements of covalency by pulsed electron paramagnetic resonance spectroscopy, which will provide textbook data that can be transferable to nuclear fuel cycles.

An ERC CoG will provide the necessary resources to build a world-leading research team that will deliver landmark synthetic results and fresh insights into f-element electronic structure, whilst opening up new chemical space for future exploitation. These findings will underpin current technologies and will facilitate the discovery of future applications, supporting key Horizon 2020 priority areas including the Flagship on Quantum Technologies, and enhancing the scientific reputation and economy of the EU.

Link to the ERC project webpage: https://erc.easme-web.eu/?p=816268

Keywords of the ERC project: synthetic coordination and organometallic chemistry; f-element; lanthanide; actinide; single-molecule-magnets

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
819856	**SUPRAVACC**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Pol Besenius**
Host Institution:	Johannes Gutenberg Universitaet Mainz - DEU

Supramolecular engineering of glycan-decorated peptides as synthetic vaccines

The main and most important feature of vaccines is the induction of an immunological memory response, which is key to providing long-term protection against pathogens. The current strategies for potent antibacterial and antiviral vaccines employ conjugation of pathogen specific entities onto carrier proteins, and are limited to formulations that suffer from low stability and short shelf-lives, and are thus not viable in developing countries. Strategies for the development of new vaccinations against endogenous diseases like cancer further remain an unmet challenge, since current methodologies suffer from a lack of a modular and tailored vaccine-specific functionalisation. I therefore propose a radically new design approach in the development of fully synthetic molecular vaccines. My team will synthesise carbohydrate and glycopeptide appended epitopes that are grafted onto supramolecular building blocks. These units can be individually designed to attach disease specific antigens and immunostimulants. Due to their self-assembling properties into nanoscaled pathogen mimetic particles, they serve as a supramolecular subunit vaccine toolbox. By developing a universal supramolecular polymer platform, we will construct multipotent vaccines from glycan-decorated peptides, that combine the activity of protein conjugates with the facile handling, precise composition and increased stability of traditional small molecule pharmaceutical compounds.
SUPRAVACC will pioneer the design of minimalistic and broadly applicable vaccines, and will evaluate the supramolecular engineering approach for immunisations against antibacterial diseases, as well as for applications as antitumour vaccine candidates. The fundamental insights gained will drive a paradigm shift in the design and preparation of vaccine candidates in academic and industrial research laboratories.

Link to the ERC project webpage: https://www.ak-besenius.chemie.uni-mainz.de/erc/

Keywords of the ERC project: Supramolecular Chemistry, Materials Chemistry, Glycopeptides, Immunotherapy

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
848339	**BioSilica**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Assaf Gal**
Host Institution:	Weizmann Institute Of Science - ISR

Materials synthesis in vivo – intracellular formation of nanostructured silica by microalgae

Organisms evolved the ability to form a magnificent array of functional materials, which surpass any man-made product. A prominent example is diatoms, marine microalgae that form an intricate cell-wall made of meso-porous silica. Diatom silica is a tough, hierarchically built, and biocompatible material that is environmentally friendly and cheap, making it an exciting target for nanotechnology. Nevertheless, the principles of this regulated formation mechanism remain elusive.

A persistent obstacle for elucidating biomineralization processes is the inaccessibility of the cellular environment for structural and chemical investigations. Recently, far-reaching developments in electron microscopy have revolutionized our abilities to investigate chemical processes inside living organisms. It is now becoming feasible to image and analyze, with nanometer-scale resolution, an intracellular mineralization process.

This proposal aims to elucidate the intracellular mechanism of silica formation by diatoms. We will study cells undergoing the silicification process in situ, using a suite of state-of-the-art electron and X-ray imaging and spectroscopy tools. The combination of structural and chemical data will enable us to elucidate:

1) The concentration and stabilization mechanism of transient Si phases in the cell.

2) The nanoscale environment in which silica condensation takes place.

3) Genetic and environmental strategies to engineer the silicification process for designed outcomes.

Diatom silica is a promising material for applications such as photonics, pharmaceuticals, and catalysis, which require hierarchical, high-surface area, nano-materials. The achievements of this project will inspire synthetic methodologies to produce and design nano-patterned silica, and genetically-engineer the biological silicification process to produce custom-made materials.

Link to the ERC project webpage:

Keywords of the ERC project: Biomineralization

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
850875	**Light-DYNAMO**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Ilka Kriegel**
Host Institution:	Fondazione Istituto Italiano Di Tecnologia - ITA

Light driven hybrid nanocrystal TMDC capacitors

Sunlight is an intermittent energy source coupled to the availability of the sun. Light-DYNAMO aims for an innovative solution to directly store the solar energy. The challenge is to implement solution-processable light-driven nanocrystal capacitors (NCCs), such as doped metal oxides. They show high charge-storage capacity accumulating multiple delocalized electrons after light absorption. This was to date shown in solution only with the additional drawback of reducing the hole with a sacrificial hole scavenger. The innovative aspect of Light-DYNAMO is to use 2D transition metal dichalcogenides (2D TMDCs), such as MoS2 or WS2, as efficient hole acceptors in a solid state structure. The sensitivity of the TMDCs' spatial electronic landscape to the local environment (i.e. strain, defects or doping) serves as driving force for energetically driven hole relocation within the TMDC. The electrons instead remain in the NCCs. This results in long-lasting and efficient charge separation and opens novel design principles. In optimized device structures, such stored carriers are extracted. The working principle of the suggested NC/TMDC hybrid device is based on several challenges: first, the absorption and charge storage capacity of the NCCs will be enhanced by exploring novel materials. Second, the TMDC's sensitivity to the surrounding will be extracted to a high level of control over the 2D energy level distribution. Third, the intentional design of the energy landscape (e.g. through strain manipulation) in the optimized hybrid geometry will be introduced to control carrier redistribution after charge transfer within the TMDC. Finally, appropriate devices for carrier extraction will be structured. The proposal embarks on a pioneering study by the PI on optical control over carrier density in NCC/TMDC hybrids, advancing such novel systems to a level in which the incoming sunlight is harnessed, converted, stored as charges and released on demand to power an electric circuit.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/850875

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
864982	**CoaExMatter**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Marleen Kamperman**
Host Institution:	Rijksuniversiteit Groningen - NLD

Bio-inspired Coacervate Extruded Materials

The threads produced by velvet worms are remarkably sticky and stiff; the beak of a jumbo squid is extremely hard; and spider silk is incredibly tough. The extraordinary material properties found in these natural systems have been of interest to researchers for a long time. However, only recently, biologists discovered that a crucial element in the processing of many of these materials are coacervates, which are concentrated macromolecular phases that form upon liquid liquid phase separation from the initial solution. An understanding is emerging that the liquid coacervate phases enable extrusion of the material and allow for conformational changes within the material before solidification. Thus, the coacervate nature is crucial for obtaining extraordinary property profiles in these natural materials.

Here I propose to mimic this environmentally benign processing of coacervate extrusion for the development of completely new synthetic materials. Previous work in my group has led to the development of bio-inspired synthetic coacervates with well-controlled architecture and composition, and of various tools to study their mechanics. Here, I will take advantage of this expertise to develop unique material systems by extruding synthetic coacervates and by using the induced mechanical stress to obtain alignment and conformational changes.

Analogous to the wide variety of materials found in natural systems that commence as a coacervate, this processing principle may be applicable to a wide variety of synthetic material classes. In this research program coacervate extrusion will be used to produce fibers, rods or scaffolds composed of: polyelectrolyte complexes, liquid-crystal elastomers, peptide-polymers, protein-polymers and nanocomposites.
This bio-inspired processing principle of coacervate extrusion will lead to materials with unexplored property profiles and holds great promise for the development of novel high performance materials obtained by green processing.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
864991	**CARBOFLOW**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Katharina Schröder**
Host Institution:	Technische Universitaet Wien - AUT

Streamlined carbon dioxide conversion in ionic liquids – a platform strategy for modern carbonylation chemistry

Since the discovery in the nineteenth century, carbonylation chemistry has found broad applicability in chemical industries and become now a key technology for bulk and fine chemical synthesis. Despite its substantial toxicity, carbon monoxide (CO) is commonly used as carbonyl source causing considerable safety issues, particularly when used on bulk scale. The replacement of this hazardous gas with more benign surrogates would be highly desirable, and recent ideas focus on the valorisation of carbon dioxide as abundant, non-toxic and renewable carbon resource. However, few industrial processes utilise carbon dioxide as a raw material, and potent catalysts are required to overcome its thermodynamic and kinetic barrier. In this regard, ionic liquids show considerable potential as cooperative media as they can solubilise large concentrations of carbon dioxide but also strongly interact and activate carbon dioxide.

This project focuses on the photocatalytic reduction of carbon dioxide in ionic liquids and its successive conversion into carbonyl compounds. Several goals need to be realised, including fundamental studies and optimisation of the ionic liquid co-catalysed photocatalytic reduction of carbon dioxide to produce CO under mild conditions (Goal 1). The reactivity of formed CO in supercritical carbon dioxide with various organic substrates needs to be explored (Goal 2) before finally developing a streamlined and continuous process for the direct formation of carbonyl compounds from carbon dioxide (Goal 3).

I envision that the photocatalytic activation of carbon dioxide in combination with the positive features of tailored ionic liquids as co-catalysts may overcome problems currently associated with carbon dioxide utilisation, eventually replacing the long-standing bastion of CO-based carbonylation chemistry with novel solutions.

Link to the ERC project webpage: https://www.ias.tuwien.ac.at/ks/research-topics

Keywords of the ERC project: Catalysis, Green Chemistry, Carbon Dioxide Valorization, Photochemistry

Keywords that characterize the scientific profile of the potential visiting researcher/s: catalysis, reacting engineering, photochemistry, electrochemistry, gas separation

Project ID:	Project Acronym:	Evaluation Panel:
865437	**ThermoRise**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Nuno Silva**
Host Institution:	Universidade De Aveiro - PRT

Rise of the 3rd dimension in nanotemperature mapping

The last decades witnessed a quest for devices responding to temperature at a distance with unprecedented space resolution, approaching the nanoscale. Such devices are valuable in both fundamental and applied science, from overheat in micromachines to hyperthermia applied to cells. Despite great advances, the response is still collected in 2D. In real systems, heat flows in 3 dimensions such that 2D nanothermometers give just a plane view of a 3D reality. The restriction to 2D emerges because space resolution is bound to time and temperature resolutions, leading to a trilemma: scanning into the 3rd dimension is time consuming and cannot be achieve without losing temperature and time resolutions. While incremental improvements have been achieved in recent years, adding the 3rd dimension to nanothermometry is crucial for further impact and requires an innovative approach. Herein, I propose the development of nano local probes with tailored magnetic properties recording critical information about local temperature in 3D. These thermometric local probes avoid the resolution trilemma by recording the most relevant temperature information instead of reading the present temperature value. In many applications, including cellular hyperthermia, most part of the current temperature reading is of minor relevance and can be dropped. The key temperature information includes the maximum temperature achieved, the surpass of a given temperature threshold, and the time elapsed after this surpass. Once recorded, this key information can be read in 3D by standard devices (such as confocal microscopes and magnetic resonance imaging scanners) without time constrains and thus keeping a high space and temperature resolution. Moreover, the reading step can be performed in-situ and/or ex-situ, decoupling probes and reading devices if needed. This widens the range of applications of nanothermometers, allowing detection in confined environments and in non-transparent media.

Link to the ERC project webpage:

Keywords of the ERC project: nanothermometers, magnetic nanoparticles, magnetic resonance imaging

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
865819	**ANFIBIO**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Laura Fabris**
Host Institution:	Politecnico Di Torino - ITA

AmplificatioN Free Identification of cancer and viral biomarkers via plasmonic nanoparticles and liquid BIOpsy

The detection of circulating disease biomarkers in bodily fluids, also known as liquid biopsy, has taken important strides toward the implementation of personalized medicine. However, it still suffers from low sensitivity and high costs, which render its clinical implementation not practical or affordable. In particular, the identification and quantification of oligonucleotide biomarkers is hampered by the need to employ long- and short-read sequencing tools that are expensive, require highly trained personnel, and are prone to error. Nonetheless, the recent clinical breakthroughs demonstrating the importance of detecting cancerous or viral biomarker to susceptibility, onset, and aggressiveness of the disease, motivate the need for further research that could render their detection simpler, cheaper, and thus more widely available.

By leveraging the intrinsic amplification capability of surface enhanced Raman scattering (SERS), in ANFIBIO I will address the issues of low sensitivity and high costs by combining plasmonic nanoparticles synthesized ad hoc to maximize SERS signal amplification with direct SERS sensing and machine learning tools for the rapid analysis of the complex spectral responses obtained by screening bodily fluids for specific target biomarkers. I will focus in particular on prostate cancer (PCa) DNA and influenza A viral (IAV) RNA in blood, urine, and saliva, to quantify and correlate their amounts to those detected in tissues and cells.

At completion, the proposed work will deliver a breakthrough sensing technology capable of detecting and quantifying cancerous and viral biomarkers in bodily fluids, with minimal sample pretreatment, no target amplification, and that uses SERS as novel and reliable transduction mechanism with distinct advantages over those currently employed. Furthermore, the fundamental insight garnered will likely assess the feasibility of using direct SERS sensing to develop beyond-third generation sequencing technologies.

Link to the ERC project webpage: https://erc.europa.eu/project-statistics/project-database

Keywords of the ERC project: SERS, biomarkers, nanomaterials chemistry, liquid biopsy, prostate cancer, influenza virus, machine learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: Liquid biopsy, cell culture, nanoparticle synthesis, machine learning

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Project ID:	Project Acronym:	Evaluation Panel:
948185	**PUSH-IT**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Dominik Munz**
Host Institution:	Universitaet Des Saarlandes - DEU

Charge Separation – A General Motif for the Activation and Catalytic Functionalization of Strong Bonds

PUSH-IT aims to establish charge-separation within formal multiple bonds as a concept for the activation of strong bonds in redox catalysis. The project is motivated by sustainable chemistry and displays a bottom-up approach for new methods relevant for chemical synthesis as well as chemical energy conversion and storage.
Inspired by heterogeneous catalysis, we will "push electrons" through formal multiple bonds and translate new principles from main-group chemistry to metals, which readily change oxidation states. We propose these charge-separated, vicinal zwitterions as the "activated" key intermediates for the functionalization of strong bonds (C–C, C–H, C–O, N–H and O–H). Importantly, we anticipate complementary and hence hitherto elusive chemo- and regiodiscrimination to the state of the art due to the unprecedented nucleophilicity of these compounds. The targeted applications include both fine- and bulk chemical synthesis.
The interdisciplinary project focuses on coordination chemistry and combines inorganic and organic synthesis with catalysis and advanced spectroscopy. High-end computational design will guide all experiments. More specifically, hitherto unknown vicinal zwitterions of an earth-abundant alkaline earth metal (magnesium), late transition metals (palladium, platinum, gold), and a non-toxic heavy p-block element (bismuth) with carbon (terminal carbides), nitrogen (terminal imides) and oxygen (terminal oxides) atoms will be isolated using innovative and novel synthetic approaches. With these new and exciting molecular coordination compounds in hand, we will establish the stoichiometric activation and functionalization of strong bonds and will develop catalytic redox cycles.
Overall, this research project will introduce a novel mechanism for bond activation in catalysis, which will allow us to understand elementary steps on heterogeneous surfaces as well as invent new chemical transformations in homogeneous reaction media.

Link to the ERC project webpage:

Keywords of the ERC project: inorganic chemistry - bond activation

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
948449	**Z-EURECA**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Michiel Dusselier**
Host Institution:	Katholieke Universiteit Leuven - BEL

ZEolite synthesis in Unusual Reactors for Enhanced CAtalysts

Approximately 9 out of 10 chemical processes use a solid catalyst, as they increase the efficiency of chemical reactions while being recyclable. Zeolites are one of the most iconic types. These porous crystalline oxides are built from networks of aluminum and silicon nodes and are characterized by regular pores with dimensions similar to most of the molecules that sustain modern society.

Although zeolite synthesis is essentially an assembly of silica and alumina around positively charged template molecules, the outcome heavily depends on kinetics. Yet, classic reactors and strategies barely allow any fine-control over the kinetic interplay, and thus the zeolite made, due the complex and not well understood role of Coulomb and other interactions among the assembling species, and their concentration profiles. Even for established catalysts, synthetic control over their key properties is often lacking. However, such fine-control is essential to develop better catalytic processes in the light of global challenges.

Z-EURECA wants to revolutionize zeolite synthesis, not by the usual search for ingredients, but by introducing new reactor-based handles, specifically external electric fields and fed-batch modes, to exert control over kinetic pathways. Based on new reactor designs, active manipulation of the various Coulomb and interspecies interactions and local concentration gradients during synthesis will be possible.

This bottom-up revolution will i) provide missing insights into the fundamentals of relevant zeolite synthesis, ii) develop active tools that engineer access to synthetic fine-control over zeolites and iii) validate this fine-control in relevant catalytic reactions for superior acid and redox zeolites in prominent sustainable catalysis challenges of our resource-hungry society.

Link to the ERC project webpage: https://www.kuleuven.be/english/research/EU/p/horizon2020/es/erc/z-eureca

Keywords of the ERC project: zeolites, catalysis, reactors, electrochemistry

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
949397	**TOPOCLIP**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Tomáš Solomek**
Host Institution:	Universitaet Bern - CHE

Topological Explorations with a Clip: New Molecular Nanocarbons

The lack of synthetic control over the chirality of curved carbon nanostructures derived from graphene, such as carbon nanotubes (CNTs), prevents the development of molecular electronics applications that require high purity and uniformity of these materials. Single- and multi-walled CNTs are typically formed as a mixture of chiral, armchair, and zigzag nanostructures that significantly differ in their properties. The urgency of controlled chirality-specific synthesis of CNTs advanced the synthesis of curved molecular nanocarbons – molecular precursors for a stepwise synthesis of uniform single-walled CNTs. Applications in bioimaging, sensing, catalysis, and organic electronics have been rapidly emerging on account of the unusual properties of these hoop-like molecular nanocarbons.

To this date, no analogous molecular precursors for topologically more complex carbon nanostructures such as double-walled CNTs or carbon nanoscrolls exist because their topologies do not yet have a stable molecular representation.

TOPOCLIP develops such stable molecular representations, enables their synthesis by using a molecular clip, and delivers unprecedented topological molecular nanocarbons. The molecular clip helps controlling the curvature, preserves the electronic communication throughout the molecular nanocarbon structure, or allows construction of the first molecular nanocarbon with a reversible dynamic behavior. TOPOCLIP (1) improves our understanding of strain and non-covalent interactions that (de)stabilize curved nanocarbons, (2) delivers responsive nanocarbons that can alter shape with an external stimulus, and (3) establishes design principles for tailor-made molecular nanocarbons for future nano- and biotechnology applications. Ultimately, TOPOCLIP takes the vital step to find a solution to a long-standing challenge: the chirality-specific synthesis of carbon nanostructures of complex topologies obtained by rolling-up a graphene sheet beyond the single-walled CNTs.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
949821	**SENF**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Alastair Lennox**
Host Institution:	University Of Bristol - GBR

Selective Electrochemical Nucleophilic Fluorination

The incorporation of fluorine into organic compounds is extremely important for designing molecules with specific function. Fluorine is primed for improving the pharmacokinetic properties of drugs and agrochemicals, and is crucial for the life-changing imaging technique, Positron Emission Tomography (PET). Thus, selective fluorination is an area of significant interest in organic synthesis.

This research programme will develop a concept that promises to revolutionise fluorination chemistry. While nucleophilic fluoride (F-) sources are inexpensive and readily available, they have unfavourable reactivity compared to electrophilic fluorine sources (F+), which are typically expensive, wasteful and not suited to either large scale synthesis or PET. By transmuting F- into F+, we can get the best of both worlds! We will develop a concept based on umpolung (polarity reversal) to invent a number of novel synthetic methodologies or to expand useful reactions into new chemical space. The overall vision is to create new pathways to new bioactive molecules that are either more potent, have improved pharmacokinetics, or can be new radiochemical tracers.

Our strategy relies on the combination of catalysis and electrochemical oxidation to perform this thermodynamically demanding task. The use of electrochemistry is essential for this strategy, because it is necessary to be able to 'dial-in' any oxidising potential with high control. New organo- and organometallic catalysts, heterogeneous electrocatalysts and fluoride sources will be developed as part of the studies, which will be of value to the fields of fluorination, homogeneous catalysis, synthesis and energy research. Medicinal, process and radio chemists will all benefit as their toolbox of methods will expand, thereby facilitating the discovery and manufacture of drugs and chemicals that improve the quality of human life around the globe.

Link to the ERC project webpage:

Keywords of the ERC project: electrochemistry, electrosynthesis, fluorination, anhydrous HF,

Keywords that characterize the scientific profile of the potential visiting researcher/s: surface characterisation, electrochemist, synthetic methodology, total synthesis

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Project ID:	Project Acronym:	Evaluation Panel:
101001591	**ALLOWE**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Shigeyoshi Inoue**
Host Institution:	Technische Universitaet Muenchen - DEU

Highly Reactive Low-valent Aluminium Complexes and their Application in Synthesis and Catalysis

This ERC-CoG 2020 proposal, ALLOWE outlines a strategy for the development of low-valent aluminium systems through their synthesis, isolation, and reactivity investigation of neutral, ambiphilic, low-valent aluminium compounds, denoted “alumylenes”. Their dimeric form “dialumenes” featuring an aluminium-aluminium double bond will also be within the scope of the project. These low-valent aluminium species are expected to provide, along with greater understanding of the fundamental behaviour of low-valent aluminium, a varied and deep reactivity profile. These highly reactive compounds will offer a cheap, sustainable and non-toxic alternative to the current transition metal-based industrial chemical processes.

The proposed scheme of work begins with the synthesis of neutral alumylenes and dialumenes, respectively. This will be achieved through the use of donor ligands (i.e. N-heterocyclic carbenes) and substituents with differing electronic and steric properties. With these compounds in hand, the reactivity towards small molecules will be investigated along with development of low-valent aluminium based catalysts. Furthermore, incorporation of transition metals into these aluminium systems will be targeted as these may possess unique and interesting properties.

Established methodologies such as reductive dehalogenation or reductive dehydrohalogenation will provide access to novel low-valent aluminium compounds bearing bulky substituents and donor ligands. The synthetic portion of the work will also be supported by theoretical calculations.

The outcome of ALLOWE will provide (i) in-depth insight and understanding into low-valent aluminium’s bonding nature, particularly emphasis laid on ambiphilic aluminium center (ii) plethora of striking reactivity towards transition metal free stoichiometric and catalytic activation of small molecules, and (iii) various potential applications in aluminium-based material chemistry.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101002131	**PHOTHERM**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Kasper Moth-Poulsen**
Host Institution:	Agencia Estatal Consejo Superior De Investigaciones Cientificas - ESP

Photo Thermal Management Materials

Since the beginning of civilization, humanity has built houses to sustain comfortable living conditions throughout the seasons. In our modern society, about 50% of the total energy consumption is used for heating and cooling. Growing demands for thermal management in many different sectors, from electronics to housing, inevitably means increased energy consumption. The primary source of heat is coming from the combustion of fossil, bio, or waste-based feedstocks, all contributing to emissions. This project seeks to fundamentally change how we generate heating and cooling by developing a new class of materials that capture, store, and release both solar and ambient heat. The solar thermal management materials are a unique combination of molecular photo-switches that capture and store sunlight, so-called MOST systems, together with phase change materials (PCM) that can contribute to thermal management. The two classes of materials operate at fundamentally different principles. The input of MOST system is photons, whereas the output is heat. The PCM materials can absorb heat from the environment. By combining the two materials into one, we can harness and upgrade two of the most abundant renewable sources of energy on the planet: ambient heat and sunlight. Additionally, we will explore if it is possible to augment the materials so that they can contribute to cooling. The materials function will be demonstrated in heat to power devices that can operate 24/7 without the need for traditional batteries. The MOST-PCM combination has the potential to disrupt how we control the temperature in a broad range of applications, from local power production to heating and cooling in electronics systems, to temperature control in automotive and housing. The materials developed in this project have the potential to radically change thermal comfort and energy consumption and give new design opportunities to thermal management systems from the 10-9 to 10 m length scale.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101019280	**AMP-Alarm**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Andreas Marx**
Host Institution:	Universitat Konstanz - DEU

Diadenosine Polyphosphate Alarmones as Drivers for Protein AMPylation

It is puzzling that the human genome has only slightly more genes than the fruit fly and only half the number of cauliflower. Obviously, the sheer number of genes alone cannot determine the complexity of human development and the sophisticated signalling systems that maintain homeostasis. In fact, the complexity of information from genome to proteome is greatly increased. Drivers for the complexity of the proteome are posttranslational modifications (PTMs), i.e. covalent modifications of polypeptides after translation.
The aim of this project is to shine light on a scientific mystery known for decades. We will elucidate the cellular roles and functions of diadenosine polyphosphates (ApnAs), which are formed in response to stress and are therefore called "alarmones", and their interactions with the PTM processes "AMPylation", i.e. the covalent modification of the target protein by adenosine monophosphate. Although both topics are known for more than 60 years, their molecular mechanism and functions are poorly understood.
Based on our preliminary results, which unambiguously show the interplay of ApnAs and AMPylation for the first time, we will search for, identify and characterize new protagonists of AMPylation and clarify their interactions with ApnAs. Therefore, new chemical tools will be developed and applied in the proteome-wide studies in living cells.
We will also investigate the molecular function of a protein that we have already identified with ApnA-based probes. We have discovered that this protein is a "5'-3' RNA ligase", the first one found in human cells! The available data indicates the involvement of this RNA ligase in cancer and neurodegeneration, and we will therefore elucidate the molecular mechanisms and functions of this protein in detail.
Overall, this project will bring significant new and previously unexplored advances and will provide a guideline for future translational research in the fight against diseases.

Link to the ERC project webpage:

Keywords of the ERC project: Chemical Biology

Keywords that characterize the scientific profile of the potential visiting researcher/s: Chemical Biology

Project ID:	Project Acronym:	Evaluation Panel:
101021358	**ElectroFun**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Lutz Ackermann**
Host Institution:	Georg-August-Universitaet Goettingen Stiftung Oeffentlichen Rechts - DEU

Electrochemical Bond Functionalization

The impressive progress in organic chemistry during the past century has propelled this discipline to its current central position as the enabling technology in the physical and life sciences. Despite remarkable advances, our ability to assemble molecules of even moderate structural complexity remains unsatisfactory, since these syntheses continue to be inefficient, rely on a high number of reaction and purification steps, and generate undesired, often toxic waste. These features led to the general consensus on the need for greener chemical transformations that will stimulate the transition to more sustainable chemical industries.

Conventional strategies in molecular syntheses make use of chemical redox reagents and directing groups, the installation of which results in costly reaction steps. Therefore, an environmentally-sound alternative is represented by molecular electrosynthesis to enable direct electro-functionalization of inert bonds. This strategy avoids prefunctionalizations, and prevents undesired waste formation, overall enabling a streamlining of organic synthesis for late-stage diversification.

While significant recent progress has been achieved in electrosynthesis, available methods are limited, and key challenges remain, particularly metalla-electrocatalyzed transformations beyond the realm of innate reactivity are in high demand.

I aim at addressing these major obstacles of selective electrochemical functionalizations. Thus, I will devise efficient electrochemical C–H and CO2 functionalizations without directing groups, gain full selectivity control in molecular electrocatalysis, and achieve late-stage polymer and peptide diversifications. Establishing a comprehensive set of sustainable strategies for organic electrocatalysis, including paired electrolysis, hybrid catalysts and electrophotocatalysis, will undeniably have a tremendous impact on applied areas, such as medicinal chemistry, drug discovery, chemical industries and material sciences.

Link to the ERC project webpage: https://www.ackermann.chemie.uni-goettingen.de

Keywords of the ERC project: Electrocatalysis, Sustainable Synthesis

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101039578	**PROTOMAT**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Pierangelo Gobbo**
Host Institution:	Universita Degli Studi Di Trieste - ITA

Integrating non-living and living matter via protocellular materials (PCMs) design and synthetic construction

The bottom-up construction of synthetic cells or protocells from inanimate molecules and materials is one of the grand challenges of our time. While research thus far has been focused on increasing the biochemical complexity individual protocells, this research proposal intends to pioneer the first scientific advancements towards the controlled assembly of protocell building blocks into forms of adaptive and self-regulating protocellular materials (PCMs) that can integrate with living cells and target their mechanochemical sensory pathways.

To achieve this, I am proposing to work at the interface of synthetic chemistry, materials science, microfluidics, and tissue engineering to address the following unprecedented aspects of PCM design and synthetic construction: (1) the engineering of PCMs with mechanical properties that mimic those of soft living tissues; (2) the engineering of PCMs with rudimentary adaptive and self-regulating higher-order behaviours; and (3) the development PCMs capable of interacting and integrating with living cells. I will start by developing the first experimental methodologies to assemble PCMs with a range of elastic moduli that mimic those of soft living tissues from protocells endowed with synthetic polymeric cytoskeletons of different composition. I will then engineer the first adaptive PCMs capable of autonomously converting environmental luminous stimuli into mechanical motions and reconfigurations that will self-regulate their endogenous enzymatic reactivity. Finally, I will develop the first forms of PCMs capable of delivering both mechanical and biochemical cues for living cell spreading, proliferation and differentiation in vitro.

Overall, the proposed work will pioneer new internationally leading science at the life/non-life interface that will generate transformative ideas in the field of bottom-up synthetic biology with profound fundamental and applied consequences, especially in tissue engineering and regenerative medicine.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101040355	**NeuRoPROBE**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Daniel Merk**
Host Institution:	Ludwig-Maximilians-Universitaet Muenchen - DEU

Probing (Orphan) Nuclear Receptors in Neurodegeneration

Neurodegenerative diseases such as Alzheimer's, Parkinson's or Multiple Sclerosis are severe health burdens and major global challenges for societies and healthcare systems. Therapeutic interventions in these diseases are not satisfying, since there is no treatment strategy that can halt or reverse disease progression. Several failed attempts at finding a cure for neurodegeneration have significantly reduced the interest for further research - yet, more than ever, new approaches are needed. Critically missing are pharmacologically validated targets for efficient neurodegenerative disease treatment and it is exactly here that NeuRoPROBE aims to close this gap. The orphan nuclear receptors (NR) tailless homologue (TLX) and nuclear receptor related-1 protein (Nurr1) have been identified in knockout studies as prime candidates. However, ligands for their pharmacological control as tools for therapeutic validation are lacking. NeuRoPROBE will enable pharmacological modulation of these transcription factors as a new and groundbreaking strategy to counteract neurodegeneration.

To meet its overall aim, NeuRoPROBE will (1) develop chemical probes (CP) and PROTACs for TLX and Nurr1, (2) employ generative artificial intelligence (AI) for molecular design to accelerate CP and PROTAC development, (3) establish phenotypic cellular models in 3D settings to mimic neurodegeneration, and (4) use CPs and PROTACs in the phenotypic models for pharmacological control of TLX and Nurr1 to validate their modulation in neurodegeneration.

This challenging and highly multidisciplinary endeavor will profit from my strong interdisciplinary background in the field of NR ligand discovery and pharmacology as well as in AI-based molecular design. NeuRoPROBE will open new avenues towards regenerative treatments in neurodegeneration, close the gaps in pharmacological control of TLX and Nurr1, and substantially contribute to consolidating AI techniques for structural optimization.

Link to the ERC project webpage:

Keywords of the ERC project: chemical probes, neurodegeneration, transcription factors, machine learning, molecular design

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101041759	**ReHuse**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr José Augusto Berrocal**
Host Institution:	Fundacio Privada Institut Catala D'Investigacio Quimica - ESP

Reversible Heterolytic Mechanophores for Dynamic Bulk Materials

Stimuli-responsive polymers adapt their properties in response to external cues. Engineering such "smart" behaviour in artificial systems by molecular design is an exciting fundamental challenge that can lead to technological breakthroughs. Most stimuli-responsive polymers rely on heat and light to trigger changes in materials properties in a predictable fashion. However, limitations intrinsic to these stimuli highlight the necessity of alternative strategies. Naturally evolved systems widely exploit mechanical stimulation to regulate their functions, but recreating such concept in artificial materials has proven extremely challenging thus far.
ReHuse proposes a radically new approach that focuses on the application of mechanical force to induce changes in bulk materials properties isothermally and reversibly. The research project aims at pushing the frontiers of covalent mechanochemistry through the development of reversible heterolytic mechanophores – molecular platforms that dynamically generate and recombine two oppositely charged (macro)molecular fragments upon mechanical stimulation. These new motifs will enable dynamic chemistries involving organic ionic species in solid-state systems in two different types of advanced bulk materials. Combining reversible mechanochemistry and dynamic covalent chemistry will lead to dynamic covalent polymers displaying selective mechanoresponsiveness. This concept will be leveraged to create recyclable materials. The reversible generation of charges from the heterolytic scission will enable to modulate hydrophilicity/hydrophobicity dynamically. Such principles will be explored to set the groundwork for mechano-responsive atmospheric water harvesters. This interdisciplinary research project will advance our understanding of mechanochemistry and, more importantly, will usher new avenues for its productive and repeatable use in adaptive materials.

Link to the ERC project webpage:

Keywords of the ERC project: Mechanochromic materials; triarylmethanes; heterolytic cleavage; reversible mechanochemistry

Keywords that characterize the scientific profile of the potential visiting researcher/s: Organic chemist; synthetic chemist; materials scientist; atmospheric water harvesting; polymer engineering

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101043783	**FOCUS**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Erik Garnett**
Host Institution:	Stichting Nederlandse Wetenschappelijk Onderzoek Instituten - NLD

Fluorescent Optical Concentration of Uncollimated Sunlight

There is an urgent need to use solar energy to produce electricity, fuels and chemicals. However, the highly diffuse nature of sunlight in angle, wavelength and space complicate its high-efficiency, low-cost and scalable conversion. FOCUS will develop thin-films that concentrate sunlight in these three aspects, creating collimated, monochromatic, high-intensity beams that can provide advantages for photovoltaics and photocatalysis. The underlying concept is a radically different design for a luminescent solar concentrator (LSC). Conventional LSCs use an emitter-doped plastic or glass sheet as a waveguide, concentrating direct and diffuse sunlight via total internal reflection of fluorescence. The losses associated with reabsorption, emission into the waveguide escape cone and Stokes shift have limited LSC efficiency to 7%. I will eliminate the waveguide completely and replace it with nanophotonic lenses, solving the longstanding problems with LSCs. The key challenges for successful implementation are addressed in three work packages. Nanophotonic design (WP1) will give FOCUS foils that absorb broadband sunlight from all angles, funnel the excitons to lower bandgap nanoscale emitters and concentrate the collimated fluorescence outside of the film. Material learning (WP2) and reciprocity-inspired photosynthesis will use the desired emission pattern to train a material to emit from self-optimized positions, leading to FOCUS foils that learn the desired optical output. Ultrafast 3D nanoprinter (WP3) development will lead to a microscope that synthesizes emitters directly within a solid-state host, tracks their performance (quantum yield, angular emission pattern) in real-time and watches excited carriers relax into directionally emitting states. My track record in nanophotonic solar cells and directional emission combined with my network of leading collaborators put me in an excellent position to achieve these goals.

Link to the ERC project webpage:

Keywords of the ERC project: nanophotonics, halide perovskites, diffuse light concentration, ultrafast spectroscopy, material learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: nanomaterials, nanophotonics, solar energy conversion

Project ID:	Project Acronym:	Evaluation Panel:
101045004	**LUX-INVENTA**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Dawid Pinkowicz**
Host Institution:	Uniwersytet Jagiellonski - POL

Bringing molecular photomagnets to light - achieving magnets through visible light excitation at room temperature

Visible light provided by the Sun is the cleanest energy source one could ever imagine. Harvesting it is crucial for further development of science and technology as well as for reducing the ecological footprint of humanity. The efficient use of the visible spectrum of the Sun can take many forms and the direct photoexcitation of molecules resulting in a dramatic magnetization change - the so called photomagnetic effect - is one of them. In other words, sunlight photons could write, read and erase magnetic states of photomagnets. Photomagnets can be designed and prepared via a bottom-up modular approach using low-energy preparation methods developed by coordination, organometallic chemistry, supramolecular chemistry and crystal engineering with the support from physical and computational sciences. Photomagnets belong to the class of smart multifunctional molecular materials that become paramagnetic, ferromagnetic or simply change their magnetic properties upon illumination - a feature that is hardly accessible in conventional magnetic solids - metal alloys and oxides. Currently known photomagnets are merely laboratory curiosities due to extremely low operation temperatures below the boiling point of nitrogen (-196?C). Hence, the overarching goal of LUX-INVENTA is the discovery of room temperature (RT) photomagnets that would show light-induced ON/OFF ferromagnetic switching under normal conditions. This goal will be pursued alongside the deep understanding of the processes occurring during the absorption of a photon by photomagnetic chromophores - the molecular components responsible for the photomagnetic effect. The proposed research focuses on (i) the design and synthesis of novel photomagnetic chromophores, (ii) investigation of the mechanism of the photomagnetic switching and (iii) preparation of RT photomagnets by a rational incorporation of the photomagnetic chromophores in the structure of coordination polymers and metal-organic frameworks

Link to the ERC project webpage:

Keywords of the ERC project: photomagnetism, molecular magnetism, multifunctional systems, coordination chemistry, organometallic, crystals

Keywords that characterize the scientific profile of the potential visiting researcher/s: magnetic measurements, or photomagnetic measurements, or organic and inorganic chemistry

Project ID:	Project Acronym:	Evaluation Panel:
101045466	**BIOMATFAB**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Filipe Natalio**
Host Institution:	Weizmann Institute Of Science - ISR

Biological fabrication of cotton fibers with tailored properties

Naturally produced fibers have always played central roles in shaping human civilizations. Current hazardous chemical-based manufacturing processes and consumers' preferences for cotton products are putting much strain on the future of cotton's global economy. Thus, it is urgent to seek future sustainable alternatives. What alternatives and tools are available? Which new avenues are waiting to be explored toward this end?

Harnessing biological systems is one of humanity's ultimate frontiers. Yet, the intrinsic complexity of higher organisms and the lack of in-depth, comprehensive understanding of the underlying mechanisms and their interactions across a multitude of scales has primarily hindered their use to manufacture bio-based materials with desired properties. This project addresses this lack of knowledge by answering key questions concerning the sugar uptake and upwards transport from the roots and biosynthesis of naturally produced fibers at the level of cotton plants while using this body of information to create a roadmap to produce cotton fibers with tailored properties.

Our approach will dive into the exploration of a recent and largely unexplored discovery that cotton plants uptake sugar by the roots, transporting them upwards, reaching as far as the fibers (root-to-fiber). In particular, we will dwell on the dynamics of this process using sugar derivatives. This body of information will set the stage for feeding the roots of whole cotton plants with sugar derivatives carrying specific functionalities to become, ultimately, biologically incorporated into the fibers modifying their end properties, particularly fluoro-sugars to yield fibers with increased hydrophobicity. We will demonstrate the feasibility of biological fabrication and material farming in whole cotton plants as a revolutionizing and sustainable alternative to manufacturing current chemical-based strategies and toward a bio-based global economy.

Link to the ERC project webpage:

Keywords of the ERC project: material farming, plants, hybrid, textile, cotton,

Keywords that characterize the scientific profile of the potential visiting researcher/s: chemistry, materials, plants, enzymes, protein expression

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Project ID:	Project Acronym:	Evaluation Panel:
101052935	**InnoChem**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Ingo Krossing**
Host Institution:	Albert-Ludwigs-Universitaet Freiburg - DEU

Innocent Deelectronation Chemistry - From the unified redox scale valid in all solvents to innocent deelectronation chemistry in innocent solvents

The elementary steps underlying the reversible addition and removal of electrons from matter M –Metals, Molecules or Materials– are the fundament to describe redox chemistry, electrocatalysis and electrochemical energy storage. However, the electrochemical potentials of reaction partners are only comparable within one solvent. This is a consequence of the solvent specific standard states.

For this reason, it is a Grand Challenge to establish a Unified Redox Scale to compare electrochemical potentials in all media without extra-thermodynamic assumptions. To achieve this, we use an 'ideal' Ionic Liquid Salt Bridge setup to measure the Gibbs transfer energies between different solvents. The measured values, corrected for residual liquid junction potential contributions, will be used to directly connect potentials to the aqueous scale. This unifying solvent-independent scale will allow for knowledge-based comparison and selection of reagents for redox reactions in the next sections.

Reagents for deelectronation (removal of an e–) at high potential are scarcely available. Hence, we prepare perhalogenated radical cation salts that act as innocent Deelectronators (iD+) with high unified redox potentials. An iD+ converts a given neutral M to the 'naked' cation M+. iD+-salts are straightforwardly accessible and room-temperature stable materials. Conveniently, they are in part weighable in air. Combined with suitable non-reactive, weakly coordinating but polar innocent solvents and robust weakly coordinating anions, reactive cation salts are accessible.

Such reversible iD+-mediated redox-processes at high potential are appealing for electrosynthesis and -catalysis. To generate, study and apply these systems, we introduce a generally applicable innocent solvent family compatible with the high potential of iD+ and M+ – also with commercially available anions. Suitable iD+/solvent couples for targeted reactions are selected based on their position on the unified redox scale.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101052997	**EDISON**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Ramon Martínez Máñez**
Host Institution:	Universitat Politecnica De Valencia - ESP

Engineered Particles for Chemical Communication

This project aims to the development of communication at the nanoscale and to advance in the understanding of how abiotic micro/nanoparticles can communicate between them and how micro/nanoparticles can communicate with living systems. In this context, an approach for establishing communication at the nanometric level is to mimic how nature communicates. Chemical or molecular communication, based on transmitting and receiving information by means of molecules (chemical messengers) is one of the communication forms used by living organisms. Moreover, many swarm systems found in nature communicate by modifying the environment using a concept called stigmergy. The advantages of nanoparticles that communicate each to another are immediately obvious; they constitute the basis of a dynamically interacting network eventually resulting in certain autonomy of the system. If we would be able to raise the bases for communication between micro/nanoparticles and between micro/nanoparticles and cells, the potential future applications in the biomedical field, environmental research and industry technology are almost unlimited. The project will establish firm handholds for the use of nanoparticles able to communicate from one to another and with cells in different applications. The project will trace, optimise and adapt all single steps from the idea to its implementation into applicable final systems with the aim of targeting issues that are difficult to address with conventional single particles. The project is divided into three WPs. The first work package (WP1) will create the basic elements for chemical communication. In a more complex situation, WP2 will use the tools of WP1 to develop systems able to establish communication between nanoparticles and living systems. Finally, WP3 will generate nano-systems integrating gated nanoparticles and up-to-date electronics to develop new communication structures.

Link to the ERC project webpage: edison.webs.upv.es

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101054751	**COLDOC**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Peter Richard Schreiner**
Host Institution:	Justus-Liebig-Universitaet Giessen - DEU

Cold Organic Chemistry

This proposal ventures into organic chemical reactions under not-so-common conditions, namely in the cold, at insufficient energies, and under the action of hard radiation. As many organic molecules have been discovered in space or brought to earth in meteorites, they must have formed under such conditions through hitherto largely undisclosed mechanisms. One key hypothesis is that quantum-mechanical tunneling (QMT) and novel reactions with exceptionally low barriers are at work. Hence, one of the key objectives is to uncover how QMT, where reactions occur through and not over barriers, controls chemical reactivity and selectivity. A second goal is the examination of cryogenic reactions of hydroxycarbenes or enols with carbonyl compounds. Our methods include organic synthesis of starting materials (also isotopically labelled) and products, infrared as well as ultaviolet/visible matrix-isolation spectroscopy, ab initio computations of structures, spectra, and potential energy surfaces as well as QMT rate calculations. We will examine isotope-selective reactions of competing QMT reactions that can be made selective through strategic isotope incorporation. QMT also offers new ways to activate carbon dioxide and even to catalyze reactions. We propose a unifying synthesis of carbohydrates and alpha-amino acids through a common mechanistic scenario, namely a newly discovered hetero-carbonyl-ene reaction of carbenes or enols in the gas phase. Finally, chemistry far from thermodynamic equilibrium is explored with probing the activation and reaction of highly stable molecules under irradiation with energetic electrons, thereby mimicking conditions of the interstellar medium exposed to galactic cosmic rays. This should shed light on the formation of larger “complex organic molecules” found in this medium and often considered as building blocks for life.

Link to the ERC project webpage:

Keywords of the ERC project: prebiotic chemistry, tunneling, astrochemistry

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
772346	**TUgbOAT**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Piotr Sankowski**
Host Institution:	Uniwersytet Warszawski - POL

Towards Unification of Algorithmic Tools

Over last 50 years, extensive algorithmic research gave rise to a plethora of fundamental results. These results equipped us with increasingly better solutions to a number of core problems. However, many of these solutions are incomparable. The main reason for that is the fact that many cutting-edge algorithmic results are very specialized in their applicability. Often, they are limited to particular parameter range or require different assumptions.

A natural question arises: is it possible to get “one to rule them all” algorithm for some core problems such as matchings and maximum flow? In other words, can we unify our algorithms? That is, can we develop an algorithmic framework that enables us to combine a number of existing, only “conditionally” optimal, algorithms into a single all-around optimal solution? Such results would unify the landscape of algorithmic theory but would also greatly enhance the impact of these cutting-edge developments on the real world. After all, algorithms and data structures are the basic building blocks of every computer program. However, currently using cutting-edge algorithms in an optimal way requires extensive expertise and thorough understanding of both the underlying implementation and the characteristics of the input data.

Hence, the need for such unified solutions seems to be critical from both theoretical and practical perspective. However, obtaining such algorithmic unification poses serious theoretical challenges. We believe that some of the recent advances in algorithms provide us with an opportunity to make serious progress towards solving these challenges in the context of several fundamental algorithmic problems. This project should be seen as the start of such a systematic study of unification of algorithmic tools with the aim to remove the need to “under the hood” while still guaranteeing an optimal performance independently of the particular usage case.

Link to the ERC project webpage: www.mimuw.edu.pl/~tugboat/

Keywords of the ERC project: algorithms, optimization

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
788980	**ESCADA**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Joan Daemen**
Host Institution:	Stichting Radboud Universiteit - NLD

Energy-optimized Symmetric Cryptography by Algebraic Duality Analysis

The main scientific contribution of this project will be a breakthrough in the understanding of cryptanalytic and side channel attacks of symmetric cryptosystems. We will do this by a unification of attacks that will a stepping stone to the holy grail of symmetric cryptography: provable security of concrete cryptosystems. The main real-world impact is that we will build cryptosystems that are much more efficient than those used today while having the same strength. Depending on the platform, higher efficiency translates to lower energy/power (in-body sensors, contactless payment cards etc.), but also lower latency (authentication for e.g car brakes or airbags) and/or lower heat dissipation (on-the-fly encryption of high bandwidth data streams). In a software implementation it simply means less CPU cycles per byte.

We build our cryptosystems as modes, on top of block ciphers or permutations. For these primitives we adopt the classical technique of iterating a simple round function (more rounds means more security but less efficiency). We focus on round functions of algebraic degree 2. Their relative simplicity will allow a unification of all cryptanalytic attacks that exploit propagation of affine varieties and polynomial ideals (their dual) through the rounds and to precisely estimate their success rates. Moreover, we will design modes that strongly restrict the exposure of the primitive(s) to attackers and that permit security reductions to specific properties of the underlying primitive(s) in a formally verifiable way. In comparison to the classical pseudorandom and ideal permutation models, this will allow reducing the number of rounds while preserving security with high assurance. We will also study side channel attacks of our round functions and ways to defend against them. We will make ASIC prototypes and implement novel efficient countermeasures against side channel attacks and use this to evaluate their effectiveness in practice.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
802020	**HARMONIC**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Yuval Filmus**
Host Institution:	Technion - Israel Institute Of Technology - ISR

Discrete harmonic analysis for computer science

Boolean function analysis is a topic of research at the heart of theoretical computer science. It studies functions on n input bits (for example, functions computed by Boolean circuits) from a spectral perspective, by treating them as real-valued functions on the group Z_2^n, and using techniques from Fourier and functional analysis. Boolean function analysis has been applied to a wide variety of areas within theoretical computer science, including hardness of approximation, learning theory, coding theory, and quantum complexity theory.

Despite its immense usefulness, Boolean function analysis has limited scope, since it is only appropriate for studying functions on {0,1}^n (a domain known as the Boolean hypercube). Discrete harmonic analysis is the study of functions on domains possessing richer algebraic structure such as the symmetric group (the group of all permutations), using techniques from representation theory and Sperner theory. The considerable success of Boolean function analysis suggests that discrete harmonic analysis could likewise play a central role in theoretical computer science.

The goal of this proposal is to systematically develop discrete harmonic analysis on a broad variety of domains, with an eye toward applications in several areas of theoretical computer science. We will generalize classical results of Boolean function analysis beyond the Boolean hypercube, to domains such as finite groups, association schemes (a generalization of finite groups), the quantum analog of the Boolean hypercube, and high-dimensional expanders (high-dimensional analogs of expander graphs). Potential applications include a quantum PCP theorem and two outstanding open questions in hardness of approximation: the Unique Games Conjecture and the Sliding Scale Conjecture. Beyond these concrete applications, we expect that the fundamental results we prove will have many other applications that are hard to predict in advance.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
819141	**PASS**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Cristian Cadar**
Host Institution:	Imperial College Of Science, Technology And Medicine - GBR

Program Analysis for Safe and Secure Software Evolution

Constant evolution is an inherent property of modern software systems. Software evolves to implement new features, adapt to new hardware and platforms, fix bugs and security vulnerabilities, or improve non-functional properties such as performance and energy consumption.

While these changes have an overall positive impact, they are also responsible for a large number of critical bugs and security attacks. The reason is twofold: first, software changes are not vetted enough, due to the difficulty of reasoning about all possible new behaviours that they introduce. Second, even when critical errors in deployed changes are later discovered and fixed, users take a long time to update their software to the latest version, mostly because they are concerned about the potential negative impact of an update.

The PASS project aims to tackle both problems and help software evolve safely and securely. It takes a holistic approach to the challenges of safe and secure software evolution, by combining offline program analysis to verify or comprehensively test software changes, with runtime mechanisms for keeping the software updated and secure against potentially erroneous changes that make it into the deployed system.

This is an ambitious project, which requires fundamental advances at the intersection of program analysis, software engineering, and computer systems to develop practical cross-version specifications, scalable patch verification, in-production testing and analysis, and low-overhead reversible software updates.

Link to the ERC project webpage: https://srg.doc.ic.ac.uk/

Keywords of the ERC project: program analysis, software testing, software changes

Keywords that characterize the scientific profile of the potential visiting researcher/s: program analysis, software testing, systems

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Project ID:	Project Acronym:	Evaluation Panel:
835197	**ViAjeRo**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Stephen Brewster**
Host Institution:	University Of Glasgow - GBR

ViAjeRo: Virtual and Augmented Reality passenger experiences

ViAjeRo will radically improve passenger journeys using immersive Virtual and Augmented Reality to support entertainment, work and collaboration on the move. In Europe, people travel an average of 12,000km per year on private and public transport, in cars, buses, planes and trains. These journeys are often repetitive and wasted time. This total will rise with the arrival of fully autonomous cars, which free drivers to become passengers. The potential to recover this lost time is impeded by 3 significant challenges

. Confined spaces: These limit interactivity, and force us to rely on small displays such as phones or seatback screens

. Social acceptability: We may share the space with others, inducing a pressure to conform, inhibiting technology use

. Motion sickness: Many people get sick when they read or play games in vehicles. Once experienced, it can take hours for symptoms to resolve

VR/AR headsets could allow passengers to use their travel time in new, productive, exciting ways, but only if bold research is undertaken to overcome these fundamental challenges. ViAjeRo will use VR/AR to do adventurous multidisciplinary work, unlocking the untapped potential of passengers. They will be able to use large virtual displays for productivity; escape the physical confines of the vehicle and become immersed in virtual experiences; and communicate with distant others through new embodied forms of communication – all whilst travelling. This will be of great benefit to European society and open a new area for products and services. Our vision requires groundbreaking contributions at the intersection of HCI, neuroscience and sensing to:

1 Develop novel interaction techniques for confined, seated spaces

2 Support safe, socially acceptable use of VR/AR, providing awareness of others and the travel environment

3 Overcome motion sickness through novel multimodal countermeasures and neurostimulation

4 Tailor the virtual and physical passenger environment to support new,

Link to the ERC project webpage: www.viajero-project.org

Keywords of the ERC project: Virtual reality, passengers, travel, interaction, social acceptability, motion sickness

Keywords that characterize the scientific profile of the potential visiting researcher/s: human computer interaction, psychology

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
850533	**LEGO-3D**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Andreas Geiger**
Host Institution:	Eberhard Karls Universitaet Tuebingen - DEU

Learning Generative 3D Scene Models for Training and Validating Intelligent Systems

Recently, the field of computer vision has witnessed a major transformation away from expert designed shallow models towards more generic deep representation learning. However, collecting labeled data for training deep models is costly and existing simulators with artist-designed scenes do not provide the required variety and fidelity. Project LEGO-3D will tackle this problem by developing probabilistic models capable of synthesizing 3D scenes jointly with photo-realistic 2D projections from arbitrary viewpoints and with full control over the scene elements. Our key insight is that data augmentation, while hard in 2D, becomes considerably easier in 3D as physical properties such as viewpoint invariances and occlusion relationships are captured by construction. Thus, our goal is to learn the entire 3D-to-2D simulation pipeline. In particular, we will focus on the following problems:
(A) We will devise algorithms for automatic decomposition of real and synthetic scenes into latent 3D primitive representations capturing geometry, material, light and motion.
(B) We will develop novel probabilistic generative models which are able to synthesize large-scale 3D environments based on the primitives extracted in project (A). In particular, we will develop unconditional, conditioned and spatio-temporal scene generation networks.
(C) We will combine differentiable and neural rendering techniques with deep learning based image synthesis, yielding high-fidelity 2D renderings of the 3D representations generated in project (B) while capturing ambiguities and uncertainties.
Project LEGO-3D will significantly impact a large number of application areas. Examples include vision systems which require access to large amounts of annotated data, safety-critical applications such as autonomous cars that rely on efficient ways for training and validation, as well as the entertainment industry which seeks to automate the creation and manipulation of 3D content.

Link to the ERC project webpage: https://uni-tuebingen.de/fakultaeten/mathematisch-naturwissenschaftliche-fakultaet/fachbereiche/informatik/lehrstuehle/autonomous-vision/research/

Keywords of the ERC project: 3D aware generative models, simulation, deep learning, 3D vision

Keywords that characterize the scientific profile of the potential visiting researcher/s: 3D computer vision, natural language processing, self-driving

Project ID:	Project Acronym:	Evaluation Panel:
851811	**VAPLCS**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Ori Lahav**
Host Institution:	Tel Aviv University - ISR

Verification-Aware Programming Language Concurrency Semantics

With the proliferation of multi-core processors, concurrent programming regularly appears at the core of heavily relied-upon systems, where both performance and correctness are of paramount importance. The canonical concurrency model is sequential consistency-identifying concurrent programs with all possible interleavings of operations of their constitute threads. It is a simple model for programmers, but unsatisfactory as a programming language concurrency semantics. First, performance-wise, it is too costly to implement. In fact, no commodity hardware provides sequential consistency. Second, the number of interleavings is often so large, posing the infamous "state explosion problem" as the utmost obstacle to any verification attempt.

Our overarching goal is to develop a novel concurrency semantics for programming languages that will: allow efficient implementation; provide easily usable guarantees, sufficiently strong for concurrent algorithms; and be amenable to scalable verification. To achieve this, we will leverage our recent advances in addressing the flaws in the C/C++ and Java specifications and in model checking under certain weak concurrency semantics. Moreover, we will develop practical verification methods to facilitate the task of concurrent programming.

This proposal makes a conceptual leap beyond the state-of-the-art, by identifying the development of a weak concurrency semantics not only as an unfortunate necessity, but also as an opportunity to revolutionize software verification. It is high-risk: it tackles a longstanding open problem in programming languages. It is also high-gain: it will significantly increase the applicability of verification, bridge a major gap between verification research and practical concurrent programming, and shed light on the role of the underlying semantics. I aim for the proposed concurrency semantics to provide new foundations for the specifications of mainstream and emerging programming languages.

Link to the ERC project webpage: https://www.cs.tau.ac.il/~orilahav/

Keywords of the ERC project: Weak memory models; Semantics; Verification; Coq

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
866435	**PIPE**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Jaakko Lehtinen**
Host Institution:	Aalto-Korkeakoulusaatio - FIN

Learning Pixel-Perfect 3D Vision and Generative Modeling

A fascinating tension exists between computer vision and computer graphics. Decades of research efforts have led to the ability of graphics algorithms to simulate the world to a degree often indistinguishable from reality -- given an accurate enough model of scene geometry and appearance. Similarly, decades of ingenuity have given computer vision techniques the already, at times, superhuman capability of detecting, recognizing, and predicting objects, actions, and identities from pictures or video.

Vision and graphics meet at a common point of pain: the model of scene geometry and appearance. To yield photorealistic results, graphics algorithms require an essentially perfect forward model. Yet, the capability of computer vision algorithms to robustly and accurately reason about the 3D shape and appearance of the world, unfortunately, greatly lags behind the capabilities to detect, recognize, segment, and so on. A great discrepancy exists between the semantic and the pixel-perfect, accurate shape and appearance. Bridging this chasm is the goal of this research.

This entails solving fundamental, long-standing, unsolved problems in computer vision through the aid of computer graphics and machine learning}. First, we seek to simultaneously capture accurate 3D shape and appearance of complex real-world scenes from photographic inputs; second, we seek to extend these capabilities still further to``zero-shot'' generative modelling. These extremely ambitious goals will be reached by marrying simulation (rendering) and machine learning, building on the PI's three existing strengths: (1) ability to capture photorealistic material appearance models using commodity devices; (2) his leading standing in physically-based image synthesis; and (3) his results on generative modeling of photorealistic images through deep convolutional neural networks.

Link to the ERC project webpage:

Keywords of the ERC project: computer vision, deep learning, computer graphics

Keywords that characterize the scientific profile of the potential visiting researcher/s: computer vision, 3d reconstruction

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
882500	**ScAlBox**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Peter Sanders**
Host Institution:	Karlsruher Institut Fuer Technologie - DEU

Engineering Scalable Algorithms for the Basic Toolbox ScAlBox

ScAlBox aims at basic algorithmic tools that can be used in a wide spectrum of applications and that scale orders of magnitude better than the state of the art with respect to input size or number of processors.
In the last decades, we witness the transition into the information age with profound effects on science, technology, and our daily life. This transition is driven by a growing spectrum of computer applications that process larger and larger data sets using increasingly complex algorithms. However, the scalability challenge has emerged as a major road block to this progress:
An explosion of the amount of data to be processed (big data) coincides with stagnating performance of a single processor core. This widening performance gap can only be closed using many parallel processors. However, parallel algorithms have long been neglected by algorithm theory while heuristic software development optimizes for existing machines and inputs but fails to give predictable scalability for future, larger data sets and more processors.
We want to overcome this roadblock by developing scalable solutions for the basic toolbox of algorithms and data structures that are needed in many applications (e.g., sorting, searching, queues, basic graph algorithms, collective communication, and load balancing). My goal is to provide algorithms and software libraries that scale to millions of processors and give hard performance guarantees for arbitrary inputs. This is challenging due to large gaps between theory and practice and because such algorithms have to integrate scalable fault tolerance and dynamic load balancing to an unprecedented extent. I am the right person to achieve this due to my extensive experience in parallel algorithms for irregular problems and my leading role in algorithm engineering that integrates modeling, design, theoretical analysis, implementation, and experimental evaluation.

Link to the ERC project webpage:

Keywords of the ERC project: algorithms, parallel computing

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
885107	**RLeap**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Hector Geffner**
Host Institution:	Universitat Pompeu Fabra - ESP

From Data-based to Model-based AI: Representation Learning for Planning

Two of the main research threads in AI revolve around the development of data-based learners capable of inferring behavior and functions from experience and data, and model-based solvers capable of tackling well-defined but intractable models like SAT, classical planning, and Bayesian networks. Learners, and in particular deep learners, have achieved considerable success but result in black boxes that do not have the flexibility, transparency, and generality of their model-based counterparts. Solvers, on the other hand, require models which are hard to build by hand. RLeap is aimed at achieving an integration of learners and solvers in the context of planning by addressing and solving the problem of learning first-order planning representations from raw perceptions alone without using any prior symbolic knowledge. The ability to construct first-order symbolic representations and using them for expressing, communicating, achieving, and recognizing goals is a main component of human intelligence and a fundamental, open research problem in AI. The success of RLeap requires the development of radically new ideas and methods that will build on those of a number of related areas that include planning, learning, knowledge representation, combinatorial optimization and SAT. The approach to be pursued is based on a clear separation between learning the symbolic representations themselves, that is cast as a combinatorial problem, and learning the interpretations of those representations, that is cast as a supervised learning problem from targets obtained from the first part. RLeap will address both problems, not just in the planning setting but in the generalized planning setting as well where plans are general strategies. The project can make a significant difference in how general, explainable, and trustworthy AI can be understood and achieved. The PI has made key contribution to the main themes of the project that make him uniquely qualified to carry it forward.

Link to the ERC project webpage: https://rleap-project.github.io/

Keywords of the ERC project: Learning symbolic representations, artificial intelligence planning, reinforcement learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: deep reinforcement learning, logic, neuro-symbolic AI

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
949707	**Interactive**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Klim Efremenko**
Host Institution:	Ben-Gurion University Of The Negev - ISR

Coding for Interactive Communication and the Power of Adaptivity

Error correcting codes allow for reliable transmission of data over unreliable channels. The 70 years of development that went into the study of error correction, following Shannon's ground-breaking paper in 1948, yielded a fairly complete theory with far reaching applications to other theoretical and practical fields.

However, many modern communication settings are not simply about transmitting information, but rather operate over many rounds of interactive communication between different parties. Cloud computing, cryptographic protocols, and distributed computing schemes are prime examples of such settings.

Due to the overwhelming success of classical error correcting codes, and because interaction is central in many applications, we strongly believe that the theory of interactive error correcting codes will be transformative.

Crafting error correcting codes tailored for interactive settings, as well as understanding their fundamental limitations, is the main goal of this proposal.

We will study some of the most exciting fundamental open problems in interactive communication. In particular, this includes computing the rate distance trade-off for interactive coding, and building error resilient schemes for distributed computing.

We will consider a diverse set of ``classical'' questions in the interactive setting, as well as aspects of interactive coding that are unique and have no counterparts in classical coding. Further, we will build adaptive coding schemes which will achieve better rates than non-adaptive counterparts.

Indeed, one of the main powers of interactive communication, and an integral part of this proposal, is adaptivity.

Here, each party can adapt its actions based on previous communication.

As our research draws ideas from several scientific communities, it will lift our understanding of interdisciplinary connections between them to new heights.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101001995	**FRESCO**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Assia Mahboubi**
Host Institution:	Institut National De Recherche En Informatique Et En Automatique - FRA

Fast and Reliable Symbolic Computation

The use of computers for formulating conjectures, but also for substantiating proof steps, pervades mathematics, even in its most abstract fields. Most computer proofs are produced by symbolic computations, using computer algebra systems. Sadly, these systems suffer from severe, intrinsic flaws, key to their amazing efficiency, but preventing any flavor of post-hoc verification.

But can computer algebra become reliable while remaining fast? Bringing a positive answer to this question represents an outstanding scientific challenge per se, which this project aims at solving.

Our starting point is that interactive theorem provers are the best tools for representing mathematics in silico. But we intend to disrupt their architecture, shaped by decades of applications in computer science, so as to dramatically enrich their programming features, while remaining compatible with their logical foundations.

We will then design a novel generation of mathematical software, based on the firm grounds of modern programming language theory. This environment will feature a new, high-level, performance-oriented programming language, devised for writing efficient and correct code easily, and for serving the frontline of research in computational mathematics. Users will have access to fast implementations, and to powerful proving technologies for verifying any component à la carte, with high productivity. Logic- and computer-based formal proofs will prevent run-time errors, and incorrect mathematical semantics.

We will maintain a close, continuous collaboration with interested high-profile mathematicians, on the verification of cutting-edge research results, today beyond the reach of formal proofs. We ambition to empower mathematical journals to install high-quality artifact evaluation, when peer-reviewing falls short of assessing computer proofs. This project will eventually impact the use of formal methods in engineering, in areas like cryptography or signal-processing.

Link to the ERC project webpage: https://fresco.gitlabpages.inria.fr/

Keywords of the ERC project: formal proofs, computer algebra, program verification

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101039196	**CRETE**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Niki Vazou**
Host Institution:	Fundacion Imdea Software - ESP

Certified Refinement Types

Refinement types are a type-based, static verification technique designed to be practical. They enrich the types of an existing programming language with logical predicates to specify program properties and automatically validate these specifications using SMT solvers. Refinement types are a promising verification technology that in the last decade has spread to mainstream languages (e.g., Haskell, C, Ruby, Scala, and the ML-family) to verify sophisticated properties of real world applications, e.g., safety of cryptographic protocols, memory and resource usage, and web security.

The weakness of refinement types is that they do not meet the soundness standards set by theorem provers. A sound verification system accepts as safe only those programs that never violate their specifications. Refinement type checkers (e.g., Liquid Haskell, F*, and Stainless) approximately report five unsoundness bugs per year, as opposed to only one reported by the Coq theorem prover. This rarity of unsoundness bugs in Coq is unsurprising since Coq is designed to soundly machine check mathematical proofs. Coq's soundness design recipe though cannot be directly applied to refinement type checkers that aim to practically verify real world programs.

The goal of CRETE is to design a sound and practical refinement type system.

This is an ambitious goal that entails the development of a verification system that is as practical as refinement types and constructs machine-checked mathematical proofs. The system will be implemented on refinement type systems for mainstream languages (i.e., Haskell and Rust) and will be evaluated on real-world code, such as web applications and cryptographic protocols.

CRETE is high-risk since it aims to develop a novel program logic in which SMT automation co-exists with real world programming. Yet, CRETE is high-gain since it proposes a low-cost, high-profit approach to formal verification that aims to be integrated in mainstream software development.

Link to the ERC project webpage: https://nikivazou.github.io/crete.html

Keywords of the ERC project: functional programming, verification, refinement types

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101039436	**A-B-C-Deep**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Daniel Soudry**
Host Institution:	Technion - Israel Institute Of Technology - ISR

Algorithmic Bias Control in Deep learning

Deep Learning (DL) has reached unparalleled performance in many domains. However, this impressive performance typically comes at the cost of gathering large datasets and training massive models, requiring extended time and prohibitive costs. Significant research efforts are being invested in improving DL training efficiency, i.e., the amount of time, data, and resources required to train these models, by changing the model (e.g., architecture, numerical precision) or the training algorithm (e.g., parallelization). Other modifications aim to address critical issues, such as credibility and over-confidence, which hinder the implementation of DL in the real world. However, such modifications often cause an unexplained degradation in the generalization performance of DL to unseen data. Recent findings suggest that this degradation is caused by changes to the hidden algorithmic bias of the training algorithm and model. This bias selects a specific solution from all solutions which fit the data. After years of trial-and-error, this bias in DL is often at a "sweet spot" which implicitly allows ANNs to learn well, due to unknown key design choices. But performance typically degrades when these choices change. Therefore, understanding and controlling algorithmic bias is the key to unlocking the true potential of deep learning.

Our goal is to develop a rigorous theory of algorithmic bias in DL and to apply it to alleviate critical practical bottlenecks that prevent such models from scaling up or implemented in real-world applications.

Our approach has three objectives: (1) identify the algorithmic biases affecting DL; (2) understand how these biases affect the functional capabilities and generalization performance; and (3) control these biases to alleviate critical practical bottlenecks. To demonstrate the feasibility of this challenging project, we describe how recent advances and concrete preliminary results enable us to effectively approach all these objectives.

Link to the ERC project webpage: https://sites.google.com/site/danielsoudry/?pli=1

Keywords of the ERC project: Deep learning, Theory, Implicit bias, implicit regularization, efficiency

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101040088	**UniversalContracts**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Dominique Devriese**
Host Institution:	Katholieke Universiteit Leuven - BEL

Formalizing, Verifying and Applying ISA Security Guarantees as Universal Contracts

The Instruction Set Architecture (ISA) is the interface that processor hardware offers to software developers. Current ISAs do not explicitly specify the security properties guaranteed by that interface, so that, for example, recent severe micro-architectural side-channel vulnerabilities like Spectre did not even violate the specifications. This project proposes a fundamentally new approach to specify ISA security properties by using what we call universal contracts. These are formal contracts in a compositional program logic that automatically hold for arbitrary code. Such contracts capture ISA-enforced upper bounds on the effects of arbitrary (even attacker-controlled) software. While this approach is widely different from traditional specifications, the approach looks extremely promising: universal contracts can be applied to general security primitives, mechanically verified against the ISA's operational semantics and they make it possible to obtain full-system security proofs by manually verifying only the trusted code of a sytem.
In this project, we will contribute reusable techniques and tools for applying universal contracts in realistic ISAs. To this end, we will (1) design, prove and evaluate universal contracts for ISAs with state-of-practice security primitives, (2) develop semi-automation machinery for verifying universal contracts of ISAs, (3) extend universal contracts to deal with semantic complications like concurrency or micro-architectural side-channels and (4) design, implement and evaluate techniques which facilitate the construction of trusted software that relies on universal contracts, particularly assembly-level reasoning support and secure compilers. If successful, the project has the potential to fundamentally improve the security foundations of all software-based systems, by (1) clearly dividing the security responsibilities between hardware and software developers and (2) enabling scalable, rigorous, full-system security proofs.

Link to the ERC project webpage:

Keywords of the ERC project: formal verification, instruction set architectures, security, secure compilation

Keywords that characterize the scientific profile of the potential visiting researcher/s: formal verification, instruction set architectures, security, secure compilation

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101042702	**InteVol**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Asier Marzo**
Host Institution:	Universidad Publica De Navarra - ESP

Interactions with Future Reach-Through Volumetric Displays

Displays in the shape of televisions, computer screens or phones are ever present in our education, work and entertainment. However, they do not take full advantage of our inner spatial abilities that we have to interact with the real world. True 3D displays can provide the same visual clues as the real world without forcing the users to wear devices. However, with State of the art (SoA) displays, the users cannot reach inside the display volume to directly interact with the virtual objects as they would do in real life. We envision a volumetric display capable of projecting true 3D virtual objects in mid-air that can be reached by the users to enable direct interaction, i.e. a reach-through volumetric display (RVD). This vision has been presented in multiple movies and books but there is no realization.

Three novel technologies will be developed and combined to create an RVD. 1) fast time-multiplexed acoustic fields will create virtual force fields that give shape to microfabricated light-scaterring particles. 2) Tomographic illumination will shine on the particles as a more scalable alternative to phase-based holographic. 3) Volumetric tracking of the particle distribution will control the previous technologies in a closed-loop manner. Applications will serve as benchmarks to test novel interaction techniques and develop a framework that fills in the knowledge gap for interactions with as yet nonexistent RVDs.

The objectives of the project are: O1) find a set of technologies that enables the realization of RVDs, O2) create interaction techniques for RVDs and categorize them using a framework that will be applicable to future displays, our current frameworks for 3d-interactions may not be applicable to RVDs. O3) enhance an RVD with tactile sensations, spatial audio and study its effects on humans.

The PI is uniquely qualified with experience in designing mid-air interactions and using levitated particles for displays.

Link to the ERC project webpage:

Keywords of the ERC project: volumetric displays, 3d graphics, hci, acoustic levitation, holography, tomography, aerosols

Keywords that characterize the scientific profile of the potential visiting researcher/s: volumetric displays, 3d graphics, hci, acoustic levitation, holography, tomography, aerosols

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101043159	**DynOpt**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Shay Solomon**
Host Institution:	Tel Aviv University - ISR

Towards a New Theory of Optimal Dynamic Graph Algorithms

Dynamic graph algorithms are of increasing critical importance. They are crucial for coping with dynamic networks, which model the ever-changing physical world, and have been instrumental in achieving numerous major breakthroughs in static graph algorithms.

The holy grail in the field of dynamic graph algorithms has been to design algorithms with poly-logarithmic (in the input size) update time. However, recent exciting developments, in which the PI has played a central role, aim to push the update time toward an absolute constant
independent of the input size – which is qualitatively very different than a poly-log bound.

This goal is of fundamental importance not just from a theoretical perspective, but also from a practical viewpoint, due to the rapidly growing size of modern networks.

An algorithm is intrinsically optimal if its update time matches the ratio of the problem's static time complexity to the input size. The main question underlying this research is:
Which graph problems admit intrinsically optimal update time?

Only few intrinsically optimal graph algorithms are known. The unique goal of this project is to establish a systematic study of intrinsically optimal algorithms. We will also study provably optimal algorithms, aiming to advance our understanding of the thin line that separates these two distinct optimality notions. To achieve this goal, we must go far beyond the current state-of-the-art, and in particular, confront some of the most central problems in the field. Meeting the project's main goal, even partially, will be groundbreaking. Results of this project will facilitate the use of dynamic algorithms in real-world application domains, and will also be illuminating to other fields, such as distributed computing and fine-grained complexity.

Consequently, we believe this research has the potential of revolutionizing the field of dynamic graph algorithms, and impacting related fields, thus enriching the general landscape of computer science.

Link to the ERC project webpage:

Keywords of the ERC project: Graph algorithms, dynamic graphs, dynamic algorithms, data structures

Keywords that characterize the scientific profile of the potential visiting researcher/s: Graph algorithms, dynamic graphs, data structures, distributed computing, computational geometry

Project ID:	Project Acronym:	Evaluation Panel:
101043637	**Intimate Touch**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Madeline Balaam**
Host Institution:	Kungliga Tekniska Hoegskolan - SWE

Developing Interaction Design Knowledge and Materials where Technology Touches the Body

Intimate Touch will re-conceptualise how technologies use touch to interact with us. Bringing intimacy as a lens on touch inspires us to think about the felt experience of touch, the diversity of places on the body where we will be touched by technology, and the sense that touch can be transformative of our view of ourselves. This project will develop the theory, methods and technologies of Intimate Touch. It will bring together research in Human-Computer Interaction on intimate technologies with new interaction techniques, alongside psychological theories on intimacy and neuroscience perspectives on touch. Technologies that touch us will constitute a new paradigm of interactive devices, most strongly exemplified by care robots. Designing technologies for Intimate Touch will be foundational in creating dignified and acceptable interactions between humans and technologies.

The first objective is to develop a model of 'intimate technology'. No researcher has done this before. This model will be developed through a large-scale interview study alongside in-situ, long-term studies of our own demonstrators of Intimate Touch. By identifying which interactions lead to intimacy, this project will have empirically identified a new class of technology, 'intimate technology'.

Autonomous systems will touch many areas of our bodies. Yet, there has been no serious study of touch experiences other than on the hands and shoulders. My second objective will counter this by innovating on a design approach that centres the felt experience of touch from technology, and by creating a dataset that describes people's experience of touch from technology across the body.

My final objective is to develop two demonstrators of Intimate Touch. This risky challenge will evidence how touch with technology transforms us. Practically this will provide a roadmap to good touch from technology. Empirically this will lay the groundwork for a re-conceptualization of our relationship with technology

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Link to the ERC project webpage:

Keywords of the ERC project: interaction design, research through design, touch, body, intimate health

Keywords that characterize the scientific profile of the potential visiting researcher/s: robotics; design; ethics; ergonomics

Project ID:	Project Acronym:	Evaluation Panel:
101045765	**DeepLearning 2.0**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Frank Hutter**
Host Institution:	Albert-Ludwigs-Universitaet Freiburg - DEU

DeepLearning 2.0: Meta-Learning Qualitatively New Components

Deep learning has revolutionized many fields, such as computer vision, speech recognition, natural language processing, and reinforcement learning. This success is based on replacing domain-specific hand-crafted features with features that are learned for the particular task at hand. The logical step to take deep learning to the next level is to also (meta-)learn other hand-crafted elements of the deep learning pipeline. We therefore propose to develop meta-level learning methods for the creation of novel customized deep learning pipelines, by means of:

1. Hierarchical neural architecture searchfor learning qualitatively new architectures and architectural building blocks from scratch;
2. Learning of optimizers and hyperparameter adaptation policies that adapt totheir context in order to converge faster and more robustly;
3. Learning the data to train on, to remove the need for large sets of labelled data; and
4. Bootstrapping from prior design efforts to increase efficiency and make an integrative design of architectures, optimizers, hyperparameter adaptation policies, and pretraining tasks feasible in practice.

These advances will allow the next generation of deep learning pipelines to achieve higher accuracy, lower training time, and improved ease-of-use (democratization of deeplearning). They will also allow a customization to particular design contexts, including additional objectives next to accuracy (such as robustness, memory requirements, energy consumption, latency, interpretability, training cost, uncertainty estimation, and algorithmic fairness) in order to facilitate trustworthy AI. In order to demonstrate the effectiveness of these methods, we plan to develop:

5. New state-of-the-art customized deep learning pipelines for various applications, including EEG decoding, RNA folding, and improving the reinforcement learning pipeline and deep learning on tabular data.

Link to the ERC project webpage: https://www.automl.org/deep-learning-2-0-extending-the-power-of-deep-learning-to-the-meta-level/

Keywords of the ERC project: AutoML; meta-learning; NAS; HPO; deep learning for tabular data; automated data science

Keywords that characterize the scientific profile of the potential visiting researcher/s: AutoML; meta-learning; NAS; HPO; deep learning for tabular data; automated data science

Project ID:	Project Acronym:	Evaluation Panel:
101055025	**HYDRANOS**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Ahmad-Reza Sadeghi**
Host Institution:	Technische Universitaet Darmstadt - DEU

Hardware-assisted Adaptive Cross-Layer Security for Computing Systems

Today's computing systems are facing an unprecedented security threat posed by recent attacks that use software to exploit hardware vulnerabilities, as shown by attacks like Spectre, Meltdown, Foreshadow, and follow-ups - affecting a wide range of computing platforms and manufacturers, including Intel, AMD, and ARM. These cross-layer attacks reach far beyond exploiting microarchitectural vulnerabilities and allow unprivileged software to exploit a variety of hardware design and implementation flaws, as we demonstrated in the world's largest System-on-Chip (SoC) security competition that we have been conducting with Intel since 2018. This adversarial paradigm shift sidesteps decades of security research that assumed a layered architecture where hardware is flawless and trustworthy. Existing solutions, such as software patching or specific hardware changes are ad-hoc, expensive, or only mitigate specific known attacks. Particularly, patching hardware after fabrication is very limited or impossible.

This proposal, HYDRANOS, envisions hardware-assisted adaptive security, a radically different approach to enable flexible security for future computing systems. We aim to design, prototype, and evaluate dedicated configurable hardware inside the SoC design to enable post-fabrication reconfiguration of key security-relevant hardware primitives to mitigate new attack vectors. Moreover, we provide an evaluation framework that includes novel hardware fuzzing techniques to significantly improve existing hardware-vulnerability detection methods at design time.

HYDRANOS is a game changer for trustworthy computing, allows to fundamentally and flexibly tackle today's and future cross-layer attacks on security-critical systems, and provides novel research to pave the way towards future-proof security. We will showcase our results on open-source hardware widely supported by academia and industry and provide it to the research community, allowing open verification by third-parties.

Link to the ERC project webpage:

Keywords of the ERC project: Adaptive Cross-Layer Security, Reconfigurable Security, Hardware Security

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
788851	**NEMO**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Francois Baccelli**
Host Institution:	Institut National De Recherche En Informatique Et En Automatique - FRA

Network Motion

NEMO, NEtwork MOtion, is an inter-disciplinary proposal centered on network dynamics. The inter-disciplinarity spans from communication engineering to mathematics, with an innovative interplay between the two.

NEMO's focus is on stochastic geometry. This emerges as one of the most important new conceptual and operational tools of the last 10 years in wireless networking, with a major academic and industrial impact on architecture, protocol design, planning and economic analysis.

Nevertheless, the state of the art is unable to cope with the dynamics introduced in recent and future network functionalities. NEMO's aim is to introduce dynamics in wireless stochastic geometry. The dynamic versions of stochastic geometry to be developed will capture these new functionalities and specifically tackle two core promises and challenges of the future of wireless networking: that of ultra-low latency networking, required for enabling the unfolding of future real time interactions, and that of draining to the Internet the unprecedented amount and structure of data stemming from
the Internet of Things.

Several fundamental types of random network dynamics underpinning these functionalities are identified. General mathematical tools combining stochastic geometry, random graph theory, and the theory of dynamical systems will be developed to analyze them. This will provide parametric models mastering the complexity of such networks, which will be instrumental in addressing the above challenges. The aim is to have, through these dynamical versions, the same academic and industrial impact on wireless networks as static stochastic geometry has today.

NEMO will leverage structural interactions of INRIA with Ecole Normale Supérieure on the mathematical side, and with Nokia Bell Labs and Orange on the engineering side. This will create in Europe a group focused on this mathematics-communication engineering interface, and to become the top innovation group of the field worldwide.

Link to the ERC project webpage: https://project.inria.fr/ercnemo/

Keywords of the ERC project: stochastic networks

Keywords that characterize the scientific profile of the potential visiting researcher/s: stochastic networks

Project ID:	Project Acronym:	Evaluation Panel:
832889	**PyroSafe**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Carole Rossi**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Integration of new nano-engineered safe energetic layers with Sensors and Electronics to manufacture Safety-Critical Microsystems

PyroSafe aims at (1) creating a new generation of safe and versatile energetic materials with tailored architectures at nanoscales to replace old unsafe energetic substances currently used in pyrodevices; (2) enabling a new technology based on the co-integration of electronic components with these new types of energetic layers; (3) manufacturing high energetic microsystems able to produce multiple functionalities (gas, heat, or generation of chemical species) to implement relevant emergency safety responses.

This involves both evolutionary and revolutionary advances in metal/oxide materials science and engineering that constitute the focus of the proposed work. Specifically, I will develop: i. multi-scale (nm to mm) processing methodologies combining vapor-deposition techniques with additive manufacturing methods, to tailor the structural features of the energetic layers to the application needs; ii. an understanding of the physical and chemical processes at the most fundamental level to predict composition/structure/performance relationships and aging mechanisms; iii. a heterogeneous assembly process to co-integrate the energetic layers with electronic circuits. As key achievements of the project, three safety-critical microsystems, capable of detecting catastrophes and trigger quick safety responses, will be demonstrated with prototypes, ensuring that the basic research performed in initial thrusts will directly contribute to the development of novel microsystems.

Overall, the PyroSafe technology will constitute a technological breakthrough in the current “pyrotechnical systems industry” by introducing a new way of thinking and manufacturing energetic materials as safe programmable and protectable components in a field led, for decades, by organic chemistry. Furthermore, the output of this research will have a deep and broad impact on the European society by introducing a real-time response to accidents in contrast to the current approach based on prevention.

Link to the ERC project webpage:

Keywords of the ERC project: reactive material, nanothermite, energy, combustion, flame

Keywords that characterize the scientific profile of the potential visiting researcher/s: nanomaterials, thin film, metal/oxide, combustion, flame

European Research Council
Executive Agency
Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
835068	**TOPSPIN**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Johan Åkerman**
Host Institution:	Goeteborgs Universitet - SWE

Topotronic multi-dimensional spin Hall nano-oscillator networks

TOPSPIN will focus on spin Hall nano-oscillators (SHNOs), which are nano-sized, ultra-tunable, and CMOS compatible spin wave based microwave oscillators. TOPSPIN will push the boundaries of SHNO lithography, frequency, speed, and power consumption by combining topological insulators, having record high spin Hall efficiencies, with materials having ultra-high spin wave frequencies. TOPSPIN will reduce the required current densities 1-2 orders of magnitude compared to state-of-the-art, making SHNO operating currents approach 1 uA, and increase the SHNO operating frequencies an order of magnitude to as high as 300 GHz.

TOPSPIN will use mutually synchronized SHNOs to achieve orders of magnitude higher signal coherence and achieve novel functionality such as pattern matching and neuromorphic computing. TOPSPIN will demonstrate mutual synchronization of up to 1,000 SHNOs in chains, and as many as 1,000,000 SHNOs in very large-scale two-dimensional arrays. Using dipolar coupling between SHNOs fabricated on top of each other, three-dimensional mutual synchronization will also be demonstrated. As the signal coherence increases linearly with the number of mutually synchronized SHNOs the oscillator quality factor will improve by many orders of magnitude. TOPSPIN will also develop such arrays using magnetic tunnel junction stacks thus combining ultra-high coherence with the highest possible microwave output power.

TOPSPIN will demonstrate ultrafast pattern matching and neuromorphic computing using its SHNO networks. It will functionalize SHNOs to exhibit ultra-fast individual voltage controlled tuning and non-volatile tuning of both the SHNO frequency and the inter-SHNO coupling.

TOPSPIN will characterize its SHNOs using novel methods and techniques such as multichannel electrical measurements, time- and phase-resolved Brillouin Light Scattering microscopy, time-resolved Scanning Transmission X-ray Microscopy, and ultrafast pump-probe Transmission Electron Microscopy.

Link to the ERC project webpage:

Keywords of the ERC project: spintronics, nano-electronics, nano-magnetism, spin waves, microwave oscillators, nano-lithography

Keywords that characterize the scientific profile of the potential visiting researcher/s: spintronics, nano-electronics, nano-magnetism, spin waves, microwave oscillators, nano-lithography

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Project ID:	Project Acronym:	Evaluation Panel:
853348	**NANO4LIFE**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Francisco Balzarotti**
Host Institution:	Forschungsinstitut Fur Molekulare Pathologie Gesellschaft Mbh - AUT

High-throughput 4D imaging for nanoscale cellular studies

Fluorescence microscopy is an invaluable tool for exploring the structure and function of biological processes. It provides high specificity and contrast for the observation of cellular components tagged with fluorescent molecules in a minimally invasive fashion, allowing the study of live specimens. Furthermore, the development of super resolution (SR) fluorescence microscopy has unlocked the access to spatial resolutions beyond the diffraction limit of visible light (~250nm), fuelling the discovery of new biological structures and dynamics.
Nevertheless, achieving resolutions below ~10nm is challenged by multiple trade-offs between spatial and temporal resolutions, depth of observation and photo toxicity, making it difficult or impossible to obtain a molecular resolution. Additionally, axial resolutions are inevitably poorer than lateral ones, unless utilizing a complex multi-objective lens approach.
I recently developed MINFLUX, a localization technique that merges concepts of SR with information theory. It achieves isotropic nanometer resolution in three dimensions with a single objective lens and has unrivalled spatio temporal resolution.
However, a platform that enables these capabilities in a high-throughput manner for entire cells and tissue in living conditions has not yet been developed. I aim to fill this technological gap by developing two complementary systems: one that covers high throughput imaging and another to track molecular dynamics with unrivalled performance.
With my background and experience, I am in a unique position to assure the success of this project and establish these technologies in the scientific community. The performance of fluorescence imaging and tracking will progress orders of magnitude in the years to come, signaling yet another revolution for optical nanoscopy.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
864017	**L2C**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Raphael Jungers**
Host Institution:	Universite Catholique De Louvain - BEL

Learning to Control - Smart and Data-Driven Formal Methods for Cyber-Physical Systems control

The engineered systems surrounding us are increasingly hard to control. Not only the complicated interaction of the physical processes with the machines that control them, but also specifications (cyber-security, safety, privacy, resilience, resource-efficiency, decentralization) are more and more complex, and critical. Last but not least, in an increasing number of situations, no model of the system is available (or the model is too complex), and one needs to 'learn' the optimal way of controlling the system by the mere observation of data. Our technological world is living a paradigm shift, which is often coined as the Cyber-Physical Revolution, or the Industry 4.0.

In view of these specificities, the only sensible way of controlling these complex systems is often by discretizing the different variables, thus transforming the model into a simple combinatorial problem on a finite-state automaton, called an abstraction of this system. Until now, this approach has not been proved useful beyond academic, small examples, as it scales very poorly.

The goal of L2C is to transform this approach into an effective, scalable, cutting-edge technology that will address the CPS challenges and unlock their potential. This ambitious goal will be achieved by leveraging powerful tools from Mathematical Engineering. Out of this research, a state-of-the-art software platform will promote our results and translate them into directly usable solutions for the scientific and industrial communities.

L2C is a pluridisciplinary project at the frontier between Control Engineering, Computer Science and Applied Mathematics. It bridges the gap between rich innovative techniques and emerging challenges in Control. It impacts both fundamental Science and Engineering, as the theoretical research is driven and fostered by cutting edge technological challenges.

Link to the ERC project webpage: https://perso.uclouvain.be/raphael.jungers/content/erc-consolidator-grant

Keywords of the ERC project: symbolic control, formal methods, combinatorial and algebraic methods in control, hybrid systems, julia programming, path-complete Lyapunov functions, data-driven control, scenario approach

Keywords that characterize the scientific profile of the potential visiting researcher/s: Electrical engineering, computer science, mathematics

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Project ID:	Project Acronym:	Evaluation Panel:
865230	**UNITY**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Niels Gregersen**
Host Institution:	Danmarks Tekniske Universitet - DNK

A Single-Photon Source Featuring Unity Efficiency And Unity Indistinguishability For Scalable Optical Quantum Information Processing

Within optical quantum information processing, the quantum bits are encoded on single photons and their quantum mechanical properties are exploited to build new functionality. A prime example is the quantum computer, which can be built simply from single-photon sources and detectors, and simple optical components. However for scalable optical quantum computing involving hundreds of photons, the performance requirements for the single-photon source are daunting: the source must feature near-unity efficiency and near-unity indistinguishability simultaneously! Today, all known source designs suffer from inherent trade-offs between efficiency and indistinguishability and their performance is insufficient for scalable quantum computing.

The project objective is to realize a source of single indistinguishable photons with performance of ground-breaking nature. The break-through lies in the simultaneous realization of near-unity efficiency and indistinguishability, a combination which overcomes the limitations of present state-of-the-art and ventures far into the regime of scalable quantum computing.

As an expert in single-photon source engineering I find myself in a unique position to address this challenge. Since it is unknown how to design such a source, I will first establish a new understanding of the physics of the near-unity regime, where phonon-induced decoherence represents a main limitation for the indistinguishability. I will then advance state-of-the-art in optical engineering by proposing a novel design, where all physical parameters can be controlled independently. The modelling of the near-unity performance source is extremely demanding, and the analysis requires additional advances within optical simulations and open quantum systems theory. Once this is achieved, I will fabricate a prototype and test it in a multi-photon interference boson sampling experiment to unambiguously prove that scalable optical quantum information processing is indeed within reach.

Link to the ERC project webpage:

Keywords of the ERC project: single-photon sources, quantum dots

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
866259	**SILENT**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Christophe Collette**
Host Institution:	Universite De Liege - BEL

Seismic Isolation of Einstein Telescope

With the first direct detection of gravitational waves on the 14th of September 2015, a new window has been opened on the Universe. This was the starting point of new science, complementary to the measurement of electromagnetic signals by optical telescopes. Since that date, several detections have been made, offering wonderful validation of Einstein's theory of general relativity, and extraordinary insight on the dynamics of heavy black hole binaries and binaries of neutron stars. The exploration of the Universe through this new window using Earth-based instruments will continue with more sensitive instruments, but will ultimately depend on our capability to isolate them from the two main sources of low-frequency disturbances on Earth: seismic activity and fluctuations of gravity field (Newtonian noise). Due to the extremely small amplitude of gravitational waves, it is a prior concern to carefully isolate the detector from any type of disturbance.

In order to address the aforementioned limitations, this project proposes to develop a completely novel platform, controlled by optical seismometers, liquid inclinometers and a gravimeter. It will virtually float in the inertial space, decoupled from ground motion for periods at least as large as 100 seconds. The controlled platform will be the most stable ever build on Earth. Such performance will be obtained thanks to a revolutionary approach, combining three major innovations: (1) Novel optical inertial sensors, (2) Efficient controllers, combining sensor fusion methods, and dedicated mechatronic architectures, (3) Direct measurement of Newtonian noise.

This project will contribute to prepare the third generation of low-frequency gravitational wave detectors. The outcomes will be also applicable to a large class of other instruments (e.g. particle colliders, atomic force microscopes, lithography machines, medical imaging instruments), ensuring a generic character to this project, and a major scientific impact.

Link to the ERC project webpage: http://www.pmlab.be

Keywords of the ERC project: mechatronics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
948063	**SKYNOLIMIT**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Mehmet Cengiz Onbasli**
Host Institution:	Koc University - TUR

Ultralow power and ultra-wideband spintronics near thermodynamic limits

Moore's Law drove the technology revolution for more than five decades and left no aspect of our lives untouched. State-of-the-art computation relies on transistors, whose dimensions or power consumption could no longer be reduced. Nevertheless, growing need for information processing, battery-constrained internet-of-things devices and wireless connectivity necessitates discoveries of nanoelectronic building blocks with novel physics. Thus, fundamental breakthroughs are needed in highly power-efficient non-volatile computational elements that meet the speed, bandwidth and scalability requirements of microelectronics industry. Using electronic spins for non-volatile computation could offer very diverse new device physics and architectures to meet these requirements. In SKYNOLIMIT project, I aim to experimentally demonstrate ultra-wideband, ultralow-power and non-volatile logic circuit architectures that operate based on nanoscale spins called magnetic skyrmions. Skyrmions are nanoscale spin structures that allow for room temperature computation and memory functions near thermodynamic limits while being robust against fabrication imperfections and stray magnetic fields. In this project, (1) I first computationally model, fabricate and test the novel functional nanomaterials with giant spin-orbit coupling and low damping to achieve all-electric generation/detection and processing of skyrmions using multilayers of topological insulators and/or 2D transition metal dichalcogenides on insulating rare earth iron garnet films. Second, (2) I plan to experimentally demonstrate skyrmion processors including signal generators, logic gates, registers, and fast Fourier transformers. Third, (3) I plan to experimentally implement neural network hardware using skyrmionics. Thus, high-speed and ultra-wideband 2D skyrmionics could help reduce power consumption, extend mobile battery life by a few orders of magnitude and help spintronics become a part of mainstream electronics.

Link to the ERC project webpage: https://onbasligroup.ku.edu.tr/

Keywords of the ERC project: 2D materials, molecular beam epitaxy, spintronics, characterization

Keywords that characterize the scientific profile of the potential visiting researcher/s: 2D materials, molecular beam epitaxy, spintronics, characterization

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Project ID:	Project Acronym:	Evaluation Panel:
948129	**COLOR-UP**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Martin Virte**
Host Institution:	Vrije Universiteit Brussel - BEL

All-optical sub-THz signal filtering with multi-COLOR lasers

MicroWave Photonics (MWP) has been delivering on-chip devices with outstanding performances to answer the demand of Information and Communication Technologies for always faster, more efficient and more compact systems. Yet, some stringent limitations form a roadblock for disruptive specifications: for instance, on-chip MWP frequency filters hardly perform beyond 60 GHz, whereas the technology and applications require frequencies in the sub-THz range from 100 GHz to several THz. This frequency band will directly support future ultra-fast telecom systems, but also sensing techniques such as THz spectroscopy e.g. for food contaminant detection or mm-precision RADARs for robotic systems.

With COLOR'UP, my goal is to remove this frequency roadblock by exploring and implementing on-chip a radically new concept exploiting the nonlinear dynamics of multi-colour lasers. These lasers naturally generate a set of sharp beat-notes in the sub-THz range corresponding to the frequency separation between the different wavelengths. Injecting an optical beam in a multi-colour laser with a modulation at well-chosen frequencies can lead to injection-locking of all wavelengths simultaneously. Spectral components that are not matching the beat-notes will however not be picked up and will be filtered out in the laser output.

In this project, I will demonstrate that this effect can be exploited to create all-optical on-chip MWP bandpass filters with the capability to cover the entire sub-THz range from tens of GHz, up to a few THz. My goals are four-fold: (1) design and realize multi-colour lasers with tailored spectra to achieve filtering at precise frequencies (2) study the underlying filtering mechanism to optimize the filter performances (3) develop on-chip control techniques based on optical feedback to control the filter properties (4) make a Proof-of-Concept demonstration of the filter on an InP photonic integrated circuit emitting in the telecom band, around the 1.55 um wavelength

Link to the ERC project webpage: https://b-phot.org/research/european-research-council/color-up

Keywords of the ERC project: semiconductor laser, integrated photonics, all-optical processing, laser dynamics, multi-wavelength lasers

Keywords that characterize the scientific profile of the potential visiting researcher/s: integrated photonics, all-optical processing

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Project ID:	Project Acronym:	Evaluation Panel:
948590	**CELLOIDS**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Stefano Palagi**
Host Institution:	Scuola Superiore Di Studi Universitari E Di Perfezionamento S Anna - ITA

Cell-inspired particle-based intelligent microrobots

Microscale robotic devices, or microrobots, could someday enable revolutionary non-invasive medical procedures. However, fundamental limitations still hinder the realisation of this vision. Current microrobots have very limited functionalities: they strongly rely on wireless operation by external fields, which impedes the execution of sophisticated movements and tasks. As a consequence, despite their intended medical use, microrobots cannot move effectively in bodily fluids and tissues. This project addresses exactly this challenge: realising self-contained microrobots that autonomously move in complex 3D biological environments (such as soft body tissues).

Our sources of inspiration are biological cells that naturally move through body tissues, such as immune cells. These cells move by continuously changing their shape, a strategy known as 'amoeboid movement'. Such shape changes are powered by the self-organized flows and stresses of their intracellular filaments and motor proteins. Analogously, we will realise microrobots that each consist of a swarm of active particles: each microrobot will have a liquid body containing self-propelled particles and different sensitive particles; moreover, the particles swarm will be engineered to exhibit desired collective behaviours. These cell-inspired particle-based microrobots, or celloids, will spontaneously adapt their morphology, generate large body-shape changes, sense environmental cues and control signals, and autonomously navigate soft tissue-like environments.

This project will establish a radically new method to design microrobots, and will result in microrobots capable of autonomous navigation of body tissues. The celloids will also constitute a robophysical model for studying the migration of immune and cancer cells, and will enable a number of revolutionary medical procedures, including long-term monitoring and non-invasive interventions in delicate organs (e.g. brain).

Link to the ERC project webpage: https://www.santannapisa.it/en/institute/biorobotics/celloids

Keywords of the ERC project: microrobotics, bioinspiration, active matter, synthetic biology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101001069	**SAW-SBS**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Avinoam Zadok**
Host Institution:	Bar Ilan University - ISR

Surface Acoustic Waves Stimulated Brillouin Scattering

Stimulated interactions between light and hypersonic elastic waves, known as stimulated Brillouin scattering (SBS), provide opportunities far beyond what is possible using light alone: From basic research of light-matter interactions and quantum mechanics, to ultra-narrow laser sources, spectroscopy, communication, signal processing and sensors. The realization of SBS in photonic integrated platforms provides large freedom of design, and would support mass production. The objectives of the proposed research program are to reveal, investigate and employ SBS processes on the most technologically-significant integration platform: silicon-on-insulator (SOI). Such interactions are largely considered out of reach. The silicon device layer of SOI does not guide acoustic modes, which leak away to the underlying bulk. Previous studies of SBS in silicon relied on suspended membranes and waveguides, in which the underlying silicon dioxide layer has been etched away. Suspended devices become fragile, and their subsequent processing is difficult. In addition, SBS in silicon has been restricted to the forward direction only. Forward scattering interactions are inherently difficult to localize. To overcome this challenge, I propose to rely on surface acoustic waves (SAWs) that are guided by the upper interface between the solid substrate and the air above. The propagation of SAWs is supported by SOI, however they were not yet considered towards SBS in this platform before. Backwards SBS will be realised between guided light in a standard SOI waveguide, with an underlying oxide layer, and a surface acoustic mode. Analysis shows that the effect should be strong enough to be observed, and also employed in signal processing and sensing applications. Additional objectives include SAW-photonic chips with tuneable acoustic frequency and SAW spectroscopy on-chip. The program outcomes could add another dimension to standard silicon-photonics, that of acoustics.

Link to the ERC project webpage:

Keywords of the ERC project: Photonics, nano-technology, opto-mechanics

Keywords that characterize the scientific profile of the potential visiting researcher/s: applied physics, devices physics, electrical engineering, sensing,

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Project ID:	Project Acronym:	Evaluation Panel:
101001331	**BEATRICE**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Michail Matthaiou**
Host Institution:	Queen'S University Belfast - GBR

Beyond Massive MIMO: Living at the Interface of Electromagnetics and Information Theory

Massive multiple-input multiple-output (MaMi) is now a core technology for 5G networks. With MaMi, we refer to systems with an unconventionally large number (e.g. hundreds or even thousands) of base station antennas simultaneously serving tens (or even hundreds) of users. To date, the development of MaMi has been exclusively based on information theory (IT) tailored towards cellular communications. While IT is undoubtedly a versatile mathematical tool, it is based on mathematical logic. This theoretical framework now needs to be extended and reshaped to: (i) account for the unique electromagnetic (EM) properties and (ii) incorporate the main feature of future MaMi-based communication systems, namely their capability of sensing the system's response to the radio waves, and thereby informing its modification. Looking ahead, MaMi will have far more general applications: optical communications, radar, and wireless power transfer to name a few. The grand question that the proposed research will address is: Are the existing IT tools sufficient to understand the physical phenomena and develop the upcoming generation of MaMi-based systems in ten years from now? BEATRICE will address this fundamental question by unifying EM theory and IT and pave the way for an extended range of applications supported by massive antenna arrays after 2025.

The specific project objectives are to:

O1) Redefine the information theoretic modelling of concurrent and future MaMi-based systems using knowledge of unique EM characteristics, thereby quantifying their realisable potential.

O2) Develop new topological designs and modulation techniques for robust communication by harnessing knowledge about the EM properties of the transceivers and the propagation medium.

O3) Leverage the world-class T&M facilities at QUB, to design, fabricate and measure novel array topologies which will be able to support a plethora of MaMi-based applications.

Link to the ERC project webpage:

Keywords of the ERC project: Information theory, electromagnetics, wireless communications

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101001448	**IoN**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Yao-Hong Liu**
Host Institution:	Stichting Imec Nederland - NLD

Intranet of Neurons: A Minimally-invasive and High-capacity Transcranial Telemetry Network for Large-scale Brain-wide Neural Recordings

With the increase of people suffering from various neural disorders, the need for brain-computer interfaces (BCIs) to regain sensory-motor or cognitive functions are expected to become acute in the coming decades. However, the existing BCIs can only control simple motions, e.g., grasping, and are far from realizing our vision to help paralyzed patients to walk again. This is due to the lack of a high-bandwidth wireless BCI, capable of supporting the recording from a large number of neurons with high spatial and temporal resolution, while having large spatial coverage, brain-wide.

In IoN, we target to achieve a breakthrough in the ability to transfer data from intracortical recording devices, e.g., multi-electrode arrays, by developing a transcranial telemetry system that enables the efficient transfer at high data rate from such high channel count sensors (e.g., imec's Neuropixels with 1000 channels). Most importantly, it will also fulfil the form factor required for minimally-invasive surgery, needed to minimize the surgical risk and the complications after insertion.

Furthermore, IoN will significantly scale up brain-wide recordings, by introducing a new telemetry network that has the capacity to support 16 distributed recording nodes (enabling a total of 16,000 channels), which has never been demonstrated from any BCIs before.

To reach these challenging targets, we propose i) a novel hybrid signal propagation method to achieve a 500Mbps data rate with a 10mm^2 implant area, 20× smaller than the state-of-the-art; ii) a completely new "spike-Aloha" protocol to maximize the network capacity, supporting 166× more channels.

The technology developed in IoN will be an important transformational step to revolutionize the way neuroscientists and neurologists collect and process brain-wide neural data. By introducing this miniature, energy-efficient, and high-capacity wireless telemetry network, we want to help patients with disability to regain the quality of life.

Link to the ERC project webpage:

Keywords of the ERC project: wireless communication, spiking neural networks, neural data processing, brain computer interfaces

Keywords that characterize the scientific profile of the potential visiting researcher/s: biomedical neural signal processing, implantable microsystem design

Project ID:	Project Acronym:	Evaluation Panel:
101001899	**RENEW**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Laurent Schmalen**
Host Institution:	Karlsruher Institut Fuer Technologie - DEU

Reinventing Energy Efficiency in Communication Networks

To this day, communications engineering has closely followed the seminal guidelines developed by Claude E. Shannon in 1948, which were mostly influenced by the telephone network of those days. The widespread use of mobile communications and the advent of machine-to-machine communications nowadays entail an exponential increase in data rates and the available models are no longer sufficient to design power-efficient, low-latency, high-speed communication systems. The overarching aim of RENEW is to further increase the data rates of the global telecommunication network while, at the same time, addressing its non-negligible environmental impact. By fundamentally revisiting the transceiver processing algorithms of the core parts of the communication network, RENEW has the potential to overcome the limitations of current design methodologies and to significantly reduce the complexity and energy consumption of the network. Capitalising on cutting-edge results in the fields of machine learning, reinforcement learning, optimisation techniques and neuromorphic computing, RENEW will reinvent the design of communication transmitters and receivers by introducing sparsely connected atomic neural blocks that realise highly parallelisable transceivers guaranteeing high throughputs with low energy consumption. RENEW will explore novel concepts for extremely energy efficient receivers based on spiking neural networks, promising efficiency gains by multiple orders of magnitude. The viability of the RENEW concepts will be demonstrated in applications of high relevance such as high-speed optical communication networks or low-power IoT applications. My industrial experience designing high-speed optical communications, together with my background in coding and communication theory as well as machine learning techniques will be an important enabler for the RENEW concept, which has a transformative potential as it will consequently yield novel energy efficient communication systems.

Link to the ERC project webpage:

Keywords of the ERC project: Machine learning in digital communications, energy efficient communications, coding theory, information theory, communication theory

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101003304	**I-Wood**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Barbara Mazzolai**
Host Institution:	Fondazione Istituto Italiano Di Tecnologia - ITA

Forest Intelligence: robotic networks inspired by the Wood Wide Web

Plants are connected to each other by an underground network of fungi that provide them with nutrients, help share resources, and extend their perception abilities. This mycorrhizal network, known as the Wood Wide Web, plays a crucial role in maintaining healthy natural ecosystems, and in limiting the global warming. Thus, it must be preserved in order to mitigate the speeding up of the carbon cycle and its effects on climate change. Robotics and Artificial Intelligence (AI) can offer concrete solutions for a deeper analysis of natural processes at the basis of this global change and for developing sustainable technologies. Based on that, I-Wood proposes a new paradigm of virtual and physical robotic networks inspired by the belowground fungus-mediated inter-plant communication and by the associated collective behaviours. Specifically, I-Wood will study, extract and formalize the rules of plant-fungus interaction mechanisms to develop: a plant-inspired perceptron-like model; and a new generation of plant-inspired robots able to explore soil using their roots with growing, ageing, branching, and elongating abilities in response to their network-augmented perception and implementing plant-inspired collective behaviours. By imitating plants, these distributed intelligent systems will co-develop morphology and behaviour in a dynamic environment. Impact and feasibility of the proposed approach will be tested in a mixed social network, scale-down in a confined environment, where robots will interact with real plants to facilitate the development of mycorrhizal networks. Grounded on a strong multi-disciplinary approach, I-Wood will pave the way for new paradigms in robotics and embodied AI, based on solutions that overcome the current animal-based or brain-based model, novel approaches for the use of robotics in biology and for new scientific knowledge on plants community with a major significance for biodiversity and climate protection.

Link to the ERC project webpage: https://iwoodproject.eu/

Keywords of the ERC project: Robotics networks, Forest Intelligence, Soft robots, Wood Wide Web, Plant roots, Fungi.

Keywords that characterize the scientific profile of the potential visiting researcher/s: Soft robotics, Plant biology, Computer science, Material science, Mechanical engineering

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Project ID:	Project Acronym:	Evaluation Panel:
101018826	**CLariNet**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Bart De Schutter**
Host Institution:	Technische Universiteit Delft - NLD

A novel control paradigm for large-scale hybrid networks

I will develop efficient on-line control methods for large-scale Networks with Hybrid Dynamics (NHDs) in the presence of uncertainties, where hybrid dynamics refers to a combination of continuous dynamics, mode switches, and/or topology changes. This topic is one of the core fundamental open problems in the field of systems and control. It is also important from a societal point of view as today's society depends heavily on the reliable and efficient operation of road, railway, electricity, gas, and water networks, all of which are examples of large-scale NHDs.

Control of large-scale NHDs is a very complex problem due to the large size of the networks, the presence of disturbances, and the hybrid dynamics, while a limited computation time is available. State-of-the-art control methods are not suited for large-scale NHDs as they either suffer from computational tractability issues or impose additional restrictions, resulting in a significantly reduced performance.

To address this problem, I will create a new on-line control paradigm for large-scale NHDs based on an innovative integration of multi-agent optimization-based and learning-based control, allowing to unite the optimality of optimization-based control with the on-line tractability of learning-based control. I will bridge the gap between optimization-based and learning-based control for NHDs through the use of multi-scale multi-resolution piecewise affine models, explicit consideration of the graph structure of the network, the unique knowledge and experience I have in both optimization-based control and learning-based decision making, and an interdisciplinary integration of approaches from systems and control, computer science, and optimization.

This will result in systematic, very reliable, highly scalable, high-performance on-line control methods for large-scale NHDs. I will demonstrate their feasibility, benefits, and impact for green multi-modal transportation networks and smart multi-energy networks.

Link to the ERC project webpage:

Keywords of the ERC project: optimization based control, learning based control, hybrid systems, large-scale networks

Keywords that characterize the scientific profile of the potential visiting researcher/s: optimization based control, learning based control, hybrid systems, large-scale networks

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Project ID:	Project Acronym:	Evaluation Panel:
101039375	**SQiMic**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Hugo Defienne**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Structuring Quantum Light for Microscopy

Optical microscopy, perhaps the most important tool in biomedical investigation and medical diagnosis, provides structural and functional information about biological specimen in a non-invasive and non-ionizing way. However, this technique still faces the challenge of imaging small and weakly scattering objects (e.g.a single cell) embedded inside complex biological tissues causing optical aberrations and scattering. This problem is even more critical in the case of samples that cannot be labelled or do not spontaneously emit light. In SQiMic, I will go one major conceptual step beyond the current paradigm by merging the fields of quantum imaging and light structuring to build a new quantum 'toolbox' for microscopy. My novel approach is based on my pioneering work showing that wavefront shaping techniques, initially developed for laser light manipulation, can also shape higher orders of optical coherence, allowing deterministic tailoring of quantum properties of light such as entanglement. I will use this approach to leverage some genuine quantum imaging concepts such as quantum holography, quantum interferences and quantum illumination, to break the current limits of fluorescent-free classical microscopy and image complex objects with higher resolution, better contrast, reduced aberrations, and less noise. Ultimately, I aim to deliver a quantum-enhanced microscope with unprecedented performances that can be used as a practical tool for biological imaging without labelling the specimens or relying on their possible ability to emit light.

From a methodological standpoint, SQiMic will bridge knowledge from quantum imaging, light structuring, adaptive optics, wavefront shaping, sensors technologies and computational imaging. It will deliver a whole new class of optical imaging methods based on quantum light manipulation and detection. Its long-term core applications are in life-science and biomedical imaging, with potential extension to quantum information science.

Link to the ERC project webpage: www.quantumimagingparis.com

Keywords of the ERC project: Quantum optics, experimental optics, quantum imaging, structured light, microscopy, entanglement.

Keywords that characterize the scientific profile of the potential visiting researcher/s: Structured light, photon pairs, entanglement, imaging, single-photon camera

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Project ID:	Project Acronym:	Evaluation Panel:
101039827	**HIGH-HOPeS**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Michael Schaub**
Host Institution:	Rheinisch-Westfaelische Technische Hochschule Aachen - DEU

Higher-Order Hodge Laplacians for Processing of multi-way Signals

Network analysis has revolutionized our understanding of complex systems, and graph-based methods have emerged as powerful tools to process signals on non-Euclidean domains via graph signal processing and graph neural networks. The graph Laplacian and related matrices are pivotal to such analyses: i) the Laplacian serves as algebraic descriptor of the relationships between nodes; moreover, it is key for the analysis of network structure, for local operations such as averaging over connected nodes, and for network dynamics like diffusion and consensus; ii) Laplacian eigenvectors are natural basis-functions for data on graphs and endowed with meaningful variability notions for graph signals, akin to Fourier analysis in Euclidean domains. However, graphs are ill-equipped to encode multi-way and higher-order relations that are becoming increasingly important to comprehend complex datasets and systems in many applications, e.g., to understand group-dynamics in social systems, multi-gene interactions in genetic data, or multi-way drug interactions.

The goal of this project is to develop methods that can utilize such higher-order relations, going from mathematical models to efficient algorithms and software. Specifically, we will focus on ideas from algebraic topology and discrete calculus, according to which the graph Laplacian can be seen as part of a hierarchy of Hodge-Laplacians that emerge from treating graphs as instances of more general cell complexes that systematically encode couplings between node-tuples of any size. Our ambition is to i) provide more informative ways to represent and analyze the structure of complex systems, paying special attention to computational efficiency; ii) translate the success of graph-based signal processing to data on general topological spaces defined by cell complexes; and iii) by generalizing from graphs to neural networks on complexes, gain deeper theoretical insights on the principles of graph neural networks as special case.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101040391	**MEMOPROSTHETICS**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Fabien Wagner**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Neuroprosthetic Modulation of Large-Scale Brain Networks for Treating Memory Disorders

Cognitive deficits caused by ageing, neurodegenerative diseases or brain injury represent a major public health issue. They are associated with a disruption of neural oscillations in large-scale brain networks, which cannot be restored using current treatments. Here, I propose a new neuromodulation framework for manipulating neural oscillations across large-scale brain networks to improve learning and memory. Specifically, I will create a large-scale neuroprosthesis of the hippocampus-prefrontal cortex circuit, which will simultaneously record and stimulate electrically key areas of the episodic memory network. I hypothesize that spatially, spectrally and temporally specific stimulation protocols within this network will enhance the functional interactions between hippocampus and prefrontal cortex, and will improve learning and memory. This conceptual approach will be evaluated in non-human primates trained on a visuospatial learning task.
First, I will combine an electrocorticographic grid over the prefrontal cortex with depth macroelectrodes in the hippocampus and entorhinal cortex to create a novel large-scale brain implant. I will use this device to investigate the neural signatures of successful vs failed trials. Next, I will optimize electrical stimulation protocols that replicate successful neural signatures, and will test whether they improve memory in healthy animals. Third, I will induce temporary cognitive deficits in the animals using a cholinergic antagonist, and will assess the effects of stimulation in this pharmacological model of dementia. Finally, I will evaluate the chronic feasibility of this approach by translating these concepts into a fully implantable and wireless platform suited for future clinical applications. MEMOPROSTHETICS will lead to the development of neuroprostheses that palliate memory deficits in preclinical models of ageing and dementia, and will open new avenues for studying and treating a wide range of cognitive impairments.

Link to the ERC project webpage: https://www.bordeaux-neurocampus.fr/en/team/neuromodulation-and-neuroprosthetics/

Keywords of the ERC project: neuroengineering, neuroprosthetics, neuromodulation, memory, non-human primates

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency
Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101041131	**BEAMS**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Daniele Melati**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Multilayer photonic integration platform for free space optics

The project explores a new class of silicon photonic devices and circuits in a three-dimensional integration technology for the generation, control, and reception of free-space laser beams. This research is motivated by the surging importance of communication, sensing, and imaging applications exploiting optical beams propagating in the free space and their urgent need for compact and flexible devices. Currently available integrated solutions based on planar integration technologies are fundamentally limited by either narrow operational bandwidth and reduced shaping capabilities or small apertures and limited steering ranges.
The original idea of the BEAMS project is to overcome these limitations by developing multi-layer antenna arrays, metasurfaces, and photonic control circuits exploiting an approach based on three-dimensional integration. This multi-pronged concept will enable unmatched performance in aperture size, efficiency, bandwidth, control flexibility, and power which cannot be achieved by currently available scientific and technological solutions, enabling the development of integrated photonic devices for long-range and broadband free-space applications. Exploiting these new capabilities, the project will demonstrate in particular innovative photonic devices for optical communications, targeting a kilometer-long communication link in free space with multiple wavelength channels.
Through its research program, the BEAMS project will combine the fields of integrated and free-space photonics, opening a plethora of new possibilities with a large impact on science and society.

Link to the ERC project webpage:

Keywords of the ERC project: silicon photonics, optical communications, free-space optics, photonic circuits, nanotechnologies

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101041486	**SIMPHONICS**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Sabina Caneva**
Host Institution:	Technische Universiteit Delft - NLD

Single-Molecule Acousto-Photonic Nanofluidics

Reading biomolecular signatures and understanding their role in health and disease is one of the greatest scientific challenges in genome and proteome biology. Yet, complete protein analysis at the single-molecule level remains an unmet milestone. This pursuit is fundamentally hindered by the huge dynamic range of protein cell expression and the insufficient spatio-temporal resolution of current analysis methods.
Next-generation single-molecule techniques that can precisely manipulate and sequence proteins in space and time are urgently needed to reach this goal. Among these, nanopore platforms are at the forefront, leading in terms of read length, throughput and sensitivity. However, the major challenges associated with translocation speed control and the precise-readout in solid-state nanopore devices, remain prohibitive.
In SIMPHONICS, I will resolve these issues by developing the first integrated platform that combines nanopore transport measurements, spatially modulated acoustic wavefields and single-molecule fluorescence time traces to confine, scan and optically fingerprint proteins in a non-invasive and massively parallel manner. The feasibility of this method will be established by attaining three main objectives: 1) Confining and controllably manipulating individual molecules using acoustic nanotweezers; 2) On-demand engineering of 2D material optical emitters as ultrabright fluorescent probes for energy transfer based detection, and 3) Identifying proteins/peptides from their optical signatures in multi-color Förster resonance energy transfer (FRET) during acoustophoresis. With this powerful and unique platform, I will harness the vast potential of acousto-photonic interactions in monolithic nanopore devices. Successful achievement of the project objectives will result in a high-throughput and non-destructive protein fingerprinting platform and signify a considerable leap forward in our quest to unravel the human proteome.

Link to the ERC project webpage:

Keywords of the ERC project: 2D materials, nanophotonics, biophysics, acoustics, single-molecule, nanotechnology

Keywords that characterize the scientific profile of the potential visiting researcher/s: biochemistry, biophysics, physics

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Project ID:	Project Acronym:	Evaluation Panel:
101042370	**SEALSENSE**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Ajay Giri Prakash Kottapalli**
Host Institution:	Rijksuniversiteit Groningen - NLD

Investigation of biological seal whiskers to create artificial whisker sensors for underwater robots

Marine animals employ diverse and fascinating flow sensing phenomena by exploiting the ambient complex fluid mechanics to track prey and escape from predators. Seals are known for their remarkable long-distance prey-hunting capabilities owing to their whiskers which serve as ultrasensitive flow sensors. For e.g., a seal is able to detect a fish swimming 180m away by following its vortex streets. While the unprecedented tracking abilities of seals and the role played by seal whiskers in reducing vortex-induced vibrations have been conclusively demonstrated in past, the fundamental mechanisms behind such pinpoint tracking remain unclear. The geometrically intricate shape of the seal?s whiskers is believed to maximize their signal-to-noise ratio to generate high sensitivity to the tiniest hydrodynamic trails. In this project, we propose investigations of the seal whisker behaviour, both in live seals and in controlled lab experiments, to shed new light on the fundamental mechanisms that enable the seal to display its excellent prey-tracking behaviour. In particular, how the seal effectively utilizes the spatial distribution of the whisker array on its muzzle to conduct multipoint flow measurements to track and locate its prey is unknown and of great significance. We propose to study the morphological, mechanical, and material properties of whiskers to explain the exquisite sensing capabilities of seals, and further use this understanding to develop biomimetic flow sensors for underwater robot navigation. Miniaturized and self-powered, micro/nano electromechanical systems (MEMS/NEMS) strain and flow sensors will be developed for experimental animal studies, and to develop artificial 3D printed MEMS whisker sensors and muzzles for experimental fluid-structure interaction studies. An artificial seal muzzle with mechanosensory MEMS whiskers will be applied on underwater robots to create artificial vision and energy-efficient maneuvering through fish-like schooling.

Link to the ERC project webpage: https://erc.easme-web.eu/?p=101042370

Keywords of the ERC project: Biomimetics, Micro electromechanical systems (MEMS), Sensors, Flexible electronic sensors

Keywords that characterize the scientific profile of the potential visiting researcher/s: Micro electromechanical systems (MEMS), Sensors, Flexible electronic sensors, Biomimetic sensors

Project ID:	Project Acronym:	Evaluation Panel:
101042407	**ScReeningData**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Michael Muma**
Host Institution:	Technische Universitaet Darmstadt - DEU

Scalable Learning for Reproducibility in High-Dimensional Biomedical Signal Processing: A Robust Data Science Framework

Data science has quickly expanded the boundaries of signal processing and statistical learning beyond their accustomed domains. Powerful and complex machine learning architectures have evolved to distinguish relevant information from randomness, artifacts and irrelevant data. However, existing learning frameworks lack computationally scalable, tractable, and robust methods for high-dimensional data. Consequently, discoveries, for example, in genomic data can be the result of coincidental findings that happen to reach statistical significance. As long as groundbreaking advances in biotechnology are not accompanied by appropriate learning frameworks, valuable efforts are spent on researching false positives. ScReeningData develops a coherent fast and scalable learning framework that jointly addresses the fundamental challenges of drastically reducing computational complexity, providing statistical and robustness guarantees, and quantifying reproducibility in large-scale and high-dimensional settings. An unprecedented approach is developed that builds upon very recent work of the PI. The underlying concept is to repeat randomized controlled experiments that use computer-generated fake variables as negative controls to trigger an early stopping of the learning algorithms, thereby mitigating the so-called curse of dimensionality. In contrast to existing methods, the proposed methods are completely tractable and scalable to ultra-high dimensions. The gains of developing advanced robust learning methods that are computed ultra-fast and with tight guarantees on the targeted rate of false positives are enormous. They lead to new reproducible discoveries that can be made with high statistical power. Due to the fundamental nature and the broad applicability of the proposed learning methods, the impacts of this project extend far beyond the considered biomedical signal processing use-cases, benefitting all scientific domains that analyze high-dimensional data.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101042585	**MEMRINESS**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Erika Covi**
Host Institution:	Namlab Ggmbh - DEU

Memristive Neurons and Synapses for Neuromorphic Edge Computing

In recent years, Artificial Intelligence has shifted towards collaborative learning paradigms, where multiple systems acquire and elaborate data in real-time and share their experience to improve their performance. MEMRINESS will generate new fundamental computing primitives that will overcome the current challenges for the deployment of intelligent systems on the edge.

The requirements of a system operating on the edge are very tight: power efficiency, low area occupation, fast response times, and online learning. Brain-inspired architectures such as Spiking Neural Networks (SNNs) use artificial neurons and synapses that perform low-latency computation and internal-state storage simultaneously with very low power consumption, but at present they mainly rely on standard technologies, which make SNNs unfit to meet the above-mentioned constraints. Indeed, the dream of compact and efficient neurons and synapses, able to work at different time scales to match real-time constants and to retain memory of their state even in the absence of a power supply, cannot be realised without flanking standard technologies with emerging ones.

In this respect, memristive technology has shown promising results, due to its ability to support non-volatile storage of the SNN parameters. Yet so far, research has prioritised the non-volatile properties of the devices rather than focusing additionally on the reproduction of multi-temporal synaptic and neural dynamics. To solve this problem, I will develop neurons and synapses that exploit the intrinsic physical characteristics and dynamics of volatile and non-volatile memristive devices to enable the design of compact, power efficient SNNs with multi timescale dynamics. I will use a holistic approach and co-develop every aspect, from the devices to the circuits, to the learning algorithms. I will use the results to design a SNN and demonstrate its collaborative and online learning capabilities in three scenarios of increasing complexity.

Link to the ERC project webpage:

Keywords of the ERC project: Memristive technology; neuromorphic circuits; brain-inspired learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: Memristive technology; neuromorphic circuits; brain-inspired learning

Project ID:	Project Acronym:	Evaluation Panel:
101042672	**LiNQs**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Klaus Jöns**
Host Institution:	Universitaet Paderborn - DEU

Lithium Niobate Quantum systems

Quantum technologies are expected to have a transformative impact by exploiting fundamental quantum mechanical effects for technological applications such as quantum computation, quantum simulation, quantum communication, and quantum sensing. Photons are the only reliable qubit for quantum information transmission, making them an essential resource for quantum technologies. However, quantum photonics will only meet its expectation as a ground breaking technology when integrated in a scalable fashion. The solution lies in quantum photonic integrated circuits where photons are used to encode and process quantum information on-chip, offering scalable quantum information processing units. Currently, different integration platforms are investigated with a selection of building blocks available. However, no platform has shown a comprehensive toolbox combining all functionalities on a single chip. In this project I will demonstrate that the thin film lithium niobate on insulator platform can simultaneously link all quantum photonics building blocks on a single platform, resulting in fully integrated quantum photonic integrated circuits. I will develop integrated Lithium Niobate Quantum systems (LiNQs) showcasing the generation, manipulation, and analysis of photonic qubits. This will result in the first compatible integration platform hosting semiconductor quantum emitters, quantum memories based on rare-earth ions, cryogenic electronics, and superconducting single-photon detectors together with the outstanding properties of CMOS-compatible lithium niobate on insulator: low-loss circuits and fast modulators. By developing all required building blocks and linking them to scalable systems, I will provide the quantum technology community a single integration platform for all quantum photonics applications. LiNQs will lay the foundation for Europe's forefront position in a future photonics-driven quantum technology industry.

Link to the ERC project webpage:

Keywords of the ERC project: LNOI, quantum integrated photonic circuits, quantum emitters

Keywords that characterize the scientific profile of the potential visiting researcher/s: nanofabrication, single ions, single ion implantation, photonic integrated circuits

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Project ID:	Project Acronym:	Evaluation Panel:
101043314	**BiNet**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Caglar Elbuken**
Host Institution:	Oulun Yliopisto - FIN

Particle distribution dynamics in nonlinear bifurcating networks

Bifurcating networks are ubiquitous in nature such as vasculature/pulmonary networks, kidney urinary tract, and branching in plants. In addition to their role of transporting the carrying fluid, these networks distribute discrete particles suspended in the fluid leading to intricate spatiotemporal particle flow dynamics. The heterogenous distribution of red blood cells (RBC) in microcirculation is an example of this behaviour, consequences of which are not well-understood. Our objective is to explain the fundamental principles and implications of nonuniform particle distributions in bifurcating networks using RBC flow in vasculature as a model system. Currently there is no systematic approach to study such complex particle distribution dynamics. We propose using droplet microfluidic as an analogue of the biological network. Microfluidics provide superb control of the droplets/particles, carrying fluid and network properties in highly engineered microfabricated devices. We aim to understand RBC distribution patterns in capillary network and the consequences during vascularization and organogenesis. Our approach is (i) to observe the in vivo RBC fractionation in chick embryo vasculature, (ii) to develop its in vitro analogue using droplet microfluidics, (iii) to develop in silico model and determine the governing parameters. This project will discover the foundations of particle transport phenomena in nonlinear bifurcating networks and address the long-lasting question of RBC nonuniformity in microcirculation and its implications as a groundbreaking contribution. Another key outcome will be correlating RBC heterogeneity to corresponding organ growth by visualising two bifurcating networks simultaneously: vasculature and urinary tree, using kidney organoid xenotransplantation. The project will advance (i) the fundamental understanding of particle distribution in nonlinear bifurcating networks and (ii) the research in vascularization and artificial kidney development.

Link to the ERC project webpage: https://www.oulu.fi/en/research-groups/elbuken-lab-microfluidics-and-biosensor-research-group

Keywords of the ERC project: vascularization, complex system dynamics, multi-phase flow microfluidics

Keywords that characterize the scientific profile of the potential visiting researcher/s: dynamic system analysis, droplet microfluidics, agent based simulation, optical detection

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101043851	**MiNet**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Fei Ding**
Host Institution:	Gottfried Wilhelm Leibniz Universitaet Hannover - DEU

Large-scale multipartite entanglement on a quantum metrology network

Hundreds and thousands of fireflies synchronize their dazzling light in summer nights – one of nature's most beautiful demonstrations on the importance of synchronization and scalability in a network. So we ask the question, is it possible and even necessary to synchronize all components in a complex large-scale quantum network?

This is not a question for the future. Rapid experimental progress in recent years has brought first rudimentary quantum networks within reach, highlighting the timeliness and need for unified frameworks. This proposal, MiNet, aims to establish a unified framework on "time", both experimentally and theoretically.

Similar to a classical network, a future quantum network may have to attach accurate timing stamps to all events occurred, such as the generation and storage of qubits. However, entanglement swapping, which will be used to scalably connect a large ensemble of quantum nodes, puts a stringent requirement on this timing task, making it beyond today's technologies.

MiNet will build a large-scale multipartite entanglement testbed connecting two science cities in north Germany, Hannover and Braunschweig. Taking advantage of the latest metrology advances, MiNet will use a telecom fiber-based optical clock network to disseminate ultra-stable time/frequency information to devices in three remote laboratories in the two cities. The important requirement on scalability, on the other hand, will be provided by semiconductor quantum dot sources that have incredible improvement recently.

This project is at the forefront of semiconductors, quantum communication and metrology. MiNet will be the first of its kind, allowing one to gain the full advantages of available resources within a clocked quantum network. In the long term, the fiber-based optical clock network, as part of a Pan-European collaborative effort, may help to synchronize a large number of quantum computing and communication devices at large scales that can never be reached before.

Link to the ERC project webpage:

Keywords of the ERC project: quantum communication, quantum optics, semiconductor photonics

Keywords that characterize the scientific profile of the potential visiting researcher/s: physics, quantum, single photon, entanglement, quantum communication, quantum computing

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Project ID:	Project Acronym:	Evaluation Panel:
101043985	**PHOENIX**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Maria Tenje**
Host Institution:	Uppsala Universitet - SWE

Paving the way for High-throughput Organoid ENgineering using Integrated acoustiX

The aim of PHOENIX is to use my expertise in microsystems engineering to close critical technology gaps in organoid generation. Cerebral organoids are 3D self-assembled structures derived from human induced pluripotent stem cells, replicating both structure and function of the human foetal brain. Organoids have the potential to replace existing 2D cell cultures and animal models, but this has not yet been realised due to rudimentary preparation methods.

In PHOENIX, three important technology gaps will be addressed: reproducibility, controlled maturation and vascularisation. I aim to build on my pioneering research on droplet acoustofluidics and the scientific output of my ERC Starting Grant to develop three microfluidic modules that at the end of the project shall be integrated into a seamless organoid engineering pipeline. The technology in focus is acoustophoresis, a method to manipulate particles and cells by ultrasound. This will be used to achieve ordered encapsulation of stem cells in hydrogel droplets and develop a microfluidic platform where the cells can be differentiated under fully controlled conditions. Finally, two-photon writing will be used to integrate a vascular network with the organoid constructs to form an important delivery architecture for nutrients and blood components. PHOENIX will be focused on both technology development and thorough biological characterisation of the resulting organoids to demonstrate both expected, and unexpected, benefits of transferring organoid generation on-chip.

Collaborations have been established with Prof. Christine Mummery and Dr. Valeria Orlova, both at LUMC, NL as well as Dr. Anna Falk at KI, SE to provide expertise in complementary fields of this highly interdisciplinary project. The expected output of PHOENIX is a microfluidic technology that enables high-throughput generation of cerebral organoid with a multi-regional structure and vascularisation in a direct process.

Link to the ERC project webpage:

Keywords of the ERC project: organs-on-chip, acoustofluidics, microfluidics, droplets, organoids

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101044629	**MINERVA**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Themistoklis Charalambous**
Host Institution:	University Of Cyprus - CYP

Emerging cooperative autonomous systems: Information for control and estimation

Nowadays, attention is drawn towards a new generation of intelligent mobile cooperative autonomous systems (CASs), built with increasingly powerful sensors that allow them to cooperate with other autonomous systems and humans, in order to accelerate the industrial ecosystem and better exploit the potential of flexible automation. The cooperation of autonomous systems, which is an emerging technology in many areas (e.g., intelligent transportation systems and factory automation) is done over a wireless network. The use of a wireless network to connect spatially distributed systems enables flexible architectures with reduced installation and maintenance costs to existing applications, while supporting the development of new applications that would otherwise be impossible. The unprecedented tight coupling between control and communication, due to the use of a shared wireless network and distributed decision making to orchestrate such systems, introduces new challenges. Current modular design approaches and incremental improvements can only provide limited performance gains and may result in inefficient solutions, which may lead to failures during practical deployments. To effectively leverage the vast space of possibilities enabled by CASs, I argue that we need to fundamentally rethink how functionally-complex CASs are interconnected and operate cooperatively. Bridging the gap between the fields of control, estimation, and information/communication theories, MINERVA will follow a bottom-up approach to develop a fundamental, yet realistic, framework to establish the foundations for real-time control, estimation, and localization in environments where autonomous systems and humans interact. MINERVA goes beyond the state-of-the-art and targets the fundamental bottlenecks of demanding systems, using methodologies fundamentally different from the existing ones, aiming towards real-time control applications with communication constraints.

Link to the ERC project webpage:

Keywords of the ERC project: networked control systems, distributed coordination, distributed control

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101044797	**3D NOAM**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Tal Ellenbogen**
Host Institution:	Tel Aviv University - ISR

Efficient and functional optical frequency conversion in 3D Nonlinear Optical Artificial Materials

Optical frequency conversion in bulk nonlinear crystals is used for generation of coherent light over the entire optical regime from extreme ultra-violet up to THz waves. This remarkable ability is at the core of a plethora of important technological and scientific applications. However, bulk nonlinear crystals pose strong limitations on integration, miniaturization, and control over the nonlinear interactions, holding back the further progress of optical frequency conversion technologies.

I propose to lead a great breakthrough in the field by developing a new kind of 3D nano-engineered nonlinear optical artificial materials with superior nonlinear optical properties, and free of the limitations of bulk nonlinear crystals. These materials will be inspired by recently developed nonlinear metasurfaces. It was demonstrated that nonlinear metasurfaces exhibit unprecedented nonlinear functionalities, and effective nonlinearities exceeding by far those of bulk nonlinear crystals, promising to replace bulk crystals in future nonlinear optical technologies. However, their two-dimensional designs and nanoscale thickness strongly limit their frequency conversion efficiency, with no existing practical nanofabrication approach nor theoretical proposition to overcome this limitation. Our research aims to close this gap. We will develop a new nanofabrication methodology that will allow to stack hundreds of nonlinear metasurfaces into a 3D nonlinear material in a technologically viable way. We will study new fundamental nonlinear interactions in these novel nonlinear materials, and demonstrate experimentally their superiority over bulk nonlinear crystals in conversion efficiency and functionalities. These achievements will potentially pave the way to the next era of nonlinear optical frequency conversion technologies. They will also immediately impact applications of 3D nanostructured optical materials in general, as well as may change the way we think about 3D nanofabrication.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101045415	**ImmunoChip**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Larysa Baraban**
Host Institution:	Helmholtz-Zentrum Dresden-Rossendorf Ev - DEU

Nano-assisted digitalizing of cancer phenotyping for immunotherapy

Every day cancer takes about 30000 lives worldwide, despite multiple treatments developed in the last 50 years. True revolution in the therapy is demonstrated by the immunooncology relying on multiple routes to activate the immune system, using e.g. Chimeric Antigen Receptors, checkpoints inhibitors. Although demonstrating success in the treatment of e.g. lymphoma, the percentage of patients responding to the immunotherapy is less than 30%. Even more, the activation of immune system does not happen at no cost, leading to severe auto-immune reactions, sometimes with lethal consequences. Therefore, the main question of clinicians is: how to efficiently predict the response/no-response of the patient to the immunotherapy? At present, there is no predictive technological platform combining both, highly sensitive analysis of the cancer immunity and the planning of the strategy for potential therapy.
I consider cancer as a smart self-adapting machine that plays its own set of rules: it generates and quenches the biochemical signals; initiates the iterative loops and builds up feedback controls to create an immune suppressive environment. My idea is to digitalize these mechanisms. 'ImmunoChip' will develop a device combining microfluidics with the specific nanosensory network to study elements of the cancer-immunity cycle to bring a new dimension in the field of preclinical immunotherapeutic cancer phenotyping. The information about the immunosuppressive activity of the cancer microenvironment, immune checkpoints, T cells, efficiency of the immunotherapy, will be collected into respective data patterns. The developed 'ImmunoChip' platform will help to answer the questions: can the patient be treated with the immunotherapy? How does the tumor protect itself? Which immunotherapy to use? I am sure that improved decision-making in immunotherapy will lead to a transformative treatment results for more patients and will help to save more lives.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101054904	**TRANCIDS**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Tolga Duman**
Host Institution:	Bilkent Üniversitesi - TUR

Transmission over Channels with Insertions and Deletions

Insertions and deletions represent perhaps the most challenging impairments exhibited by communication channels in a wide range of applications from recording systems and covert communications to DNA storage. While tremendous progress has been made in determining the ultimate limits of communication using information-theoretic tools as well as in designing and implementing signaling solutions for various channel models with practical significance; for the case of insertion/deletion channels, even the simple scenarios are not fully understood. For instance, we do even not know the capacity of the basic independent and identically distributed binary deletion channel.

TRANCIDS will take on the monumental challenge of conquering the insertions and deletions by developing precise theoretical limits of communication and by designing explicit and implementable coding solutions approaching these limits. Specifically, TRANCIDS will 1) establish with precision the capacity of basic deletion/insertion channels, and obtain tight upper and lower bounds on the capacities of more sophisticated channel models encountered in practice (including the effects of noise and interference); 2) formulate and explore wireless communication problems with insertions and deletions (including multi-input and multi-output systems as well as different multi-user communications settings); 3) develop explicit and implementable channel coding solutions for a variety of channel models with insertions and deletions of practical importance; 4) address the channel capacity and code design problems for channels with additional impairments such as permutations as motivated by in-vivo DNA storage applications. TRANCIDS will highly impact different emerging applications such as DNA storage and beyond 5G wireless communications. Furthermore, the findings will help facilitate the development of DNA computing technologies of the future.

Link to the ERC project webpage:

Keywords of the ERC project: information theory, coding, deletion channel, DNA storage.

Keywords that characterize the scientific profile of the potential visiting researcher/s: information theory, channel coding

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
758056	**PURPOSE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Jose Antonio Rodriguez-Martinez**
Host Institution:	Universidad Carlos Iii De Madrid - ESP

Opening a new route in solid mechanics: Printed protective structures

Dynamic fragmentation of metals is typically addressed within a statistical framework in which material and geometric flaws limit the energy absorption capacity of protective structures. This project is devised to challenge this idea and establish a new framework which incorporates a deterministic component within the fragmentation mechanisms.

In order to check the correctness of this new theory, I will develop a comprehensive experimental, analytical and numerical methodology to address 4 canonical fragmentation problems which respond to distinct geometric and loading conditions which make easily identifiable from a mechanical standpoint. For each canonical problem, I will investigate traditionally-machined and 3D-printed specimens manufactured with 4 different engineering metals frequently used in aerospace and civilian-security applications. The goal is to elucidate whether at sufficiently high strain rates there may be a transition in the fragmentation mechanisms from defects–controlled to inertia–controlled. If the new statistical-deterministic framework is proven to be valid, defects may not play the major role in the fragmentation at high strain rates. This would bring down the entry barriers that the 3D-printing technology has found in energy absorption applications, thus reducing production transportation and repairing, energetic and economic costs of protective structures without impairing their energy absorption capacity.

It is anticipated that leading this cutting-edge research project will enable me to establish my own research team and help me to achieve career independence in the field of dynamic behaviour of ductile solids.

Link to the ERC project webpage: https://www.nonsolmecgroup.com/

Keywords of the ERC project: Impact, Ductile Fracture, Constitutive Modelling, Additive Manufacturing

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
758887	**REACT**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Eduardo Ruiz-Hernandez**
Host Institution:	The Provost, Fellows, Foundation Scholars & The Other Members Of Board Of The College Of The Holy & Undivided Trinity Of Queen Elizabeth Near Dublin - IRL

REsponsive theranostic nanosystems for Advanced Cancer Treatment

REACT aims to dramatically impact the targeted release of diagnostic agents and drugs with nanomedicines that respond to biological cues or changing pathophysiological conditions, thus enabling ultrasensitive diagnosis and exquisite therapy selectivity. Nanomedicine research against cancer focuses on the local targeted delivery of chemotherapeutics to enhance drug efficacy and reduce side effects. Despite all the efforts in the design of chemotherapeutic agents as nanomedicines, hardly any improvement has been translated into benefits for patients' survival. There is an urgent need for improved carrier systems able to deliver high doses of diagnostic agents and anti-cancer drugs to the tumor. Stimuli responsive carriers are promising candidates since the release of the cargo can be triggered locally in the tumor environment. Currently, there exists an unparalleled effort to identify genes, proteins and metabolites implicated in human disease and utilize systems biology and mathematical approaches in order to develop new prognostic tools for the treatment of cancer and develop more targeted therapies for patients. As an expert in drug delivery systems, the PI intends to bring all these efforts and advances into the design of stimuli responsive organic-inorganic hybrid nanoparticles that can adapt their response to the biological milieu. The novel engineered delivery systems will consist of an inorganic porous matrix surface-modified with tumor-specific molecules with the ability to sense changes in the environmental conditions and react by providing a proportional release. These nanosystems can potentially be employed for early in vitro diagnosis through effective screening of deadly tumors, such as neuroblastoma and glioblastoma. Moreover, through the sustained delivery of the nanosystems from injectable gels that can be locally implanted in patients at risk of developing a tumor, a clinically relevant tool for in vivo diagnosis and targeted therapy can be achieved.

Link to the ERC project webpage: https://pharmacy.tcd.ie/staff/ruiz-hernandez-cv.php

Keywords of the ERC project: drug delivery; nanoparticles; injectable hydrogels; stimuli-responsive; theranostics; cancer

Keywords that characterize the scientific profile of the potential visiting researcher/s: drug delivery; nanoparticles; injectable hydrogels; stimuli-responsive; theranostics; cancer

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
771237	**TriboKey**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Christian Greiner**
Host Institution:	Karlsruher Institut Fuer Technologie - DEU

Deformation Mechanisms are the Key to Understanding and Tayloring Tribological Behaviour

Tribology, the science of interacting surfaces in relative motion, is crucial for many aspects of modern life. Friction and wear decisively impact the lifetime and durability of many products-from nanoelectromechanical systems to gears and engines. In the USA alone, an estimated 1E18 joules of energy could be saved each year through improved tribological practices.

During sliding of a metallic contact, a mutated surface layer forms, carries most further plastic deformation and largely determines friction and wear. The origin and evolution of this distinct subsurface layer remains elusive, since our knowledge of the elementary mechanisms promoting these changes is limited. Only this knowledge however will allow for a strategic tailoring of tribologically loaded metals.

In this project, we will elucidate these elementary mechanisms for a wide range of alloys and strain rates. We will develop ground-breaking new strategies for probing the subsurface microstructure during the tribological test itself with non-destructive testing sensors like ultrasound and eddy current, resulting in subsurface in situ tribology. The data from these sensors will be analysed online, during the tribological experiment, relying on cutting edge data science methods as they have already been applied for fatigue testing. Based on these analyses, implemented on a Field Programmable Gate Array, we will interrupt the test exactly when the dominating elementary mechanisms manifest themselves. These mechanisms will then be revealed by sophisticated electron microscopy and be visualized in deformation mechanism maps for unidirectional and reciprocating sliding. Such maps have proven very successful in other fields of materials science, e.g. creep at elevated temperatures. They are used to guide material selection and alloy development processes, yielding materials tailored for each specific tribological scenario, promising enormous savings in energy and resources, an important challenge of our time.

Link to the ERC project webpage:

Keywords of the ERC project: Materials Science, Tribology, Bio-inspiration

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
802205	**COTOFLEXI**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Xiaoying Zhuang**
Host Institution:	Gottfried Wilhelm Leibniz Universitaet Hannover - DEU

Computational Modelling, Topological Optimization and Design of Flexoelectric Nano Energy Harvesters

Flexoelectricity is the generation of electric polarization under mechanical strain gradient or mechanical deformation due to the electric field gradient (converse flexo). It is a more general phenomenon than the linear change in polarization due to stress, the piezoelectric effect. Flexoelectricity exists in a wider range of centrosymmetric materials especially nontoxic materials useful for biomedical application. It grows dominantly in energy density at submicro- or nanoscale enabling self-powered nano devices such as body implants and small-scale wireless sensors. Among the emerging applications of flexoelectricity, energy harvesters are the basic front devices of wide technological impact. Despite the advantages offered by flexoelectricity, research in this field is still in germination. Experiments are limited in measuring, explaining and quantifying some key phenomena. Materials engineering and engineering of strain are the key challenges to bring energy harvesting structures/systems to become a viable technology. Accomplishment of this task pressingly requires a robust modelling tool that can assist the development of flexoelectric energy harvesters. Hence, the aim of the project is to develop a computational framework to support the characterization, design, virtual testing and optimization of the next generation nano energy harvesters. It will be able to (1) predict the energy conversion efficiency and output voltage influenced by layout and surface effects of structures in 3D, (2) to virtually test the performance with various vibrational dynamic conditions, and (3) to break through current designs of simple geometry for flexoelectric structures by optimization considering manufacturing constraints. Innovative metamaterial/3D folding energy harvesters expectantly outperforming current piezoelectric energy harvesters of the same size will be manufactured and tested.

Link to the ERC project webpage: https://www.cotoflexi.uni-hannover.de/en/about-cotoflexi/team-cotoflexi

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
818607	**OPTIMA**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Kevin Van Geem**
Host Institution:	Universiteit Gent - BEL

PrOcess intensification and innovation in olefin ProducTIon by Multiscale Analysis and design

New manufacturing techniques such as 3D printing have the potential to drastically transform the chemical industry. Novel, complex, integrated reactor designs can now be created, that will allow to unlock alternative chemical routes, such as for methane activation. Driven by process intensification and the power of high performance computing, this project will enhance heat and mass transfer in advanced chemical reactors by multiscale modelling and experimentation. OPTIMA aims to:

(1) develop in silico novel 3D reactor technologies and concepts with significantly improved selectivity and heat transfer by the use of additive manufacturing;
(2) generate new fundamental understanding of kinetics, heat transfer and mass transfer by using advanced measuring techniques for processes of both current and future importance;
(3) demonstrate the practical applicability of an open-source multiscale large eddy simulation (LES) platform in combination with finite rate chemistry for turbulent reacting flows;
(4) transform the chemical industry by valorising methane and converting it to a platform molecule through oxidative coupling of methane.

OPTIMA will focus on two olefin production processes of industrial and social importance in Europe, the exothermal oxidative coupling of methane and the endothermic steam cracking, demonstrating the universality of the proposed new paradigm. Starting from fundamental experiments and kinetic modelling (WP1), detailed chemistry will be implemented in an open-source LES multiscale modelling framework (WP2) generating in silico novel 3D reactor technologies with significantly improved selectivity (WP3). The power of the approach will be ultimately demonstrated in a novel, 3D integrated reactor, in which the studied exothermic and endothermic processes are cleverly combined (WP4).

OPTIMA will pave the way for designing the 3D reactors of tomorrow and promote the new techniques and tools that will be driving innovation in the next decades.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
818941	**LINCHPIN**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Dorota Koziej**
Host Institution:	Universitaet Hamburg - DEU

A platform to LINk between CHemistry and PhysIcs of colloidal Nanomaterials

The recent successful applications of photon-in-photon-out spectroscopy in condense matter physics, bio-inorganic chemistry and catalysis build upon the high brilliance of modern X-ray sources and realization of dedicated emission spectrometers. However, probing with highly energetic X-ray beam puts many constraints on the sample environment and requires probing faster than the X-ray radiation damage occurs. This strongly limits the applicability of the method in studying the chemistry of colloidal nanomaterials.
The objective of LINCHPIN is to investigate the emergence of electronic structure of nanomaterials in solution by hard X-ray photon-in-photon-out spectroscopy. To reach this very ambitious target, LINCHPIN consolidates an interdisciplinary engineering, spectroscopic and chemically driven effort. My group aim for developing micro-reactors, which will enable new fundamental insights related to the chemistry and electronic properties of the transition metal nitrides and sulfides.
The main scientific goals are to study at the relevant time scales the kinetics and dynamics of: (a) short-lived molecular intermediate states and pre-nucleation clusters, (b) metal-sulfur and metal-nitrogen bond formation and their condensation in solution, (c) electronic structure changes during growth of nanostructures, and (d) concurrently interdependent electronic and chemical processes. The ultimate goal is to have a handle on designing and selecting, still in the reaction solution, the nanomaterials with the most promising electronic properties relevant for energy conversion and storage. Moreover, the proposed micro-reactors along with experimental spectroscopic protocols and the concurrent fundamental knowledge create a paradigm shift for in situ time-resolved experiments with an impact in many other fields ranging from catalysis, sustainable flow chemistry to biomedical applications.

Link to the ERC project webpage: https://www.physik.uni-hamburg.de/en/inf/ag-koziej/forschung/linchpin-link-between-chemistry-and-physics.html

Keywords of the ERC project: X-ray absorption and emission spectroscopy, nanomaterials, solution, in-situ, photon-in photon-out

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
833125	**HIGHWAVE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Frederic Dias**
Host Institution:	Ecole Normale Superieure De Cachan - FRA

Breaking of highly energetic waves

HIGHWAVE is an interdisciplinary project at the frontiers of coastal/ocean engineering, earth system science, statistics and fluid mechanics that will explore fundamental open questions in wave breaking. Why do waves break, how do they dissipate energy and why is this important? A central element of the work builds on recent international developments in the field of wave breaking and wave run-up led by the PI that have provided the first universal criterion for predicting the onset of breaking of water waves in uniform water depths from deep to intermediate. This work has also shown that the run-up of nonlinear waves impinging on a vertical wall can exceed up to 12 times the far-field amplitude of the incoming waves. These results have now opened up the possibility for more accurate operational wave models. They have practical and economic benefits in determining structural loads on ships and coastal/offshore infrastructure, evaluating seabed response to extreme waves, and optimizing operational strategies for maritime and marine renewable energy enterprises. This is a tremendous advance comparable to the introduction of wave prediction during World War II, and the PI aims to be at the forefront of this research effort to take research in wave breaking into fundamentally new directions. The objectives of the project are: (i) to develop an innovative approach to include accurate wave breaking physics into coupled sea state and ocean weather forecasting models; (ii) to obtain improved criteria for the design of ships and coastal/offshore infrastructure; (iii) to quantify erosion by powerful breaking waves, and (iv) to develop new concepts in wave measurement with improved characterization of wave breaking using real-time instrumentation. This highly interdisciplinary project will involve an ambitious and unconventional combination of computational simulation/theory, laboratory experiments, and field measurements of sea waves, closely informed by application needs.

Link to the ERC project webpage: https://www.highwave-project.eu

Keywords of the ERC project: ocean waves; machine learning; CFD

Keywords that characterize the scientific profile of the potential visiting researcher/s: mathematics and mechanics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
834238	**C0PEP0D**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Christophe Eloy**
Host Institution:	Ecole Centrale De Marseille Egim - FRA

Life and death of a virtual copepod in turbulence

Life is tough for planktonic copepods, constantly washed by turbulent flows. Yet, these millimetric crustaceans dominate the oceans in numbers. What have made them so successful? Copepod antennae are covered with hydrodynamic and chemical sensing hairs that allow copepods to detect preys, predators and mates, although they are blind. How do copepods process this sensing information? How do they extract a meaningful signal from turbulence noise? Today, we do not know.

C0PEP0D hypothesises that reinforcement learning tools can decipher how copepod process hydrodynamic and chemical sensing. Copepods face a problem similar to speech recognition or object detection, two common applications of reinforcement learning. However, copepods only have 1000 neurons, much less than in most artificial neural networks. To approach the simple brain of copepods, we will use Darwinian evolution together with reinforcement learning, with the goal of finding minimal neural networks able to learn.

If we are to build a learning virtual copepod, challenging problems are ahead: we need fast methods to simulate turbulence and animal-flow interactions, new models of hydrodynamic signalling at finite Reynolds number, innovative reinforcement learning algorithms that embrace evolution and experiments with real copepods in turbulence. With these theoretical, numerical and experimental tools, we will address three questions:

Q1: Mating. How do male copepods follow the pheromone trail left by females?

Q2: Finding. How do copepods use hydrodynamic signals to ‘see’?

Q3: Feeding. What are the best feeding strategies in turbulent flow?

C0PEP0D will decipher how copepods process sensing information, but not only that. Because evolution is explicitly considered, it will offer a new perspective on marine ecology and evolution that could inspire artificial sensors. The evolutionary approach of reinforcement learning also offers a promising tool to tackle complex problems in biology and engineering.

Link to the ERC project webpage: https://c0pep0d.github.io

Keywords of the ERC project: Fluid Mechanics, Reinforcement Learning, Plankton behaviour

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
834742	**ATOP**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Zhipei Sun**
Host Institution:	Aalto-Korkeakoulusaatio - FIN

Atomically-engineered nonlinear photonics with two-dimensional layered material superlattices

The project aims at introducing a paradigm shift in the development of nonlinear photonics with atomically-engineered two-dimensional (2D) van der Waals superlattices (2DSs). Monolayer 2D materials have large optical nonlinear susceptibilities, a few orders of magnitude larger than typical traditional bulk materials. However, nonlinear frequency conversion efficiency of monolayer 2D materials is typically weak mainly due to their extremely short interaction length (~atomic scale) and relatively large absorption coefficient (e.g.,>5×10^7 m^-1 in the visible range for graphene and MoS2 after thickness normalization). In this context, I will construct atomically-engineered heterojunctions based 2DSs to significantly enhance the nonlinear optical responses of 2D materials by coherently increasing light-matter interaction length and efficiently creating fundamentally new physical properties (e.g., reducing optical loss and increasing nonlinear susceptibilities).
The concrete project objectives are to theoretically calculate, experimentally fabricate and study optical nonlinearities of 2DSs for next-generation nonlinear photonics at the nanoscale. More specifically, I will use 2DSs as new building blocks to develop three of the most disruptive nonlinear photonic devices: (1) on-chip optical parametric generation sources; (2) broadband Terahertz sources; (3) high-purity photon-pair emitters. These devices will lead to a breakthrough technology to enable highly-integrated, high-efficient and wideband lab-on-chip photonic systems with unprecedented performance in system size, power consumption, flexibility and reliability, ideally fitting numerous growing and emerging applications, e.g. metrology, portable sensing/imaging, and quantum-communications. Based on my proven track record and my pioneering work on 2D materials based photonics and optoelectronics, I believe I will accomplish this ambitious frontier research program with a strong interdisciplinary nature.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
848590	**MULTIMAG**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Paavo Rasilo**
Host Institution:	Tampereen Korkeakoulusaatio Sr - FIN

Multiscale Magnetic Models for Emerging Energy Conversion Applications

About 30 % of all the electrical power generated passes through a power electronic converter, and the proportion is expected to rise to 80 % in 10-15 years. The amount of electricity annually wasted due to the losses in such systems in the EU corresponds to at least billions of euros. A major part of these losses arises in passive magnetic components, such as inductors and transformers, which are also the largest and heaviest components of a power electronic device. The physical phenomena related to the power losses in the magnetic cores of these components are not properly understood at the moment. In addition, the engineering community is currently lacking efficient modeling tools for analyzing the losses in the windings of such components at high frequencies.

Improvement of high-frequency magnetic components would require accurate understanding of the power loss mechanisms. However, the device-level losses are affected by physical effects taking place in the microscopic grain and domain structures and very thin conductors, which are often subject to geometrical uncertainties. Accurate geometrical models cannot be used for analyzing the devices due to the impossibly large computational burden.

In MULTIMAG, we will address these challenges by establishing a set of new multiscale numerical modeling tools, which will provide insight into the origin of the power losses and make it possible to perform statistical analysis of the electromagnetic behaviour of such components. The application potential of these new numerical tools will be demonstrated by designing working prototypes of emerging power electronic devices, such as a solid-state transformer and a wireless power transfer system. We will also develop inverse problem approaches for identifying the models from available catalog data, lowering the threshold for adopting the models into use.

As the outcome, new means for improving the energy efficiency and power density of power electronic devices will arise.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/848590

Keywords of the ERC project: eddy currents, electromagnetics, finite element method, magnetic components, power losses, windings, wireless power transfer

Keywords that characterize the scientific profile of the potential visiting researcher/s: eddy currents, electromagnetics, finite element method, magnetic components, power losses, windings, wireless power transfer

Project ID:	Project Acronym:	Evaluation Panel:
849841	**REBOOT**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Patrick Biller**
Host Institution:	Aarhus Universitet - DNK

Resource efficient bio-chemical production and waste treatment

The REBOOT project will create a disruptive wet waste valorisation technology where valuable resources are re-used rather than disposed of while tackling two urgent environmental challenges: nutrient circularity and climate change. Wastewater treatment sludge and manure treatment technologies are currently not satisfactory and there is no solution to efficiently re-use the resources it contains: phosphorous and carbon.
The aim of REBOOT is to completely recover phosphorous from wastes while generating carbon neutral transportation fuels and a carbon sink in the form of carbon materials. The project will employ a frontier technology called hydrothermal liquefaction (HTL) which uses high temperature and pressure to produce a liquid product similar to petroleum termed bio-crude. This will be used for a range of innovative applications such as renewable aviation fuel, functionalized carbon materials and bio-bitumen.
The possibility of complete phosphorous recovery in HTL is a completely new concept, previously thought impossible as only continuous HTL reactors can theoretically achieve this. The complex hydrothermal chemistry of salts can only be exploited on such advanced reactors that are currently beyond state-of-the-art. The specific objectives of REBOOT are: (1) mechanistic understanding of salt behaviour in multi-phase hydrothermal systems with the aim of full recovery. (2) Develop tailored strategies for in-situ jet fuel synthesis. (3) Establish microbial electrolysis cells for in-situ hydrogen production and nutrient recovery.
REBOOT will be carried out on pilot continuous reactors, where the challenging physical conditions can be explored, exploited and new engineering solutions developed. If REBOOT is successful it will enable society to tackle existing waste problems while recovering nutrients and producing renewable materials, replacing fossil derived ones; representing a revolutionary solution to wet waste management in the emerging circular bio-economy.

Link to the ERC project webpage:

Keywords of the ERC project: biofuel, hydrothermal, phosphorous, liquefaction, biomass

Keywords that characterize the scientific profile of the potential visiting researcher/s: chemical engineer

Project ID:	Project Acronym:	Evaluation Panel:
850437	**PRE-ECO**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Alfonso Pagani**
Host Institution:	Politecnico Di Torino - ITA

A new paradigm to re-engineering printed composites

Additive manufacturing and Automated Fibre Placement (AFP) processes brought to the emergence of a new class of fibre-reinforced materials; namely, the Variable Angle Tow (VAT) composites. AFP machines allow the fibres to be relaxed along curvilinear paths within the lamina, thus implying a point-wise variation of the material properties. In theory, the designer can conceive VAT structures with unexplored capabilities and tailor materials with optimized stiffness-to-weight ratios. In practise, steering brittle fibres, generally made of glass or carbon, is not trivial. Printing must be performed at the right combination of temperature, velocity, curvature radii and pressure to preserve the integrity of fibres. The lack of information on how the effect of these parameters propagates through the scales, from fibres to the final structure, represents the missing piece in the puzzle of VAT composites, which today are either costly or difficult to design because affected by unpredictable failure mechanisms and unwanted defects (gaps, overlaps, and fibre kinking).
This proposal is for an exploratory study into a radical new approach to the problem of design, manufacturing and analysis of tow-steered printed composite materials. The program will act as a pre-echo, a precursor, to: 1) implement global/local models for the simulation and analysis of VATs with unprecedented accuracy from fibre-matrix to component scales; 2) develop a (hybrid) metamodeling platform based on machine learning for defect sensitivity and optimization; and 3) set new rules and best-practices to design for manufacturing. A 5-year, highly inter-disciplinary programme is planned, encompassing structural mechanics, numerical calculus, 3D printing and AFP, measurements and testing of advanced composites, data science and artificial intelligence, and constrained optimization problems to finally fill the gap between the design and the digital manufacturing chain of advanced printed materials.

Link to the ERC project webpage: http://www.pre-eco.eu/

Keywords of the ERC project: Composites, Computational mechanics, Mechanics of Solids

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
851630	**BuBble Gun**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr David Fernandez Rivas**
Host Institution:	Universiteit Twente - NLD

Penetrating microjets in soft substrates: towards controlled needle-free injections

The needle-free delivery of liquid jets into soft and heterogeneous substrates, e.g. human tissue, has been hindered by (1) the need to reach specific penetration depths with energy efficient means, (2) the break-up of jets that impedes control over the dose delivery, and (3) liquid splash-back after impacting the substrate that cause cross-contamination between injections. BuBble Gun is aimed at overcoming these challenges. My team and I have recently uncovered new operational regimes of cavitation with continuous-wave lasers. My next goal is to study the energy partition between the creation of bubbles, the formation of liquid jets, and the penetration of these jets into soft substrates. Fundamental insights on energy partitioning will then be applied to achieve major breakthroughs in jet injection, by (1) controlling cavitation within microfluidic confinement, (2) tuning the rheology of jets emerging from confined cavitation, and (3) deriving the relationships between fluid dynamics and material properties governing jet injection into soft substrates. I expect to advance the knowledge at the intersection of microfluidics, physics, and bioengineering, to enable unprecedented control over cavitation, jetting, and injection phenomena. We will develop a portable energy- efficient injection platform by using ultra-high-speed imaging, and quantifying injections with experimental resolutions below the microsecond and micrometer scales. The rheological properties of the jets will be tuned with biocompatible additives to ensure cohesion, before injecting them into in-vitro targets and ex-vivo skin. Numerical models will assist untangling the influence of microfluidic configuration and material properties on the injection outcomes. The ultimate result will be the predictable, reproducible, and efficient injection of liquids that will enable a wide-range of technologies, such as additive manufacturing, coating modifications, the delivery of drugs and vaccinations.

Link to the ERC project webpage: www.bubble-gun.eu

Keywords of the ERC project: rheology, microfluidics, drug delivery

Keywords that characterize the scientific profile of the potential visiting researcher/s: bioengineering, biomedical, physics, rheology, drug delivery

Project ID:	Project Acronym:	Evaluation Panel:
853096	**ThermoTON**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Beni Cukurel**
Host Institution:	Technion - Israel Institute Of Technology - ISR

Thermophone - a novel heat transfer based approach to global TOnal Noise cancellation in aviation

Limiting the number of people affected by significant aircraft noise is one of the most important tasks of modern civil aviation. Among different contributors, tonal noise is the most important due to regulatory definitions and its attenuation characteristics, with the largest contributor being the fan aero-acoustics. Current passive noise reduction methods alone are insufficient to conform with the increasingly stringent noise emission regulations. This motivates our research in active noise cancellation, based on creation of equal amplitude and frequency pressure waves, in opposite phase to the disturbance. Having identified that the actuator technology is the main hindrance against hardware implementation in flying platforms, we have been investigating a revolutionary technology based on a truly static and surface-deposited sound emitter (thermophone), which creates pressure fields by thermo-acoustic effects rather than the vibro-acoustics utilized by common speakers. Comprising of a periodically Joule heated electrically conductive thin layer, a highly efficient thermophone requires modeling of non-Fourier heat conduction in deposits.
The project is divided into 4 multi-disciplinary objectives:

1. Derivation of accurate macro-scale heat conduction model, including non-Fourier effects
2. Developing thermophone performance model by analyzing thermo-acoustic effect
3. Optimization of performance by material and geometric selection, and by manufacturing processes
4. Demonstrating aero-acoustic fan noise cancelation via the thermo-acoustic effect created by static heat flux transducer

In addition to the significance that this project will have to the field of aviation, I strongly believe that successful completion of each work package will provide dramatic improvements over the state of the arts in conduction heat transfer modelling, consumer electronics such as speakers, manufacturing methods for thermo-acoustic devices, and active aero-acoustic noise cancellation.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
865985	**CLEANH2**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Nicolas Boscher**
Host Institution:	Luxembourg Institute Of Science And Technology - LUX

Chemical Engineering of Fused MetalloPorphyrins Thin Films for the Clean Production of Hydrogen

This project stands in the general context of the current worldwide energy and environmental crisis. It aims to engineer a new generation of conjugated microporous polymers based on fused metalloporphyrins for the low-cost, clean and efficient production of hydrogen from solar water splitting. The CLEANH2 concept relies on the gas phase reaction of metalloporphyrins to engineer new heterogeneous catalysts with remarkable hydrogen production yields. Metalloporphyrins, selected by Nature to fulfil the main catalytic phenomena allowing life, are attractive molecules for water splitting owing to their highly conjugated structure and central metal ion, which can readily interconvert between different oxidation states to accomplish oxidation and reduction reactions. For efficiency and sustainability considerations, it is highly desirable to employ metalloporphyrins in conductive assemblies for heterogeneous catalysis. Nevertheless, due to the lack of synthetic approach, the design and application of conjugated porphyrin assemblies is a largely unexplored topic in view of the plethora of available porphyrin patterns.

The central idea of CLEANH2 builds upon our recent advance in the gas phase synthesis and deposition of directly fused metalloporphyrins coatings. Progress in our approach is expected to open the way for the construction of powerful catalytic and photocatalytic materials. To achieve this, the key challenging goals of this project are: 1) the engineering of the microstructure and electronic structure of directly fused metalloporphyrins thin films; 2) the use of the full potential of directly fused metalloporphyrins thin films for the unmet, clean and high quantum yield overall water splitting for hydrogen production. The outcomes of CLEANH2 will be foundational for the engineering of directly fused metalloporphyrins systems and their implementation in advanced technological applications related to catalysis and solar energy.

Link to the ERC project webpage:

Keywords of the ERC project: Porphyrin; Conjugated Polymer; Heterogeneous Catalysis; Water Splitting

Keywords that characterize the scientific profile of the potential visiting researcher/s: Porphyrin; Conjugated Polymer; Heterogeneous Catalysis; Chemical Transformation

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
866005	**MIGHTY**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Michael De Volder**
Host Institution:	The Chancellor, Masters And Scholars Of The University Of Cambridge - GBR

Roll-to-Roll Manufacturing of Hierarchical Li-Ion Battery Electrodes

Research in the field of micro and nanotechnology has led to the development of materials with fundamentally new or improved functionality, which have the potential to revolutionise electronics, drug delivery, water purification, and energy storage. These scientific discoveries can help address many of the grand challenges our society is facing, but unfortunately, too few of these new materials are implemented in real commercial devices. This is not because of a lack of interest or commercial potential, but often because there are no manufacturing methods available that allow for controlled processing of these materials at scale.

This project aims to address this challenge by developing advanced nano and microstructures directly on a scalable Roll-to-Roll manufacturing platform, rather than considering manufacturing as an after-thought. This will be achieved by following a methodical approach, where material organisation is optimised from the bottom-up, starting with the nanoscale chemical material composition, followed by the microscale particle morphology, and finally their large area coating using Roll-to-Roll manufacturing. This hierarchical material build-up will be achieved by taking advantage of emerging scientific insights in robust self-assembly processes, combined with novel coating processes to allow for precise control over the particle flow and assembly on Roll-to-Roll.

Our Roll-to-Roll process will be optimised to manufacture Li-Ion batteries with new form factors that allow the enhancement of their volumetric performance. This project will demonstrate for the first time how complex hierarchical battery electrodes can be manufactured with a continuous process. These batteries are important to support the EU's strong automotive industry as it transitions to electric vehicles, and therefore this project will contribute to the EU economy as well as to the de-carbonisation of our society.

Link to the ERC project webpage:

Keywords of the ERC project: Li-Ion Batteries, Scale-up, Roll-to-Roll

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
866126	**ACHIEVE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Dimitrios Zevgolis (Zeugolis)**
Host Institution:	University College Dublin, National University Of Ireland, Dublin - IRL

Advanced Cellular Hierarchical Tissue-Imitations based on Excluded Volume Effect

ACHIEVE focuses on the application of Excluded Volume Effect in cell culture systems in order to enhance Extracellular Matrix (ECM) deposition. It represents a new horizon in in vitro cell culture which will address major challenges in medical advancement and food security. ACHIEVE will elucidate extracellular processes which occur during tissue generation, identifying favourable conditions for optimum tissue cultivation in vitro. These results will be applied in the diverse fields of regenerative medicine, drug discovery and cellular agriculture which all require advancements in in vitro tissue engineering to overcome current bottlenecks. Effective in vitro tissue culture is currently limited by lengthy culture periods. An inability to maintain physiologic (in vivo) conditions during this lengthy in vitro culture leads to cellular phenotype drift, ultimately resulting in generation of an undesired tissue. Enhanced tissue generation in vitro will greatly reduce culture times and costs, effecting improved in vitro tissue substitutes which remain true to their original phenotype. The research will be addressed under four work-packages. WP1 will investigate biochemical, biophysical and biological responses to varying culture conditions; WP 2, 3 and 4 will apply results in the fields of Tissue Engineering, Drug Discovery and Cellular Agriculture respectively. Research will involve extensive characterisation of derived- and stem-cell cultures in varying conditions of expansion and relevant health and safety and preclinical testing. The five year programme will be undertaken at the National University of Ireland, Galway, a centre of excellence in tissue engineering research, at a cost of € 2,439,270.

Link to the ERC project webpage:

Keywords of the ERC project: macromolecular crowding; regenerative medicine; tendon engineering; skin engineering; in vitro pathophysiology models; cellular agriculture

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
882340	**Smart-TURB**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Luca Biferale**
Host Institution:	Universita Degli Studi Di Roma Tor Vergata - ITA

A Physics-Informed Machine-Learning Platform for Smart Lagrangian Harness and Control of TURBulence

Where is it difficult to control, predict and model a flowing system? to search and navigate inside it? to be prepared against extreme events? to tame them? It is in turbulent flows.

Turbulence is ubiquitous and unsolved from the point of view of out-of-equilibrium fundamental physics, uncontrollable from the engineering aspects, and a deadlock for brute-force numerical and experimental investigations. Indeed, progress by using conventional methods has been slow.

In this project, I propose to explore new avenues crossing the boundaries between Theoretical Engineering and Applied Physics using algorithms from Artificial Intelligence (AI) to study and control turbulence in an innovative way using smart Lagrangian objects in a vast array of flows. I am committed to: (i) develop original applications of AI algorithms to track and harness moving coherent structures and/or statistical turbulent fluctuations, (ii) optimise flow navigation of buoyant objects and active surface drifter, (iii) invent collective search protocols to locate emissions from fixed or floating sources, (iv) minimise turbulent dispersion of a swarm of autonomous underwater explorer and (v) perform new in-silico experiments for data-assimilation, to predict extreme-events, or to control turbulent fluctuations by novel Lagrangian injection/adsorption mechanisms.

The unifying fil-rouge of my project is to gain a Deep Understanding of turbulence by performing cutting-edge Lagrangian numerical studies. The project is both methodology oriented, with the grand challenge of developing fully unconventional applications of (Deep) Reinforcement Learning for fluid dynamics, and problem driven, delivering a series of specific optimal control strategies for important realistic flow set-ups and applications to the geophysical fields. With my experience and the impact of my contributions in the discipline, I am confident that I offer the highest chances to carry out this ambitious project with success.

Link to the ERC project webpage: https://biferale.web.roma2.infn.it/

Keywords of the ERC project: Machine Learning, Transformers, Turbulence, Computational Fluid Dynamics

Keywords that characterize the scientific profile of the potential visiting researcher/s: Data-driven tools, fluid mechanics, computational physics

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Project ID:	Project Acronym:	Evaluation Panel:
883849	**TRUFLOW**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Stephane Zaleski**
Host Institution:	Sorbonne Universite - FRA

TRansfers at tiny scales in tUrbulent multiphase FLOW

The prediction of heat and mass transfer across fluctuating fluid interfaces is a considerable challenge. It is however not only an ubiquitous part of industrial processes, but also a critical component of the global climate system through ocean-atmosphere interactions. Sustainable development and greenhouse gas emission containment will require an overhaul of already knowledge-intensive processes. TRUFLOW thus aims at enabling the quantitative prediction of the heat and mass transfer in fluid flow using simulation, high performance computation and multiphysics, multiscale methods. Using presently available, cutting edge interface tracking and subgrid scale methods TRUFLOW will investigate a range of critical processes, allowing for example industry to plan for improved carbon capture processes such as rotating packed beds, new processes such as hydrogen-based metallurgy to replace carbon based metallurgy, heat and mass transfer in hydrogen fuel cells, boiling and cavitation simulation and CO2 transfer across the wavy ocean surface. The key limiting factor in the success of simulation in this domain is the considerable range of scales expected, with slowly diffusing chemicals creating boundary layers that are orders of magnitude smaller than the typical fluid structures, bubbles or droplets. Critical heat fluxes in boiling and interface motion at the microscale are determined by contact line motion, which involves tiny molecular scales. TRUFLOW will bridge these various extreme length scale gaps using state of the art methods. It will result in direct high performance simulations of heat and mass transfer, coupled simulation and analysis of existing experimental data, an analysis of the performance of reduced models of flows with tiny scale transfers, and a systematic use of these models in industrial or natural configurations.

Link to the ERC project webpage:

Keywords of the ERC project: two-phase flow, contact lines, boiling, phase change, heat and mass transfer, turbulence

Keywords that characterize the scientific profile of the potential visiting researcher/s: numerical simulation

Project ID:	Project Acronym:	Evaluation Panel:
947606	**PowFEct**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Holger Grosshans**
Host Institution:	Physikalisch-Technische Bundesanstalt - DEU

Preventing Explosions: How do Powder Flows Electrify?

The electrification of powder flows is one of the most pervasive phenomena in environmental processes and of tremendous importance for technical applications. In industrial plants, excessive electrostatic charges can even lead to hazardous sparks, which have caused numerous catastrophic dust explosions in the past. However, despite its long history of investigation, it is not currently possible to predict the buildup, transport, and accumulation of charge.

Starting from 2015, I developed a numerical approach with the important capability to couple the involved scientific disciplines – fluid mechanics (turbulent carrier flow), surface science (triboelectric particle charging), and electrostatics (forces between charges). The first ever fully-resolved simulations revealed that the occurrence of distinct physical flow mechanisms determines the charging rate of powder. This knowledge opens a new way to control the electrification through triggering these mechanisms and, thus, to solve the problem finally. To this end, this proposal aims to develop a novel interdisciplinary computational tool. This task includes establishing several new numerical concepts, such as a single-particle charging model. Beyond the state-of-the-art single-particle and powder flow electrification experiments which both employ innovative measurement methodologies will support the theoretical efforts. The proposed test set-ups will bring about a paradigm shift by quantifying, for the first time, reproducible, facility independent data, tailored specifically to complement the model formulation.

The successful project will provide an open-source tool that enables the prediction, evaluation, and limitation of electrostatic charges. To this respect, the research aims not only to prevent accidents in industrial facilities but also to understand the physics of other kinds of electrifying powder flows and to solve a long-standing scientific riddle.

Link to the ERC project webpage:

Keywords of the ERC project: powder, fluid mechanics, electrostatics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
947897	**GREEN**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Paulo Rocha**
Host Institution:	Universidade De Coimbra - PRT

Generating Energy from Electroactive Algae

The aim of this grant is to establish a world leading research centre focusing on developing a radically different way to generate clean energy from algae. GREEN will deliver a self-sustainable bioenergy generator, with an output power of the order of W/m2 that is at least 100 times larger than current state-of-art bioenergy generators. The unprecedented enhancement in output power finally breaks the power scalability barrier for bioenergy generators and in this way delivers impact on the world's renewable energy research trajectory.

I have recently discovered that a population of diatoms, a form of algae, communicate in a cooperative manner and produce long lasting large magnitude electrical oscillations. The discovery has been made possible through my recent breakthrough - I have developed a large area and low impedance transducer to record cooperative communication in cells.

My idea is to harvest the generated electricity from the algae. Using 2D electrodes, the output power is µW/m2, which is low. However, the power increases with the density of diatoms adhered to the electrode and with the electrical coupling of the cells to the electrode. By going from a 2D to porous 3D electrodes, and by optimizing the coupling an output power of W/m2 is within my reach.

To deliver the new bioenergy generator, it is essential to understand 1) which materials and 3D electrode geometries comprise larger cell densities and enable a more efficient charge transfer from the living organisms to the electrode 2) which organisms provide the higher output powers, and 3) how the electric circuitry will be developed to store and deliver the generated power.

This multidisciplinary research will advance the state-of-the-art by delivering a prototype for a new green self-sustained energy harvester, suitable for power scalability, through realising technological advances in 1) electrochemical electrodes, 2) cooperative signalling mechanisms in algae and 3) energy harvesting circuits.

Link to the ERC project webpage: https://www.greenproject.pt/

Keywords of the ERC project: bioelectronics, bioenergy

Keywords that characterize the scientific profile of the potential visiting researcher/s: Electrical engineering, microelectronics, signal processing, energy harvesting

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Project ID:	Project Acronym:	Evaluation Panel:
948739	**PEM-SPrint**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Ruth Cardinaels**
Host Institution:	Katholieke Universiteit Leuven - BEL

Polymeric Electromagnetic Metamaterials created by flow-induced Structure PRINTing

The increasing miniaturization and integration of numerous components in electronic devices and the booming use of wireless technologies leads to an explosion in the amount of electromagnetic waves and resulting crosstalk. In addition, with the recent 5G mobile network, a major challenge is to enhance the range of the electromagnetic waves, which could be accomplished by suitable wave bending around obstacles. To make these upcoming technologies viable for the future, a novel class of materials is needed. These materials need to fulfil two major requirements namely processability into complex and customized shapes and local interactions with selected electromagnetic waves. The aim of this research is to develop polymeric multi-phasic electromagnetic metamaterials generated by a novel processing method, i.e. flow-induced structure printing. The novel method, featuring a complex static mixer in the nozzle of the printer, will make it possible to create 3-dimensional materials having substructures that are up to 100 times smaller than the dimension of the printer nozzle. By using polymeric materials with conductive and magnetic inclusions, 3D structures will be generated that allow to induce electromagnetic metamaterial responses such as wave bending or complete absorption. To enable these groundbreaking developments in material design and processing, fundamental understanding should be generated on the relations between microstructure and electromagnetic properties in 3D structured materials with conductive and magnetic inclusions combined with their flow-induced structure development. My extensive background in rheology, fluid mechanics, material design and equipment development will allow to tackle the diverse challenges in realizing these unique materials and processing method. The general design strategies and processing method will also enable to generate hierarchical materials for other high-end applications such as interdigitated batteries and solar cells.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/948739

Keywords of the ERC project: additive manufacturing, electromagnetic metamaterial, polymer nanocomposite, rheology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
949085	**NEXTFLOW**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Stefano Discetti**
Host Institution:	Universidad Carlos Iii De Madrid - ESP

Next-generation flow diagnostics for control

Fast-paced advancements of hardware and machine-learning algorithms have triggered successful applications of active flow control, even though mainly limited to laboratory-scale applications. One of the main limits resides in the lesson we are able to learn today from experiments. We can successfully train actuators with probes in a controlled environment to reach a certain goal, e.g. aerodynamic drag minimization or noise reduction; on the other hand, an experimental technique that provides a full description of the flow is not available, thus generalization of the actuation effects to real applications is often prohibitive.

The objective of NEXTFLOW is to conceive the next-generation flow-diagnostics aimed to flow control by leveraging the principles of completeness and compactness of the measurements. Completeness implies aiming to pursue a complete flow description, i.e. a time-resolved 3D characterization of velocity and thermodynamic variables. This will be achieved through a technique-integration approach based on data-driven methods. This grounds its basis on the principle that the superposed application of techniques is superior to their separate use. Compactness is pursued by exploring solutions with minimum technological complexity, and on developing new data output formats that are directly aimed at flow control applications. Key enablers for this task are (i) the novel concepts I recently proposed on data-driven techniques integration, (ii) the deep embedding of compressed-sensing methods in the data processing and (iii) the data-driven discovery of simplified governing equations of the dynamics.

The next-generation flow diagnostics concept will deeply change experimental fluid mechanics and flow control, allowing bridging the gap between the laboratory experiment to the real application, with tremendous potential impact on numerous industrial applications.

Link to the ERC project webpage: https://erc-nextflow.uc3m.es/

Keywords of the ERC project: Particle Image Velocimetry; Flow control; Machine learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: Particle Image Velocimetry; Flow control; Machine learning

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Project ID:	Project Acronym:	Evaluation Panel:
949229	**CryForm**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Elena Simone**
Host Institution:	Politecnico Di Torino - ITA

Crystal Engineering the New Generation of Sustainable, Biocompatible and Stimuli Responsive Formulations for the Delivery of Active Ingredients

CryForm aims at progressing our fundamental knowledge in organic materials crystallization and crystal engineering by: (1) gleaning a mechanistic understanding of the relationship between crystal structure and surface properties; (2) uncovering the thermodynamic and kinetic mechanisms of crystal nucleation and growth at liquid/liquid and liquid/gas interfaces; (3) understanding the role of large biomolecules in the modification of crystal growth and nucleation kinetics. This knowledge will enable the design of novel sustainable, biocompatible and stimuli responsive multiphase formulations (e.g., emulsions, foams) for the encapsulation and controlled release of active ingredients. Developing formulations with enhanced dissolution rate and bioavailability is critical for many industrial sectors: about 40% of the active pharmaceutical ingredients on the market and 60% of the ones in development are poorly soluble or scarcely bioavailable. Agrochemicals and food nutraceuticals present similar problems. Currently, synthetic excipients, surfactants and specialty polymers are used to create formulations with enhanced properties. However, these compounds are derived from non-renewable resources through some of the most greenhouse gas-intensive manufacturing processes. The production and incineration of polymeric materials will produce, in 2019, more than 850 million metric tons of greenhouse gases. Furthermore, the chemical synthesis of many polymers involves highly toxic, flammable and polluting reagents such as ethylene oxide, responsible for the 2004 explosion at Sterigenics International in California. It is clearly necessary to move away from polymer-based formulations and find more sustainable and safer alternatives. CryForm proposes a unique approach whereby synthetic additives will be replaced with natural crystals specifically engineered to enable controlled release of active ingredients via a unique mechanism based on stimuli-triggered solid form transformations.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
949807	**ELECTRODE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Jan Torgersen**
Host Institution:	Technische Universitaet Muenchen - DEU

Exploring the Limits of Mass Transport in Electro-Chemical Energy Converters ThRough uncOnstrained Design and Interface Engineering

A promising option to store and transport clean energy are electrochemical fuels that can be converted to electricity on demand. Fuel cells, electrolysers and flow batteries are used for conversion to and from fuel and have advantages over batteries as storage capacity is cell size independent. Reactant and product transport set the maximum current density obtainable determined by the interplay between multiphase and opposing vapor and liquid flow. To understand this limit, a better way of controlling transport of reactant and products within electrodes is necessary. In particular, we need to (1) tune convection for distributing reactant concentration, (2) tailor the interplay between Knudsen and bulk diffusion, (3) tailor capillary forces to remove liquid products and (4) ensure fast reaction kinetics through reducing the reaction energy barrier. Electrode design is hence key, yet current architectures provide limited control over feature sizes, length scales and geometrical complexity, making the study of transport mechanisms tedious and controlled experiments difficult. We propose a radically new way of studying mass transport in electrodes via the direct conversion of multiscale computer designs into physical glassy carbon electrodes with desired surface functionality. We propose to (i) develop a photopolymer based AM process for tailored glassy carbon architectures with features ranging over multiple length scales, (ii) study the interplay between convective flow and diffusion throughout the electrode architecture, (ii) geometrically separate reactant and product transport, (iii) study and improve liquid product management and (iv) create catalytically active nitrogen doped carbon architectures potentially omitting the need for noble metal catalysts. ELECTRODE will improve our understanding of mass transport and arrive at a new toolbox for designing electrode architectures that may generate knowledge for next generation energy conversion and storage.

Link to the ERC project webpage: https://www.mae.ed.tum.de/en/lww/research/current-projects/electrode/

Keywords of the ERC project: fuel cells, electrochemistry, photopolymers, carbon, graphite, mass transport

Keywords that characterize the scientific profile of the potential visiting researcher/s: electrochemistry, materials science, catalysis, characterization, fuel cell

Project ID:	Project Acronym:	Evaluation Panel:
950038	**Bi3BoostFlowBat**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Pekka Peljo**
Host Institution:	Turun Yliopisto - FIN

Bioinspired, biphasic and bipolar flow batteries with boosters for sustainable large-scale energy storage

To satisfy our growing energy demand while reducing reliance on fossil fuels, a switch to renewable energy sources is vital. The intermittent nature of the latter means innovations in energy storage technology is a key grand challenge. Cost and sustainability issues currently limit the widespread use of electrochemical energy storage technologies, such as lithium ion and redox flow batteries. As the scale for energy storage is simply enormous, the only option is to look for abundant materials. However, compounds that fulfil the extensive requirements entailed at low cost has yet to be reported. While it is possible that the holy grail of energy storage will be found, for example by advanced computational tools and machine learning to design “perfect” abundant molecules, a more flexible, innovative solution to sustainable and cost-effective large-scale energy storage is required. Bi3BoostFlowBat will develop game changing strategies to widen the choice of compounds utilizable for batteries to simultaneously satisfy the requirements for low cost, optimal redox potentials, high solubility and stability in all conditions. The aim of this project is to develop cost-efficient batteries by using solid boosters and by eliminating cross over. Two approaches will be pursued for cross-over elimination 1) bio-inspired polymer batteries, where cross-over of solubilized polymers is prevented by size-exclusion membranes and 2) biphasic emulsion flow batteries, where redox species are transferred to oil phase droplets upon charge. Third research direction focuses on systems to maintain a pH gradient, to allow operation of differential pH systems to improve the cell voltages. Limits of different approaches will be explored by taking an electrochemical engineering approach to model the performance of different systems and by validating the models experimentally. This work will chart the route towards the future third generation battery technologies for the large-scale energy storage.

Link to the ERC project webpage: https://www.utu.fi/en/university/faculty-of-technology/mechanical-and-materials-engineering/research/battery-materials-and-technologies

Keywords of the ERC project: flow batteries, eletrochemistry, organic synthesis, electrochemical engineering

Keywords that characterize the scientific profile of the potential visiting researcher/s: solid redox active materials, organic synthesis, electrochemical engineering, biphasic systems

Project ID:	Project Acronym:	Evaluation Panel:
101001024	**MicroDisco**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Simon Kuhn**
Host Institution:	Katholieke Universiteit Leuven - BEL

Electro- and photochemical microreactors intensified by acoustics

Small-scale flow reactors for electro- and photochemistry support the shift in chemical manufacture towards green and sustainable processes based on renewable energy sources. However, the industrial application of these small-scale flow reactors is significantly limited by their currently achieved throughput and productivity.
The MICRODISCO project aims to overcome these productivity limitations by exploiting the synergistic effect of ultrasound on intensified electro- and photochemical reactors. Specifically, we will gain a fundamental understanding of the underlying ultrasound physics and their interplay with reactor geometry, material and fluid properties, based on beyond state-of-the-art modeling and experiments (Objective 1). Subsequently, we will exploit this fundamental understanding to controllably excite ultrasound resonance modes to overcome species and electron/photon transport limitations in rationally designed intensified reactors. We will eliminate the diffusion limitation of electrochemical reactors for high-throughput self-supported organic synthesis by inducing active mixing via ultrasound resonance (Objective 2). Furthermore, we will increase light utilization and mass transfer in two-phase photochemical reactors by inducing the gas-liquid atomization phenomenon (i.e. to nebulize liquid droplets from the liquid slug into the illuminated gas bubble) via ultrasound resonance (Objective 3).
The MICRODISCO project will provide fundamental understanding of ultrasound resonance modes and a theoretical tool for their prediction, leading to innovative and intensified electro- and photochemical reactors promoting green and sustainable chemistry.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101001499	**DANDIDRONE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Ignazio Maria Viola**
Host Institution:	The University Of Edinburgh - GBR

A dandelion-inspired drone for swarm sensing

In the next decade, distributed sensor network systems made of small flying sensors, from dust-scale to insect-scale, will enable a step change in monitoring natural disasters and remote areas. They will contribute to protecting the environment by providing data on the contamination of physical and biological systems and on the impact of human activities. To date, a key limitation of this technology is that small sensors can remain airborne only for a few tens of minutes.

By contrast, some natural flyers such as the dandelion fruit, travel unpowered for days and hundreds of kilometres. Recent work led by Viola and published in Nature1, reveals that the dandelion adopts a highly porous wing to forms a new fluid vortex that has never been observed before, and to increase its aerodynamic efficiency by an order of magnitude. Furthermore, the dandelion's unique shape enables to exploit horizontal wind gusts to re-gain altitude and remain airborne for days. This latter mechanism has never been studied, nor artificially replicated, and could lead to a ground-breaking discovery on how to sustain the unpowered flight of small manmade flyers.

Fundamental bio-inspired fluid mechanics research will be undertaken with high-fidelity computational fluid dynamics (work packages WP1-2) and will inform the design of a dandelion-inspired drone, the DANDIDRONE. This will be the first unpowered insect-scale flyer capable to sustain hover in wind gusts.

A steering system to control the swarm dispersal in the atmosphere will be developed in WP3; a prototype will be manufactured in WP4 and it will be demonstrated with wind tunnel tests in WP5. A first-of-its-kind wind tunnel for low Reynolds number gust encounter research will be developed. Finally, the impact of this project will be maximised in WP6 by engaging with key stakeholders and by paving the way to the development of a new class of distributed sensor network systems with unprecedented endurance.

Link to the ERC project webpage: www.voilab.eng.ed.ac.uk

Keywords of the ERC project: aerodynamics, fluid mechanics, insect flight, plant seed dispersal, free-falling bodies, bodies settling due to gravity, robotics, drones, swarm sensing, environmental monitoring

Keywords that characterize the scientific profile of the potential visiting researcher/s: plant biology, locomotion, insect flight, fluid mechanics, turbulence, robotics, drones, sensing

Project ID:	Project Acronym:	Evaluation Panel:
101001567	**MA.D.AM**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Benjamin Klusemann**
Host Institution:	Helmholtz-Zentrum Hereon Gmbh - DEU

Modelling Assisted Solid State Materials Development and Additive Manufacturing

The MA.D.AM project addresses the strong need of wire-based additive manufacturing (AM) for customized value-added metallic materials that are not established yet. The project aims at establishing novel scientific knowledge for the fabrication of novel wire materials and AM parts with hitherto not reached properties, based on the application of high-strength Al-Cu-Li alloys, as cutting-edge candidates for AM in aerospace applications. For this purpose, innovative solid-state materials development and AM processes are utilized to obtain alloys beyond the known thermodynamic borders. The solid-state Friction Extrusion process allows generating phases under non-equilibrium conditions, leading to so far unexplored microstructural states, enabling to produce novel high-performance wire material with tailored properties. To avoid microstructural deterioration and preserve or even improve the beneficial properties of the designed wires, the Solid State Layer Deposition process is employed. The overarching objective of MA.D.AM is to establish the real-world process chain paired with numerical approaches, leading to a digital twin to achieve a hitherto unavailable decryption of the composition-process-microstructure-property relationships for solid-state materials development and AM. To achieve this objective, a systematic multidisciplinary approach based on the combination of sophisticated physical modelling concepts, advanced experimental approaches including characterization techniques and machine learning is pursued. The selected modelling approaches along computational thermodynamics, microstructure and process modelling, together with special-designed (in situ) experiments will establish a clear link between process characteristics and evolution mechanisms such as phase formation and recrystallization kinetics. The digital twin will be built via a novel hybrid modelling strategy based on experimental and numerical data developed on the concepts of machine learning.

Link to the ERC project webpage: https://www.hereon.de/institutes/materials_mechanics/solid_state_materials_processing/madam/index.php.en

Keywords of the ERC project: solid-state processes; friction extrusion; friction surfacing; additive manufacturing; computational mechanics; modeling and experiment; machine learning

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101002561	**BIOMITRAL**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Antonio D'Amore**
Host Institution:	Fondazione Ri.Med - ITA

Engineering the mitral valve: bioinspired control of structure and function for enhanced in vivo performance

Tissue Engineered Heart Valves (TEHVs) can restore function in the pulmonary and aortic positions and have shown capacity for tissue regeneration and growth in pre-clinical models. Yet, this concept has not been extended to the Mitral Valve (MV), whose pathologies affect >25% of the valve disease patients in Europe. In this proposal, we introduce a bio-inspired design methodology and bioprocessing technology to engineer BIOMITRAL: a polymeric, stent-less, tissue engineered MV that recapitulates native structure-function. Key to our approach is the engineering of MV leaflets and chordal apparatus. In the native MV, this set of tendon-like appendages mechanically connects the leaflets to the left ventricle (LV) and allows for harmonization of the valve kinematics, coaptation and ventricle contractile dynamics. Commercial MV prostheses used for MV replacement, as well as most existing TEHVs are mounted on synthetic stents that lack of this important structure and consequently neglect this physiological mechanism. In addition, non-degradable stents cannot adapt to patient's growth, de-facto negating a key advantage in TEHVs. Our specific hypothesis is that recapitulating native leaflet structure-function and incorporating engineered chordal apparatus will lead to an engineered MV with enhanced functional and remodeling performances. To verify our hypothesis, we will: Aim 1. Characterize the structure-function of freshly isolated human valve tissue and use the derived properties to fabricate stented (control) and stentless BIOMITRAL prototypes; Aim 2. Assess prototypes mechanics and kinematics in silico via finite element modeling and in vitro in a pulse duplicator; Aim 3. Evaluate BIOMITRAL in vivo functional performance and assess remodeling in a chronic ovine model. Engineering a “living” MV with bioinspired leaflets and chordae that connect engineered leaflets with the LV is a revolutionary concept that can fundamentally transform the design of MV prostheses.

Link to the ERC project webpage:

Keywords of the ERC project: tissue engineered heart valve; bioprocessing; mitral valve disease; valve prosthesis

Keywords that characterize the scientific profile of the potential visiting researcher/s: tissue engineered heart valve; bioprocessing; mitral valve disease; valve prosthesis

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Project ID:	Project Acronym:	Evaluation Panel:
101002582	**MAGNETO**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Alexandra Teleki**
Host Institution:	Uppsala Universitet - SWE

Nanoengineered magnetoresponsive diagnosis and personalized treatment of pediatric inflammatory bowel disease

Inflammatory bowel disease (IBD) is an incurable, inflammatory condition of the gastrointestinal tract (GIT) that affects millions of patients worldwide and places an enormous economic burden on society. Most alarmingly, children account for one quarter of all IBD cases with steadily increasing incidence. Current clinical practices for IBD diagnosis and therapy are demanding and ineffective in terms of treatment outcome, patient compliance and cost and by far not optimized for children. Our aim is to establish a theranostic platform for diagnosis and personalized treatment of pediatric IBD by an interdisciplinary approach bridging discovery of disease biomarkers, nanomaterial and drug delivery system engineering to manufacture of personalized dosage forms.
We will capitalize on scalable and reproducible flame engineering to tailor the properties of superparamagnetic iron oxide nanoparticles (SPION) and achieve functionalities beyond their current use in the clinic. This multifunctional material will serve as contrast agent in magnetic resonance imaging, tracer particle in magnetic particle imaging and for hyperthermia-triggered drug release. Ligands for disease biomarkers identified by global protein quantification will ensure targeted delivery of the theranostic SPION. We will push the frontiers of magnetic bioimaging for non-invasive and accurate diagnosis of IBD to guide stimuli-responsive drug delivery. To optimize the treatment of sick children, we will design personalized oral dosage forms incorporating our targeted drug carriers by additive manufacturing. The nanoengineering approach along with industrially relevant microencapsulation and 3D printing technologies will provide fundamental insight into physicochemical properties that govern the targeted use of nanomaterials in the challenging GIT environment. The outcome of this research will support personalized therapy of pediatric IBD, improving patient quality of life and reduce the healthcare burden.

Link to the ERC project webpage:

Keywords of the ERC project: drug delivery, nanomedicine, iron oxide nanoparticles, aerosol synthesis, inflammatory bowel disease, magnetic resonance imaging, biosensors

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101002649	**Mod-L-T**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Stephen Dooley**
Host Institution:	The Provost, Fellows, Foundation Scholars & The Other Members Of Board Of The College Of The Holy & Undivided Trinity Of Queen Elizabeth Near Dublin - IRL

Models for Lignocellulose Thermochemical Conversion

Chemicals, fuels and energy must be produced from lignocellulosic plant-matter if global economies are to decarbonise. To be successful, these lignocellulose-derived products must compete in technical quality and price with fossil derived products. Thus, we must understand what lignocellulose is, and how its chemical structures react in thermochemical processing technologies, such as pyrolysis. Pyrolysis is a promising method to produce valuable products from lignocellulose and the basic fundamental process of more complex thermochemical technologies, such as catalysis. Mod-L-T deciphers the elementary reaction mechanism and kinetics of lignocellulose pyrolysis. Relative to cellulose, the reaction kinetics of hemicellulose and lignin are less studied, and thus the focus of Mod-L-T.

Mod-L-T creates the first detailed, elementary, mass- and energy-conserved chemical reaction model for lignocellulose pyrolysis.

A compositional characterisation and modelling procedure utilising Nuclear Magnetic Resonance spectroscopy identifies what molecular structures comprise, and best represent actual lignocelluloses. The mechanism and kinetics of the pyrolysis reaction of the identified hemicellulose and lignin functionalities are then rigorously and systematically determined by the study of model molecules of incrementally increasing structural complexity, up to actual hemicellulose and lignin structures. Experimental and theoretical means are coordinated; A Thin Film Reactor obtains kinetically limited isothermal reaction rate and time-resolved evolved species information. Potential Energy Surfaces are determined by the M06-2X/6-311++G(d, p) methodology. This new fundamental knowledge is assimilated by the construction of detailed reaction kinetic models for hemicellulose, lignin and lignocellulose pyrolysis. The knowledge is disseminated for application in optimized and reduced models, envisaging their coupling to process and fluid dynamic engineering modelling tools.

Link to the ERC project webpage:

Keywords of the ERC project: biomass, energy, fuels, catalysis, reaction kinetics, machine learning, density functional theory

Keywords that characterize the scientific profile of the potential visiting researcher/s: biomass, energy, fuels, reaction kinetics, machine learning, density functional theory, mass spectrometry, reacting flow, catalysis

Project ID:	Project Acronym:	Evaluation Panel:
101018587	**ICoMICS**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Jose Manuel Garcia-Aznar**
Host Institution:	Universidad De Zaragoza - ESP

Individual and Collective Migration of the Immune Cellular System

The immune system consists of a collection of cells with a high ability to migrate that work together to remove harmful foreign material from the body. Each immune cell can migrate between tissues, fulfilling specific functions in different microenvironments. However, this immune-surveillance response is not very effective in those tissues with a high non-physiological stiffness and a significant level of residual stresses, which are characteristics of solid tumors. Understanding the mechanisms that govern the cellular immune response to solid tumors is crucial to strengthen the development of novel immunotherapies. ICoMICS aims to develop a novel predictive modeling platform to investigate how therapeutic immune cells (TICs) sense, migrate and interact with cancerous cells and with the tumor microenvironment (TME). This platform will be built on two key pillars: in-vitro 3D tumor organoids and multicellular simulations, which will be combined and integrated by means of Bayesian optimization and machine learning techniques. On the one hand, cell culture microfluidic chips will be microfabricated, allowing continuous perfusion of chemical modulators through hydrogels (including decellularized matrices from murine stroma) inhabited by human tumor cells arranged to recreate 3D solid tumor organoids. On the other hand, an agent-based model will be developed to simulate cells as deformable objects, including cell-cell and cell-matrix interactions, combined with a continuum approach to model matrix mechanics and chemical reactions of cells, such as reactive oxygen species (ROS) and nutrients diffusion. Finally, ICoMICS will originally develop two innovative mechanistic-based immunotherapies. First, TICs will be subjected to high strains in micro-channels to induce them higher migration capacity. Second, TICs will be clustered as bio-bots, to ensure that they have improved functionality. All this research will be applied to 3 main solid tumors: lung, liver and pancreas.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101019937	**HYPOTHESis**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Christian Oliver Paschereit**
Host Institution:	Technische Universitat Berlin - DEU

HYdrogen combustion: Pressure effects On combustion and THErmoacousticS

The need to shift to carbon-free energy generation is impelling, but renewable energy sources such as wind and solar are intermittent. Significant storage and additional energy sources are needed to guarantee continuous supply of heat and power. To limit global warming, these sources need to be carbon-free/neutral. Hydrogen represents a promising alternative in future energy generation. It can be produced using renewable sources by electrolysis from excess energy or by gasification, stored, and then converted in highly efficient gas turbines delivering electrical energy and heat in peak demand periods. But it does not come without challenges. Hydrogen has unique combustion properties that differentiate it from traditional natural gases. They dramatically affect flame dynamics and combustion stability, particularly at the high-pressure conditions at which gas turbines operate. HYPOTHESis supports the paradigm shift to a carbon-free society by developing greater fundamental and applied understanding on combustion dynamics and control of pure and highly-enriched hydrogen flames and enabling future gas turbines to be operated at up to 100% hydrogen content. We will perform an extensive experimental campaign using our medium-pressure combustor to enable single stage hydrogen combustion at high pressure. Using both physics and machine learning based methods, novel models will be developed for predicting and controlling the dynamical behaviour of hydrogen flames. This will lead to (1) the understanding of the dynamics of hydrogen combustion, with a focus on the scaling of its properties at high pressure, for which little is yet known; (2) the establishment of new design strategies, thermoacoustic prediction methods and control tools that are of paramount importance for practical applications enabling industry to use hydrogen as a safe and clean future fuel. Ultimately, the proposed research will help in significantly accelerating the shift towards a carbon-free society.

Link to the ERC project webpage:

Keywords of the ERC project: Hydrogen combustion, thermoacoustics, pressure influence, machine learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: Expert in one of the following topics: combustion, hydrogen combustion, hydrogen generation, thermoacoustics, flow and combustion control, machine learning, experimental techniques, CFD

Project ID:	Project Acronym:	Evaluation Panel:
101021024	**FLUIZYME**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr John Woodley**
Host Institution:	Danmarks Tekniske Universitet - DNK

Understanding the Effect of Non-natural Fluid Environments on Enzyme Stability

Enzymes are the protein-based catalysts found throughout nature and are of immense scientific importance, and of great practical value in medicine, chemistry and biotechnology. In most practical applications (such as industrial biocatalysis), enzymes are exposed to non-natural conditions, resulting in a loss of stability. Our understanding of what leads to a loss in enzyme stability under these conditions is very poor and therefore the aim of this project is to obtain such understanding. Current studies on enzyme stability mostly measure thermodynamic stability, and in some more limited cases operational stability, after exposure to different conditions (such as different temperatures and pH values). However, they overlook the effect of mixing, exposure to high concentrations of reactant and product as well as to dynamic fluid-fluid interfaces, all of which are common in a most practical applications. This project aims to understand the effect on enzyme stability of exposure to such non-natural conditions, using designed experiments in novel apparatus (mimicking industrial conditions), complemented by a suite of analytical characterization tools. The result of such studies will firstly enable the re-design of suitable equipment for industrial biocatalysis, which is of increasing interest as an alternative catalytic method for the synthesis and production of a vast array of valuable products. Secondly, the knowledge gained will be of great importance for protein engineering, providing the basis for pre-screening of enzymes on the basis of stability. Finally, the results will also have implications for other areas of bioprocessing, including microbial fermentation for the extracellular to produce enzymes and cell culture to produce therapeutic proteins.

Link to the ERC project webpage:

Keywords of the ERC project: Enzyme stability; Gas-liquid interface; Biocatalysis scale-up

Keywords that characterize the scientific profile of the potential visiting researcher/s: Protein science; Interfacial science

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Project ID:	Project Acronym:	Evaluation Panel:
101039198	**SURFACE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Antonio Papangelo**
Host Institution:	Politecnico Di Bari - ITA

Towards Future Interfaces With Tuneable Adhesion By Dynamic Excitation

Macroscopic adhesion is of utmost importance in key technologies such as soft and climbing robots, aerospace grasping technologies, human-robot interactions, pick-and-place manipulators. Commonly, bioinspired adhesives interfaces have been characterized from a quasi-static perspective, neglecting the effect of dynamic excitations. Nevertheless, recent observations suggest that added micro-vibrations may be exploited to strongly enhance and rapidly tune macroscopic adhesion. By exploiting the multiplicative coupling between geometric- and viscoelastic vibration-induced enhancements of macroscopic adhesion, SURFACE aims at designing future soft interfaces with unprecedented and tuneable adhesion strength. To this end, I aim to: (i) develop highly efficient numerical tools for studying adhesion of patterned soft surfaces under micro-vibration excitation, (ii) unveil the coupling effect between topography and viscoelasticity that determine the interfacial strength and toughness (iii) design optimal surface topography and excitation for macroscopic adhesion tuning, by exploiting artificial intelligence models to unveil new mechanisms for adhesion enhancement, (iv) prove the adhesive performance reached, by experimentally testing high-resolution 3D printed interfaces with the desired topography and superposed micro-vibrations. So far, the adhesive performance of bioinspired patterned interfaces has been limited by manufacturing capabilities at the micro/nanoscale. SURFACE ground-breaking approach aims at exploiting dynamics excitation to outperform state-of-the-art adhesive interfaces. By exploiting artificial intelligence models, SURFACE aims at revealing new mechanisms for adhesion enhancement, which lay beyond our intuition. Rapidly tuneable strong adhesive interfaces have the potential to revolutionize cutting-edge technologies based on soft adhesive interfaces that require to move and place objects quickly and with accuracy.

Link to the ERC project webpage: https://www.dmmm.poliba.it/index.php/en/ercstarting-grant

Keywords of the ERC project: adhesion, patterned interfaces, soft material, viscoelasticity, grasping

Keywords that characterize the scientific profile of the potential visiting researcher/s: adhesion, interfaces, fracture, contact mechanics, numerical analysis, tribology, vibrations, dynamics

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Project ID:	Project Acronym:	Evaluation Panel:
101039657	**CARDIOTRIALS**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Francesco Viola**
Host Institution:	Gran Sasso Science Institute - ITA

Using CARDIac simulations to run in-silicO clinical TRIALS

Clinical trials are a key tool for advancing medical knowledge, but they consist of a long and costly process entailing the recruitment of a representative cohort of participants to properly account for the population statistical variability. Computational engineering is a promising approach to gain more insight into patients' cardiac pathologies and to test innovative medical devices before running conclusive in-vivo experiments on animals or medical trials on humans. This technological breakthrough, however, is limited by some technical and epistemic challenges: (i) the reliability of cardiovascular computational models depends on the accurate solution of the hemodynamics coupled with the deforming biologic tissues; (ii) the resulting multi-physics solver requires an immense computational power and long time-to-results; (iii) a great variability among individuals exists, thus calling for a statistical approach. For the first time I will accomplish and employ a computational platform for determining the outcome of pathologies or devices implantation by combining my GPU-accelerated multi-physics solver for the accurate solution of cardiac dynamics with an uncertainty quantification analysis to account for the individuals variability. The input parameters of the computational model will be treated as aleatory variables, whose probability distribution function will be obtained using three-dimensional datasets of cardiac configurations available to the PI's group and acquired in-vivo by the clinical members involved in the project. Simulation campaigns (rather than a single simulation) will be then run in order to sweep the uncertain input distributions and obtain the synthetic population response in the case of selected pathologies like myocardial infarction and the optimal stimulation pattern for cardiac resynchronization therapy. My approach removes the main barrier that keeps up from a systematic use of computational engineering to run in-silico clinical trials.

Link to the ERC project webpage:

Keywords of the ERC project: hemodynamics, fluid-structure-interaction, uncertainty quantification

Keywords that characterize the scientific profile of the potential visiting researcher/s: hemodynamics, fluid-structure-interaction, uncertainty quantification

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101039802	**SMADBINS**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Minshen Zhu**
Host Institution:	Technische Universitaet Chemnitz - DEU

Smart Dust Batteries Integrated with Near-Zero-Power Surveillance

The lack of an on-chip power source providing uninterrupted energy impedes the progress of smart dust in moving from lab-level demonstrations to everyday applications. Tiny generators relying on external energy sources face spatial and temporal limitations. Batteries with adequate energy are not available in an area of less than 1 mm2, and the reasons for their absence are manifold. Mainstream battery architectures require either thick or tall electrodes created by etching into the wafer, but it is very fiddly to deposit materials onto these electrodes without defects. High-capacity materials such as lithium cobalt oxide, sulfur and lithium metal are often excluded because on-chip techniques to synthesize or stabilize such materials are missing. Moreover, a low-power monitor to provide precise information about the energy storage state and battery health is essential for real applications but unexplored so far. These difficulties demand a paradigm shift in microbattery development to pursue novel approaches that offer energy-dense microbatteries integrable into microsystems. Therefore, we propose a micro-origami technology for on-chip microbatteries using aqueous zinc battery chemistry, together with embedded surveillance based on a non-volatile redox transistor with near-zero power consumption. SMADBINS is expected to bring advances in battery chemistry and materials and on-chip energy production and management, boosting research for microbattery and smart dust applications, as was recently highlighted by the PI [Nature, 2021, 589, 195]. The PI has decisively contributed to the field of aqueous microbatteries and developed the smart dust battery concept together with his team in several publications. However, a smart dust battery has not been achieved yet. Therefore, the main objective of this project is to develop the first smart dust battery embedded with a low-power monitor, which attains a footprint capacity of more than 10 mAh/cm2 within 1 mm2.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101039854	**TRACE-it**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Sophie Roman**
Host Institution:	Universite D'Orleans - FRA

Controlling particle flow driven by local concentration gradients in geological porous media

Many engineering applications foreseen the usage of small particles for groundwater remediation or for sealing damaged geological confinement barriers, however, delivering materials to a contaminated or damaged region is challenging. TRACE-it aims at controlling the flow of colloidal particles in subsurface geological environments using in situ solute concentration gradients. The phenomenon, known as diffusiophoresis, has a tremendous potential to move colloids to regions that are inaccessible by conventional transport. Diffusiophoretic transport in porous media, however, has received very little attention so far, especially in standard transport in porous media models where it remains unconsidered.

What is the magnitude and location of solute concentration gradients produced during subsurface processes? How to use these gradients to transport colloids towards target regions? The answers will be found through a combined experimental-modelling approach to: (i) measure coupled hydro-electro-chemical dynamics, (ii) characterize concentration gradients generated in situ in geological porous media, (iii) identify the influence of concentration gradients on particle transport and develop a macroscale model of transport in porous media that includes diffusiophoresis. TRACE-it integrates the usage of microfluidic experiments, observation techniques, and multi-scale computational fluid dynamics to describe the transport mechanisms at the pore-scale before upscaling to the continuum-scale.

The experimental-modelling toolset will open new ways for moving colloidal particles by sensing chemical gradients generated naturally or from human activity, leading them to their target such as oil, contaminants, or reacting minerals. During column-scale experiments, controlling colloid transport will be achieved through the characterization of solute concentration gradients and the use of specifically designed particles.

Link to the ERC project webpage: https://erc-trace-it.cnrs.fr/

Keywords of the ERC project: porous media ; microfluidics ; colloids ; geosciences

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101040379	**SCRAMBLE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Lluis Jofre**
Host Institution:	Universitat Politecnica De Catalunya - ESP

Turbulence-On-a-Chip: Supercritically Overcoming the Energy Frontier in Microfluidics

The technological opportunities enabled by understanding and controlling the microscale world have not yet been capitalized to disruptively improve energy processes, especially heat transfer and power generation. This is mainly due to the laminar flows typically encountered in microdevices resulting in low mixing and transfer rates. This is a central unsolved problem in the thermal-fluid sciences, in what some researchers refer to as lab-on-a-chip and energy - the microfluidic frontier. Therefore, the overarching goal of the SCRAMBLE project is to overcome this long-standing frontier by (i) discovering the fundamentals of inducing turbulent flow in microchips by means of utilizing high-pressure supercritical fluids, (ii) finding the critical conditions to drastically enhance and control mixing and transfer processes, and (iii) designing, fabricating and testing a disruptive first-ever series of turbulence-on-a-chip prototypes for transferring energy with a hundredfold performance improvement with respect to standard microsystems.
Achieving microconfined turbulence has deep scientific and engineering implications for disruptively advancing microfluidic-intensive applications, like for example in chemistry and biomedicine, and to open a new research avenue to develop and apply groundbreaking turbulent flow solutions to microfluidic energy conversion and power generation technologies (these consume an aggregated 70% of the European Union?s energy). In the medium- to long-term future, the technology proposed could enable (i) the efficient miniaturization of thermodynamic cycles for power generation, (ii) reconceptualization of the next-generation of computer processors based on remarkably powerful microfluidic-based cooling, and (iii) the adoption of novel microfluidic solutions in fuel cells for transportation and propulsion. These advances, together with many other potential breakthroughs, could help drive the transition toward a greener energy economy.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101040994	**REACHER**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Silvia Lasala**
Host Institution:	Universite De Lorraine - FRA

Reactive fluids for intensified thermal energy conversion

Thermal engines, refrigeration systems and heat pumps rely on thermodynamic cycles, in which an inert working fluid converts input thermal and mechanical energies into another useful energy form (work or heat) by cyclically transforming its thermal energy content. Although the selection of the working fluid is the main lever to increase their performances, whatever the fluid is, recorded efficiencies remain far below the highest achievable ones. This deficiency is strongly affecting the exploitation of waste heat and renewable thermal energies by closed power cycles, as well as representing the main cause of the slow performance improvement of heat pumps and cooling technologies. With the aim to effectively increase the performances of thermodynamic cycles, I propose to investigate a radically new thermodynamic structure, resulting from the use of equilibrated reactive working fluids instead of inert ones. Preliminary calculations have indeed shown that the simultaneous conversion of the thermal and chemical energy of reactive fluids may result in the intensification of these energy conversion processes. This project applies an original methodology that integrates thermodynamic and kinetic predictive tools to discover and characterize suitable reactive fluids, allowing for the quantification of the effects of reaction features on cycle performance and the optimization of the cycle?s configuration. The novelty of such a solution approach and comprehensiveness of the applied methodology builds the innovative character of REACHER. Probably due to the complex multi-disciplinarity of the problem or to the negligence of this possible way to convert chemical energy in thermodynamic cycles, this field has remained substantially unexplored. The successful development of REACHER will provide the former fundamental understanding on how chemical energy can be efficiently exploited in the intensification of thermodynamic cycles for power, refrigeration and heating purposes.

Link to the ERC project webpage: https://www.univ-lorraine.fr/erc-reacher (online starting from January 2023)

Keywords of the ERC project: Reactive fluids, Raman spectroscopy, fluid design and characterization, thermodynamic cycles.

Keywords that characterize the scientific profile of the potential visiting researcher/s: Molecular dynamics, Monte Carlo simulations, Thermodynamics, Quantum chemistry.

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Project ID:	Project Acronym:	Evaluation Panel:
101041342	**ACC-3D**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Branko Šavija**
Host Institution:	Technische Universiteit Delft - NLD

Auxetic Cementitious Composites by 3D Printing

Concrete is inherently brittle. This is a problem because important structures such as nuclear power plants need ductility to remain functional after earthquakes and impacts. ACC-3D aims at creating novel, ductile cementitious composites by using local reinforcement with an unusual quality, negative Poisson's ratio, known as auxetics. Currently, steel rebars or fibers are used to make concrete ductile. Such reinforcement is only active once the concrete has cracked: it prevents existing cracks from growing. Cracking might leave structures unfunctional or vulnerable to repeated events and aftershocks. Can we make reinforcement actively work with concrete already before cracking by making it auxetic? This has never been attempted before. Emerging auxetics with complex architectures fabricated by 3D printing offer excellent energy absorption capacity. However, they have low stiffness which makes them unsuitable for structural applications. I believe that using auxetics as reinforcement in cementitious composites will result in energy absorption at least 2 times higher than current approaches without impairing the stiffness. Through a preliminary study I discovered that auxetics can outperform conventional reinforcement in cementitious composites in terms of flexural strength and energy absorption. However, the mechanism of interaction between deformable auxetic reinforcement and the stiff cementitious matrix is unknown. In ACC-3D I aim to fundamentally understand and fully exploit the potential of auxetic cementitious composites by combining design, experiments, and numerical modelling. This will allow me to create innovative cementitious composites with high ductility and energy absorption capacity. The approach developed in ACC-3D will open possibilities for development of designer construction materials, allowing mechanical response of building materials to be tuned through purposefully adjusting their material architecture.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101042466	**CHORUS**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Joris Heyman**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

How does Chaos drive Transport Dynamics in Porous Media ?

Fluid flow in porous media plays a central role in a large spectrum of geological, biological and industrial systems. Recent advances have shown that microscale chemical gradients are sustained by pore-scale chaotic flow dynamics. This fundamentally challenges the current macrodispersion paradigm that assumes that porous transport processes occurs under well-mixed microscale conditions. Using novel experimental, numerical and theoretical approaches, CHORUS will explore the origin, diversity and consequences of chaotic mixing in porous and fractured media. For this, the team will develop a new generation of imaging techniques coupling laser induced fluorescence, refractive index matching and additive manufacturing of complex and realistic porous and fractured architectures (WP1 and WP2). The CHORUS team will use these insights to develop new modelling concepts for describing scalar mixing and dispersion in microscale (WP3) and multiscale (WP4) systems. Building on these experimental, numerical and theoretical breakthroughs, CHORUS will design “smart” porous flows with porous architectures that selectively optimize mixing, dispersive or reactive properties (WP5). CHORUS will thus develop a new paradigm for transport dynamics in porous and fractured media, with far-reaching applications for the understanding, modelling and control of a range of natural and industrial processes, including contaminant transport and biogeochemical reactions in the subsurface, CO2 sequestration, membrane-less flow batteries, flow chemistry, chromatography or catalysis.

Link to the ERC project webpage: https://sites.google.com/view/erc-chorus

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: Mathematics, Computational sciences, Physics, transparent 3D printing

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Project ID:	Project Acronym:	Evaluation Panel:
101042844	**FAIR-RFB**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Antoni Forner-Cuenca**
Host Institution:	Technische Universiteit Eindhoven - NLD

Engineered Porous Electrodes to Unlock Ultra-low Cost Fe-Air Redox Flow Batteries

This proposal will develop a game-changing paradigm to design, synthesize, and functionalize porous electrode materials with far-reaching consequences in electrochemical science and engineering. Focusing on the Fe-air redox flow battery (FAIR-RFB), which holds promise for low-cost, long duration energy storage, I will employ an interdisciplinary approach bridging (electro)chemical engineering, materials science, and computational design to address the following fundamental challenges:

(1) I will elucidate the role of the porous electrode microstructure. I will introduce a new methodology that couples evolutionary algorithms with microstructure-informed simulations to predict ideal electrode geometries. A versatile synthetic platform, non-solvent induced phase separation, will be leveraged to synthesize highly controlled 3D microstructures and train neural networks to accelerate the discovery of optimal geometries.

(2) I will determine to what extent surface moieties of the porous electrode influence transport phenomena, kinetics, and durability. I will employ electrografting of select molecules to functionalize porous electrodes and impart functional properties (wettability, activity, stability). I will perform nanoelectrochemical imaging to elucidate the role of electrode-coating-electrolyte phenomena.

(3) I will develop a novel electrochemical reactor architecture for high-power Fe-air RFBs. Building upon the two previous developments, I will synthesize tailored iron and air electrodes and leverage polymeric bipolar membranes to realize a high voltage and low resistance electrochemical cell. Advanced imaging techniques, i.e. energy- and wavelength-selective neutron imaging, will be employed to visualize reactive transport phenomena during operation, thus helping to address these questions.

The novel approaches developed in FAIR-RFB will enable breakthroughs in performance and durability of large-scale electrochemical energy storage systems.

Link to the ERC project webpage: https://www.fornercuencaresearch.com/

Keywords of the ERC project: electrochemical energy storage, redox flow batteries, porous electrodes

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101043288	**COCONUT**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Cyprien Soulaine**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Colloidal control of multi-phase flow in geological porous media

The COCONUT project aims at developing predictive capabilities to understand how colloids (nanometals, fine particles, bacteria, viruses, asphaltenes..) control immiscible two-phase flow in complex geological formations. Colloids (including nanoparticles) have an incredible potential to remobilize non-aqueous phases trapped by capillary forces in soils and the subsurface, and then to remediate contaminated groundwater or to enhance oil recovery. Their use in daily engineering, however, is still underexploited because the lack of knowledge regarding their transport mechanisms is an obstacle to precise control of two-phase flow. Importantly, the presence of colloidal particles flowing in the subsurface challenges the standard modeling viewpoint of flow and transport based on Darcy's law. We posit that the precise control of colloids on the motion of two-phase flow can only be achieved by developing a deep knowledge of the coupled hydro-electro-chemical processes at the pore-scale. The COCONUT project uses a combined modelling-experimental strategy focusing on the pore-scale mechanisms and on the upscaling to the continuum-scale. The project is multi-disciplinary and uses computational and experimental sciences, fluid dynamics, electrochemistry, and mathematics. The project will require the development of hydro-electro-chemical computational models at different scales of interest (WP1). We will use high-resolution simulations to interrogate emergent physico-chemical processes and characterize the surface attractive and repulsive forces at the nanoscale (WP2). Then, we will decipher the mechanisms leading to the displacement of fluids trapped in an unsaturated porous medium in the presence of colloids using pore-scale modelling and microfluidic experiments (WP3). Finally, we will demonstrate and optimize the two-phase flow colloidal control in geological systems at the column-scale (WP4).

Link to the ERC project webpage:

Keywords of the ERC project: porous media ; simulation ; microfluidics ; microtomography ; CFD ; colloids

Keywords that characterize the scientific profile of the potential visiting researcher/s: porous media ; simulation ; microfluidics ; microtomography ; CFD ; colloids

Project ID:	Project Acronym:	Evaluation Panel:
101045042	**CURE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Elie Hachem**
Host Institution:	Association Pour La Recherche Et Le Developpement Des Methodes Et Processus Industriels - Armines - FRA

Fluid-Structure Interaction and Machine Leaning for Controlling Unruptured Intracranial Aneurysms

Developing new capabilities to predict the risk of intracranial aneurysm rupture and to improve treatment outcomes in the follow-up of endovascular repair is of tremendous medical and societal interest, both to support decision-making and assessment of treatment options by medical doctors, and to improve the life quality and expectancy of patients.

The proposal aims at identifying and characterizing novel flow-deviator stent devices through a high-fidelity computational framework that combines state-of-the-art numerical methods for fluid-structure interaction modeling (to accurately describe the mechanical exchanges between the blood flow, the surrounding vessel tissue, and the flow-deviator) and deep reinforcement learning algorithms (to identify and to invent a new stent concepts enabling patient-specific treatment via accurate adjustment of the functional parameters in the implanted state). This has never been done before in this context and should thus open both new theoretical and numerical opportunities.

CURE takes the vital steps of bringing novel computational and optimization frameworks to the next level capable of studying the selected flow diverter treatment in order to reduce the risk of hemorrhage in cerebral aneurysms, of supporting the decisions of treatment options by medical doctors and finally of providing guidance in the development of new implant design. Such unique capabilities can save millions of lives worldwide, improve the life quality of patients, eliminate lifelong side-effects due to sub-optimal treatment planning and delivery; and reduce the tremendous societal and economic burden linked to poor patient outcome.

The proposed work has potential to reshape the future of intracranial aneurysm risk management. It is highly multidisciplinary, and the methods proposed and developed as a part of this research can be quickly adapted to a wide range of engineering and bio-medical applications.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101045299	**WaTurSheD**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Simen Adnoy Ellingsen**
Host Institution:	Norges Teknisk-Naturvitenskapelige Universitet Ntnu - NOR

Small Flows with Big Consequences: Wave-, Turbulence- and Shear current-Driven mixing under a water surface

The triple interactions of surface waves, turbulence, and shear currents (WTS) in the upper layer of the ocean play a key role in the Earth's climate and ecology by controlling fluxes of heat, gas, and momentum between ocean and atmosphere. Climate simulations have large systematic errors because the mixing of waters due to WTS flow is not properly modelled, yet these flows remain little investigated and poorly understood. We urgently need to learn how WTS mixing depends on flow parameters, but none of today's research approaches can produce the empirical data which is needed.

WaTurSheD presents the only practical way out of this stalemate: an extensive experimental campaign where each WTS parameter is individually controlled and systematically varied. I will make use of the new, large water channel laboratory at NTNU, the only facility where such an experimental campaign is currently possible, and combine experiments with new theory and a novel data analysis method. Through WaTurSheD the WTS-driven mixing in the upper ocean can for the first time be modelled based on direct empirical evidence.

WaTurSheD is a unique opportunity for progress, combining my group's specialised expertise on wave-current interactions through both theory and experiment, and one-of-a-kind laboratory where my team can create a faithful, fully tuneable scale model of upper ocean WTS flow. The theory framework for ocean waves and currents must be advanced in order to accommodate the new insights, a task I will attend to myself. We will develop a completely new way to analyse near-surface turbulence: By detecting the imprints they leave on the surface using a computer vision technique, the most essential turbulent structures can be selected, allowing trends in WTS data to emerge which would otherwise be obscured by fast fluctuations. All WaTurSheD's components will unite towards its final goal: a universal scaling law for WTS flows valid from centimetres to hundreds of metres.

Link to the ERC project webpage:

Keywords of the ERC project: Waves, turbulence, fluid mechanics

Keywords that characterize the scientific profile of the potential visiting researcher/s: Waves, fluid mechanics, turbulence

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Project ID:	Project Acronym:	Evaluation Panel:
101045453	**fitsCAN**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Lisa Prahl Wittberg**
Host Institution:	Kungliga Tekniska Hoegskolan - SWE

Blood flow induced thrombosis and stenosis due to cannulation – an interdisciplinary study

In extracorporeal organ support (ECOS), one or more organ functions fail and are replaced by an artificial device. Kidney failure requires hemodialysis, at least until transplantation. Temporary lung- and/or heart-failure may be treated by Extracorporeal Membrane Oxygenation (ECMO). About 1.5 Million patients require hemodialysis worldwide. ECMO has an essential life-saving role during the ongoing COVID-19 pandemic, as during the Influenzae H1N1 pandemic in 2009. In ECOS, two or more accesses are used; one for blood drainage and another to return oxygenated blood. The flow rate in the cannula and the cannulated blood vessels is often significantly higher than physiologically experienced. The high flow velocity implies larger forces (stress) acting on the blood cells and the vessel walls. Thromboembolism and morphological and mechanical changes in the affected blood vessel are common complications in ECOS. This project focus on the impact of blood flow on these complications. Patient-specific data (CT, MRI and Ultrasound based) will be used to construct laboratory and simulation relevant frameworks. Set-ups for measurement of flow and mixing in-vitro will be used. Simulations will include modeling of transport of chemical species and blood cells along with modeling of platelet activation and risk for thrombus formation. The different tools will enable a considerably better understanding of the underlying pathological processes. The results will support further model development of these processes and facilitate improved cannulation techniques and new devices. These propositions are to be assessed by our clinical partners. Therefore, the project group includes, fluid mechanical expertise, and also clinical specialist in nephrology, intensive care/ECMO, and radiology. The outcome of research will enable device development and clinical decision-making reducing overall treatment complications.

Link to the ERC project webpage:

Keywords of the ERC project: blood flow, extrcorporeal organ support, cannulae, cfd, experimental studies

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101045646	**Partres**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Hans Bihs**
Host Institution:	Norges Teknisk-Naturvitenskapelige Universitet Ntnu - NOR

Particle Resolving Fluid-Sediment Interaction

Climate change leads to increased frequency and magnitude of flash flood events in rivers and of storm surges in coastal areas. Flash floods are associated with larger discharges and water levels, whereas storm surges are characterized by higher wave heights and water levels. These events have significant consequences for both rivers and coastlines triggering a morphodynamic response. Resulting erosion and soil mechanical failures can result in severe damage to civil infrastructure and buildings. There is a knowledge gap that connects the hydraulic, hydrodynamic and geotechnical aspects of environmental loading due to current, wave action as well as sediment and soil response respectively. With the increased likelihood of extreme weather events, there is an urgent need to study coastal morphology and mitigation approaches from a multi-disciplinary physics-based perspective.

Representing the interconnected processes of current, waves, sediment transport and soil deformation constitutes an interdisciplinary challenge. In the current project, particle based sediment transport models are created that take a significant step towards a realistic representation of these processes. The missing link between the individual modules will be developed, bridging the confinements of the disciplines of hydraulic, coastal and geotechnical engineering with heavy use of advanced computational fluid and solid mechanics. The multi-scale nature of extreme hydrodynamic events and their interaction with sediment and soil particle physics will be solved through a holistic multi-scale numerical framework. The proposed research lays the foundation for taking a significant step in sediment transport research that is required for dealing with current and future challenges arising from climate change. Innovative solutions to extreme weather event impact in the coastal, estuarine and riverine environments can be rapidly proposed and verified using the current numerical modeling strategy

Link to the ERC project webpage:

Keywords of the ERC project: sediment transport, particle transport, discrete sediment modeling, discrete soil modeling, wave hydrodynamics

Keywords that characterize the scientific profile of the potential visiting researcher/s: numerical modeling, sediment transport, wave hydrodynamics, soil modeling

Project ID:	Project Acronym:	Evaluation Panel:
101052376	**ABSOLUTE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Eoin Casey**
Host Institution:	University College Dublin, National University Of Ireland, Dublin - IRL

Analysis of Biofilm Solid Interactions Underpinning Wastewater Treatment

Wastewater treatment (WWT) processes that use biofilms as their biocatalyst have been in use for over 100 years. Over the past few decades, a greater understanding has emerged on how biofilms can be exploited for enhanced nutrient removal and this knowledge has been translated into new technologies representing about one-third of all WWT processes in a multibillion-euro global wastewater technology market.

Despite the success of these technologies, there is significant need for enhanced efficiencies in these processes and the development of new technologies that are more energy efficient and are capable of better resource recovery from wastewater are needed. To achieve this, there is need for new mechanistic insight, in particular the interaction between biofilms and particulate organic matter in the influent wastewater. The knowledge-gap spans three key areas: (i) non-oxidative interactions, (ii) hydrolysis and (iii) bioflocculation. This research project will develop an enhanced multispecies biofilm model that better incorporates new understating of these areas. We will go significantly beyond current state of the art by first building an experimental platform that exploits recent developments in advanced imaging, nanosensors & particle-tracking to probe the fundamentals of these mechanisms. To achieve this, the platform will be uniquely based on fluorescently tagged monospecies biofilms, rather than on conventional multispecies biofilm in a first phase of the project. This work will then inform the development of new mathematical model relationships, which will be implemented in an extended multispecies model and validated against data from a pilot plant operating with conditions representative of a real WWT plant.

The transformative approach in this project will lead to a more fundamental insight into the mechanisms underpinning particle-biofilm interactions and pave the way to new application of biofilms for advanced wastewater treatment.

Link to the ERC project webpage:

Keywords of the ERC project: biofilm, wastewater

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101053122	**BEACONSANDEGG**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Manuela Teresa Raimondi**
Host Institution:	Politecnico Di Milano - ITA

Mechanobiology of cancer progression

Invasive cancers are a leading cause of death worldwide, with almost ten million deaths per year caused by resistance to antitumor treatments. In breast cancer, aggressiveness correlates with fibrotic stiffening of the tumour. There is an urgent need to understand how the fibrotic microenvironment evolves, to design better targeted cancer therapies. Fibrotic stiffening is caused by fibroblasts secretion of a matrix with mechanical properties that stabilise the tumour vascular network. However, the hierarchy and stability of the tumour vascular network are not reproducible in vitro. To advance the field, I will develop a revolutionary platform able to recapitulate tumour fibrosis by exploiting the vascularisation of a living organism.

To achieve my goal, I will use human breast cancer cells adhering to 3D polymeric micro scaffolds to create arrays of tumour micro environments. I will implant the arrays in vivo in the chorioallantoic membrane of an embryonated avian egg, to elicit a foreign-body fibrotic reaction. I will vary the micro scaffolds geometry to condition tumour infiltration by the host's vessels and cells. I will exploit fluorescent spatial beacons incorporated in the micro scaffolds for multiphoton image correlation, to derive morphological and functional information of the regenerated fibrous matrix and vessels. I will predict mass transport of solutes and anticancer agents by computational modelling. To validate the platform, I will quantify in vivo the dose-dependent efficacy and cancer specificity of therapeutic agents whose success is known to depend on the fibrotic stage of tumours.

This project combines mechanobiology to bioengineering, biomechanics, oncology, genetics, microtechnology, intravital imaging, biophysics and pharmacology to understand the progression mechanisms of the most incurable cancers. It will also provide an ethical and standardizable testing platform to boost the clinical translation of new therapeutic products in oncology.

Link to the ERC project webpage: http://www.nichoid.polimi.it/beaconsandegg/

Keywords of the ERC project: bioengineering, biomedical engineering, mechanobiology, drug discovery, two-photon imaging, biomechanics, cancer

Keywords that characterize the scientific profile of the potential visiting researcher/s: computational mechanic, computational fluid-dynamic, pharmacologist, cancer biologist, biophysicist, computer scientist

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Project ID:	Project Acronym:	Evaluation Panel:
772086	**ASSESS**	**PE9** Universe Sciences

Principal Investigator:	**Dr Alceste Bonanos**
Host Institution:	Ethniko Asteroskopeio Athinon - GRC

Episodic Mass Loss in the Most Massive Stars: Key to Understanding the Explosive Early Universe

Massive stars dominate their surroundings during their short lifetimes, while their explosive deaths impact the chemical evolution and spatial cohesion of their hosts. After birth, their evolution is largely dictated by their ability to remove layers of hydrogen from their envelopes. Multiple lines of evidence are pointing to violent, episodic mass-loss events being responsible for removing a large part of the massive stellar envelope, especially in low-metallicity galaxies. Episodic mass loss, however, is not understood theoretically, neither accounted for in state-of-the-art models of stellar evolution, which has far-reaching consequences for many areas of astronomy. We aim to determine whether episodic mass loss is a dominant process in the evolution of the most massive stars by conducting the first extensive, multi-wavelength survey of evolved massive stars in the nearby Universe. The project hinges on the fact that mass-losing stars form dust and are bright in the mid-infrared. We plan to (i) derive physical parameters of a large sample of dusty, evolved targets and estimate the amount of ejected mass, (ii) constrain evolutionary models, (iii) quantify the duration and frequency of episodic mass loss as a function of metallicity. The approach involves applying machine-learning algorithms to existing multi-band and time-series photometry of luminous sources in ~25 nearby galaxies. Dusty, luminous evolved massive stars will thus be automatically classified and follow-up spectroscopy will be obtained for selected targets. Atmospheric and SED modeling will yield parameters and estimates of time-dependent mass loss for ~1000 luminous stars. The emerging trend for the ubiquity of episodic mass loss, if confirmed, will be key to understanding the explosive early Universe and will have profound consequences for low-metallicity stars, reionization, and the chemical evolution of galaxies.

Link to the ERC project webpage: http://assess.astro.noa.gr/

Keywords of the ERC project: massive stars, stellar evolution, mass loss

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
788113	**EPOCHS**	**PE9** Universe Sciences

Principal Investigator:	**Dr Christopher Conselice**
Host Institution:	The University Of Manchester - GBR

The Formation of the First Galaxies and Reionization with the James Webb Space Telescope

Within the first few hundred million years after the Big-Bang the first galaxies and stars were born. Sometime soon after, these first objects produced enough energetic photons to reionization the neutral gas in the universe. This frontier of early galaxy assembly has not yet been observed, but will be uncovered by deep imaging and spectroscopy taken with the James Webb Space Telescope (JWST). Key problems include: how the very first galaxies were assembled, and evolved, in their first few Gyr, and the history of reionization. With this ERC funded EPOCHS project I will lead a major effort to investigate these questions using JWST GTO time discovering galaxies before, during, and after the epoch of reionization. This proposal has three interconnected and complementary themes: (i) Identifying the first galaxies and characterizing their UV luminosities, stellar masses, and star formation rates at 7<z<12. JWST imaging and spectroscopy will allow us to make significant progress beyond the current state of the art, and to use these measures to test models of the earliest galaxy assembly. (ii) Using these galaxies we will map the process of reionization: the sources of it, and the time-scale of its onset and duration. Using new diagnostics we will address uncertainties that currently plague this calculation, including escape fractions and the number of ionizing photons, using UV emission lines, spectral shapes, and measuring hardness ratios with radiative transfer models. (iii) We will measure the rest-frame optical structures of galaxies at 3<z<7 to reveal the formation modes of galaxies when they assembled their first masses and structures. We will determine how and when compact galaxies, mergers, dissipative formation in star forming disks, and the formation of bulges and disks are occurring. This includes measuring the formation history of internal components in 3<z<7 galaxies, allowing us to examine how quenching is occurring 'inside-out' or 'outside-in'.

Link to the ERC project webpage: https://sites.google.com/view/cconselice/home

Keywords of the ERC project: Galaxy formation, JWST, galaxy structure, machine learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: Galaxy evolution, galaxies, cosmology

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
818930	**KETJU**	**PE9** Universe Sciences

Principal Investigator:	**Dr Peter Johansson**
Host Institution:	Helsingin Yliopisto - FIN

Post-Newtonian modelling of the dynamics of supermassive black holes in galactic-scale hydrodynamical simulations (KETJU)

Supermassive black holes (SMBHs) with masses in the range ~10^6-10^10 M⊙ are found at the centres of all massive galaxies in the Local Universe. In the ΛCDM picture of structure formation galaxies grow bottom-up through mergers and gas accretion, leading to multiple SMBHs in the same stellar system. Current simulation codes are unable to resolve in a single simulation the full SMBH merging process, which involves dynamical friction, three-body interactions and finally gravitational wave (GW) emission. KETJU will provide a significant breakthrough in SMBH research by following for the first time accurately global galactic-scale dynamical and gaseous astrophysical processes, while simultaneously solving the dynamics of SMBHs, SMBH binaries and surrounding stellar systems at sub-parsec scales. Our code KETJU (the word for 'chain' in Finnish) is built on the GADGET-3 code and it includes regions around every SMBH in which the dynamics of SMBHs and stellar particles is modelled using a non-softened Post-Newtonian algorithmic chain regularisation technique. The remaining simulation particles far from the SMBHs are evolved using softened GADGET-3. Using KETJU we can study at unprecedented accuracy the dynamics of SMBHs to separations of ~10 Schwarzschild radii, the formation of cores in massive galaxies, the formation of nuclear stellar clusters and finally provide a realistic prediction for the amplitude and frequency distribution of the cosmological gravitational wave background. The UH theoretical extragalactic team is ideally suited for this project, as it has an unusually versatile background in modelling the dynamics, feedback and merging of SMBHs. KETJU is also particularly timely, as the spectacular direct detection of GWs in 2016 is paving the way for a new era in gravitational wave astronomy. Future space-borne GW observatories, such as the European Space Agency's LISA, require accurate global GW predictions in order to fully realise their science goals.

Link to the ERC project webpage: https://www.mv.helsinki.fi/home/phjohans/Site/Research.html

Keywords of the ERC project: Galaxy formation, galaxy mergers, supermassive black holes, gravitational waves.

Keywords that characterize the scientific profile of the potential visiting researcher/s: Galaxy formation, galaxy mergers, supermassive black holes, gravitational waves.

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Project ID:	Project Acronym:	Evaluation Panel:
833925	**STAREX**	**PE9** Universe Sciences

Principal Investigator:	**Dr Georges Meynet**
Host Institution:	Universite De Geneve - CHE

STARs at the EXtreme

The first stars in the Universe are extreme objects. Extreme in their composition: they are made of material having been processed only by the Big Bang nucleosynthesis, and having a content in dark matter likely very different from the one of the present-day stars. Extreme in their properties: one of the most important properties is their mass that might reach values as high as even 100 000 solar masses (supermassive black-hole seeds). Their properties may differ from the today massive star populations also by their likely fast axial spins, the processes of mass loss, their magnetic fields, multiplicity. Extreme in their physics: born in over densities made mainly by dark matter, the physics of candidate dark matter particles may have a significant effect on their evolution and produce what has been called dark or frozen stars, i.e. stars sustained by dark-matter particle annihilation. The aim of STAREX is to determine which observable features can be used to constrain the composition (baryonic and dark matter), the properties (masses, rotation, magnetic field, multiplicity) and the physics of the first stars in the Universe. These observables will be collected by present-day and future facilities as, for instance, the JWST, ELT, adLigo, VIRGO, LISA and are linked to ionising fluxes, nucleosynthesis, radiation of both stellar populations and transient events, and gravitational waves. STAREX will explore new physical processes, build and use new numerical tools, provide observables that will account together for a sophisticated description of the physics of individual stars, single or in binary systems, and for the dynamics of the stars in the first stellar clusters. STAREX is at the crossroad of topics such as stellar physics, nucleosynthesis, hydrodynamics, evolution of galaxies, and will potentially engender ground-braking consequences for observational cosmology, astrophysics and even fundamental physics (fluid dynamics, dark matter properties).

Link to the ERC project webpage: https://www.unige.ch/sciences/astro/evolution/fr/erc-starex/

Keywords of the ERC project: first stars, rotation, nucleosynthesis, reionisation, supermassive stars

Keywords that characterize the scientific profile of the potential visiting researcher/s: stellar physics, numerical modeling

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Project ID:	Project Acronym:	Evaluation Panel:
851555	**SCORE**	**PE9** Universe Sciences

Principal Investigator:	**Dr Xavier Dumusque**
Host Institution:	Universite De Geneve - CHE

Signal Correction to Reveal other Earths

Searching for life signatures on another planet is one of the key endeavours of astrophysics and today, we are in a unique position to make this possible. The TESS satellite, which just started observing, will find the first Earth-twins orbiting bright stars, which will allow follow-up studies with JWST and ELTs to characterize the atmosphere of those exoplanets. However, TESS will only measure the radius of the detected Earth-twins, which is not enough to interpret the spectroscopic features in their atmospheres. The mass is also required, and it can be obtained using the radial-velocity (RV) technique, which measures the gravitational influence of an exoplanet on its host star. To measure the mass of the Earth-twins that TESS will detect, the community have built incredible RV instruments that can reach a RV precision of 0.25 m/s (ESPRESSO commissioning). Such an extreme precision is required to measure the tiny signature of an Earth-twin, however, this is without considering the perturbing signals induced by its host star, by Earth's atmosphere and by instrumental noise. Indeed, we know that these perturbing signals mask completely the signal induced by an Earth-twin, and now that the RV instruments have the sensitivity to detect such planets, it is urgent to develop novel methods for mitigating the different perturbing signals. Understanding the different perturbing signals is extremely challenging and require incredible data. The PI have built two telescopes that feed Sun-light into the best RV instruments. The obtained data are of exceptional quality, and the goal of SCORE is to analyse them, explore novel promising methods for mitigating the different perturbing signals and find the tiny signatures of Earth and Venus. This will open the way towards the mass-measurement of Earth-twins, which is essential in the quest for finding life elsewhere, but also to understand planetary formation and dynamics. SCORE will therefore benefit the entire planet community.

Link to the ERC project webpage:

Keywords of the ERC project: observational astrophysics, exoplanet detection, radial velocity, spectroscopy, stellar activity

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
853022	**PEVAP**	**PE9** Universe Sciences

Principal Investigator:	**Dr James Owen**
Host Institution:	Imperial College Of Science, Technology And Medicine - GBR

Planet Evaporation as a Window into Exoplanetary Origins

Modern astronomy has truly entered the exoplanet era. Although our knowledge of what planet formation produces has grown immensely thanks to observational advances, our actual understanding of the physical processes that give rise to planets and planetary systems is limited. We now know most stars are unlike our own Sun, in that they host planets which orbit around their star with periods of months or shorter, yet many have volatile rich atmospheres. These planets must result from a dominant (if not the dominant) mode of planet formation, yet they were completely missing from our planet formation theories a decade ago.

Planets which are close to their parent star are extremely vulnerable to mass-loss through evaporation, where UV/X-ray photons can heat their upper atmospheres to close to the escape temperature, causing them to lose-mass. Recently, I have played a leading role in showing that evaporation drives the evolution of the observed exoplanet population. Thus, the observed exoplanet population is not representative of the one at birth; to use it as a probe of planet formation we must understand evaporation. However, the evaporation of highly-irradiated planetary atmospheres is not well understood. This especially true for terrestrial planets where the atmospheres are dominated by heavy elements.

My team will use a combination of theory, simulations and observations to build the first global and comprehensive models of exoplanet evaporation. In doing this, my team will use evaporation as a window into planet formation by answering the following key questions:

1 What are the mass-loss rates and evaporative flow structures for the full spectrum of observed planets?

2 How can we use observations of evaporating planets to learn about their compositions and histories?

3 How does evaporation affect and control the evolution of planets and their atmospheres?

By understanding how exoplanets evaporate and evolve, my team will unveil the exoplanet population at birth.

Link to the ERC project webpage:

Keywords of the ERC project: exoplanets

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
865637	**Hot Milk**	**PE9** Universe Sciences

Principal Investigator:	**Dr Gabriele Ponti**
Host Institution:	Istituto Nazionale Di Astrofisica - ITA

Flows of hot plasma connecting the Milky Way centre to the corona, halo and beyond

We are less than one year away from the beginning of a revolution in our understanding of the hot, X-ray emitting, plasma of the Milky Way.
The growth of galaxies in the local Universe critically depends on the interplay (via outflows and re-condensation) between the hot plasma with the other phases of the interstellar medium (ISM). As a prototype for typical spiral galaxies, the Milky Way offers the unique opportunity to capture the important details of such feedback all the way from sub-parsec to galactic scales.
In the 90's, the ROSAT all-sky X-ray maps confirmed the existence of a hot component of the ISM, the Galactic corona. However, because of strong obscuration in the soft X-ray energy band, those maps have a limited horizon of ~1 kpc in the Galactic plane. Therefore, despite the fundamental role of the hot ISM phase, its properties are still basically unknown outside the Solar neighbourhood.
My XMM surveys of the Galactic centre (GC) demonstrate that the hot ISM phase can be traced throughout the disc in the harder X-ray band, confirming the feasibility of this ERC project and the strong connection between GC activity and the Galactic corona. Additionally, the hot plasma is a plausible candidate for containing the missing Galactic baryons and a key ingredient for galaxy evolution. However, so far only less than 0.03% of the Milky Way has been covered by the narrow fields of view of current X-ray imaging telescopes.
The eROSITA all-sky survey will rectify this state of affairs. Should this ERC proposal be approved, we will trace the connection and feedback between the Galactic corona and halo with the energetic activity at the GC (e.g., due to cosmic rays, stellar and AGN outflows). This will represent one to two orders of magnitude improvement in sensitivity and/or coverage, compared to current surveys.
Our sensitive X-ray maps will represent an invaluable legacy for future multi-wavelength studies with current and next generation array instruments.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
865657	**QUANTUMGRAIN**	**PE9** Universe Sciences

Principal Investigator:	**Dr Albert Rimola**
Host Institution:	Universitat Autonoma De Barcelona - ESP

Quantum Chemistry on Interstellar Grains

The Universe is molecularly rich, comprising from the simplest molecule (H2), to complex organic molecules (e.g., NH2CHO) and biomolecules (e.g., amino acids). The physical phases involved in a Solar-type planetary system formation go hand-in-hand with an increase in molecular complexity, which is ultimately connected with the origin of life. Interstellar (IS) grains play a key role in this chemical evolution as they provide surfaces where key chemical reactions occur. The IS grain chemistry is not fully understood yet. Spectroscopic astronomical observations combined with astrochemical modelling and laboratory experiments have dedicated great efforts to this end but they are still severally limited at reproducing, characterizing and, ultimately, understanding truly existing IS surface reactions. The QUANTUMGRAIN project aims to overcome such limitations by adopting a fourth approach: new state-of-the-art quantum chemistry simulations. These simulations will provide unique, unprecedented information at a molecular level (structures, energetics and dynamics) of the physico-chemical processes occurring in IS surface reactions, with the final objective to fully unveil the actual chemistry on IS grains. To achieve this objective QUANTUMGRAIN is based on three pillars: i) construction of realistic atom-based structural models for IS grains to characterize their structural, energetic and spectroscopic features, ii) molecular simulation of crucial “on-grain” reactions (formation of simple molecules, complex organic molecules and biomolecules) to disentangle the most favourable mechanisms, and iii) assessment of the actual role of IS grains in each reaction (catalyst? concentrator? third body?) to know why their presence is fundamental. My ambition is to have a complete, accurate molecular description of the different elementary physico-chemical steps involved in IS surface reactions, with the ultimate goal to definitely unveil in a comprehensive way the IS grain chemistry.

Link to the ERC project webpage: https://www.quantumgrain.eu/

Keywords of the ERC project: Astrochemistry, computational chemistry, surface modeling, chemical reactivity, catalysis,

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
865931	**TRUSTPATH**	**PE9** Universe Sciences

Principal Investigator:	**Dr Shaul Shalvi**
Host Institution:	Universiteit Van Amsterdam - NLD

Responsible sharing: Paving the path for transparent trust

The collaborative economy is estimated to add €160-€572 billion to the EU economy. Faced with blurry definitions in this emerging market, regulators use a top-down approach and introduce regulations that often fail to consider users' behaviour. Although considerable knowledge on top-down regulatory solutions for the collaborative economy is accumulating, little is known about the bottom-up psychological factors driving the collaborative economy users' behaviour. Online platforms rely and promote trust between users and service providers. For responsible sharing, however, trust is necessary but not sufficient. Only when trust is encouraged transparently can users share responsibly. TRUSTPATH will assess, if: (1) users are aware of, or motivated to learn about, the side effects of trade; (2) platforms' promotion of trust increases users' information neglect; and (3) transparent environments reduce information neglect and increase responsible sharing. Building on my expertise on trust and cooperation, and using insights from psychology, management, and economics, I will develop and test a novel psychological theory of how people use the collaborative economy: Transparency Based Trust theory (TBT). TBT's novel hypothesis suggests trust encouraged without transparency leads users to neglect the negative side effects trade has on others. TRUSTPATH innovates by developing a novel methodology (the collaborative economy game) and using cutting-edge technologies (large-scale experiments). Support for TBT implies a major step forward in the systematic understanding of the collaborative economy in the social sciences, and the psychological mechanisms underlying users' behaviour on platforms like Airbnb, Uber, and others. TRUSTPATH will contribute to establish a new field of study: the psychology of the collaborative economy; inform policymakers seeking to regulate the collaborative economy; and inform companies seeking to promote responsible sharing among users.

Link to the ERC project webpage: https://www.behavioralethics.org/

Keywords of the ERC project: Cooperation, Experimental Economics, Social Psychology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
883830	**ExoMolHD**	**PE9** Universe Sciences

Principal Investigator:	**Dr Jonathan Tennyson**
Host Institution:	University College London - GBR

ExoMolHD: Precision spectroscopic data for studies of exoplanets and other hot atmospheres

It is just over two decades since the first extrasolar planet was discovered; we have learnt that such planets are ubiquitous with (nearly?) every star in our local neighbourhood supporting a planetary system. These newly-discovered planets are generally unlike those in our Solar System. Astronomers have taken the first steps in characterising exoplanetary atmospheres through spectroscopy. The advent of new space missions, such as Ariel and WFIRST, and high performance observatories from space and the ground, such JWST and ELTs, allied to new techniques, will begin to answer fundamental questions about the composition, formation and properties of exoplanets through detailed spectroscopic. A prerequisite for advances to be made is the availability of the fundamental atomic and molecular data necessary for interpreting new observations. The unusual conditions found on most known exoplanets, involving elevated temperatures and high fluxes of stellar radiation, means the required data are missing and not readily measurable in the laboratory. The ExoMolHD project will use advanced molecular quantum mechanics allied to novel empirical techniques based on available experimental data to respond to the modern challenges of exoplanetary models and retrievals by providing extensive ``higher definition'' data. ExoMolHD will (a) provide precise wavelengths for key molecules applicable for use in high resolution spectroscopic studies performed by telescopes such as the VLT and ELTs; (b) predict accurate spectroscopic data on key isotopically-substituted species; (c) provide temperature-dependent pressure shifts and pressure broadening parameters; (d) compute photodissociation cross sections and photolysis rates both in and outside thermodynamic equilibrium and (e) develop appropriate database structures, including detailed opacities, k-tables and precomputed atmospheric models. We will act to ensure the widest possible utilisation of the data.

Link to the ERC project webpage: www.exomol,com

Keywords of the ERC project: laboratory astrophysics, exoplanets, molecular spectroscopy

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
945155	**GWmining**	**PE9** Universe Sciences

Principal Investigator:	**Dr Davide Gerosa**
Host Institution:	Universita' Degli Studi Di Milano-Bicocca - ITA

Gravitational-wave data mining

Gravitational-wave astronomy is entering its large-statistics regime. Catalogs with thousands of gravitational-wave events will soon be available, providing a wealth of information on the most compact objects in the Universe --black holes and neutron stars. These new datasets need new tools to be exploited effectively in order to maximize their scientific impact.

GWmining is an ambitious program to explore upcoming gravitational-wave catalogs with data-mining techniques. We will develop a complete framework to analyze gravitational-wave data in light of astrophysical predictions. Going beyond phenomenological models, we will train machine-learning algorithms directly on large banks of population-synthesis simulations and post-Newtonian integrations. The development of these astrophysical predictions requires new modeling strategies to accurately capture all the gravitational-wave observables, notably spins and eccentricities.

Combined with a hierarchical Bayesian analysis, our neural network will deliver the most stringent measurements to date on elusive phenomena influencing the lives of massive stars. We will constrain phenomena such as binary common envelope, supernova kicks, stellar winds, tidal interactions, etc.

Besides harnessing the catalog in its entirety, our complete framework will put us at the forefront to analyze outliers --golden events with favorable properties of one or more parameters. We will design a complete strategy to exploit the strongest signals to infer exquisite details of the relativistic dynamics of their sources.

GWmining is a unique project strategically placed at the intersection of astronomy, data analysis, and relativity. As the large-statistics revolution of gravitational-wave astronomy unfolds, GWmining will pioneer the application of data-mining techniques in gravitational-wave population studies, setting the foundations of this booming field for decades.

Link to the ERC project webpage: www.davidegerosa.com

Keywords of the ERC project: Gravitational waves, black holes

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
945536	**LensEra**	**PE9** Universe Sciences

Principal Investigator:	**Dr Thomas Collett**
Host Institution:	University Of Portsmouth Higher Education Corporation - GBR

The statistical era of strong gravitational lensing cosmology

Strong gravitational lensing is on the cusp of a new era. Strong lensing occurs when the mass of a galaxy deforms space time so much that multiple images of a single background source is observed. Strong lensing is a powerful cosmological probe, but it is hamstrung by sample size: currently we only know of a few hundred systems. I am leading the work on a new telescope, the Large Synoptic Survey Telescope, which in its first year will observe more of the optical Universe than all previous telescopes combined. This revolutionary dataset will transform strong lensing into a statistical science by enabling LensEra to discover 30,000 new lenses and exploit them for cosmology.

The first objective of LensEra uses machine learning, citizen science and automated lens modelling to build a discovery engine to find 30,000 new lenses in the Large Synoptic Survey Telescope data, including 600 lenses with multiple background sources, and 300 lensed supernovae. LensEra will then confirm these using the 4MOST multi-object spectroscopic survey and the robotic Liverpool Telescope.

The second objective of LensEra develops 3 new tests of cosmology using rare subsets of the lens population: measuring the expansion of the Universe with samples of lensed supernovae; measuring the equation of state of dark energy with lenses with multiple background sources; and, testing the validity of General Relativity with lensing combined with stellar kinematics. The new sample from the first objective will allow LensEra to launch strong lensing cosmology into a new statistical age. Combining detailed analysis of ~200 golden lenses (the best LSST lensed supernovae and brightest double source plane lenses) with an automated modelling of the full sample will enable precise and accurate cosmological inference.

Link to the ERC project webpage:

Keywords of the ERC project: Strong gravitational lensing

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
947660	**H1PStars**	**PE9** Universe Sciences

Principal Investigator:	**Dr Richard Anderson**
Host Institution:	Ecole Polytechnique Federale De Lausanne - CHE

Measuring Hubble's Constant to 1% with Pulsating Stars

What's up with Hubble's constant (H0)? Recent H0 measurements have shown that the Universe is expanding faster than cosmology predicts, indicating a possible cosmological crisis. To wit, H0 measured to 1.9% precision in today's Universe using a cosmic distance ladder composed of classical Cepheids and type-Ia supernovae differs by 8.9% (4.2 sigma) from H0 predicted by cosmology based on observations of the Cosmic Microwave Background emitted 13.8 billion years ago. However, it remains unclear whether new physics must be invoked to reconcile cosmology with today's H0, or whether today's H0 is subject to as yet unknown or underestimated systematic errors. An unbiased 1% measurement of H0 is required to understand whether physics is on the brink of a major breakthrough.

So, how solid is our distance ladder? To answer this, my research seeks to a) mitigate biases that can shift the center value of reported H0 measurements, b) quantify relevant systematic uncertainties, and c) reinforce the foundation of the distance ladder through a solid astrophysical understanding of pulsating stars, in particular, classical Cepheids. These steps must be taken now to achieve an unbiased 1% H0 measurement and to ensure the legacy of today's distance ladder for future space-borne facilities and ground-based extremely large telescopes. Imminent data releases of the ESA mission Gaia and precise time series spectroscopy will provide unprecedented opportunity to calibrate the distance ladder and unravel the structure and evolution of Cepheids through their variability.

My extensive expertise in both the astrophysics of classical Cepheids and the calibration of the distance ladder uniquely qualifies me to support precision cosmology via accurate stellar physics, and vice versa, and provides the much-needed fresh perspective to either reconcile the tension in H0, or confidently establish a need to revise cosmology.

Link to the ERC project webpage: www.epfl.ch/labs/scd

Keywords of the ERC project: astronomy, astrophysics, cosmology, distance scale, Hubble constant, Cepheids, pulsating stars, stellar variability, standard candles, Gaia, photometry, spectroscopy

Keywords that characterize the scientific profile of the potential visiting researcher/s: distance scale, Hubble constant, standard candles, surveys, machine learning, computer vision

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
948582	**IMAGINE**	**PE9** Universe Sciences

Principal Investigator:	**Dr Daniele Viganò**
Host Institution:	Agencia Estatal Consejo Superior De Investigaciones Cientificas - ESP

Imprints of Magnetic fields in Exoplanets

The fast-growing sample of thousands of extrasolar planets is unveiling an amazing variety of properties. It represents an opportunity to shed light on long-standing physics and astrobiology issues from a much wider sample than our Solar neighbours, especially for what concerns the still unclear internal structure, only grossly constrained by observable values of mass and/or radii. Planetary magnetism and its long-term evolution is currently understood only partially for the Earth, at a lesser extent for Jupiter and other Solar planets, and is still elusive in exoplanets. The project focuses on magnetic fields as a key factor in shaping habitability and as a messenger of the internal composition and dynamics.

For terrestrial planets, long-lasting, strong enough magnetic fields are arguably a key factor to guarantee habitability, but we are not even sure about how the Earth's magnetic field has survived for so long. Magnetism leaves other detectable imprints in giant planets. A quest for the first exoplanetary Jupiter-like magnetospheric emission in radio is on-going, but the search needs to be driven by a reliable prediction of the most likely emitters. Magnetic fields can delay the cooling via Ohmic dissipation and could explain the often observed inflated radii in hot Jupiters, but models are still incomplete.

IMAGINE will simulate the long-term (Gyr) evolution of the exoplanetary magnetic fields, coupled with a cooling model, and will assess the relevant imprints on their observables for a broad range of distinctive features mass, composition, irradiation, rotation.

Combining a novel formulation, emission models and advanced numerical techniques partially imported and adapted from the scenario of magnetized neutron stars, on which the PI is expert, IMAGINE will predict values of magnetic fields for different exoplanets, comparing the associated observable properties of gas giants and contributing to identify the best rocky worlds candidates to habitability.

Link to the ERC project webpage: www.ice.csic.es/erc-imagine

Keywords of the ERC project: Magnetism, Exoplanets, Dynamo, Radio emission

Keywords that characterize the scientific profile of the potential visiting researcher/s: LOFAR, Merkaat, Radio emission, Dynamo, Exoplanets

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101002352	**LOVE-NEST**	**PE9** Universe Sciences

Principal Investigator:	**Dr Manuel Linares**
Host Institution:	Norges Teknisk-Naturvitenskapelige Universitet Ntnu - NOR

Looking for Super-Massive Neutron Stars

The astrophysics field of compact binary millisecond pulsars is thriving. This growing class of rapidly spinning neutron stars – also known as "spiders"– constitutes the most promising place to find massive pulsars. Super-massive neutron stars, with a mass significantly higher than two Solar masses, cannot contain exotic particles. Finding such stars would have profound implications for nuclear physics. The maximum neutron star mass has also important consequences for the fate of supernovae and the gravitational wave signal from neutron star mergers. In addition, spiders offer a unique probe of the pulsar's innermost wind and a nearby site for particle acceleration. The past years have seen exciting discoveries in this field, in which I have been closely involved. As a result, a new way has opened up to study fundamental astrophysical phenomena from compact binary millisecond pulsars.

The purpose of this project is to find the most massive neutron stars and to understand the interaction between accretion flows, pulsar winds and neutron star magnetospheres. LOVE-NEST will first uncover a hidden population of millisecond pulsars, with a targeted search of gamma-ray candidate sources. We will then measure accurately the masses of the heaviest pulsars, using a novel technique that we have recently established. We will also investigate nearby spiders as potential sources of cosmic rays and astrophysical neutrinos, placing unprecedented constraints on particle acceleration in relativistic pulsar wind shocks.

LOVE-NEST will have a strong impact on gravitational wave astronomy, nuclear physics, astrophysics and astro-particle physics. As a leader in the field, and having developed a new method to measure pulsar masses, I am in an excellent position to achieve these ambitious goals.

Link to the ERC project webpage: https://home.phys.ntnu.no/LOVE-NEST/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101002761	**BHianca**	**PE9** Universe Sciences

Principal Investigator:	**Dr Eleonora Troja**
Host Institution:	Universita Degli Studi Di Roma Tor Vergata - ITA

Black Hole Interactions and Neutron star Collisions Across the universe

Recent years witnessed a blossoming of multi-messenger astrophysics, in which gravitational waves (GWs), neutrinos, and photons provide complementary views of the universe and its most enigmatic objects, such as black holes (BHs) and neutron stars (NSs). The staggering dataset collected for the compact binary merger GW170817 -- including fundamental contribution by the PI -- showed the tremendous discovery potential of this field, which will unfold in the years ahead of us. The global network of interferometers will progressively sharpen its view of the gravitational wave sky and could soon allow us to see a new kind of light, arising from the encounter of a NS with a stellar mass BH. At the same time, wide-field gamma-ray instruments will continue to pinpoint these violent collisions in distant galaxies, and sensitive all-sky surveys might soon reveal the collision aftermath without the aid of gravitational or gamma-ray alerts. On the verge of a transformational era in the study of transients, I propose a cutting-edge investigation of compact binary mergers harnessing the unprecedented wealth of multi-messenger and multi-wavelength data. By combining a vigorous observational program with theoretical research at the forefront, this project will allow my team to fully exploit the discovery potential of a vastly uncharted territory and tackle the following emerging questions. Do all compact binary mergers launch relativistic jets? Are they the primary cosmic source of heavy metals? What are the properties of cold ultra-dense matter, and how do they affect the observed light? Can we use these mergers for precision cosmology? Stemming from the PI's pioneering results, BHianca is uniquely positioned to timely address these central questions, and lead to seminal results in the nascent field of multi-messenger astronomy.

Link to the ERC project webpage: 101002761

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101018897	**CosmicExplorer**	**PE9** Universe Sciences

Principal Investigator:	**Dr Hiranya Peiris**
Host Institution:	Stockholms Universitet - SWE

Exploring the Cosmos with the Vera Rubin Observatory

The standard model of cosmology postulates ingredients that are not present in the standard model of particle physics – dark matter, dark energy, and a primordial origin for cosmic structure. Their physical nature remains a mystery. In the past few years, it has become clear that formidable modelling and data analysis challenges stand in the way of establishing how these ingredients fit into fundamental physics.

Starting in 2023, we have an opportunity to uncover the physical underpinning of the cosmological model, using a new window on the universe opened by the Vera C. Rubin Observatory's Legacy Survey of Space and Time (LSST). Just in its first year, LSST will see more of the universe than all previous surveys combined. By repeatedly mapping huge sky areas, it will create the first motion picture of our universe. The resulting catalogues will contain billions of galaxies and other, more exotic objects such as the electromagnetic counterparts of gravitational wave sources.

This project aims to turn these catalogues into physical insight by solving three pressing challenges: (1) the formidable computational expense of accurately modelling this complex data; (2) the need to tease out subtle signals from (possibly unknown) systematics; (3) capturing the rich information in the "cosmic web" of galaxies tracing the large-scale structure of the universe, inaccessible by standard analysis methods. I will achieve these aims through a unique approach, combining innovative data emulation techniques to accelerate forward-modelling, a ground-breaking 'explainable artificial intelligence' approach to scientific discovery, and advanced hierarchical Bayesian methods to achieve not just precision (small error-bars) but accuracy (unbiased results). The combination of the unique tools I will develop, and LSST's new view of the universe, opens up a vast discovery space. I will explore this space with the aim of achieving a breakthrough in our understanding of physical cosmology.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101018897

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: cosmology, machine learning, bayesian statistics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101019653	**ISSP**	**PE9** Universe Sciences

Principal Investigator:	**Dr Denis Mourard**
Host Institution:	Observatoire De La Cote D'Azur (Oca) - FRA

Interferometric Survey of Stellar Parameters

Fundamental stellar parameters are the primary data required for an in-depth understanding of stars, their interiors, and their environments. With the progress of stellar physics and the prospects of ground facilities or space missions, it is critical to improve the accuracy, and quantity of such data. The development of exoplanet and asteroseismology domains is demanding direct data to eliminate any bias in the parameters. And finally, the differences between methods for determining the Hubble constant is motivating new and precise direct determination of distances on the primary candles of the cosmic scales. Many methods like asteroseismology, photometric transits of exoplanets, radial velocities, or Surface Brightness Colour (SBC) relations are linked to the stellar radius. Usually estimated through models, its determination by coupling an optical interferometric measurement of the angular diameter and, for example, a Gaia parallax, is the best way to avoid any model dependence. Furthermore, characterizing any activity (limb darkening, convection, rotation, spots, or binarity) is also mandatory, both for bias removal and for the required progress on stellar physics.

Through an ambitious and homogenous survey of the angular diameters of a thousand stars as faint as magnitude 8 in the visible and as small as 0.2 milliseconds of arc, my project is built to address key questions about the relation between planets and stars and to offer to the broader community a unique and primary source of direct information on a representative and large sample of stars all over the HR diagram. A few hundred of direct measurements of limb darkening will be accessible, and, for about 100 stars, activity characterization with a more detailed surface imaging will be possible. These data will also permit the development of new unbiased SBC relations to serve the faint targets of space missions like PLATO or ARIEL in the future and the distance scale within the Araucaria project.

Link to the ERC project webpage: https://lagrange.oca.eu/fr/welcome-erc-issp

Keywords of the ERC project: Stellar physics, optical interferometry, exoplanets, distance scales

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101019978	**SPEED**	**PE9** Universe Sciences

Principal Investigator:	**Dr Stefan Hild**
Host Institution:	Universiteit Maastricht - NLD

Speedmeter: Quantum back-action noise-free interferometry for improving the science capabilities of future gravitational wave observatories

The discoveries enabled by observations of gravitational waves (GW) from merging black holes and neutron stars provided us with a stunning glimpse of the immense potential of GW multi-messenger astronomy and cosmology. In order to discover new phenomena and better understand the constituents of the Universe and the forces driving it, it is vital to improve the sensitivity of future GW observatories. Indeed, to maximise the observation capacity of future GW observatories such as the Einstein Telescope (ET) it is imperative to go beyond the current quantum noise limit imposed by the uncertainty relation originating from a continuous position measurement of the interferometer mirrors, i.e. $[x(t),x(t')]\neq 0$. Quantum mechanics provides speedmeter interferometers (SMI) as a more elegant approach: measuring momentum (speed) of the test masses evades the uncertainty limit, i.e. $[p(t),p(t')]=0$. However, though SMI have been shown theoretically to offer superior sensitivity compared to currently used Michelson interferometers with squeezed light injection, the SMI concept lags behind in technical readiness and hence is currently not yet considered mature enough to build the baseline for ET.

This grant will enable me to change this. In particular I will focus on two novel SMI concepts, we invented and which (in contrast to earlier SMI concepts) are easily implementable into current long-baseline interferometers. The main objectives of this proposal are: 1) development of the required new optical components and quantum noise analysis tools; 2) experimental demonstration, initially in proof-of-concept table-top experiments, followed by implementation in ETpathfinder, a unique cryogenic interferometer test facility; 3) verification of the SMI concept with complementary quantum technologies such as squeezed light; 4) development of a detailed SMI practical design for ET including a science case detailing possible improvements in astrophysics, cosmology and fundamental physics.

Link to the ERC project webpage: www.etpathfinder.eu

Keywords of the ERC project: Gravitational Wave Observation, Laser Interferometery, Quantum noise, quantum non-demolition, squeezed light.

Keywords that characterize the scientific profile of the potential visiting researcher/s: Enthusiastic, creative, happy to work in a team

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101020943	**SPECMAP-CGM**	**PE9** Universe Sciences

Principal Investigator:	**Dr Lutz Wisotzki**
Host Institution:	Leibniz-Institut Fur Astrophysik Potsdam (Aip) - DEU

Spectro-mapping of the circumgalactic medium across cosmic times

This project aims at developing a radically new view on the structure and dynamics of gas flows in the surroundings of galaxies, a domain known as the circumgalactic medium (CGM). In the last years it became clear that the CGM is crucial for our understanding of galaxy evolution, which are largely shaped in the CGM by the interplay of inflows from the intergalactic medium and outflows driven by supergalactic winds. I plan to investigate the CGM of normal galaxies by means of integral field spectroscopy, or spectro-mapping, in various emission lines. I bring privileged access to two new major astronomical facilities, MUSE on the ESO Very Large Telescope in Chile, and HETDEX on the 10m Hobby-Eberly Telescope in Texas. These instruments are both unique in their capability of performing integral field spectroscopy over unprecedented fields of view, delivering high-quality spectro-mapping information for hundreds of galaxies and their circumgalactic environments simultaneously. I have a leading role in both, and I am the only astronomer in the world with direct access to MUSE Guaranteed Time Observations and to the entire HETDEX survey. The major challenge for this experiment is the extreme faintness of the CGM emission, which so far made spectro-mapping unfeasible except for a few extreme objects. My recent breakthrough discoveries with MUSE of ubiquitous Lyman-alpha haloes around high-redshift galaxies demonstrate that finally we have achieved the sensitivity required to detect the CGM directly in emission through imaging spectroscopy. I now want to go a big step beyond and apply this approach to large representative samples of typical galaxies at all redshifts. My goal is not only to detect and establish line emission from the CGM as a universal phenomenon, but to disantangle its complex substructures and, through comparisons with physical models and the latest numerical galaxy formation simulations, build a comprehensive picture of these processes.

Link to the ERC project webpage:

Keywords of the ERC project: high-redshift galaxies, circumgalactic medium, galactic outflows, Lyman-alpha emission

Keywords that characterize the scientific profile of the potential visiting researcher/s: high-redshift galaxies, circumgalactic medium, galactic outflows, Lyman-alpha emission

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Project ID:	Project Acronym:	Evaluation Panel:
101039651	**DiscEvol**	**PE9** Universe Sciences

Principal Investigator:	**Dr Giovanni Rosotti**
Host Institution:	Universita Degli Studi Di Milano - ITA

Rebuilding the foundations of planet formation: proto-planetary disc evolution

With thousands of exoplanets known, we have truly entered the exoplanet era. Explaining the huge diversity of observed exoplanetary systems remains however a big challenge. The only way we have to study planet formation is to study the environments in which they form, proto-planetary discs: to understand planets, we have to understand discs and the physical processes happening in them.

The field of proto-planetary discs is currently being shaken by the crumbling of viscous theory, the traditional paradigm used to describe how discs evolve in time. The paradigm relied on the presence of turbulence, which affects a myriad of processes of planet formation. The crumbling of viscous theory thus has ramifications across our entire understanding of planet formation.

How can we rebuild the foundations of planet formation? Thanks to advances in observational capabilities, we can now perform large surveys of proto-planetary discs and study the evolution of their properties (mass, radius, mass accretion rate). Over the last few years I played a leading role in showing how to use this information to guide and constrain models of disc evolution, computing quantities from the models that can be directly compared to observations.

Building on my expertise, at the convergence of theory and observations, I propose a) to develop quantitative models of an alternative paradigm of disc evolution in which discs evolve under the influence of disc winds rather than viscously. The long-lasting impact of DiscEvol will be to deliver a new standard model of disc evolution tested against the existing data from observational surveys. DiscEvol will also b) reassess how crucial steps of the planet formation process, such as the accretion of solids onto growing planetary cores and planetary migration, differ in a disc evolving under the influence of winds. Altogether, this program will bring the link between models and observations of planet formation in discs to a new level.

Link to the ERC project webpage:

Keywords of the ERC project: planet formation, proto-planetary discs

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101040021	**SMILE**	**PE9** Universe Sciences

Principal Investigator:	**Dr Carolina Casadio**
Host Institution:	Foundation For Research And Technology Hellas - GRC

Search for Milli-lenses to discriminate between dark matter models

One of the most compelling mysteries in both cosmology and particle physics is the nature of Dark Matter (DM). We propose to investigate this problem using strong gravitational lensing of active galaxies on the key but poorly-explored milliarcsecond scales. Gravitational lensed images with angular separation on milliarcsecond scales probe gravitational lens systems where the lens is a compact object with mass in the range 10^6 - 10^9 solar masses. This mass range is particularly critical for the widely accepted Lambda-CDM cosmological model, which predicts many more DM sub-halos, i.e., DM halos on sub-galactic scales (masses below ~ 10^11 solar masses), than currently observed. The most direct way to explore these small angular scales is through the high-resolution of radio Very Long Baseline Interferometry (VLBI). We propose to use VLBI data on a complete and large sample of active galaxies (~ 5000 sources) to search for gravitational lens systems on milliarcsecond scales. Given that no gravitational lenses on milliarsecond scales have yet been found, if any of the gravitational lens candidates that this search will produce is indeed confirmed as a true gravitational lens system, this would be a first and a major discovery. A null result instead will allow us to infer a new constraint on the abundance of compact objects in the mass range of interest, with over an order of magnitude better precision than in previous studies, and tighter than the number of 10^6 - 10^9 solar masses subhalos predicted by Lambda-CDM. Such a constraint could help discriminate between DM models that predict different numbers of sub-halos in this mass range. It could also help to constrain a possible contribution of primordial black holes as a DM component.

Link to the ERC project webpage: https://smilescience.info/

Keywords of the ERC project: dark matter; gravitational lensing; vlbi; optical spectra; radio quasars

Keywords that characterize the scientific profile of the potential visiting researcher/s: radio-interferometry; optical spectrum classification; dark matter models; gravitational lensing

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101042275	**Stellar-MADE**	**PE9** Universe Sciences

Principal Investigator:	**Dr Nicolas Cuello**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Exploring the impact of Stellar Multiplicity on planet formation Across Disc Evolution

In regions of active star formation, the protoplanetary discs around young stars act as planetary factories. Recent observing campaigns have shown that the majority of protostars belong to multiple stellar systems: the younger the stars, the higher the degree of multiplicity. Young discs are then strongly affected by stellar multiplicity, unavoidably modifying the way in which planets form. The detailed evolution of multiple systems with discs and planets however remains to be explored. Since most current models have been designed for single stars, there is an urgent need to extend these models to multiple stars. This will pave the way for a better understanding of the process of planet formation, at a more general level. The Stellar-MADE project aims to provide a comprehensive view of disc dynamics and planet formation within multiple stellar systems. My team and I will thoroughly study multiples to: (1) Establish the formation channels of protoplanetary discs around young stellar objects; (2) Follow disc dynamics and grain growth in order to identify the regions of planetesimal formation; (3) Characterise planetary architectures and the resulting exoplanet population. To achieve our goals we will perform hydrodynamical and N-body simulations, developing and adapting state-of-the-art codes (Phantom, MCFOST, Rebound). Our calculations will include a broad range of physical processes: disc thermodynamics, radiative transfer, gravitational perturbations, aerodynamic friction, dust growth, and Mean-Motion Resonances. This will allow us to identify and quantify stellar multiplicity effects across evolution. My previous work on binary stars constitutes proof-of-concept that it is possible to coherently connect protoplanetary disc evolution to planetary architectures. Unveiling the effects of stellar multiplicity on planet formation will be a major breakthrough, which will enable us to interpret the whole exoplanetary population under a new and more realistic prism.

Link to the ERC project webpage: https://nicolascuello.github.io/Stellar-MADE/

Keywords of the ERC project: planet formation, multiple stars, young stars, disc dynamics, celestial mechanics, hydrodynamics, SPH, ALMA, SPHERE, observations, radiative transfer, stellar populations, exoplanets

Keywords that characterize the scientific profile of the potential visiting researcher/s: Researcher, Postdoc, PhD Student, planet formation, young stars, modeller, observer

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101053992	**OCULIS**	**PE9** Universe Sciences

Principal Investigator:	**Dr Hendrik Hoekstra**
Host Institution:	Universiteit Leiden - NLD

Observational Cosmology Using Large Imaging Surveys

The current standard model of cosmology successfully describes a variety of measurements, but its main ingredients, dark matter and dark energy, are a great mystery. ESA's Euclid satellite is the biggest step forward towards solving this fundamental problem in physics. It is designed to reveal the nature of the dark constituents and gravity by measuring the growth of structure over most of cosmic time with unprecedented precision, but the interpretation of the data is complex: incorrect modelling of the galaxy populations, astrophysical processes or instrumental effects can easily be mistaken as evidence for new physics. To fully exploit the statistical power of Euclid, the intricacies of the data need to be understood, but we also need an accurate model of structure formation that can describe the interplay between galaxy formation, astrophysics, dark matter and cosmology.

OCULIS tackles both aspects by providing the best measurements of the lensing signal and using the Euclid data in novel ways to relate observed galaxy properties directly to the matter distribution. To do so, we will (i) use in-flight data to correct for instrumental biases; (ii) measure the intrinsic alignments of galaxies that contaminate the lensing signal; (iii) exploit Euclid's unique ability to determine the lensing signal on small scales to directly determine the stellar masses of galaxies for the first time, and to study the tidal stripping of dark matter halos; (iv) use the results to inform models that describe the small-scale astrophysics in hydrodynamic simulations, yielding robust predictions of the cosmological signals. As cosmology coordinator of the Euclid mission, the PI is uniquely positioned to achieve these objectives. The synergetic approach of OCULIS exploits that Euclid is much more than a cosmology mission: it is also a prime dataset for the study of the formation and evolution of galaxies. By linking both science cases, OCULIS maximizes the scientific return of Euclid.

Link to the ERC project webpage:

Keywords of the ERC project: weak gravitational lensing, Euclid, cosmological surveys

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101054354	**SUBSTELLAR**	**PE9** Universe Sciences

Principal Investigator:	**Dr Eduardo L. Martin**
Host Institution:	Instituto De Astrofisica De Canarias - ESP

Substellar Science with the Euclid Space Mission

Euclid is a space mission led by the European Space Agency (ESA) to conduct a deep, single-epoch survey of 15,000 deg2 of sky with visible and near-infrared photometry and spectroscopy, and 40 deg2 multi-epoch very deep surveys. Its primary science goal is to investigate the geometry of the dark universe by mapping the distribution and shapes of galaxies.

The unprecedented combination of sensitivity, areal coverage, spatial resolution, data homogeneity and spectral information will naturally be of tremendous benefit to other areas of astrophysics. Two Euclid Independent Legacy Science (ILS) programs have been designated by ESA to develop and pursue independent science programs that capitalize on the unique data products of the Euclid surveys.

In this proposal the PI of the Euclid Ultracool Dwarf (UCD) ILS team lays out an Advanced ERC project aimed at mining the Euclid surveys for pushing the frontier of knowledge in substellar science.

The first challenge of the project is to identify, based on Euclid data, an unprecedented large number (>1,000,000) of very low mass (VLM) stars and Substellar-mass Objects (SMOs), including hard to find objects such as halo brown dwarfs and young free-floating planetary-mass objects. Specific pipelines will be developed to extract the utmost information from Euclid for faint infrared objects.

The second challenge is to discover very low-mass binaries and giant planets around VLM stars and SMOs using custom-made image analysis, astrometric monitoring and spectral fitting techniques.

The third challenge is to combine the information gathered from harnessing the previous two challenges to determine the VLM stellar and substellar luminosity function, infer the most likely low-mass end of the Initial Mass Function (IMF), and explore its degree of universality in different components of the Milky Way.

Link to the ERC project webpage: www.substellar.net

Keywords of the ERC project: Binaries, biomarkers, brown dwarfs, Euclid, exoplanets, IMF, spectroscopy, substellar-mass, ultracool

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101054502	**DUSTSPEC**	**PE9** Universe Sciences

Principal Investigator:	**Dr Sijme-Jan Paardekooper**
Host Institution:	Technische Universiteit Delft - NLD

Sizes Matter: The Dust Size Distribution during Planet Formation

Planets form in discs of gas and dust around young stars. Within these discs, micron-sized dust particles need to clump together to grow 14 orders of magnitude to form Earth-like planets as well as the cores of giant planets. It is a major challenge to understand dust growth from start to finish. State of the art observations provide spectacular glimpses of the dust distribution at a limited range of sizes: ALMA produces images of the thermal emission of mm-sized dust, while instruments such as SPHERE probe the distribution of much smaller particles. However, for a comprehensive theory of planet formation, we need to understand the process from start to finish, from micron-sized to planet-sized. This is therefore the story of the dust size distribution: how many dust specks, pebbles and boulders are present? While there are large size ranges that are out of reach observationally, in this project we will exploit the fact that all dust sizes are coupled to the gas via friction to take a panoptic view of the size distribution for the first time. Since the gas feels friction from all dust sizes, the size distribution is encoded in the gas kinematics, and therefore in every single dust size as well. We will perform hydrodynamical simulations including the full dust size distribution to write the polydisperse story of planet formation. We aim to reconstruct the full size distribution from sparse observations, thereby avoiding the need for expensize multi-wavelength observations. We will compare dust and gas distributions with observations of protoplanetary discs as well as the composition of Solar system bodies. We will use a novel numerical method that allows us to perform these computationally expensive simulations, and employ machine learning to speed up the calculations. This way, we will for the first time be able to build up a complete picture of how dust particles grow into planets and construct a comprehensive model of planet formation.

Link to the ERC project webpage:

Keywords of the ERC project: planet formation, numerical simulations

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
759526	**SNOWISO**	**PE10** Earth System Science

Principal Investigator:	**Dr Hans Christian Steen-Larsen**
Host Institution:	Universitetet I Bergen - NOR

Signals from the Surface Snow: Post-Depositional Processes Controlling the Ice Core Isotopic Fingerprint

For the past 50 years, our use of ice core records as climate archives has relied on the fundamental assumption that the isotopic composition of precipitation deposited on the ice sheet surface determines the ice core water isotopic composition. Since the isotopic composition in precipitation is assumed to be governed by the state of the climate this has made ice core isotope records one of the most important proxies for reconstructing the past climate.

New simultaneous measurements of snow and water vapor isotopes have shown that the surface snow exchanges with the atmospheric water vapor isotope signal, altering the deposited precipitation isotope signal. This severely questions the standard paradigm for interpreting the ice core proxy record and gives rise to the hypothesis that the isotope record from an ice core is determined by a combination of the atmospheric water vapor isotope signal and the precipitation isotope signal.

The SNOWISO project will verify this new hypothesis by combining laboratory and field experiments with in-situ observations of snow and water vapor isotopes in Greenland and Antarctica. This will enable me to quantify and parameterize the snow-air isotope exchange and post-depositional processes. I will implement these results into an isotope-enabled Regional Climate Model with a snowpack module and benchmarked against in-situ observations. Using the coupled snow-atmosphere isotope model I will establish the isotopic shift due to post-depositional processes under different climate conditions. This will facilitate the use of the full suite of water isotopes to infer past changes in the climate system, specifically changes in ocean sea surface temperature and relative humidity.

By establishing how the water isotope signal is recorded in the snow, the SNOWISO project will build the foundation for future integration of isotope-enabled General Circulation Models with ice core records; this opens a new frontier in climate reconstruction.

Link to the ERC project webpage: https://steenlarsen.w.uib.no/erc-stg-snowiso/

Keywords of the ERC project: Ice core, water isotopes, snow, climate, SMB, fluxes

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
802281	**RISeR**	**PE10** Earth System Science

Principal Investigator:	**Dr Natasha Barlow**
Host Institution:	University Of Leeds - GBR

Rates of Interglacial Sea-level Change, and Responses

Global sea-level rise is one of our greatest environmental challenges and is predicted to continue for hundreds of years, even if global greenhouse-gas emissions are stopped immediately. However, the range, rates and responses to sea-level rise beyond 2100 are poorly understood. Current models that project sea-level rise centuries into the future have large uncertainties because the recent observations upon which they are based, encompass too limited a range of climate variability. Therefore, it is crucial to turn to the geological record where there are large-scale changes in climate. Global temperatures during the Last Interglacial were ~1oC warmer than pre-industrial values and 3-5oC warmer at the poles (a pattern similar to that predicted in the coming centuries), and global sea level was 6-9 m higher, far above that experienced in human memory.

Through the RISeR project, I will lead a step-change advance in our understanding of the magnitude, rates and drivers of sea-level change during the Last Interglacial, to inform both global and regional sea-level projections beyond 2100. Specifically I will:

1. Develop new palaeoenvironmental reconstructions of Last Interglacial sea-level change from northwest Europe;
2. Provide the first ever chronological constraints on the timing, and therefore rates, of relative sea-level change that occurred in northwest Europe during the Last Interglacial;
3. Use state-of-the-art numerical modelling to distinguish the relative contributions of the Greenland and Antarctica ice sheets to global sea-level rise during the Last Interglacial;
4. Provide estimates of the land areas and exposed populations in northwest Europe at risk of inundation by long-term (2100+) sea-level rise, providing high-end scenarios critical for coastal-risk management practice.

These ambitious objectives will result in a state-of-the-art integrated study of the most appropriate analogue for a critical global environmental challenge; future sea-level rise.

Link to the ERC project webpage: https://riser.leeds.ac.uk/

Keywords of the ERC project: sea level; quaternary

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
834225	**EAVESDROP**	**PE10** Earth System Science

Principal Investigator:	**Dr Donald Dingwell**
Host Institution:	Ludwig-Maximilians-Universitaet Muenchen - DEU

Experimental access to volcanic eruptions: Driving Observational Potential

The Earth System is impacted continually by dozens of volcanic eruptions per year. Predicting their collective effects is hampered by our incomplete mechanistic understanding of eruptive and post-eruptive processes. The activity of explosive volcanic systems especially, is a key to the evolution of our world, not only for the eruptive catastrophes themselves but also for the massive injection of volcanic materials into the critical zone of the Earth System. (e.g. Ayris and Delmelle, 2012; Baldini et al., 2015; Dingwell, 1996; Dingwell et al., 2012; Martin et al., 2009; Robock, 2000). For this reason - as well as the many pragmatic issues of living with active volcanism – a mechanistic understanding explosive volcanism and the interaction of its products in the Earth System is a grand challenge of modern Earth Sciences.

Fortunately, three recent experimental breakthroughs bring the challenge of mechanistic understanding within our grasp: these are the development of in situ high temperature 1) synchrotron-based real-time imaging techniques for deforming systems (Baker et al., 2012; Wadsworth et al., 2016). 2) acoustic monitoring of failure and fragmentation processes in exploding magma (Arciniega et al., 2015) and 3) dynamic ash-gas environmental reaction chambers (Ayris et al., 2015).

Accompanying these experimental advances, have been fundamental advances in our mechanistic view of magma ascent and eruption (Tuffen et al., 2003; Gonnermann and Manga, 2003; Lavallée et al., 2008; Castro and Dingwell, 2009), volcano seismicity (Arciniega et al., 2015; Vasseur et al., 2017) , and the fate of volcanic ash (Delmelle et al., 2018; Renggli et al., 2018). Vast experimental expertise, together with the global impact of our work to date, place me uniquely to exploit these recent advances and to bring the impact of an experimental approach to volcanology to its fullest potential, with Europe at its forefront.

Link to the ERC project webpage:

Keywords of the ERC project: volcanism materials rheology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
848698	**GLAD**	**PE10** Earth System Science

Principal Investigator:	**Dr Sebastian Schemm**
Host Institution:	Eidgenoessische Technische Hochschule Zurich - CHE

Global Lagrangian Cloud Dynamics

This project will address fundamental gaps in our understanding of how clouds form, how they interact with the atmospheric flow and how they need to be simulated in weather and climate models. Our inability to improve the representation of clouds and their interactions with the atmospheric flow is the leading cause of the high level of uncertainty associated with projections of future changes in storm tracks, precipitation bands and weather extremes. The representation of clouds in models is poor, largely because clouds are unresolved. Given the potentially significant impacts of projected global warming and the significant benefits of improved weather predictions, it is imperative to improve the representation of cloud-circulation interactions in models. However, how do we acquire the necessary process understanding to close existing knowledge gaps? I propose a fundamentally new perspective on clouds and their control of the large-scale flow leading ultimately to a unique cloud classification system. Instead of studying clouds based on the traditional Eulerian perspective, I suggest analysing cloud-circulation couplings based on the history of air parcels (Lagrangian perspective). A systematic Lagrangian-based investigation of cloud-circulation couplings in ultra-high-resolution simulations is a true novelty and has never been attempted. Based on convection-permitting simulations over a climatological period, which exploit recent advances in supercomputing architectures, the cloud parcels are classified according to their circulation impact and feed into a machine learning algorithm that is trained using the physical processes acting along their pathways. This approach has the potential to drastically improve our mechanistic understanding of how to represent clouds in models and to identify the leading cloud-related processes that control regional to large-scale flow variability, which is one of the Grand Challenges defined by the World Climate Research Programme.

Link to the ERC project webpage: glad.ethz.ch

Keywords of the ERC project: high-resolution weather and climate modelling

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
853045	**SHExtreme**	**PE10** Earth System Science

Principal Investigator:	**Dr Jadranka Sepic**
Host Institution:	Sveuciliste U Splitu, Prirodoslovno-Matematicki Fakultet - HRV

Estimating contribution of sub-hourly sea level oscillations to overall sea level extremes in changing climate

Coping with a sea level rise, induced by climate change processes, is one of the most important challenges of modern society. It has been projected that, by the end of the 21st century, mean sea level (MSL) will rise between 40 and 60 cm worldwide. Higher MSLs imply that flood risks associated to extreme sea levels (ESLs) will also increase, with the 100-year return levels of extreme events along European coasts projected to increase between 50 and 90 cm by the 2100. ESLs occur due to a superposition of numerous oceanic phenomena which act over different temporal (from seconds to millennia) and spatial scales (from bays to oceans). Within SHExtreme project, for the first time, contribution of under-researched sub-hourly sea level oscillations to the ESLs along the European coast will be extensively studied. High resolution 1-min sea level data measured at more than 100 tide gauge stations, as well as reanalysis, hindcast and future climate simulations, will be analyzed to achieve project goals: (i) assessing present day distribution of sub-hourly sea level oscillations and estimating their contribution to the overall ESLs; (ii) linking sub-hourly ESLs to governing atmospheric conditions; (iii) estimating future strength and distribution of sub-hourly ESLs. Project SHExtremes will result with the first comprehensive estimate of intensity, frequency, and spatial and temporal distribution of present and future-day sub-hourly ESLs along the European coasts.

Link to the ERC project webpage: https://projekti.pmfst.unist.hr/SHExtreme/

Keywords of the ERC project: sea level, meteotsunami, climate change, extremes

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
865403	**TroPeaCC**	**PE10** Earth System Science

Principal Investigator:	**Dr Angela Gallego**
Host Institution:	The University Of Exeter - GBR

Tropical Peatlands and the Carbon Cycle

Tropical peatlands are the most carbon-dense ecosystems in the world and they store the equivalent of ~10 years of global anthropogenic CO2 emissions. Despite their importance, crucial questions remain about carbon cycling in tropical peatlands and improving understanding is critical as they are at high risk from climate change and drainage for oil palm cultivation.

TroPeaCC will provide a step-change gain in our understanding of tropical peatland functioning and in projecting their response to climate change. PI Gallego-Sala will use her unique background that bridges peatland modelling and observations to deliver a novel interdisciplinary approach to tackle four outstanding questions about tropical peatlands:

Q1: What controls the geographical distribution of peatlands in the tropics? TASK1: To assess the tropical peatland extent using a combination of models

Q2: How large is the tropical peatland CO2 sink and what are its main climatic drivers? TASK2: To characterize the drivers of carbon accumulation rates in tropical peatlands using the palaeo-archive.

Q3: How large is the methane flux in tropical peatlands? What are the main controls at the intercontinental scale? TASK3: To determine the main controls on methane fluxes in tropical peatlands, using eddy covariance, chamber-based gas flux measurements, and ground penetrating radar.

Q4: What is the overall carbon balance of tropical peatlands and how will this change in the future? TASK4: To forecast future changes of the extent of tropical peatlands, of the carbon sink and of methane emissions, using the results of Tasks 1-3 to parameterise and evaluate a global dynamic vegetation model that includes tropical peatlands for the first time.

The interdisciplinary approach will lead to a comprehensive understanding of the role of tropical peatlands in the global carbon cycle, allowing their inclusion in earth system models, and informing management decisions to optimise provision of multiple ecosystem services.

Link to the ERC project webpage:

Keywords of the ERC project: peat, carbon, tropical, methane, soil

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
865963	**DEEP-trigger**	**PE10** Earth System Science

Principal Investigator:	**Dr Anne Socquet**
Host Institution:	Universite Grenoble Alpes - FRA

Preparation of Subduction Earthquakes: Slow, Deep, Large-scale trigger

Subduction zones host the world's largest earthquakes and tsunamis. Understanding how such earthquakes initiate and interact is a first-order challenge in earth sciences. A puzzling and unexplained observation is that megathrust earthquakes seem to be clustering at the scale of the plate boundary. This suggests that the subducting slab plays an important role, albeit downplayed, in the triggering of megathrust earthquakes.
I propose to study subduction zones recently affected by megathrust events or earthquakes sequences, with an enlarged perspective, considering the mechanisms of deformation in the larger subduction system, including the slab, and their potential role in pushing the megathrust to failure:

- At the scale of the seismic asperity, how aseismic slip can trigger earthquakes and how this triggering depends on depth, duration, migration, periodicity, and amplitude will be examined, notably by integrating new observations of small, short or long-lived slow slip events.
- At the scale of the subduction zone, how distant changes transfer into large-scale deformation, potentially initiate slow slip and eventual rupture on the plate interface will be analyzed. The role of metamorphic fluids in the softening of the mantle surrounding the slab, which may contribute to distant triggering of earthquakes, and recently observed deep-shallow interactions will be explored.

Multi-scale observations of deformation and seismicity will be extracted from the great amount of geophysical data available in South America, Japan and Sumatra, complemented by in-situ GPS monitoring at a promising area in south Peru. Machine Learning will serve to systematize these complementary observables, to characterize how their empirical relationships evolve with time and space, and to isolate the key processes hidden in these large datasets. Physical mechanisms driving the plate interface destabilization will be explored through mechanical and fluid modeling, and tested against the data.

Link to the ERC project webpage: https://deeptrigger.osug.fr/

Keywords of the ERC project: subduction, seismology, geodesy, machine learning, geodynamic modelling

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
948498	**AeroSurf**	**PE10** Earth System Science

Principal Investigator:	**Dr Bryan Bzdek**
Host Institution:	University Of Bristol - GBR

Comprehensive Investigations of Aerosol Droplet Surfaces and Their Climate Impacts

By serving as cloud droplet seeds, aerosols represent the largest negative (cooling) and most uncertain climate forcing. Particulate matter is also a major contributor to air pollution, attributed to ~7 million annual deaths. Aerosol surfaces hold the greatest source of uncertainty for atmospheric chemistry and climate impacts. Surfactants are now routinely identified within atmospheric aerosol samples, and surface tension governs the fraction of particles that activate into cloud droplets, significantly impacting aerosol-cloud climate effects. Sunlight-driven interfacial reactions have recently emerged as important modifiers of atmospheric composition and proceed via unique pathways relative to bulk solutions. A complete understanding of aerosol climate and health impacts requires detailed knowledge of aerosol surface composition and reactivity. However, few approaches directly interrogate droplet surfaces, hindering incorporation of surface-mediated processes into climate and air quality models. This project will study directly the droplet-air interface of picolitre droplets in size ranges relevant to growing cloud droplets to develop a comprehensive, molecular level understanding of interfacial composition, reactivity, and climate and health impacts. Aerosol droplet surfaces will be studied with novel, sensitive approaches. The dynamic and equilibrium partitioning of surfactants to aerosol droplet surfaces will be investigated directly for the first time, providing information required for accurate cloud droplet activation predictions. Entirely new approaches to selectively analyse the surface and bulk molecular composition of a levitated micron-sized droplet by mass spectrometry will allow direct investigation of chemistry on aerosol surfaces. Together, these approaches will address outstanding questions in interfacial photochemistry, link directly droplet surface tension to climate impacts, and resolve a poorly understood aspect of aerosol chemistry.

Link to the ERC project webpage: https://www.bzdeklab.com/index.html

Keywords of the ERC project: aerosol, single particle, chemistry, atmospheric, mass spectrometry

Keywords that characterize the scientific profile of the potential visiting researcher/s: aerosol, mass spectrometry, atmospheric

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
949495	**BOOGIE**	**PE10** Earth System Science

Principal Investigator:	**Dr Ryan Pereira**
Host Institution:	Heriot-Watt University - GBR

Breathing Oceans: understanding the organic skin that modulates the exchange of greenhouse gases between the atmosphere and the ocean

Oceans are a global reservoir of greenhouse gases, estimated to account for 20–40% of the post-industrial sink for anthropogenic carbon dioxide (CO2). However, quantifying the exchange of gases such as CO2, methane (CH4), and nitrous oxide (N2O) between the ocean and atmosphere is a major challenge. Understanding how the ocean's organic skin layer modulates this exchange is critical to estimate the intrinsic oceanic sinks and sources of these key greenhouse gases both now and in the future. Organic substances in the skin layer, known as surfactants, span across traditional operational definitions and are derived from multiple sources undergoing biotic and abiotic transformations along the land-ocean continuum. This proposal will investigate a land-ocean transect from South America toward the African Continent to investigate organic matter control of air-water gas exchange. Central to this work is the application of new technologies, using novel in-situ sensor platforms and advanced geochemical characterisation techniques. This new and unique data will be incorporated into hydrological and gas flux models to examine spatial and temporal effects of surfactant suppression of gas exchange – both now and in the future.

Link to the ERC project webpage: https://carbonwaterdynamics.wordpress.com/

Keywords of the ERC project: Dissolved organic matter, surfactants, gas exchange, rivers, oceans, atmosphere

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101001957	**FluidMICS**	**PE10** Earth System Science

Principal Investigator:	**Dr Anna Nele Meckler**
Host Institution:	Universitetet I Bergen - NOR

Fluid Inclusion Microthermometry in Speleothems

Ongoing global warming is rapidly moving us away from the climate states we are used to and understand from observational time series. This poses the urgent need to extend our "climate memory" by deciphering climate information stored in geologic archives. However, obtaining quantitative estimates for past climate changes is challenging, particularly in terrestrial archives due to common limitations in time coverage, resolution, and chronology. FluidMICS will employ a novel technique to reconstruct past temperatures based on physical properties of relict drip water preserved in cave formations (speleothems). The behavior of such micrometer-scale fluid inclusions during cooling and heating is directly related to the temperature at which the inclusions were once closed off. This physical basis makes the method uniquely robust and distinguishes it from other paleo-thermometers that depend on empirical calibrations. Combined with the distinct advantages of speleothems, which cover long time periods and can be absolutely dated, this approach will lead to unprecedented insights into magnitude, timing, and distribution of past temperature changes, lifting paleoclimate research to a new level. Our pilot data show that the microthermometry method faithfully discloses past temperatures several hundred thousand years ago. In FluidMICS, we will generate a solid understanding of potential non-thermal effects, further increasing precision and accuracy of the reconstructed temperatures, streamlining the analysis, and extending the applicability of the method. These advances will enable us to generate uniquely accurate and precise terrestrial temperature records far back in time that are distributed over large areas of the globe. These new datasets will serve as invaluable resources to better understand the complexities of our climate system under different atmospheric CO2 concentrations and in times of rapid change, and to test climate models used for future projections.

Link to the ERC project webpage:

Keywords of the ERC project: paleoclimate, speleothems, fluid inclusions

Keywords that characterize the scientific profile of the potential visiting researcher/s: paleoclimate, speleothems

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101003125	**COSMYCA**	**PE10** Earth System Science

Principal Investigator:	**Dr Lisa Wingate**
Host Institution:	Institut National De La Recherche Agronomique - FRA

The role of the Earth's mycelial community and enzyme activity on global atmospheric CO2 and COS budgets

The recent activity of humans has had such a profound impact on the chemistry of the Earth's atmosphere that ecosystems and societies face a 'human-induced' climate crisis. Given the key role of the biosphere in climate change feedbacks, the Paris Agreement emphasised every effort should now be taken to ensure ecosystems are managed to reduce the growth rate of atmospheric CO2 without altering climate. However, Land Surface Models (LSM) still lack consensus on critical processes driving the exchange of CO2 between ecosystems and the atmosphere. Variations in atmospheric carbonyl sulphide (COS) could provide independent constraints on LSM performance at large scales and evidence for the recent 'CO2 fertilisation' effect on the biosphere. Free-Air CO2 Enrichment (FACE) studies also reveal that, as CO2 rises, trees forming symbiotic relationships with ectomycorrhizal (EM) fungi may accumulate biomass more readily than trees in symbiosis with arbuscular mycorrhizal (AM) fungi, especially in nutrient-poor soils. So far, incorporating EM and AM functional traits into LSMs remains a challenge. Representing key differences in AM and EM plant root and fungal processes in LSMs such as the secretion of acids and enzymes into the soil will be necessary, as they augment organic matter mineralisation and soil weathering, impacting atmospheric CO2, and potentially COS budgets. Because EM plants tend to grow on acidic soils, EM fungi should express more carbonic anhydrase (CA) an enzyme that helps regulate their internal pH, with repercussions on COS fluxes. As nitrogen availability inhibits CA activity this may help explain why the growth of EM plants is reduced in acid environments. COSMYCA will quantify EM and AM fungal CA activity for the first time and characterise mechanistically how CO2 levels and nutrients drive changes in fungal enzyme activity, weathering rates and SOM mineralisation, and their large-scale consequences on the COS and CO2 budgets over the last century.

Link to the ERC project webpage:

Keywords of the ERC project: fungal biology biogeochemistry atmospheric chemistry integrated -omics

Keywords that characterize the scientific profile of the potential visiting researcher/s: GHG fluxes Bioinformatics Biosphere-Atmosphere Modelling

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101043356	**PROGRESS**	**PE10** Earth System Science

Principal Investigator:	**Dr Alida Gabor**
Host Institution:	Universitatea Babes Bolyai - ROU

Reading provenance from ubiquitous quartz: understanding the changes occurring in its lattice defects in its journey in time and space by physical methods

Quantitative provenance analysis studies are instrumental in understanding the tectonic and climatic processes that are shaping Earth`s landscape. Although the most abundant mineral in the sedimentary system is quartz, almost all studies in provenance analysis investigate accessory minerals. Quartz crystals contain a vast number of point defects, intrinsic or due to impurities. Although our understanding on the formation and dynamics of these defects is far from complete, a few of these defects in quartz are used for dating Quaternary sediments by luminescence (thermoluminescence (TL) or optically stimulated luminescence (OSL)) or by electron spin resonance (ESR). PROGRESS aims at proving that point defects in quartz have also the capacity to carry genetic information and their modifications can provide evidence for antiquity, metamorphism (or lack thereof) as well as knowledge on weathering, transport, or recycling. This information can be unravelled by ESR and luminescence methods in combination with microscopic techniques such as scanning electron microscopy coupled with cathodoluminescence (CL) wavelength resolved spectroscopy. To understand changes that are occurring at atomic level in quartz in nature in geological time, PROGRESS will investigate quartz grains extracted from independently dated old to young quartz-bearing continental crustal sources, metamorphosed rocks versus their unmetamorphosed equivalents, fresh versus highly weathered samples, as well as intrusive versus volcanic rocks, besides conducting experiments in laboratory environments. To tackle nature`s complexity during sediment movement in space and time the effect of physical and chemical changes that occur during transport of quartz grains will be investigated by the study of river sediments that drain different lithologies. These investigations will allow a simple quartz based fingerprinting method to be developed, that will have a significant impact on quantitative provenance studies.

Link to the ERC project webpage: https://www.facebook.com/ProgressERC

Keywords of the ERC project: provenance, quartz, luminescence dating, electron spin resonance, hyperspectral cathodoluminescence, scanning electron microscopy

Keywords that characterize the scientific profile of the potential visiting researcher/s: -

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101043844	**EPIC**	**PE10** Earth System Science

Principal Investigator:	**Dr Mathew Domeier**
Host Institution:	Universitetet I Oslo - NOR

Untangling Ediacaran Paleomagnetism to Contextualize Immense Global Change

The Ediacaran-early Cambrian (~635-520 Ma) was an interval of immense global change with fundamental state shifts occurring in the bio-cryo- and atmosphere. Such changes included the abrupt appearance and rapid diversification of modern metazoan life (the Ediacaran fauna and Cambrian 'explosion'), the end of protracted, global-scale glaciations (Snowball Earth), the rise of atmospheric oxygen to present-day levels, and the perturbation of carbon isotopic records to extremes otherwise unknown to Earth history. Given the immensity and abruptness of those changes, they are clearly essential to an understanding of the development of life, the history of climatic change and the evolution of the oxygen and carbon cycles. Accordingly, great effort has been dedicated to acquiring detailed temporal records to investigate those changes through time, but we still lack a robust paleogeographic framework to study them in space. This is because paleomagnetic data—which are used to determine the ancient positions of continents—exhibit aberrant behaviour at this time, the meaning of which is unknown. Four alternative hypotheses have been formulated to explain them: 1) rapid rotations of the entire solid Earth (true polar wander), 2) an unstable magnetic field, 3) pervasive data corruption, or 4) ultra-fast plate motion. Each of these hypotheses has far-reaching implications: Hypotheses 1, 2 & 4 reflect dramatic non-uniformitarian processes that would defy our understanding of geodynamics, whereas hypothesis 3 poses grave challenges to the interpretation of paleomagnetic data in Precambrian time. My vision with EPIC is to investigate and identify the origin(s) of the aberrant paleomagnetic data of this age, and to use that knowledge to directly reconstruct Ediacaran-early Cambrian paleogeography for the first time. EPIC will thus transform one of geophysics' most outstanding enigmas into one of our greatest assets in understanding this critical time in Earth's development.

Link to the ERC project webpage:

Keywords of the ERC project: Paleomagnetism; Ediacaran; Paleogeography; Geodynamics; Geochronology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101045217	**PALEONILE**	**PE10** Earth System Science

Principal Investigator:	**Dr Faysal Bibi**
Host Institution:	Museum Fur Naturkunde - Leibniz-Institut Fur Evolutions- Und Biodiversitatsforschung An Der Humboldt-Universitat Zu Berlin - DEU

Evolution on the Nile: Faunal Regionalization and Continuity in the Pleistocene of Sudan

Over a century of paleontological investigation in Africa has revealed a rich Pleistocene fossil record that includes the evolution of hominins and their material cultures. However, the vast majority of fossil sites are located in the East African Rift Valley (EARV), and our knowledge is heavily skewed by this geographic bias. Poor continental geographic sampling means we lack an understanding of faunal regional variations, and the role of dispersal and geographic variation in the emergence of modern ecosystems. Furthermore, many have questioned the role of the Nile, the longest river in the world, in promoting faunal and cultural dispersal between Subsaharan and North Africa, and beyond to Eurasia. For decades such questions have been answered speculatively, with little data to stand on. PALEONILE is an ambitious project that will address these major gaps in our knowledge through large-scale surveys to reveal a new fossil record from the Middle Nile River Basin in Sudan. This project will test an overarching hypothesis of Pleistocene zoogeographic regionalization in the Nile Basin with respect to the EARV and surrounding areas, and will use an interdisciplinary array of paleontological, geological, geochronological, and archaeological approaches to reach its objectives. The geographic scale of the project is large and the techniques are cutting edge, including high-risk experimental methodologies such as paleobiomolecular recovery and new developments in sedimentary dating. PALEONILE forms the first ever large-scale systematic paleontological project to be conducted in Sudan, where the Cenozoic fossil record remains largely undiscovered, and its potential overlooked. PALEONILE will generate a new paradigm of zoogeographic dynamics and evolution in the African Pleistocene that represents a new synthesis of hydrographic, phylogenomic, archaeological, and paleontological evidence.

Link to the ERC project webpage:

Keywords of the ERC project: Paleontology; Africa; Nile; Human evolution; Pleistocene

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101052601	**SOFA**	**PE10** Earth System Science

Principal Investigator:	**Dr Christian George**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Spontaneous interfacial oxidant formation as a key driver for aerosol oxidation

Aerosols and clouds are key players in tropospheric chemistry. These tiny particles suspended in the air, with a radius ranging from a few nanometres to tens of micrometres, impact atmospheric composition, represent one of the largest uncertainties in climatic projections and cause millions of deaths worldwide every year. Hence, they have enormous societal and economic consequences. Nonetheless, there is still a knowledge gap preventing us from describing the chemical evolution of aerosols and clouds during their atmospheric lifetime. Supported by preliminary experiments, I therefore propose to unravel the impact of the spontaneous oxidant formation at the air/liquid interface as a key driver for multiphase oxidation processes.

Water molecules in bulk liquid are stable and inert under ambient conditions. In sharp contrast, it was very recently shown that the local orientation of water molecules at an air/water interface induces an electric field that generates spontaneous radicals in micron-sized droplets. This production does not involve any catalysts such as light or heat. It is an intrinsic property of the air/water interface, and therefore potentially ubiquitous in the troposphere.

This spontaneous interfacial oxidant formation has never been explored for its atmospheric significance. Therefore, the SOFA project aims to unravel the atmospheric importance of this interfacial (dark) chemistry. If oxidants (including OH radicals) are in fact spontaneously produced at the air-water interface, under atmospherically relevant concentrations, this would profoundly challenge our understanding and description of atmospheric multiphase chemistry.

SOFA will develop a novel strategy, scaling up from laboratory-based measurements to fieldwork and modelling to assess the importance of this interfacial chemistry. SOFA will advance an entirely new perspective on how to address the multiphase oxidation capacity of the troposphere, and will therefore have a wide impact.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101054994	**HotCores**	**PE10** Earth System Science

Principal Investigator:	**Dr Sébastien Merkel**
Host Institution:	Universite De Lille - FRA

High Temperature Dynamics of Metals and the Earth's Solid Inner Core

The Earth's inner-core (IC) is 1220 km radius planet within the Earth, made of solid iron (Fe) crystallizing from the outer core (OC) as the Earth cools down. The IC affects our life at the surface; its growth provides a major source of energy for maintaining the Earth's magnetic field. One may view the IC as a freezing ball of Fe floating at the center of the OC, but seismic exploration reveal structures of increasing complexity, raising fundamental questions on the history and internal dynamics of the IC. Geophysical observations unearth the IC as it is today. Understanding the history of the IC and the effect of the IC on the global Earth dynamics, however, requires a reconstruction based on today's observations and knowledge of the physical properties of the IC Fe alloy, how they could affect IC dynamics, and their relation with present-day geophysical observables. There are significant knowledge gaps and outdated principles regarding the underlying physical properties of the IC Fe alloy. The IC temperature is close to melting, and the IC might even be partially molten. How does temperature affect of the mechanical properties of the IC Fe alloy? What is the effect of temperature and partial melting on seismic observables such as wave travel time and attenuation? This is poorly known and it hinders our interpretation capability of the ever-growing body of geophysical observations. In HotCores, advanced high pressure and/or high temperature experiments will be performed on Fe alloys and analogues. I propose to reenact key events of the history of the IC in the laboratory, as Fe crystallizes at the inner-outer-core boundary, as the IC grows and dynamically evolves to its present state, and as we see it today through the lenses of geophysical exploration. What is the structure and dynamics of the IC? How will the IC evolve in the future? HotCores aims at providing the mineralogical foundation that will help solving these mysteries.

Link to the ERC project webpage: https://erc-hotcores.univ-lille.fr/

Keywords of the ERC project: High pressure, iron alloys, visco-elasticity, microstructures, seismic attenuation, synchrotron, hcp metals, Earth's inner core, seismic anisotropy, deformation mechanisms

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101039576	**POSEIDON**	**PE11** Materials Engineering

Principal Investigator:	**Dr Marco Miníaci**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Unconventional principles of underwater wave control in the sub-wavelength regime

The growing interest in marine renewable energy and ocean-related human activities are the main causes of an alarming increase of the noise level in the oceans and seas. Nevertheless, the performance of underwater noise mitigation systems has since long been (and still is) limited by the fact that dissipation in linear systems is inherently poor at the sub-wavelength scale. Consequently, a viable solution to attenuate underwater waves over low, broadband, and multiple frequencies does not exist, yet. POSEIDON aims to tackle the intrinsic reasons for such a scientific / technological delay and declares an ambitious goal: to develop a new class of meta-screens allowing zero-transmission / zero-radiation over low and broadband frequencies exploiting rather than avoiding complexities stemming from heavy-fluid/structure interaction and exhibiting practical structural requirements, such as being compact, lightweight, and efficient under hydrostatic pressure.

POSEIDON will take the risk of exploring two unconventional and ground-breaking approaches in the challenging context of extremely sub-wavelength underwater acoustics to design a new class of metamaterials allowing unprecedented low and broadband wave reflectivity and absorption:

1) anti-auxetic underwater metamaterials, exploring the intimate relationship between the micro-structure and the macroscopic vibrational properties of a multi-scale metamaterial immersed in a heavy-fluid and exhibiting Poisson's ratios > 0.5.

2) topologically protected and impedance adapted underwater metamaterials, assigning crystalline properties to non-crystalline materials by breaking precise classes of symmetries over multiple length scales.

Both approaches are supported by the innovative assumption that (3) underwater wave control through metamaterials be already exploited by Nature.

If successful, POSEIDON will fill the gap in the knowledge of underwater acoustics and significantly advance the frontiers of bottom-up material design.

Link to the ERC project webpage:

Keywords of the ERC project: Metamaterials, Acoustics, Wave Propagation, Elasticity

Keywords that characterize the scientific profile of the potential visiting researcher/s: Finite Element Modelling, Expertise in Wave Propagation

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101039683	**PROMETHEUS**	**PE11** Materials Engineering

Principal Investigator:	**Dr Dmitry Baranov**
Host Institution:	Fondazione Istituto Italiano Di Tecnologia - ITA

Engineering of Superfluorescent Nanocrystal Solids

The time is right for light-emitting colloidal nanocrystals to meet the demands of the second quantum revolution. The cooperative emission (superfluorescence) was recently observed in the micron-sized solids of colloidal lead halide perovskite nanocrystals, offering a path to low-cost, solution-processed sources of bright and coherent light. Superfluorescence, characterized by high-intensity and ultrashort bursts of indistinguishable photons, makes nanocrystal solids desired targets for photonics and quantum information applications. However, the exact origin of the superfluorescence is debated, and the rules of nanomaterial design for on-demand cooperativity are unknown.

PROMETHEUS tackles these issues by combining nanochemistry with spectroscopy and tools of quantum optics. The project's approach consists of 1) synthesis and judicious selection of emissive metal halide nanocrystals with minimal exciton energy inhomogeneity, 2) accelerated self-assembly of nanocrystals into binary solids with a tunable fraction of emitters, 3) cryogenic micro-photoluminescence spectroscopy at the level of individual nanocrystal solids. The control of the coupling between emissive nanocrystals is achieved by diluting optically-dense nanocrystal solids with a second, transparent nanocrystal component. Measurements of spectroscopic observables, coherence, and photon statistics on single nanocrystal solids are used to dissect the roots and properties of cooperative emission.

The project introduces a concept of light-coupled nanocrystal solids where light-matter interactions are engineered through structure and composition. This concept goes beyond metal halides and applies to emissive nanocrystals of any shape, opening a class of colloidal nanomaterials with light emission controllable between single-particle and many-body regimes. Such materials are expected to expand applications of emissive nanocrystals in quantum technologies and yield new uses in materials science.

Link to the ERC project webpage:

Keywords of the ERC project: superradiance, cooperative phenomena, self-assembly, nanocrystals, perovskites, quantum technology

Keywords that characterize the scientific profile of the potential visiting researcher/s: quantum optics, fluorescence microscopy, laser spectroscopy,

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Project ID:	Project Acronym:	Evaluation Panel:
101039748	**ELECTROCOFS**	**PE11** Materials Engineering

Principal Investigator:	**Dr Manuel Souto**
Host Institution:	Universidade De Aveiro - PRT

Molecular Design of Electrically Conductive Covalent Organic Frameworks as Efficient Electrodes for Lithium-Ion Batteries

A major breakthrough in chemistry and materials science has been the development of Lithium-Ion Batteries (LIBs), which show great potential for storing energy from renewable sources and as the power sources for electric cars. However, commercially available LIBs are based on transition metal oxide cathodes, presenting limited energy density and raising relevant environmental concerns. Organic materials have received much attention as alternative electrodes because of their high theoretical capacity, resources availability and sustainability. In particular, Covalent Organic Frameworks (COFs) have emerged in the past few years as promising organic electrode materials due to their high stability, high ionic conductivity and outstanding chemical and structural versatility. Low electrical conductivity remains the main bottleneck for real applications of COFs as electrode materials, usually addressed by adding in large amounts of conductive carbon additives that decrease the energy density of the battery.

The overarching objective of this project is to design and synthesize new conductive redox-active COFs as cathode materials to enhance LIBs electrochemical performance. The specific goals are:

a) To design a new family of stable redox-active COFs built from unexplored building blocks to achieve an optimal balance between capacity, electrical conductivity and porosity.

b) To investigate the role of the linkages, building blocks, doping, pressure, anisotropy and morphology on the electrical conductivity, unravelling the fundamental mechanisms of charge transport in COFs.

c) To manufacture and test lithium batteries using conductive COFs cathode materials, assessing the influence of the processing techniques on the electrochemical performance.

Link to the ERC project webpage: https://electromolmat.com/electrocofs/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101040057	**2D-sandwich**	**PE11** Materials Engineering

Principal Investigator:	**Dr Tim Verhagen**
Host Institution:	Fyzikalni Ustav Av Cr V.V.I - CZE

2D sandwiches, artificial layered building blocks for multifunctional materials

The possibility to create new materials bottom-up was enhanced via the stacking of atomically thin layers of two-dimensional (2D) materials with van der Waals interactions (vdWIs). Unfortunately, the downside of vdWIs is the, in general, weak electronical and mechanical interaction between the individual layers. This hinders the creation of multiferroic materials working at ambient conditions, which are despite extensive research still very scarce, from stacked layers with vdWIs.

This research aims to create a new 2D building block: the 2D sandwich. This is a layered heterostructure with a strong interaction between the sandwich's individual layers mediated via an ionic or multivalent bond, whereas the interaction with other layers is still solely due to the vdWIs. As the prototype functional material, a 2D magnetoelectric multiferroic sandwich composed of layered transition metal chalcogenides, oxides or iodides will be grown using the modulated elemental reactants method.

To tackle the possible sample degradation in the sandwiches, ultra-high vacuum optical surface science spectro-microscopy techniques will be developed to optically probe the 2D multiferroic sandwiches for both magnetism, ferroelectricity and the coupling between them.

The concept of open samples will be introduced, facilitating the scientific community with the straightforward verification of the data and accelerate the development of this new class of 2D sandwiches.

This project will provide material design strategies that can remove the stringent lattice matching criteria to stack different classes of layered materials and provide these class of layered materials with similar stacking freedom as layered materials with vdWIs. These insights will allow the interbreeding of different classes of layered quantum materials, such as complex oxides, 2D layered crystals with vdWIs, cuprate superconductors or topological insulators or semimetals.

Link to the ERC project webpage:

Keywords of the ERC project: heterostructure, multiferroic, van der Waals interactions, ionic bonding, multivalent bonding, modulated
elemental reactants method

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101040153	**IDOL**	**PE11** Materials Engineering

Principal Investigator:	**Dr Andrea Crovetto**
Host Institution:	Danmarks Tekniske Universitet - DNK

Inverse Design of Optoelectronic Phosphosulfides

Progress in sustainable energy technology relies on the discovery of new earth-abundant materials with unprecedented ability to conduct ions, catalyze reactions, transport photogenerated carriers, etc. The main scientific question is how to find the materials with exactly the desired functionality from the huge pool of all possible materials (more than 10^12).

In IDOL, we will attempt to answer the long-standing question of inverse materials design. Our targeted functionality is high optoelectronic quality (i.e., long photocarrier lifetimes, high mobilities, and high absorption coefficient) in an earth-abundant semiconductor with band gap above 1.5 eV. This will be a breakthrough in three areas key to a sustainable energy future: multijunction photovoltaics, light-emitting diodes, and solar fuels.

The IDOL approach is a combination of experimental and computational research, focusing on the most device-relevant material form: thin films. Initially, we will restrict our search to the intriguing and still highly underexplored family of phosphosulfides (PSs). Later, we will extend our insights to other chemistries. From my preliminary investigation, many PSs should exhibit high mobilities and appropriate band gaps.

We will break the inverse design problem into logically connected steps: from application-specific figures of merit, going back to defect properties, generic optoelectronic properties, structure, growth conditions, and composition. We will exploit a unique combinatorial deposition system to grow candidate materials and characterize them using high throughput facilities at our host. For properties not experimentally accessible, we will employ first-principles calculations. This hybrid dataset will be analyzed step-by-step by human intelligence and machine learning to formulate design criteria and generate new materials with the desired properties. The discovered PS with the highest figures of merit will be incorporated into an actual photovoltaic device.

Link to the ERC project webpage:

Keywords of the ERC project: materials science; thin films; materials discovery; solar cells; optoelectronics; phosphides; sulfides

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101041229	**JANUS BI**	**PE11** Materials Engineering

Principal Investigator:	**Dr Teresa Gatti**
Host Institution:	Politecnico Di Torino - ITA

All-liquid phase JANUS BIdimensional materials for functional nano-architectures and assemblies

Asymmetry is a key structural feature in natural systems and allows for self-organization and unidirectionality of chemical transformations. JANUS BI aims at developing an innovative protocol for the production of 2D materials bearing different functionalities on the two opposite sides. The challenge is to implement the full process in the liquid phase and thus not resorting to solid phase transfer techniques, which is the current state-of-the-art. With this new method, Janus 2D material colloidal inks can be directly produced and used as they are, or for further solution processing of thin-films and/or more complex architectures. The core of the project is the challenging protocol proposed, which rely on the versatility of liquid phase exfoliation (LPE) of 3D crystalline powders of intrinsically layered species to produce 2D material inks and on the large availability of chemical functionalization approaches for 2D materials, both aspects being soundly mastered by the PI of JANUS BI. A first exfoliation produces quasi-2D nanosheets, which are a-selectively functionalized with bulky groups so as to completely cover the exposed faces. The functionalized quasi-2D objects are then subjected to further LPE, providing single-faced functionalized 2D materials. A second functionalization step is forced to happen on the un-covered face, due to the steric hindrance of the pendant functionalities present on the other. The setting-up of a similar protocol requires a tight control over the nanochemistry and nanomorphology of the substrates employed, resulting in a substantial gain of knowledge in controlled functionalization processes for 2D colloids. Once the guidelines for its successful implementation are identified, the development of a whole library of Janus 2D inks is enabled and many further goals can be targeted, which are here exemplified by the construction of self-assembling superstructures/interfaces and of photoactive and photocatalytic nanosystems.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101041229

Keywords of the ERC project: 2D materials, liquid phase exfoliation, 2D material ink, Janus 2D material, 2D material functionalization, nanochemistry, photovoltaics, photocatalysis

Keywords that characterize the scientific profile of the potential visiting researcher/s: Chemist with specialization in nanomaterial chemistry, nanochemist, materials chemist, synthetic chemist, colloidal chemist

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Project ID:	Project Acronym:	Evaluation Panel:
101041871	**TexTOM**	**PE11** Materials Engineering

Principal Investigator:	**Dr Tilman Gruenewald**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

TexTOM - X-ray texture tomography as a tool to enable, multi-scale, in-situ imaging of the enthesis, a biological hinge between bone and tendon

Hierarchical structures are signature elements of many biological and technical materials. The orientational distribution of their crystalline constituents (the crystallographic texture) is important for their mechanical properties. Resolving the local structure and orientation spatially while keeping a large field of view is an unsolved problem. I will solve this by introducing texture tomography, a new 3D x-ray diffraction imaging method, the core of the TexTOM project. It will enable to study the enthesis, the biological connection between tendon and bone, and by in-situ deformation and micromechanical modelling, couple its hierarchical structure with the mechanical behaviour.

I will use the brilliance gain of 4th generation synchrotrons to develop texture tomography as a tool to image complex crystallographic textures in 3D and overcome the spatial resolution barriers of current approaches.

I will develop the reconstruction approach for the crystallographic texture and use it to image the whole enthesis structure with 100nm spatial resolution and, with high energy x-rays, image the enthesis structure during in-situ tensile deformation with µm resolution at several load steps. The unique combination of 3D texture information and loading will allow to build a micromechanical enthesis model.

The novelty lies in the structural 3D characterization of the enthesis under deformation. This is enabled by the development of texture tomography to reconstruct the 3D textures, which will be useful for many other scientific problems. I will build an accurate micromechanical enthesis model and this will shed light on the unknown load transfer mechanism in the enthesis on the nano- and crystal level.

The flexible, open-source approach of TexTOM will ensure adaptation for new users and scientific problems. 4th generation synchrotrons will propel texture tomography to the forefront of (bio)materials science, revolutionizing our study of crystallographic textures.

Link to the ERC project webpage: https://www.fresnel.fr/spip/spip.php?article2657&lang=en

Keywords of the ERC project: Biomaterials, hierarchical materials, x-ray diffraction, crystallographic texture, in-situ mechanics

Keywords that characterize the scientific profile of the potential visiting researcher/s: biomaterials, x-ray scattering, hierarchical materials, x-ray diffraction, inversion methods, multi-scale mechanics

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Project ID:	Project Acronym:	Evaluation Panel:
101042148	**4D-PhytoHybrid**	**PE11** Materials Engineering

Principal Investigator:	**Dr Eleni Stavrinidou**
Host Institution:	Linkopings Universitet - SWE

Plant based 4D biohybrid systems

Modern technology relies on fully artificial systems. While in many cases these systems are high performing there have been approaches to add further complexity or intelligence inspired by natural processes. Biomimetic systems however are purely synthetic and cannot fully mimic the high complexity of living systems. The overall goal of the 4D-PhytoHybrid is to develop photosynthetic biohybrid systems that maintain fundamental properties of the living components and set the foundation for the development of a generic hybrid technology. The biohybrid system will consist of four dimensions with increasing level of complexity and sophistication. The first dimension consists of the plant cells with their natural ability to photosynthesize and produce sugars, oxygen, sequester CO2 but also produce materials as cell wall components. The second dimension is represented by the non-native functionality of the living cells that is acquired with electronic, biocatalytic and structural materials that integrate into the plant cell wall. The third dimension is the 3D spatial organization of cells and physicochemical gradients with additive manufacturing. The fourth dimension is time that will enable responsive and evolvable functionality of the biohybrid system driven by the cell processes. I have a background in organic electronic materials, bioelectronics and plant based biohybrid systems. I was the first to demonstrate plants with augmented electronic functionality, but also to discover conjugate oligomers that can polymerized in vivo by the plant and assemble into functional components in the plant cell wall. My unique skillset and expertise will therefore ensure the successful implementation of the proposed high risk / high gain project. With the ERC funding, I will establish a team for developing next generation technology based on photosynthetic biohybrid systems in order to open the pathway for new technological concepts and launch a European hub for living technology.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: photosynthetic biohybrids, 3D bioprinting, organic electronics, plant biology, conjugated polymers

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101042751	**RE3MODEL**	**PE11** Materials Engineering

Principal Investigator:	**Dr Eoghan Cunnane**
Host Institution:	University Of Limerick - IRL

Representative, Reliable and Reproducible in vitro Models of the Human Testes

Western society is on the brink of a fertility crisis, whereby human sperm counts have dropped by 59% over the past four decades and are projected to reach zero by 2045. Treatments for the primary causes of male infertility have no scientific basis, with urologists relying on ineffective empirical medical strategies (guess work). Identifying effective male fertility treatments requires appropriate preclinical models of the sperm-producing testes that can establish a mechanistic basis for treatment choice, dosage and duration. Preclinical models must accurately represent the organ-specific tissue and be amenable to high-throughput experimentation with automated analysis to ensure that they provide representative, reliable and reproducible data. However, current models necessitate manual low-throughput methods and do not accurately represent testicular tissue as the pertinent tissue properties are unknown. The urological field therefore lacks an appropriate model of the testes upon which to evaluate male infertility treatments.

The applicant will address this gap by characterising the relevant properties of human testicular tissue, and establishing their effects on resident cell function. The resulting data will inform the development of a hydrogel material with properties tailored to match those of the native tissue. Microspheres of the representative hydrogel, containing primary testicular cells arranged to mimic the native tissue structure, will be fabricated using a high-throughput platform and analysed using an automated Raman spectroscope, thereby forming the first representative, reliable and reproducible model of the human testes. The RE3MODEL system will be validated against established in vitro models and used to determine the therapeutic mechanisms of current empirical medical strategies, while also identifying and optimising the most promising treatment approaches as an exemplar application.

Link to the ERC project webpage: https://mobile.twitter.com/emcunnane

Keywords of the ERC project: Male infertility, preclinical models, tissue charactiersation, tissue engineering, germ cell culture, spectroscopy, hydrogel fabrication/characterisation, microfluidics, automated analysis

Keywords that characterize the scientific profile of the potential visiting researcher/s: Tissue charactiersation, tissue engineering, germ cell culture, spectroscopy, hydrogel fabrication/characterisation, microfluidics, automated analysis

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101042781	**DREAM**	**PE11** Materials Engineering

Principal Investigator:	**Dr Daniel Grave**
Host Institution:	Ben-Gurion University Of The Negev - ISR

Design Rules for Efficient Photogeneration in Metal Oxides

Photoelectrochemical (PEC) water splitting is an attractive route for green hydrogen production. Despite nearly half a century of research efforts, no material has successfully met the stringent requirements for a photoelectrode material, the light harvesting semiconductor within the PEC cell. Metal-oxides are widely viewed as the most promising photoelectrode materials for their exceptional stability in aqueous electrolytes, but those with suitable band gaps for visible light absorption typically have open d shell configurations, and suffer from low photoconversion efficiencies. I hypothesize that the underperformance of such materials is related to their electronic configuration which reduces the photogeneration yield of mobile charge carriers, an overlooked yet critical loss mechanism in metal-oxides. Thus, unlike conventional semiconductors where all absorbed photons generate electrons and holes, in metal-oxides with open d shell configuration, many of the photons give rise to localized electronic transitions that do not contribute to the photocurrent. In addition, polaronic transport and charge carrier recombination reduce the charge carrier collection efficiency. DREAM will address these challenges and provide a leap forward in understanding the photogeneration processes in metal-oxide photoelectrodes and their effect on photoconversion efficiency. To achieve these goals, we will couple systematic control of crystallographic structure, d orbital occupancy, and local cation environment using heteroepitaxial thin film growth together with wavelength and temperature-resolved characterization of the photogeneration yield spectrum. The knowledge gained by these fundamental investigations will lead to new design rules, which we will employ to engineer new metal-oxides with near unity photogeneration yield, and integrate them into novel device architectures, enabling highly efficient PEC-PV tandem cells for unassisted solar water splitting.

Link to the ERC project webpage:

Keywords of the ERC project: Metal-oxides, Photogeneration Yield, Microwave Conductivity, Thin Films, Photoelectrochemistry, Solar Water Splitting, Green hydrogen

Keywords that characterize the scientific profile of the potential visiting researcher/s: Thin films, RF, Microwave, Transient Spectroscopy, Photoelectrochemistry, Metal oxides, solar cells, photovoltaics

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101043417	**Elmo**	**PE11** Materials Engineering

Principal Investigator:	**Dr Christian Müller**
Host Institution:	Chalmers Tekniska Hoegskola Ab - SWE

Electrical Modulation of Elastic Moduli

How could a textile change its feel upon the push of a button? While we are accustomed to visual displays and loudspeakers, interactive tactile perception largely eludes our experience. Electronic textiles that change their pliability and texture would allow for communication using our sense of touch. Potential applications abound, from human-machine interfaces for robotics to new forms of virtual reality.

To facilitate such a tuneable mechanical response, materials are needed whose stiffness can be switched electrically. This project will use conjugated polymers to realise materials that can be electrically switched between soft and hard.

Conjugated polymers can be anything from stretchable to tough. This project will establish that molecular and electrochemical doping allow to strongly alter the elastic modulus of soft conjugated polymers. Two parallel methodologies, based on electrophoresis and electrochemistry, will be explored to realise a reversible change from soft-as-skin to hard-as-bone upon application of an electrical stimulus. Finally, the developed materials will be integrated into prototype electronic textile devices that can undergo a reversible change in pliability and texture.

The explored materials science concepts will open up a new line of research in the blossoming field of organic electronics, while the application-oriented part of the project opens new horizons for the interdisciplinary field of wearable electronics.

Link to the ERC project webpage:

Keywords of the ERC project: polymer; elastic modulus; stimuli responsive materials; molecular doping; electrochemistry

Keywords that characterize the scientific profile of the potential visiting researcher/s: polymer; mechanical properties; electrochemistry

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101044020	**GIULIa**	**PE11** Materials Engineering

Principal Investigator: **Dr Teresa Pellegino**

Host Institution: Fondazione Istituto Italiano Di Tecnologia - ITA

MAGNETIC HYPERTHERMIA FOR METASTASIZED TUMOR TREATMENT AND REMOTE MANIPULATION OF MICRODEVICES

In magnetic hyperthermia (MHT), magnetic nanoparticles (MNPs) convert magneto-energy into heat under a time-varying magnetic field. MHT with MNPs is used in catalysis to promote reactions in solution and in cancer therapy, to 'burn' primary tumors in clinic, e.g. Glioblastoma, upon deposition of nanoparticles at the tumor site. The power of MHT, being an externally triggered approach to produce heat, goes beyond these actual uses. In GIULIa project I will apply MHT in tasks not yet explored to target the unmet needs of treatment of metastasized tumors and address MHT-mediated locomotion. MHT treatment of cancer metastases is now not doable because of scarce MNP dose accumulation at the spreading tumor sites. In GIULIa, MNPs designed for MHT, will be loaded in/on natural killer (NK) immune cells, which, intravenously injected, will deliver as Trojan horses the right dose of magnetic materials needed for MHT to the metastases. I will aim at raising the capability of NK and CAR-NK immune cells to infiltrate and recognize the tumor. This will merge synergic toxic effects of NK cells immunotherapy with MHT-heat damage of MNPs.

Next, magnetic microdevices and their remote locomotion based on MHT-heat gradient, represent a new technological solution for delivery purposes with no tissue-depth attenuation for their actuation. Under MHT, I will explore the localization of heat spots on metallic magnetic-based heterostructures as a means to generate bubbles in a liquid and drag an ad hoc designed magnetic-microdevices to which the heterostructures are anchored. For the scale-up synthesis of metallic-magnetic heterostructures needed for the microdevices, I will merge an in-flow approach to an MHT-route synthesis. The heat at the MNP surface will be used as an in situ energy source to promote the growth of the metallic domain on the MNP. Advanced NK cells and microdevice technology of GIULIa will impact the medical fields of MNP/drug delivery, immunotherapy and smart robotics.

Link to the ERC project webpage:

Keywords of the ERC project: magnetic hyperthermia, magnetic nanoparticles, magnetic particle imaging, immunotherapy NK cells, microdevice, magnetic manipulations

Keywords that characterize the scientific profile of the potential visiting researcher/s: medical students, chemist, physicist, biotechnologist, biologist

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101044468	**ARCHI-SKIN**	**PE11** Materials Engineering

Principal Investigator:	**Dr Anna Sandak**
Host Institution:	Innorenew Coe Center Odlicnosti Za Raziskave In Inovacije Na Podrocju Obnovljivih Materialov In Zdravega Bivanjskega Okolja - SVN

Bioinspired living skin for architecture

Biofilms, an assemblage of surface-associated microbial cells that is enclosed in an extracellular polymeric substance matrix, are recognised as one of the most stable biological systems on earth. The beneficial use of biofilms for protection is nearly unexplored since up-to-date research is focused on the prevention of its formation. In the ARCHI-SKIN project, we will explore the design principles underlying fungal biofilm to bridge the knowledge gap on the chemistry-structure-properties of the biological systems' interface. Mechanisms of biofilm formation, its structure, function, quorum sensing, and performance will be understood at multiple scales following the best practices of materiomics. It will be achieved by advancing state-of-the-art in-situ laboratory routines and use the latest mathware solutions in combination with the design-build-test-learn approach for the experimental work.

In the following step, we will develop a bioactive protective coating system working in conjunction with nature. We will benefit from the synergic strength of living fungal cells, bio-based ingredients, and bioinspired concepts for materials protection. Advanced in-silico methods will be used for the integration of active ingredients and modelling of optimal and long-lasting nutrient sources compatible with the enzymatic profile of selected fungal strains. We will design and create technically applicable, controlled, and optimized biofilm built by the yeast-like ubiquitous and widespread oligotroph fungus, Aureobasidium pullulans, that will effectively protect the surfaces of biomaterials, concrete, plastics, and metals, among others, assuring optimal service life performance and remarkable functionalities including self-healing and bioremediation.

Our pioneering approach for materials protection will push the boundaries of traditional materials concepts toward the development of engineered living materials capable to interact, adapt, and respond to environmental changes.

Link to the ERC project webpage: https://archiskinproject.eu/

Keywords of the ERC project: living coatings system, bioinspired materials design, engineered living materials, smart living surfaces

Keywords that characterize the scientific profile of the potential visiting researcher/s: biofilm, multi-mode spectroscopy and microscopy, microbiology, fungi, living materials

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101045098	**LEAP**	**PE11** Materials Engineering

Principal Investigator:	**Dr Feng Gao**
Host Institution:	Linkopings Universitet - SWE

Electrically Pumped Perovskite Lasers

Electrically pumped lasers are considered as a holy grail in the field of optoelectronics. Despite the success of lasers based on expensive epitaxially grown semiconductors, low-cost solution-processed semiconductors provide new opportunities to significantly expand the applications of lasers. On one hand, low-cost and scalable deposition can meet increasing demand of using lasers in consumer electronics. On the other hand, solution-processed semiconductors can be easily proceeded into thin films, providing great promise to develop thin-film lasers which are required for highly integrated photonics chips in advanced applications.

A superstar in the family of solution-processed semiconductors is metal halide perovskites, which have shown great success in a range of optoelectronic applications. Especially, recent breakthroughs on optically pumped perovskite lasers and high-performance perovskite light-emitting diodes indicate great potential of developing perovskites into a new generation of materials for electrically pumped lasers.

This project has the ambitious goal to realise solution-processed electrically pumped perovskite lasers. I will take a holistic approach, where novel concepts are proposed to address critical challenges on the development of perovskite lasers. Both type-I and type-II perovskite quantum well heterostructures, which utilise fundamentally different mechanisms to reach low thresholds, will be developed as the gain media. Edge-emitting devices based on these new perovskite gain media will then be coupled into rationally designed cavities for lasing actions. At the core of the research is the synthesis of new perovskite materials, combined with advanced spectroscopic characterizations and device/cavity development. This project makes use of recent advances in perovskite optoelectronics to create a new paradigm for electrically pumped perovskite lasers, and will open up new possibilities to revolutionize the current laser technology.

Link to the ERC project webpage:

Keywords of the ERC project: Metal halide perovskites, lasers, LEDs, photophysics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101045394	**UNIYARNS**	**PE11** Materials Engineering

Principal Investigator:	**Dr Juan José Vilatela**
Host Institution:	Fundacion Imdea Materiales - ESP

Universal processing route for high-performance nanostructured yarns

Yarns are a natural architecture to assemble small building blocks into macroscopic objects and are thus woven in our history, from fabrics of natural fibres in ancient times to fibres of synthetic polymers developed in the 20th century for lightweight applications. Humankind's new building blocks are nanomaterials, with superlative properties in all areas (optoelectronic, catalytic, transport, structural) relevant for global challenges related to energy use, storage and conversion. UNIYARNS proposes a new universal route for gas-phase assembly of one-dimensional nanomaterials into kilometric yarns, applicable to materials central to energy applications (metal oxides, semiconductors and semi-metals), and reaching high volume fractions without use of processing solvents or polymers. The strategy is to grow ultra-long nanomaterials by atmospheric-pressure floating catalyst chemical vapour deposition (FCCVD) at sufficiently high concentration for them to entangle and form aerogels suspended in the gas phase that can then be directly drawn as continuous, macroscopic yarns. The first objective of the project is to demonstrate the generality of the FCCVD synthesis process, with a particular focus on metal oxide nanowires. A further objective is to study the kinetics and reaction paths in 1D nanomaterials synthesis with floating catalyst in order to understand the exceptionally fast growth rate inherent to this synthesis mode and to explore its boundaries of selectivity and conversion. The next objective is to describe aerogel formation by determining factors at the aerogel network level and at the molecular-scale level that govern gas-phase assembly. The final objective is to establish clear structure-property relations for nanostructured yarn systems to overcome the current envelope of materials properties through the low charge transport resistance and high toughness of their network structure.

Link to the ERC project webpage: https://www.materials.imdea.org/groups/mng/

Keywords of the ERC project: nanowire, nanotextile, electrode, cvd

Keywords that characterize the scientific profile of the potential visiting researcher/s: synthesis, nanowire, electrode, fabric, cvd

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Project ID:	Project Acronym:	Evaluation Panel:
101045433	**KISSIES**	**PE11** Materials Engineering

Principal Investigator:	**Dr Rob Ameloot**
Host Institution:	Katholieke Universiteit Leuven - BEL

Kinetic selectivity in molecular sieve sensors

Detecting and monitoring volatile organic compounds (VOCs) is an important task with applications ranging from disease diagnosis via breath analysis to monitoring exposure to toxic chemicals. However, in all such applications, selectively measuring specific VOCs is challenging due to their low concentrations and the presence of a multitude of interfering compounds. Since current miniature sensors cannot efficiently distinguish between VOCs, there is a need for a novel technology capable of distinguishing a VOC of interest from a complex background.

KISSIES will address this challenge by bridging the worlds of porous crystalline materials and sensor technology. For the first time, kinetic selectivity in the tailored nanopores of metal-organic frameworks will be leveraged to mimic nature's approach to olfaction and enable selective sensing. This way, KISSIES will not only enable cross-fertilization between research fields that have thus far been separated by traditional subject boundaries but also open up perspectives on solving unaddressed real-world challenges. Moreover, the novel methodology that will be developed will have an impact beyond the scope of the project, in domains such as separation technology and adsorption measurements.

Link to the ERC project webpage: https://amelootgroup.org/

Keywords of the ERC project: Diffusion, nanoporous materials, metal-organic frameworks, zeolites

Keywords that characterize the scientific profile of the potential visiting researcher/s: Diffusion measurements in metal-organic frameworks and zeolites

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Project ID:	Project Acronym:	Evaluation Panel:
101076680	**PhotoSwim**	**PE11** Materials Engineering

Principal Investigator:	**Dr Katherine Villa**
Host Institution:	FUNDACIO PRIVADA INSTITUT CATALA D'INVESTIGACIO QUIMICA - ESP

Engineering of Photo-rechargeable Nanoswimmers using Multicomponent Heterojunctions

The realization of smart nanoswimmers capable of moving and performing desired tasks in an aqueous environment is a technological challenge due to the viscous and thermal forces exerted upon them. While various types of external stimulus can be used to activate their autonomous motion, light is the easiest to operate and most flexible, due to the opportunities that it offers for motion modulation through intensity, wavelength, and direction. However, such optical control is affected by the properties of the aqueous media, limiting the applicability of light-driven nanoswimmers to non-scattering environments. The novel approach of this project (PhotoSwim) is the design of hybrid nanoswimmers that consist not only of photocatalytic but also persistent luminescent materials in order to provide triple light-responsive, light-storage, and light-emissive properties at the material level. This project will explore the potential of these innovative photoactivated swimmers to: (1) store and emit sufficient light energy to maintain motion in the absence of external irradiation, (2) exhibit long-term luminescence for tracking purposes, (3) move and interact with their surroundings at high speeds due to efficient charge pair separation and (4) achieve a major control over their motion by wavelength tunability. The knowledge obtained will then be used to expand the applicability of these hybrid nanoswimmers in scenarios of limited light penetrability. Specifically, their capabilities to maintain their photoactivity in the presence of chemical and biological interferences, along with real-time monitoring of their location by the emitted luminescence, will be tested. In this way, the potential of advanced multi-functioning nanoswimmers to keep moving and interacting with the surroundings in scenarios where the light supply is not fully available will be demonstrated.

Link to the ERC project webpage:

Keywords of the ERC project: Photocatalysis, persistent luminescence, micro/nanomotors, numerical simulations, photodynamic therapy, active matter, long-after glow phosphors, heterostructures, nanostructures

Keywords that characterize the scientific profile of the potential visiting researcher/s: Material Science, Chemistry, Physics, Nanomaterials, Photophysics

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Project ID:	Project Acronym:	Evaluation Panel:
804104	**VALURED**	**SH1** Individuals, Markets and Organisations

Principal Investigator:	**Dr Paolo Giovanni Piacquadio**
Host Institution:	Universitaet St. Gallen - CHE

Value Judgments and Redistribution Policies

Heterogeneity and diversity are a pervasive aspect of modern societies. Differences in individuals' preferences, needs, skills, and information are key to explain variation in individuals' behavior and to anticipate individuals' responses to policy changes. There is no consensus, however, about how to take these differences into account when evaluating policies.

Project VALURED will reexamine this ethical challenge by characterizing the mapping between value judgments—i.e. principles of distributive justice—and redistribution policies. This mapping is tremendously important for welfare analysis and policy design. First, it associates the most desirable policy to each set of value judgments, providing an "ethical menu" to policy design. Second, it gives an ethical identity of each policy proposal, that is, it identifies the value judgments a policymaker endorses when proposing a specific policy.

The main objectives of VALURED are to:

1) identify transparent and compelling value judgments that accommodate heterogeneity and diversity;
2) show the implications of these value judgments for the evaluation and design of redistribution policies;
3) characterize welfare criteria that respect individuals' preferences and account for individuals' differences in needs, skills, and information;
4) provide new insights for the design of income, capital, and inheritance taxation;
5) develop simple formulas that express optimal policies as a function of observable heterogeneity and ethical parameters.

Project VALURED combines welfare economics with public economics. The first part deals with income taxation and addresses the ethical challenges related to individuals' heterogeneity in preferences, needs, and skills. The second part focuses on capital taxation and addresses individuals' differences in risk preferences and information. The third part analyses the design of inheritance taxation and addresses the social concerns for intergenerational and intragenerational equity.

Link to the ERC project webpage: https://fgn.unisg.ch/en/chairs/paolo-piacquadio/forschung-und-publikationen/erc-grant

Keywords of the ERC project: Normative economics; public economics; redistribution

Keywords that characterize the scientific profile of the potential visiting researcher/s: Economist interested in redistribution or normative economics

Project ID:	Project Acronym:	Evaluation Panel:
818767	**SharingGains**	**SH1** Individuals, Markets and Organisations

Principal Investigator:	**Dr Rocco Macchiavello**
Host Institution:	London School Of Economics And Political Science - GBR

Sharing Gains from Trade: Global Markets and Farmers Welfare in Developing Countries

The majority of the global poor live in rural areas and earn their livelihoods in agriculture. Linking farmers in developing countries (LDCs) to global markets, therefore, could potentially spur growth and reduce poverty. Market imperfections in agricultural chains in producing countries, however, limit these gains. Which policy tools, if any, help farmers in LDCs realize and share the gains from trade? I propose three broad projects that develop the tools to answer this question.

The first project designs and implements the first randomized control trial (RCT) to test for the causes and consequences of market failures interacting along multiple layers of agricultural value chains. This is a necessary step to design targeted policy responses.

The second project develops and estimates the first structural model of an agricultural value chain to evaluate different regulatory interventions. Historically, as well as today, governments have intervened in agricultural chains through a diverse array of policies and regulations. RCTs are not sufficient to evaluate these policies. The project develops flexible tools to perform counterfactual analysis and evaluate the merits of alternative policies and regulations in a variety of contexts.

The third project studies voluntary sustainability standards (VSSs) (e.g., Fair Trade, Rainforest Alliance). VSSs are increasingly popular responses to market failures in agricultural chains in LDCs. Unlike regulatory interventions, VSSs directly affect only market participants that take them up. The project combines quasi-experimental and structural techniques to evaluate the direct impact, the indirect spillover effects, and the broader distributional consequences of VSSs.

The three projects form a coherent research agenda that develops a comprehensive set of tools to evaluate existing agricultural policies and design better ones so that small producers in developing countries can realize and share the gains from globalization.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
833714	**COOKIES**	**SH1** Individuals, Markets and Organisations

Principal Investigator:	**Dr Bernd Skiera**
Host Institution:	Johann Wolfgang Goethe Universitaet Frankfurt Am Main - DEU

Economic Consequences of Restrictions on the Usage of Cookies

Cookies (or "HTTP cookies") enable companies to collect and exchange extensive information about users. This information is often used to improve the performance of online advertising, which website publishers rely on in order to finance the "free" content to which their users have become accustomed. Yet, the collection of information leads to a loss of privacy. Accordingly, EU policy makers have put forward initiatives to restrict cookie usage (e.g., General Data Protection Regulation (GDPR), upcoming EU ePrivacy Regulation).

So far, there exists very little empirical knowledge on the trade-off between user privacy and the economic value that website publishers, advertisers, and even users derive from cookies. As a result, policy makers have no way of telling whether their restrictions on cookies have the intended positive consequences for user privacy, or whether any benefits are outweighed by negative effects on the profits of companies—which policy makers also seek to nurture.

This proposal's vision is to eliminate the gap in knowledge regarding the economic consequences of restrictions on the usage of cookies. I propose four work packages, each outlining the economic consequences of a specific type of restriction. In WP1-3, I will analyze a proprietary and massive (60-65 TB) set of "cookie data" that includes 472 publishers, 842 advertisers, 2.8 billion cookies and the prices of >110 billion ad impressions, that indicate the value of cookies for companies. In WP4, I collect "implementation data" to analyze the steps taken by thousands of the world's most highly-trafficked websites to become GDPR-compliant.

My results will provide a crucial empirical foundation for cookie restrictions in an industry worth more than €10 billion per year in the EU. The required interdisciplinary research will also involve the development of novel methodologies for deriving such information from big data, and theories as to why the observed economic consequences occur.

Link to the ERC project webpage: https://www.marketing.uni-frankfurt.de/professoren/skiera/erc-advanced-grant.html

Keywords of the ERC project: consumer privacy; online advertising; GDPR

Keywords that characterize the scientific profile of the potential visiting researcher/s: empirical researcher with knowledge on online consumer privacy

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Project ID:	Project Acronym:	Evaluation Panel:
101001694	**IMEDMC**	**SH1** Individuals, Markets and Organisations

Principal Investigator:	**Dr Eduardo Perez**
Host Institution:	Fondation Nationale Des Sciences Politiques - FRA

Information and Misinformation Economics: Design, Manipulations and Coutermeasures

Informational environments are largely endogenous. They can be, and often are, chosen or designed by individuals or organizations with specific objectives in mind. As recognized by a large literature in economics, information plays a crucial role in shaping the outcome of downstream decisions by strategic players (i.e. at the receiving end of informative signals). However, the structure of information also impacts decisions by strategic agents upstream of the generation of signals, as agents mould the underlying reality differently depending on how other players will eventually be informed about it. Finally, designed information production systems are susceptible to manipulations by third party agents pursuing their own interests.

I will seek to further our understanding of socially or privately optimal information designs, how they shape upstream and downstream decisions, how they can be manipulated by private interests, and how to best anticipate and counter such manipulations. I will rely on the analysis of a largely unexplored designer-agent-receiver class of games, in which the designer picks an information generation system, the agent takes an upstream decision affecting the states of the world, or manipulates the production of information, and receivers choose downstream actions based on realized signals.

The project is organized around the different technologies available to the agent. I will consider fake news production, which is the fabrication of signals that pass as informative but are in fact independent of the truth; state falsification, which consists in falsifying the state of the world, or feeding the information production process with falsified data; pure agency, which is the possibility for the agent to secretly deviate to a different but undistinguishable information generation technology; and state shifting, which is the upstream effort an agent can exert to actually transform the probability distribution of states of the world.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101041334	**MacroTaxReforms**	**SH1** Individuals, Markets and Organisations

Principal Investigator:	**Dr Isaac Baley**
Host Institution:	Universitat Pompeu Fabra - ESP

The Macroeconomic Effects of Corporate Tax Reforms

Taxes paid by companies are a key source of government revenue. Among OECD countries, corporate taxes in 2018 accounted for an average of 10% of total tax revenue, 3.1% of GDP, and 5.7% of gross business profits. Beyond their importance for fiscal revenue, corporate taxes have large economic effects through their impact on private investment, a key driver of short-run fluctuations and long-run growth. Moreover, recent developments revived the interest in corporate taxation, including the massive debts accumulated during the pandemic, the exhaustion of monetary policy, the secular increase in business profits, and tax competition.

I will develop and apply new structural frameworks to assess the macroeconomic impact of corporate tax reforms on business cycle fluctuations, capital misallocation, capital valuation. Relative to the literature, my investigation integrates important dimensions that have not been jointly examined before due to their complexity, including (1) the interaction of corporate taxes and empirically relevant investment frictions, (2) the richness of firm heterogeneity in the microdata, (3) the general equilibrium feedback and dynamic effects that differentiate short and the long-run responses, and (4) the relationship with monetary policy. I will apply methodological advances that I recently developed which overcome the technical challenges and allow me to contribute to the state-of-the-art by incorporating all of these dimensions into the analysis.

Part I develops the theory to formalize how corporate taxes determine macroeconomic outcomes and conduct counterfactuals.

Part II combines the theory with cross-country data to provide systematic evidence on the impact of corporate tax reforms, organize the historical experience, and derive policy recommendations.

Part III examines how the corporate tax regime mediates the effects of monetary policy, and how the stance of monetary policy shapes the effects of tax reforms.

Link to the ERC project webpage:

Keywords of the ERC project: corporate taxes, tax reforms, investment, convex and non-convex adjustment costs, irreversibility, monetary policy

Keywords that characterize the scientific profile of the potential visiting researcher/s: pre-doc, ph students, post-docs

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Project ID:	Project Acronym:	Evaluation Panel:
101042069	**HousingAndMortgages**	**SH1** Individuals, Markets and Organisations

Principal Investigator:	**Dr Nicola Pavanini**
Host Institution:	Stichting Katholieke Universiteit Brabant Universiteit Van Tilburg - NLD

Welfare, redistribution and financial stability in housing and mortgage markets

Worldwide, housing wealth represents the most important asset in households' balance sheet, and mortgage debt is the most important liability. In the past two decades, several countries have experienced house price bubbles, excessive households' leverage, and increasing risk-taking behavior of banks. To limit these phenomena, and in response to the 2008 financial crisis, new regulations have been introduced in housing and mortgage markets. The lack of disaggregate and extensive micro level data on housing and mortgages has so far prevented researchers from carefully investigating these events and the effectiveness of regulation. This project will bridge this gap. I will assemble a unique and extensive platform of datasets on housing and mortgage markets, combining disaggregate information on housing transactions, buyers and sellers, and loan level data on mortgages for two European countries, the Netherlands and Norway. These data will be used to develop and estimate novel structural econometric models of demand and supply in housing and mortgage markets. These models will serve to investigate three main questions of concern to policymakers, and to evaluate the welfare effects of existing and alternative regulations via counterfactual simulations. First, I will investigate a novel demand channel of housing and mortgages driven by the rise of accommodation sharing platforms such as Airbnb. While these platforms provide extra income to households renting their property, they also fuel housing bubbles and affect mortgage markets. Second, I will evaluate the role of mortgage securitization in reducing lenders' funding costs, quantify its effect on lenders' risk taking behavior, and propose regulations to balance this trade off. Last, I will document the distributional effects of leverage regulations, that have helped to reduce credit risk, but have also disproportionally penalized low income households and first time buyers, worsening income and wealth inequality.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101043127	**LABFLEX**	**SH1** Individuals, Markets and Organisations

Principal Investigator:	**Dr Manudeep Bhuller**
Host Institution:	Universitetet I Oslo - NOR

Causes and Consequences of Labor Market Flexibility

Globalization and technological change have transformed the workplace and the organization of labor. At the core of these major developments is the degree of flexibility in the labor market. Alternative work arrangements, e.g., outsourcing, sub-contracting, flexible scheduling, and flexible pay jobs have become a common feature of labor markets across the globe. While most economists would argue that labor market flexibility facilitates reaping the benefits of globalization and technology growth, these developments can have far reaching consequences for the division of resources in society. Indeed, the recent decades have witnessed a sharp rise in wage inequality. LABFLEX is motivated by these developments and seeks to investigate the causes and consequences of labor market flexibility.

LABFLEX raises a series of questions: Do differences in job contracts reflect shifts in worker preferences, or do they mirror advances in technology that facilitate gains from organizing job tasks differently? What are the impacts of flexibility in job contracts on wage inequality and gender wage gaps? Are workers being compensated for the adverse work conditions or the higher income risks, or do changes in job contracts reflect changes in the sharing of rents between workers and firms? How do labor market institutions affect flexibility? And what is the role of labor market policies?

To answer these questions, LABFLEX will for the first-time link register data to large-scale experimental evidence on workers' stated preferences for a wide array of work and pay arrangements, and an exhaustive full-text corpus of vacancies with information on job attributes. This will allow drawing a very detailed picture of both the supply and the demand side of the labor market, facilitating a study of flexibility in job contracts. Combining these data with experimental and structural methods, LABFLEX will provide new evidence on the causes and consequences of labor market flexibility.

Link to the ERC project webpage:

Keywords of the ERC project: Labor Market Flexibility, Alternative Work Arrangements, Wage Inequality, Firm Performance, Collective Bargaining

Keywords that characterize the scientific profile of the potential visiting researcher/s: Labor Market Flexibility, Alternative Work Arrangements, Wage Inequality, Firm Performance, Collective Bargaining

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Project ID:	Project Acronym:	Evaluation Panel:
802070	**BROKEX**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Heidi Østbø Haugen**
Host Institution:	Universitetet I Oslo - NOR

Brokering China's Extraversion: An Ethnographic Analysis of Transnational Arbitration

Chinese global engagements are deepening across sectors and geographic regions. The objective of BROKEX is to fill specific gaps in knowledge about how China's extraversion advances. The project takes an original approach by examining brokers who mediate in transnational fields. It opens the "black box" of China's global integration by moving beyond descriptions of input and output characteristics to elucidate underlying dynamics. The objective will be achieved in two phases. First, the PI and two postdoctoral researchers will carry out three ethnographic case studies that yield complementary information on the common challenge of brokering across geographic scales: (1) Connecting low-cost Chinese manufacturing with African markets; (2) Integrating Chinese academic research with global scientific communities; (3) Attracting new foreign investments to China to underpin industrial upgrading. The diverse cases offer insights into the mechanisms of brokerage across distinctive sectors. The team will collect data in the Pearl River Delta, South China, while based at Sun Yat-sen University, with which the PI has longstanding collaboration. In the second step, we build on the empirical findings and extant literature to develop brokerage theory. Social scientific research on brokerage commonly uses the morphology of social networks as its starting point, and focuses on how actors positioned at the intersection between groups operate. BROKEX adopts an innovative approach by examining how actors strategically seek to shape network morphologies in order to bridge gaps between groups. By directing theoretical attention towards relationship formation that precedes acts of brokerage, this line of inquiry advances understandings of how and why brokered connections emerge. Ethnographic case studies combined with critical theorization will generate new knowledge about the processes beneath the "rise of China" – one of the most consequential socioeconomic developments of our times.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: China's international engagements; migration, the Greater Bay Area

Project ID:	Project Acronym:	Evaluation Panel:
802362	**BIT-ACT**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Alice Mattoni**
Host Institution:	Alma Mater Studiorum-Universita Di Bologna - ITA

Bottom-up initiatives and anti-corruption technologies: how citizens use ICTs to fight corruption

Corruption is a global challenge that affects the lives of millions of citizens. In the past decade, Information and Communication Technologies (ICTs) have become indispensable tools in the fight to reduce corruption, especially when employed from the bottom-up by civil society organizations. While pioneering initiatives in this direction have flourished, to date we only have unsystematic and descriptive evidence regarding how they work and the associated consequences. With the objective of significantly advancing knowledge on this topic, BIT-ACT will open a new line of inquiry by investigating what I call anti-corruption technologies (ACTs) to: (1) assess how civil society organizations engage with ACTs to counter corruption, (2) appraise how ACTs enable intersections between bottom-up and top-down efforts against corruption, and (3) evaluate how ACTs blend with the transnational dimension in the struggle against corruption. Based on an interdisciplinary framework that combines corruption studies, science and technology studies and social movement studies, BIT-ACT will use the constructivist grounded theory method to analyze a combination of textual and visual data in a comparative and transnational research design including nine countries – Algeria, Bangladesh, Brazil, Estonia, India, Italy, Spain, Ukraine, Uruguay. BIT-ACT will be groundbreaking in three ways. At the theoretical level, it will expand the debate on anti-corruption providing grounded concepts and models to explain ACTs; at the empirical level, it will advance knowledge on how the usage of ACTs is changing the relationship between citizens and democratic institutions; at the methodological level, it will innovate in the use of grounded theory assessing a new standard for cross-national comparative grounded theory. Finally, BIT-ACT will produce sound and useful knowledge for the stakeholders involved in the fight against corruption worldwide by suggesting how to best employ ICTs from the bottom-up.

Link to the ERC project webpage: https://site.unibo.it/bit-act/en

Keywords of the ERC project: social movements, civil society, digital media, anticorruption, qualitative methods

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
802891	**LINKS**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Nadia Ameli**
Host Institution:	University College London - GBR

Kick-starting global cLimate Investments:
uncovering hidden liNks in climate finance and exploring dynamic evolution of investment networKs for policy deSign

LINKS aims to contribute to a transformation of the climate finance system to deliver the scale and quality of investment needed to meet the Paris climate goals and ensure effective capital allocation. By understanding the architecture of the financial system, exploring macro patterns in low-carbon investment emerging from observed investors' behaviour and interactions, and designing cross-cutting policies aligned with long-term climate targets, LINKS will promote essential guidance for a re-orientation of financial flows towards low-carbon and energy efficiency investments.
LINKS aims to advance the understanding of the role of climate finance to foster the low-carbon transition by using network theory, advanced computational techniques and extensive empirical data to model the financial system as a complex adaptive system. LINKS will thus lay the foundations of, and pioneer a new field, namely climate finance networks, where dynamics of interconnected investors represented as a network, results in the complex behavior of the whole system.

LINKS will bring together interdisciplinary theories and developments in finance, environmental economics, sociology, computer science, network analysis and complexity in an integrated approach to study and model climate finance. Taking this approach will allow advancements in at least three directions: i) a new theoretical approach to account for complexity thinking and systemic perspective in climate finance, ii) more empirical analyses on networks structures of low-carbon investments and their dynamics to shape the development of the climate finance system, iii) policy modelling analyses to explore whether specific architectures of the climate finance system have significant impact on the effectiveness of climate public policies and invested public resources. LINKS will thus deliver robust conclusions on how the financial system could contribute to the required investments to achieve the low-carbon transition.

Link to the ERC project webpage: https://links-erc.eu/

Keywords of the ERC project: climate finance; network; complexity; low-carbon investments

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
833177	**DiCED**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Rachel Gibson**
Host Institution:	The University Of Manchester - GBR

Digital Campaigning and Electoral Democracy

Overview: This project will set a new agenda and direction for the study of political campaigns. It will examine whether and how new digital technologies are transforming election campaigns and citizen behaviour in new and established democracies. More specifically, it will assess claims that democracies are now entering a new data-driven era of political campaigning that is profoundly reconfiguring how campaigns' are run, who runs them and their implications for the quality of voter decision-making, the vibrancy of political parties and ultimately, the future of representative democracy. It will do so in three main stages: (1) First, it will define what data-driven campaigning is and critically assess whether it forms new and distinct era of electioneering in conceptual and historical terms? In particular, it will argue that the two key traits of this new mode of campaigning are the increased individualization or micro-targeting of party messages and the automated use of misinformation to mobilize and persuade voters. (2) Based on this definition it will map the 'supply' of the new mode of campaigning across new and older democracies by designing an innovative new index to compare use of data-driven techniques by parties. Where is it most commonly seen and why are some parties and countries more likely to promote its growth? (3) Finally, it will assess the impact of these new methods on key political actors and assess the consequences for the longer term future of liberal democracy. Does use of these techniques help counter recent declines in voter turnout by identifying under-mobilized groups? Or, do they ensure parties focus on the already engaged, bypassing those that are harder to reach? Can data-driven campaigning improve citizen choices by giving them the information on the issues they primarily care about or does it help to increase disinformation and even manipulation of voter choices?

Link to the ERC project webpage: https://sites.manchester.ac.uk/diced/

Keywords of the ERC project: Digital, Data-Driven, Campaigning, Elections,

Keywords that characterize the scientific profile of the potential visiting researcher/s: Social Data Science, Social Media and Elections Analyst, Big Data and Politics

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
834709	**BIOSPACE**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Andrew Skidmore**
Host Institution:	Universiteit Twente - NLD

Monitoring Biodiversity from Space

Life, with all its diversity, is in crisis. As humans increasingly encroach on biologically complex semi- natural landscapes, no organism, place or ecological function remains unaffected. While all 196 parties (195 countries plus the European Union) to the UN Convention on Biodiversity (CBD) have agreed to monitor the state of biodiversity, the currently available methods to do so leave much to be desired. Traditional monitoring involves the field observation of species by trained specialists, aided by skilled volunteers, whose expertise is restricted to specific biotic groupings. In a process that is both time consuming and inconsistent across time and space, botanists identify and record the presence of plant species and ornithologists the bird biota, resulting in 'unpopular' biotic groups such as fungi, bacteria and insects being under-observed or escaping identification altogether. In this project, a fundamentally different approach to terrestrial biodiversity monitoring couples next generation satellite remote sensing with environmental DNA (eDNA) profiling, complemented where available by legacy human-observed datasets. Satellite remote sensing is able to survey the environment as a single, continuous, fine-resolution map, while eDNA profiling can rapidly quantify much greater taxonomical and functional breadth and depth than human field observation. This project combines, for the first time, these two powerful, cutting-edge techniques for monitoring biodiversity at the global level in a consistent manner. Following from this, another key innovation will be the deepening of our scientific understanding of how biodiversity is impacted by anthropogenic pressure as well as by natural environmental gradients. In concert, these scientific developments will enable the accurate and fine grain monitoring of biodiversity from space – a ground-breaking contribution to the quest to meet the UN Sustainable Development Goals and CBD Aichi targets.

Link to the ERC project webpage: https://www.bio-space.nl/

Keywords of the ERC project: spatial ecology, environmental DNA (eDNA), remote sensing, GIS, microbiome, image spectroscopy, deep learning, R, Python, forest degradation and stress

Keywords that characterize the scientific profile of the potential visiting researcher/s: spatial ecology, forest stress, environmental DNA (eDNA), microbiome, remote sensing, image spectroscopy, GIS, R, Python

Project ID:	Project Acronym:	Evaluation Panel:
851940	**RadicalHOUSING**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Michele Lancione**
Host Institution:	Politecnico Di Torino - ITA

Radical Housing: Cities and the global fight against housing precarity

According to UN-Habitat, each year millions of people face forced eviction from their homes, while a staggering 1.6 billion are inadequately housed. Forecasts suggest housing precarity will continue to grow in future, worldwide. In response, grassroots housing movements are becoming increasingly common. Crucially, these groups fight for more than just housing, often advancing critiques of wider societal inequalities. Yet little is known of the broader significance of these struggles, and research has failed to offer an understanding of geographically dispersed movements. The ways in which the fight for the right to housing operates is essential to understand contemporary urban life. RadicalHOUSING will fill these critical gaps through an innovative Radical Housing Approach and pioneering empirical research at a global scale.

First, the project identifies the importance of a historical understanding of dwelling precarity, to appreciate the relevance of housing struggles worldwide (Objective I). Second, it investigates and profiles prominent grassroots networks in the Americas, Europe, Africa, and Asia to analyse their goals and organisational culture (Objective II). To appreciate the wider significance of radical housing resistance, the project deploys an ambitious ethnographic encounter with grassroots struggles in eight emblematic cities (Objective III). It then brings selected participants and experts together in a Global Forum of Radical Housing, fostering the exchange of peer-to-peer knowledge to generate further findings (Objective IV). Finally, the project will gather these insights into an innovative critical comparative framework, which will lead to agenda-setting publications, interventions, and academic scholarship (Objective V).

RadicalHOUSING is a ground-breaking project that will contribute to housing, urban and geographical studies, as well as to grassroots knowledge, opening a new phase in understanding the global fight against housing precarity.

Link to the ERC project webpage: www.beyondinhabitation.org

Keywords of the ERC project: Housing, Geography, Urban Studies

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
852334	**MIDEBT**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Matthew Digiuseppe**
Host Institution:	Universiteit Leiden - NLD

The Micro-foundations of Debt Crises

This project takes a new bottom-up approach to understanding the political roots of government debt crises. It proposes that in order to understand why governments borrow excessively and experience crises, we must first understand what citizens are thinking (or not thinking) about debt policy. Citizens' preferences are the cornerstone of political theories because they inform policymakers' incentives. Yet, no studies have systematically examined why citizens in some countries are willing to take steps before a crisis to reduce government debt while others ignore warnings and reward political inaction.

This proposal pursues two successive objectives.

First, the project will conduct the first comprehensive analysis of individual-level preferences for debt reduction before a crisis. It will develop and test multiple hypotheses that seek to explain which elements of society are (un)supportive of debt reduction policies, what rational or irrational factors motivate their decisions, and how stable these preferences are to manipulation by elites. The analysis centers around original and innovative multi-country survey experiments that elicit the character and stability of preferences for debt reduction.

The project's second phase uses these insights to connect the micro to the macro. By understanding which groups of citizens are motivated by which material factors or cognitive biases, we will develop new theories explaining how the distribution of these groups, and their interaction with institutions, influence political decisions and ultimately affect the risk of sovereign debt crises. This analysis will include two empirical innovations. First, it will include the first ever survey experiment conducted on actual bond traders to determine which country political and economic factors are most important in assessing credit risk. Second, it will produce a new data set of government attempts to engage in debt reduction.

Link to the ERC project webpage:

Keywords of the ERC project: sovereign debt, political economy, survey experiments

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
852990	**N-EXTLAW**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Marija Bartl**
Host Institution:	Universiteit Van Amsterdam - NLD

Law as Vehicle for Social Change: Mainstreaming Non-Extractive Economic Practices

The current economic model is overdue for revision. The relentless focus on economic growth is ravaging the environment, and the concomitant social problems have either already reached glaring levels (rocketing global inequality) or seem poised to do so (climate displaced persons). A number of radical proposals, such as prosperity without growth, circular economy, or doughnut economics, have been proposed to chart a trajectory towards socio-ecological transformation, arguing that a profound change in our ways of living and modes of production is necessary in order to respond to the threats we face. Yet such proposals, however commendable, have gained only modest political traction, insofar as they seem unthinkable from the vantage point of our current economic system, consumption patterns, political discourse and legal institutions.

This project will show how law can contribute to making such transformative projects politically credible. More specifically, it will demonstrate how law, and private law in particular, can be used to nurture those existing economic practices that already build on the environmental and social aspirations embodied by such projects. The two main objectives are, first, to offer a set of legal tools and policy proposals that would make the adoption of environmentally and socially non-extractive economic practices, such as social cooperatives or solidary financial institutions, more attractive for people to implement. Second, N-EXTLAW theorizes how law can turn seemingly utopian projects for socio-ecological transformation into a realistic legal-political project. By refashioning the concrete socio-legal arrangements for pursuing non-extractive economic practices as well as re-shaping the values on which economic decision-making draws, law can make non-extractive economic practices more present in everyday action, and thereby uphold those cultural frames that affirm the sense that socio-ecological transformation is within our reach.

Link to the ERC project webpage: https://www.nonextractivefuture.eu/

Keywords of the ERC project: private law, sustainable business practices, socio-ecological transformation

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
853050	**SMOOTH**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Emanuele Campiglio**
Host Institution:	Alma Mater Studiorum-Universita Di Bologna - ITA

Sustainable finance for a smooth low-carbon transition

The threat of climate change calls for a rapid transition to a low-carbon society. Aligning the financial system with climate stability is a crucial prerequisite for achieving decarbonisation while preserving economic prosperity and societal welfare. However, we currently lack a comprehensive understanding of how the institutional and behavioural features of financial systems may affect the speed and shape of the low-carbon transition. Additionally, the coevolving socioeconomic, financial and environmental repercussions of such a large-scale societal transformation have not yet been systematically analysed. The SMOOTH project will lay the foundations of an innovative macro-financial analytical framework to provide essential insights on the links between financial systems and decarbonisation dynamics. Methodologically, I will introduce a breakthrough by linking macroeconomic analysis with an original evidence-based representation of investment decisions based on forward-looking expectations of transition pathways. In the course of five years, this integrated modelling framework will enable the first comprehensive assessment of the transition financial drivers and obstacles, and their implications for growth, financial stability, employment, private/public debt and functional distribution, with a focus on Europe. Building on this knowledge, a harmonised set of policies aimed at achieving a rapid and smooth transition can be designed. I will go beyond the current state of the art by integrating the analysis of fiscal policies with monetary policies and financial regulation, and investigating their institutional requirements and implications. SMOOTH will create a new interdisciplinary field of research integrating elements from macroeconomic modelling, climate economics, behavioural finance, socio-technical transition theory and political science, lifting the analytical power of transition modelling to a new level and opening up novel avenues for future research.

Link to the ERC project webpage: https://site.unibo.it/smooth/en

Keywords of the ERC project: climate macroeconomics; low-carbon transition; modelling; beliefs; heterogeneous expectations; production networks; central banking; green finance; innovation

Keywords that characterize the scientific profile of the potential visiting researcher/s: climate macroeconomics; low-carbon transition; modelling; beliefs; heterogeneous expectations; production networks; central banking; green finance; innovation

Project ID:	Project Acronym:	Evaluation Panel:
865088	**NEWNEWS**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Joost Van Spanje**
Host Institution:	Royal Holloway And Bedford New College - GBR

New Parties on the News: How New(s) Media and New Parties Shape Attention and Electoral Support for Political Ideas

For democracy, a necessary condition is openness to new political ideas. New ideas are often advanced by new political parties. New parties must rely on media to communicate with the electorate. In the process of that communication, it is inevitable that these media largely shape new parties' public image.

However, studies of new parties pay little attention to media. Vice versa, studies of media pay little attention to new parties.

As a result, we lack a full explanation of new party emergence. This hinders our understanding of the openness of democratic systems, and of their current renewal. While Vox, M5S, and AfD experience unprecedented success, we hardly know

1. how (much) news media cover new parties;
2. what factors shape that coverage;
3. how (much) that coverage facilitates new party emergence;
4. how (much) social media use facilitates new party emergence.

NEWNEWS addresses these questions by developing and testing an Integrative Framework of Political Party Gatekeeping. It adds to the literature in terms of theory ('bringing in' media and voter perceptions) and methodology (experimental methods and data science).

The project seizes new opportunities:

-Thanks to cutting edge analytical models, it adequately tests causes and electoral effects of that coverage, taking into account agency of new parties and heterogeneity of news outlets and voters;

-Thanks to recent data collection, it encompasses all national-level new parties in 19 countries since 1950 (instead of only successful ones);

-Thanks to innovations in automated content analysis, it maps national-level coverage of these parties in various offline and online sources (instead of only newspapers).

NEWNEWS will reveal media portrayals of new parties, how these portrayals vary, and how they matter for election outcomes. This way, it will offer a novel theoretical framework, conceptualisations, operationalisations, data, and algorithms – and open up new lines of research on media and new voices.

Link to the ERC project webpage: www.newnewsproject.com

Keywords of the ERC project: Political parties; elections; media

Keywords that characterize the scientific profile of the potential visiting researcher/s: Strong focus on research design and quant methods.

Project ID:	Project Acronym:	Evaluation Panel:
865564	**EARLY-ADAPT**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Joan Ballester**
Host Institution:	Fundacion Privada Instituto De Salud Global Barcelona - ESP

Signs of Early Adaptation to Climate Change

Nearly 8% of deaths are attributable to ambient temperatures, but little is known about the future impact in a warming world. I conducted studies in high-impact journals showing that this death toll can be largely reduced if a substantial degree of adaptation to ambient temperatures takes place. Adaptation strategies have been increasingly implemented in Europe in recent years, but the last IPCC report indicated that evidence of their effectiveness is still lacking. I postulate that adaptation measures are starting to generate positive benefits for the wellbeing of societies, including an adaptive response to climate change, but the degree to which they are effectively reducing human vulnerability is largely heterogeneous among and within European societies. I aim to describe the major sources of vulnerability, and if, which and to what extent societies have already started to adapt to changing conditions. Towards this aim, I will use predictive models to quantify the potential beneficial effect of early adaptation strategies through the attribution of temporal changes in human vulnerability. For that purpose, I will generate a massive database with daily counts of death for different subdomains and spatial resolutions, including data for countries, regions, cities and neighbourhoods, together with the best available climate, air pollution, influenza, socioeconomic and demographic datasets. In addition, I will combine the best epidemiological techniques with weather and climate forecasts and climate change simulations to perform an integrated predictability assessment of mortality risks and provide a realistic re-estimation of the likely range of future heat- and cold- attributable mortality. Expected results will provide a better understanding of the real impact of adaptation measures, which is key for decision-making and the design of strategies minimizing the negative impacts of future temperature rises in Europe.

Link to the ERC project webpage: https://early-adapt.eu/

Keywords of the ERC project: Global Warming, Climate Impact and Predictability, Temperature, Urban Heat Island Effect, Air Pollution, Risk
Factors, Attributable Mortality, Vulnerability, Early Adaptation, Resilience, Europe

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
866155	**NUCLEARREV**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Andrew Futter**
Host Institution:	University Of Leicester - GBR

Towards a Third Nuclear Age? Strategic Conventional Weapons and the Next Revolution in Global Nuclear Order

The world stands on the cusp of a major transformation in nuclear affairs. This paradigmatic shift is being driven by the development and deployment of an entirely new class of strategic weaponry, facilitated by the latest information revolution. The most important characteristics of these weapons are that they are all hi-tech and non-nuclear; that they can be used against an adversary's nuclear forces, and that they are increasingly able to augment and even replace nuclear weapons for key national security functions. Taken together, we can think of these of these systems as Strategic Conventional Weapons (SCW), and as representing a fundamental challenge to the way that our nuclear world is managed. SCW raise questions about deterrence strategy, mutually assured destruction, future arms racing and arms control, and how best to retain and maintain global nuclear stability and peace. NUCLEARREV will therefore provide the first ever systematic scholarly study of SCW, make the case for a paradigmatic shift in nuclear studies, set the stage for a complete rethinking of the global nuclear order. The main research question is: How will Strategic Conventional Weapons change the Global Nuclear Order? To answer this the objectives are to: Chart the SCW phenomenon, globally; Analyse how SCW will impact regional nuclear relations and balances; Examine what the development of SCW means for the frameworks and dogma that govern international nuclear relations; Make the case for a revolution in nuclear affairs and define the embryonic Third Nuclear Age. This urgently required research will provide the landmark study of this phenomenon and the centrepiece for a whole new generation of interdisciplinary and multidisciplinary work on nuclear affairs. The project combines interviews with politicians, defence contractors, scientists, bureaucrats, and experts across the world; an innovative War Game exercise, as well as extensive archival research and Regional Feedback Workshops.

Link to the ERC project webpage: https://thethirdnuclearage.com

Keywords of the ERC project: Nuclear weapons, deterrence, disarmament, security

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
946012	**EmergentCommunity**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Eeva Puumala**
Host Institution:	Tampereen Korkeakoulusaatio Sr - FIN

Coexistence and conflict in the age of complexity: An interdisciplinary study of community dynamics

Polarization and inequality amongst citizens are on the rise across Europe. In a context of multiple, and intersecting forms of diversity, peaceful coexistence has been increasingly placed under sustained pressure. Crucially, the urgency of finding sustainable solutions to these developments is constrained by a lack of conceptual and theoretical nuance that inhibits critical thinking about emergent constellations of social and political life. This project explores how affective orientations and everyday practices of peace and conflict intertwine and influence societies. In this respect, the study adopts an interdisciplinary research design that uses multi-sited ethnography, immersive virtual technologies, and psycho-physiological measuring to provide cutting-edge insight into community dynamics. The study will provide new grounded knowledge on how societies hold together whilst social and political positions within and between communities multiply. Using complexity as an analytical angle, the project considers the relations, tensions, and forms of collaboration that unfold in the course of everyday life in nine urban neighbourhoods in Finland, Sweden and France. The three countries share a mix of similarities and differences through which the variations in community dynamics and their societal consequences can be identified. Through the adopted interdisciplinary approach, the project will generate beyond state-of-the-art insight into how community dynamic in contemporary societies develops. It will use this knowledge to rethink the notion of community. In the final stage of the project, the empirical, methodological and conceptual insights will be combined to feed into the process of building a theory of emergent communities through which changes to the form of social and political life can be understood. The project will have a high societal impact by providing policymakers and politicians with knowledge on how social sustainability and inclusion can be promoted.

Link to the ERC project webpage: https://www.tuni.fi/en/research/coexistence-and-conflict-age-complexity-emergentcommunity

Keywords of the ERC project: community relations, urban space, diversification, societal change, interdisciplinarity, everyday life

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
947713	**PROSPERA**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Mario Pansera**
Host Institution:	Universidad De Vigo - ESP

Prospering without growth: Science, Technology and Innovation in a post-growth era

The feasibility and desirability of endless economic growth is increasingly being questioned by scholars and activists. While envisioning alternative economic models is key to assure the sustainability and wellbeing of present and future generations, few studies have analysed what might be the role of 'innovation' in a post-growth era. Innovating has become the imperative for the survival and expansion of any form of organisation. But this 'innovate or die mania' underpins assumptions – such as technological determinism and productivism - that neglect the socially constructed character of technological development, its politics and its capacity to enable just and equitable societies but also dystopian technocratic futures. This project posits that untangling innovation from growth is key to imagining a post-growth era. If growth is going to be unsustainable, we need new narratives for innovation that would accordingly also have to change and increase the scope of the innovation concept itself, beyond technology, into cultural and institutional change, and indeed social life and social order. Organizations – in particular capitalist enterprises - are the core of modern industrial societies but are also one of the places in which the discourse of growth is legitimised and constantly reproduced. However, they can also be the places in which people can start to build the capacity for developing alternatives to challenges the growth ideology. But how organizations would look like in a different paradigm, in a system that is not based on and doesn't not rely on endless growth? Under which conditions STI without growth would be able to flourish? What levels of technological complexity can we reach in a non-growing economy? What policies, infrastructures and organizational forms are needed or are more likely to facilitate this new paradigm of STI? These are questions, rarely asked by innovation, management and organization scholars, that the proposed project will address.

Link to the ERC project webpage: https://postgrowth-lab.webs.uvigo.es/prospera/

Keywords of the ERC project: post-growth, degrowth, innovation

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
947879	**CoChina**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Yanliu Lin**
Host Institution:	Universiteit Utrecht - NLD

Collaborative Planning in China: Authoritarian Institutions, New Media, Power Relations, and Public Spheres

Collaborative planning has become an effective means to address conflicts of interest in urban renewal and environmental management in China. However, the egalitarian principles that ground collaborative planning theory call into question its validity in China. The theory emphasizes consensus building in which various stakeholders come together for dialogue to address controversial issues. It rests on three assumptions: democratic institutions, neutral power and communicative rationality. These assumptions, which are often debated in the Western context, should clearly be questioned in the Chinese context, due to authoritarian institutions and the challenging nature of power relations. Therefore, the aim of my project is to examine the practices of collaborative planning in China and identify the challenges to the assumptions of the theory. I will develop three novel tracks for examination and reconceptualization. The first will analyze how Chinese political and planning systems, social capital and culture affect the interactive processes. The second will apply network theory and social network analysis to analyze various types of power relations between government, planners, civil society and citizens. The third will identify various forms of online public spheres and how they interact with offline public spheres to affect communicative and agonistic approaches to collaborative planning. The research will employ an innovative mixed methods approach combining critical discourse analysis, data mining, computer-assisted content analysis, and social network analysis to research a wide range of case studies.
My project will lead to a new understanding of collaborative planning in China, and a reconceptualization of the collaborative planning theory to make it suitable for authoritarian contexts.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
949252	**ProblemShifting**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Rakhyun E. Kim**
Host Institution:	Universiteit Utrecht - NLD

Problem-Shifting between International Environmental Treaty Regimes: Causes, Consequences, and Solutions

International environmental treaties (e.g., Paris Agreement) are designed to solve specific environmental problems. Yet their potentially negative impact on environmental issues other than their own is rarely studied. Until now global governance theories have assumed that environmental treaties are inherently 'green', and hence, any adverse consequences are conveniently set aside as unintended or inevitable. But is that true? Here I question, do environmental treaties ever pursue their objectives by merely shifting problems to others? If so, when and why? Does such buck-passing create any systemic risk beyond those directly affected? And what might be appropriate responses to ensure our efforts add up to a net positive impact? Environmental problem-shifting, or protecting one part of the environment by damaging another, is a major dilemma arising in global governance. Yet the issue remains under-investigated, requiring an urgent scientific inquiry. PROBLEMSHIFTING will thus examine the causes and consequences of, and provide solutions to, environmental problem-shifting between international environmental treaty regimes. By drawing on my interdisciplinary and multi-method expertise in 'earth system' law and governance, I will (1) identify and explain conditions under which problem-shifting occurs; (2) assess and predict systemic effects of problem-shifting; and (3) offer solutions for optimizing the currently fragmented governance system. The project aims to advance the theoretical debate on the architecture of global governance and its overall effectiveness. The scientific breakthrough will be enabled through methodologically innovative combinations of qualitative and quantitative methods, including process tracing, comparative case studies, network analysis, system dynamics modelling, and multi-stakeholder workshops. Building on the theoretical and empirical foundations, I promise unique insights and valuable advice to markedly improve global governance decisions.

Link to the ERC project webpage: https://problemshifting.org

Keywords of the ERC project: global governance, sustainability, environment, institutions, law, politics

Keywords that characterize the scientific profile of the potential visiting researcher/s: global governance, sustainability, environment, institutions, law, politics

Project ID:	Project Acronym:	Evaluation Panel:
949316	**EVICT**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Michel Vols**
Host Institution:	Rijksuniversiteit Groningen - NLD

The Impact of the International Right to Housing on National Legal Discourse: Using Data Science Techniques to Analyse Eviction Litigation

Eviction – the involuntary loss of one's home – has a devastating impact on people's wellbeing and has severe consequences for society as a whole. During and after the financial crisis of 2007-2011, over 700,000 people in Europe either lost their homes or were at risk of losing them.

National courts use national laws to rule on whether an eviction is just. However, the right to housing, as laid down in international and European law, often demands more protection of the power- and propertyless than national laws prescribe. As a result, national courts are at the centre of the complex interaction between national and international law. In times of growing national resistance towards international law, the questions whether, how, and why international law impacts on national law are among the most topical that legal scholars face.

Evictions provide a timely opportunity to determine why international rights, such as the right to housing, may or may not have an impact on national law. The financial crisis has led to an enormous amount of case law (legal big data). The combination of the developed, but understudied, international right to housing and these vast amounts of national data offers a unique opportunity to examine the interaction between international law and national law.

It is impossible to analyse all judgments manually. Therefore, I will use a data-driven approach that is unique in the legal discipline. Using citation network analysis, I conceptualise the right to housing as a network of international rights and conduct the first empirical analysis of the impact of this right in case law from national supreme courts and lower level courts. With the use of machine learning, I will identify predictors for courts' decisions, and explain how these predictors may mirror the right to housing. This approach has long been called for but, so far, rarely been executed. If successful, it could be used in future research projects in other areas of the law.

Link to the ERC project webpage: https://www.eviction.eu/

Keywords of the ERC project: Housing, law, human rights, data science, poverty

Keywords that characterize the scientific profile of the potential visiting researcher/s: Law, human rights, housing, soco-economic rights

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
949670	**realTRIPS**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Chen Zhong**
Host Institution:	University College London - GBR

Redefining Variability: Evaluating Land Use and Transport Impacts on Urban Mobility Patterns

Urban mobility analysis, advanced by the emerging fine-granularity location data (e.g. smart card data, mobile phone data and social media data), has received significant attention in recent years. It has become an important subject for understanding the functionality, ever-increasing dynamism and complexity of urban space. realTRIPS aims to open a new avenue of research in urban mobility analysis using emerging automatic data by developing an analytical and modelling framework, particularly addressing variability across spatial-temporal scales. I argue that the variability of urban mobility should not be simply interpreted as a number of errors, but indicators of changes in regular human behaviours impacted by land use and transport at different scales. A deeper understanding of variability and regularity would contribute to a more accurate prediction of urban development scenarios. The relevant theories and measures on variability have been long-researched in spatial statistics, but not well applied to the context of urban mobility studies. The proposed framework will take advantage of the research progress in multi-disciplines and leverage key concepts from uncertainty in spatial analysis, time geography, and land use transport planning. Under such framework, variability will be measured in mobility patterns and integrated as a function of space and time into operational urban models for predicting impact of land use and transport on people's travel and location choices at different spatiotemporal scales. Case studies presenting typical urban contexts (i.e. London, Shenzhen, Nairobi) will be explored to demonstrate the feasibility and generic applicability of the theory, analytical methods and urban models.

Link to the ERC project webpage:

Keywords of the ERC project: urban mobility, human movement data, big data, urban planning, transport, spatial analysis, AI

Keywords that characterize the scientific profile of the potential visiting researcher/s: urban mobility, AI, data mining, spatial analysis, urban analytics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
949795	**CitizenGap**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Imke Harbers**
Host Institution:	Universiteit Van Amsterdam - NLD

Legal Identity for All?

Although we often think of undocumented persons as migrants or non-citizens, about one in seven people across the globe lack documents such as birth certificates, ID cards or passports to prove their legal identity, and thus their status as citizens in their own country. This gap between citizens with and without state-recognized documents is just as consequential as the distinction between citizens and non-citizens.

Existing approaches portray the citizenship gap – the difference between legal status and the ability of citizens to document their claim to this status – as the apolitical by-product of deficiencies in governance. The proposed research project – CitizenGap – aims to change how scholars and policy-makers think about achieving one of the key targets of the United Nations' Sustainable Development Goals "By 2030, provide legal identity for all, including birth registration" by developing a novel political understanding.

The project establishes the citizenship gap as a field of social scientific research, and pursues two main questions: (1) How and why do states invest in civil registration? (2) How and why do citizens decide to obtain documents? To understand why millions of citizens are undocumented, it is crucial to remember that citizenship is not only a legal status, but first and foremost a political relationship between states and the populations they govern. CitizenGap advances a strategic theory that seriously considers the incentives of states and citizens in the politics of civil registration. Empirically, the project contributes a comprehensive, cross-national measure that captures the number and characteristics of undocumented citizens, including those at risk of having their citizenship status questioned. The project analyzes the origins and nature of the citizenship gap in India and Mexico with a mixed methods design, combining demographic and spatial (GIS) datasets with fieldwork, archival sources, interviews and focus groups

Link to the ERC project webpage:

Keywords of the ERC project: citizenship, civil registration, legal identity, politics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
949852	**COMPASS**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Christoph Oberlack**
Host Institution:	Universitaet Bern - CHE

Is environmental justice necessary for human well-being? Comparative analysis of certification schemes, inclusive business, and solidarity economy strategies

Unprecedented concentration in agri-food value chains is reinforcing global inequality. Waves of land grabbing threaten the livelihoods of millions. Reshaping the effects of agricultural investment, land use, and trade on human well-being is thus an urgent challenge. Certification schemes (CS) such as “Fairtrade” have become a common strategy to meet this challenge. However, accumulating evidence shows that many CS have limited effects on well-being. Inclusive business (IB) and solidarity economy (SE) strategies are emerging alternatives. Inclusiveness and solidarity are widely believed to enhance well-being, but evidence and theories disprove this common belief. Environmental justice may be a necessary condition to understand and reshape the effects of CS, IB, and SE on well-being. However, lack of reliable data and comparative analyses limits understanding of these links. COMPASS will tackle these challenges. This project aims to demonstrate how environmental justice influences the effects of CS, IB, and SE strategies on human well-being. COMPASS is organized in four work packages (WPs) and focuses on the cocoa and coffee sectors of Peru and Switzerland. WP1 surveys organizations (n=120) to compare their instruments used in CS, IB, and SE strategies. WP2 surveys households (n=840) and uses set-theoretic and process-tracing methodology to explain the effects of CS, IB, and SE on well-being. WP3 identifies the rules that organizations (n=18) create to regulate land use, investment and trade, assesses their environmental justice, and explains how they influence well-being. WP4 generates context-sensitive generalizations of these effects, and it tests and advances pertinent theories. COMPASS breaks new ground by systematically comparing CS, IB, and SE strategies and their effects on human well-being. It develops a new strand of environmental justice research on private-sector strategies and it tests the transformative potential of environmental justice.

Link to the ERC project webpage:
https://www.cde.unibe.ch/research/projects/environmental_justice_for_human_well_being_compass/index_eng.html

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
950056	**GRIP-ARM**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Jewellord Nem Singh**
Host Institution:	Erasmus Universiteit Rotterdam - NLD

Green Industrial Policy in the Age of Rare Metals: A Transregional Comparison of Growth Strategies in Rare Earth Mining

Our new global political economy is increasingly defined by 'critical raw materials' – of which rare earths elements (or 'rare earths') are the most significant. The proposed study examines the globalized supply and demand for rare earths – from mining, processing, manufacturing, use and recycling – to have a closer scrutiny of mining both as a strategy for industrialization and as an integral part of contemporary efforts towards a sustainable supply of raw materials. GRIP-ARM interrogates the dynamics in rare earth mining that might lend this particular resource a tool for economic development. The project seeks to answer the following questions: (1) How do state capacity, business power and organizational structure of domestic markets shape the design of industrial policies in resource-rich countries? (2) What explains the success of some countries in generating linkages between resource extraction and manufacturing, and what accounts for their failure? (3) How effective are the responses of importing countries and their manufacturing industries in securing a stable supply while reducing the socio-environmental costs of extraction?

The proposed research is one of the first systematic, comparative study on rare earths mining and economic development, which brings political science perspectives in conversation with natural resource geography and international political economy.

Link to the ERC project webpage:

Keywords of the ERC project: Critical minerals; rare earth; supply chain; industrial policy; Sectoral linkages

Keywords that characterize the scientific profile of the potential visiting researcher/s: Expertise on industrial policy, political economy, governance, mining

Project ID:	Project Acronym:	Evaluation Panel:
950313	**AWAR**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Henrikas Bartusevicius**
Host Institution:	Institutt For Fredsforskning - NOR

Adapted to War

Have humans evolved psychological adaptations to war? This question has generated major scientific debate involving anthropologists, archaeologists, economists, primatologists, psychologists, and political scientists. It has shaped popular perceptions of human nature and influenced the views of political leaders.

Observing the limits of archaeological, ethnographic, and comparative evidence, I posit that only evidence of special design, obtained from an integrated program of psychological experiments, can conclusively answer this fundamental question. If humans are adapted to war, then human psychology must be equipped with specialized adaptations designed for the effective navigation of war: planning, executing, and defending against coalitional attacks.

AWAR probes the existence of such adaptations. It focuses, specifically, on coalitional formidability assessment mechanisms, which likely helped ancestral humans to avoid costly fights. Such mechanisms, if revealed, likely constitute "smoking-gun" evidence that war shaped human evolution. AWAR also explores real-world implications of coalitional formidability assessment mechanisms: if they indeed exist, do they shape our attitudes and behavior today, particularly in the context of modern political violence (e.g., violent anti-government protests and armed civil conflicts)?

AWAR presents the first elaborate information-processing model of a coalitional formidability assessment mechanism. In turn, it conducts an integrated program of 20 lab experiments and surveys in 40 countries. Crucially, AWAR holds the potential to reveal the existence of a psychological adaptation in humans, contributing to the growing efforts to map the universal architecture of the human mind. The project's results will likely appear in major multidisciplinary journals, advancing scholarly debates in at least six disciplines. Most importantly, AWAR breaks new ground for a novel perspective in the study of modern domestic political violence.

Link to the ERC project webpage: https://www.prio.org/projects/1901

Keywords of the ERC project: war; aggression; human evolution; political violence; coalitional aggression; cognitive science;

Keywords that characterize the scientific profile of the potential visiting researcher/s: war; aggression, evolutionary social sciences; political violence; cognitive science; experimental psychology

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101002240	**PaCE**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Thomas Chadefaux**
Host Institution:	The Provost, Fellows, Foundation Scholars & The Other Members Of Board Of The College Of The Holy & Undivided Trinity Of Queen Elizabeth Near Dublin - IRL

The Patterns of Conflict Emergence: Developing an Automated Pattern Recognition System for Conflict

Are there recurring patterns in the escalation and emergence of wars? The idea that history may repeat itself is old. But recent advances overcoming methodological and data barriers present an opportunity to identify these recurrences empirically and to examine whether these patterns can be classified to improve forecasts and inform theories of conflict. I propose to combine new methods—using the shape of the sequence of events rather than its raw values—and novel data on conflict from finance, diplomatic cables, and newspapers, to extract typical pre-war motifs. Just as DNA sequencing has been critical to medical diagnoses, PaCE aims to diagnose international politics by uncovering the relevant patterns in the area of conflict. Our goals are to: (i) Identify patterns in the pre-conflict actions using data on conflict events—from the onset of WWI to Hamas's rocket launches—and in their perceptions using data from financial markets (the "crowd's" perception), news articles (the "experts"), and diplomatic documents (the policy-makers). This will allow us to evaluate the patterns of escalation over different timescales—from the decade to the minute. The similarity between temporal sequences will be measured using algorithms which allow for flexible matching, such as Dynamic Time Warping. (ii) Evaluate the utility of these patterns to improve forecasts of conflict with both historical and live out-of-sample predictions. Our results, using shape-based classification methods, will be made public and evaluated in real time. Moreover, using new measures of complexity to distinguish regular, chaotic, and random behavior, I will measure possible fundamental limits to the predictability of conflict events. (iii) Summarize the core features of dangerous patterns into motifs—recurring patterns—that can help build new theories of conflict emergence and escalation. PaCE will build a repository of shapes—a grammar of patterns—to be used as the building blocks of new theories.

Link to the ERC project webpage: https://conflictlab.github.io/

Keywords of the ERC project: Conflict, machine learning, war, patterns, time series

Keywords that characterize the scientific profile of the potential visiting researcher/s: Machine learning, time series, neural networks

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101002784	**EQUALSEA**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Sebastian Villasante**
Host Institution:	Universidade De Santiago De Compostela - ESP

Transformative adaptation towards ocean equity

Inequality is one of the key major social challenges of our time, with far-reaching ramifications for human well-being. Our oceans, which produce vital food, enable jobs and economic activities, and provide opportunities to shape cultures and identities of people, face unprecedented cumulative pressures from human activities and climate change due to industrialization of the seas. Although some researchers have explored ocean equity, significant gaps remain. Firstly, interdisciplinary approaches combining ecological and social sciences are fundamental to induce transformative changes towards ocean equality, but lacking. Secondly, there is a clear lack of data on different inequalities at seas for both small-scale and commercial fisheries. Thirdly, more than 4.3 billion people globally rely on fish as their major source of protein, but social, cultural and health factors which explain oceans inequalities remain largely unknown. Consequently, there is an urgent need for an interdisciplinary approach that addresses asymmetric social power relationships and concentration of capital assets and ownership of fishing rights focused on the most vulnerable groups. EQUALSEA will (a) develop a new transformative adaptation framework for ocean inequality, (b) identify multiple critical drivers which induce social tipping points dynamics and transformative changes across space and time, and (c) contribute to monitor progress towards ocean equity for local communities and top international organizations. To do this, I will combine modelling and simulation techniques and cross-case comparison to develop a typology of different inequalities tested in 20 MPAs and implemented for 3 in-depth case studies across Africa, Europe and Latin America. Together, the ontological framework and integration of modelling methods will significantly advance research on ocean inequality, developing the necessary tools to deliver sustainable impacts towards achieving equity for economies and societies.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: Oceans, social sciences, equity

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101003012	**LostInZoom**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Guillaume Touya**
Host Institution:	Institut National De L'Information Geographique Et Forestiere - FRA

Not Getting Lost in Multi-Scale Maps: Exploring the Anchor Theory in Cartographic Zoom Interactions in the Context of Crisis Management

Multi-scale interactive maps such as Google Maps or OpenStreetMap have replaced paper topographic maps for most professional and daily uses. Past research told us how to design paper topographic maps at a given scale to make them readable and understandable by human users. But these rules/guidelines do not apply anymore, and map designers lack guidelines to make maps that are smooth to explore through scales, and it is common for a multi-scale map user to feel lost for a few seconds after a zooming interaction. The LostInZoom project (Not Getting Lost in Multi-Scale Maps: Exploring the Anchor Theory in Cartographic Zoom Interactions in the Context of Crisis Management) seeks to establish a new zooming paradigms for multi-scale maps, based on multi-scale visual landmarks that act as anchors during the zoom. To achieve this novel zooming paradigm, we need new grounding knowledge on how people perceive and understand interactive multi-scale maps, in order to design maps and interaction that make multi-scale explorations smoother. The LostInZoom project will be based on three main pillars. In the first one, we will explore the cognition of multi-scale interactive maps with an experimentation approach, in order to identify the anchors or landmarks that help a map reader locate himself when zooming. In the second pillar, we will design new cartographic generalisation techniques to derive multi-scale maps that magnify the landmarks that are important for multi-scale exploration. Finally, the third pillar will be dedicated to the design of new zooming interactions that focus on these landmarks to smooth even more the zooming exploration.

Link to the ERC project webpage: https://lostinzoom.github.io/home/

Keywords of the ERC project: cartography, zoom, spatial cognition, disorientation, deep learning

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101019318	**REGFUT**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Ayona Datta**
Host Institution:	University College London - GBR

Regional Futures: The territorial politics of digitalisation-as-urbanisation in the global south

In the last two decades, an information revolution in the global south has profoundly shaped the urbanisation of metropolitan regions. Global and national initiatives to adopt smart technologies in local governments, with the claim that opportunities presented by digitalisation will resolve the challenges of urbanisation – are now literally automating regional futures. This project will conduct the first comprehensive South-South investigation of the dynamics of digitalisation-as-urbanisation – the transition to automated planning processes in metropolitan regions, and its impacts on regional urbanisation. The project will conduct research in peri-urban municipalities of three rapidly growing metropolitan regions of Mumbai, Nairobi, and Guadalajara where municipal digitalisation is directed towards strategic regional planning. These municipalities face major challenges with transforming paper-based colonial and postcolonial bureaucracies into automated planning processes within highly unequal contexts, and therefore represent the wider experience of digitalisation-as-urbanisation in the global south. Through detailed ethnography, interviews and information audit trails in digitalising municipalities, the project will investigate a) the rescaling of governance to the local digitalising state; b) the territorialisation of information infrastructures; and c) territorial politics of digitalisation. It will examine how digitalisation produces new territories for regional urbanisation and how state and non-state actors are assisting, contesting and disrupting these regional futures. It will bring to fruition the applicant's agenda setting work on postcolonial urban futures, smart cities, digital citizenships and recent work on the governance of small cities in the global south. The project will build new theories and detailed empirical evidence of southern urbanisation as both a product and a producer of the 'information revolution' in the global south.

Link to the ERC project webpage: https://www.regionalfutures.org

Keywords of the ERC project: regional futures, urbanisation, digitalisation, information infrastructures, digitalising state, territorial politics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101019693	**ECO-METABOLISTIC-ARC**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Mette Ramsgaard Thomsen**
Host Institution:	Det Kongelige Danske Kunstakademis Skoler For Arkitektur, Design Og Konservering. - DNK

An Eco-Metabolistic Framework for Sustainable Architecture

This interdisciplinary project asks how we can rethink sustainable building practices through a bio-based material paradigm in response to the increasing global crisis of material depletion. Despite well-organised calls for action maturing into legislation and an attentive profession, architecture is proving reticent in this transition. Bio-based materials are fundamentally different to current building materials being characterised by their complex heterogeneity, unpredictable behaviours and limited lifespans. This project identifies that the key impediments to this transition lie with architecture's inability to represent, conceptualise and operationalise bio-based materials. It argues that to design with bio-based materials we must challenge the fundamental value proposition of architecture and expand our conception of material lifespan to find new practices of construction. It proposes a holistic eco-metabolistic framework, that allows for carbon-neutral, renewable and materially optimised design solutions. It employs a research-by-design method to investigate three bio-based material perspectives (glulam, bio-polymer composites and bioluminescent bacteria) and instrumentalises them through three advanced computational modelling networks for the predictive modelling, adaptive fabrication and environmental sensing of bio-based materials. It challenges our preconception of design agency as restricted to the traditional cut-off point of building completion, proposing new participatory practices of continual construction to recast the short lifespans of bio-based materials as effective properties of a new sustainable practice. By enabling us to think of buildings as co-present and actively engaged through processes of maintenance and intervention, the project responds to the search for sustainable, more socially conscious and more democratic models of production.

Link to the ERC project webpage: https://royaldanishacademy.com/case/eco-metabolistic-architecture

Keywords of the ERC project: biodesign, architecture, digital fabrication

Keywords that characterize the scientific profile of the potential visiting researcher/s: FEA, volumetric modelling, monitoring, sensing

Project ID:	Project Acronym:	Evaluation Panel:
101039648	**TransLitigate**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Phillip Paiement**
Host Institution:	Stichting Katholieke Universiteit Brabant Universiteit Van Tilburg - NLD

The Agency of Transnational Strategic Litigators in Global Governance

Litigators feature in a crucial role as we confront the pressing global environmental governance challenges of the 21st Century. They possess an agency which is capable of driving the evolution and implementation of law across national boundaries and at the supranational level. This project proposes to develop a groundbreaking, explanatory model of transnational collaborations among strategic litigators which accounts for their modes of collaboration, how those collaborations affect their agency in controlling the issues in their respective fields, and how they negotiate complex ethical and professional challenges in their work. It proposes to develop this model through the combination of comparative doctrinal research and inductive qualitative socio-legal research across four case studies of strategic litigation: climate change, large-scale land transfers, pollution caused by extractives industries, and species conservation. It pursues the ground-breaking aim of explaining the multi-faceted and complex deliberations among transnational communities of litigators which give rise to and shape the landmark cases transforming environmental governance in diverse national contexts. With this contribution to the sociology of strategic litigators, the project will achieve a break-through in our understanding of how change can be initiated in legal systems to overcome perpetual obstacles and meet our global environmental challenges. It pursues a breakthrough in understanding how litigators drive states and their legal systems to act upon their ability to govern global environmental challenges, given the unlikeliness of it occurring through domestic and international lawmaking alone. In sum, the project aims to develop a groundbreaking model of an innovative type of agency and actor in global governance: the strategic litigator collaborating across borders.

Link to the ERC project webpage:

Keywords of the ERC project: strategic litigation, environmental law, transnational law, climate change

Keywords that characterize the scientific profile of the potential visiting researcher/s: socio-legal studies, strategic litigation, transnational law

Project ID:	Project Acronym:	Evaluation Panel:
101040070	**FARRIO**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Lisbeth Zimmermann**
Host Institution:	Johann Wolfgang Goethe Universitaet Frankfurt Am Main - DEU

The Effects of Far-Right Challenges on International Organizations

The rise of the far right poses a profound challenge to global politics. Diverse far-right actors, such as political parties, civil society groups, and social movements, have been gaining support in domestic contexts, while intensifying their transnational contacts. As these groups focus on national sovereignty and share a stance against globalization, they often contest international organizations (IOs) and their policies. Yet their impact on international organizations differs: On the one hand, far-right groups have profoundly changed negotiations on the Global Compact for Migration in the UN. On the other hand, radical-right parties in the European Parliament have hardly brought about any deeper policy changes. Why does transnational far-right contestation have varying effects on international organizations?

While scholars have analyzed far-right actors in domestic politics, knowledge about their transnational activities and effects is limited. FARRIO fills this gap empirically, theoretically, and methodologically. Empirically, it compares effects of far-right contestation on the EU, the UN, and its specialized agencies/treaties in four central policy fields (migration, women's rights, climate change, and public health). Theoretically, it proposes that IO changes depend on the directness of far-right strategies and the liberal character of international organizations. It thereby breaks new ground in identifying scope conditions for far-right impact highly relevant for research on transnational protest as well as IO resilience and change. Methodologically, FARRIO draws on and further develops quantitative and qualitative methods. It adapts protest event and networks analysis to map transnational far-right contestation, also including social media data. Bridging Comparative Politics, Social Movement Studies, and the study of International Relations, FARRIO assesses the challenge far-right actors pose to IOs as well as what measures are suited to respond to it.

Link to the ERC project webpage:

Keywords of the ERC project: international organizations; contestation; transnational far-right networks; social movement studies, International Relations

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101040948	**WarEffects**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Carlo Koos**
Host Institution:	Universitetet I Bergen - NOR

The Micro-Level Effects of Civil Wars on Multiple Dimensions of Women's Empowerment

WarEffects aims to advance a systematic, nuanced, and rigorous understanding of how civil wars affect women's social and political empowerment at the local level. Recent quantitative research suggests that civil wars promote women's political representation, but these accounts reflect country-level aggregate measures and often focus on a minority of political 'elite' women. Thus, they do not inform us how subnational and individual-level variation in civil war experiences affect the majority of 'non-elite' women at the local level. To address this challenge, I propose a novel theoretical framework that simultaneously explores the effects of civil wars on i) multiple dimensions of women's empowerment in the household and family, the community, and local politics. Moreover, I introduce ii) nuanced definitions for different types of exposure to civil wars, iii) the difference between changes in gender roles and gender attitudes, and iv) the moderating effect of context conditions. Building on the variation of each of these four dimensions allows me to generate a large set of hypotheses to advance a systematic and nuanced understanding of when, why, and how civil wars promote women's empowerment, and when they do not. To empirically explore these hypotheses, I will combine novel quantitative survey experiments and qualitative research in Colombia, DR Congo, and Sri Lanka. While each country case has experienced several decades of civil war, there is significant within-case and between-case variation in social context, conflict dimensions, patterns of violence, and conflict status, rendering them ideal for exploring the local effects of civil war violence on women's empowerment. Drawing on this comparative design will allow me to make statements about common patterns, divergences, and conditional effects. Altogether, this wealth of findings will establish a new conceptual and empirical research platform on the impact of civil wars on gender relations.

Link to the ERC project webpage: https://www.wareffects.eu/

Keywords of the ERC project: legacy of violence in civil wars, micro-level quantitative research, surveys, causal inference

Keywords that characterize the scientific profile of the potential visiting researcher/s: peace and conflict researcher; quantiative methods, survey methods, political scientists, economists

Project ID:	Project Acronym:	Evaluation Panel:
101041316	**INTRAPARTY**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Ann-Kristin Kölln**
Host Institution:	Goeteborgs Universitet - SWE

The Benefits of Conflict: How Factions Can Enhance Political Parties' Electoral Performance

Political parties and voters form important relationships in a democracy. The conventional wisdom is that divided parties lose elections. Yet the empirical evidence for this is ad hoc, and there are good reasons to suspect that it is, at best, a conditional wisdom. Firstly, the factional groups that divide parties vary in many different ways, even if the conventional wisdom treats them all the same. Secondly, since factions have somewhat different preferences than the rest of the party, they could also be useful in representing additional segments of society. However, there is currently no systematic analysis of the impact of factions – whether negative or positive – on a party's electoral result.

INTRAPARTY is a comparative study of factions and their effects on political parties' electoral success in Europe. By answering the overall research question of When and how can factions have positive effects on political parties' electoral performance?, INTRAPARTY launches a new scientific inquiry that challenges the conventional wisdom and seeks to explain the positive effects of factions on parties' electoral performance. It provides unprecedented theoretical and empirical insights into the true role of factions in representative democracies.

The project elaborates an original theory explaining factional effects on parties' electoral performance that accounts for the inherent balancing factions face between inducing pressure but not harm on their party. Factions constitute a source of representation and reputation to voters that was previously neglected. Empirically, the project breaks new ground by combining theory-testing and exploratory approaches from research in party politics, interest group, and computational social sciences. By constructing an original comparative dataset on factions and parties over time and designing creative survey experiments to test voters' reactions, the project tests the effects of factions on parties' electoral success in Europe.

Link to the ERC project webpage:

Keywords of the ERC project: political parties, factions, voters, electoral performance, computational social sciences, survey experiments, Europe

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101043468	**RITUAL DETERRENCE**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Maria Mälksoo**
Host Institution:	Kobenhavns Universitet - DNK

Ritual Action: Making Deterrence Matter in International Security and Memory Politics

Deterrence is the strategy of dissuading an opponent from taking an unwanted action for its prospective costs would outweigh the anticipated benefits either by the threat of effective defence or that of retaliation. The role of ritual in making deterrence effective, affectively charged and credible in the eyes of its practitioners has remained below the radar of the existing research. RITUAL DETERRENCE is the first project to pursue a ritual-centred investigation of deterrence in order to advance the understanding of the political and psychological functions of this newly foregrounded practice in international security and memory politics. Theoretically, the project breaks new ground in fostering the understanding of ritual action in international relations, the symbolic logic of which remains neglected compared to the logics of consequences, appropriateness, practice, and habit in the study of world politics. Empirically, it addresses the imperative for systematic cross-cultural and cross-domain research on deterrence as a multi-modal social practice. In delivering a new description of the practice of deterrence and an overhaul of the theory of deterrence, the project offers a comprehensive rethinking of the performance, credibility and the presumed effect of deterrence. The project will provide an innovative ritual theory of deterrence in the contexts of international security and memory politics on the example of a vital historical (NATO-Warsaw Pact) and different contemporary cases (NATO-Russia, USA-Russia, USA-China; memory laws in Eastern Europe). The study combines discourse and practice analysis with expert interviews, participant observation of military exercises and wargaming, encompassing both direct and extended deterrence along traditional and emerging domains of deterrence. Tracing and historicising the interaction ritual chains of deterrence will generate crucial knowledge about how deterrence performances enact and legitimise political communities.

Link to the ERC project webpage: https://politicalscience.ku.dk/research/projects/ritual-deterrence/

Keywords of the ERC project: deterrence (nuclear, conventional, cyber, hybrid, political), ritual theory, NATO, Russia, United States, China, Eastern Europe, historical memory

Keywords that characterize the scientific profile of the potential visiting researcher/s: critical security studies, international relations, international history, deterrence theory, alliance politics

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Project ID:	Project Acronym:	Evaluation Panel:
101044015	**MENA-PERC**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Kevin Koehler**
Host Institution:	Scuola Superiore Di Studi Universitari E Di Perfezionamento S Anna - ITA

Political Elites and Regime Change in the Middle East and North Africa: Accommodation or Exclusion?

Whether political elites accommodate or exclude their rivals during regime crises can be a matter of life and death. Following the 2011 uprisings in the Middle East and North Africa (MENA), elite compromise sustained a democratic transition in Tunisia, while elite conflict triggered a coup in Egypt. Tunisia has since seen three democratic elections, while thousands of Egyptians were jailed or killed by the new military regime. Why do elites in some cases pursue accommodation while they push for excluding their rivals in others?

MENA-PERC proposes an answer to this puzzle: the degrees of asymmetry and polarization between regime coalitions and their challengers shape elite preferences for accommodation or exclusion. These preferences, in turn, determine the type of regime emerging from crisis. Regime coalitions comprise elites who provide crucial links to social constituencies and whose collective support stabilizes the regime. The project theorizes the role of these actors, linking macrolevel outcomes in terms of regime types to evidence on the microlevel of individual elites.

The project draws on evidence on 12 regime spells in three MENA countries across more than a century. Regime coalitions are identified by focusing on members of parliament in Egypt (1882-present), Tunisia (1907-present), and Turkey (1908-present), observing processes of elite change empirically based on individual-level data on these elite members and leveraging these data in a mixed-methods design. Second, the project traces causal mechanism through elite surveys and in-depth fieldwork examining authoritarian consolidation in contemporary Egypt, democratization in Tunisia, and democratic backsliding in Turkey.

The project makes three contributions. It theorizes why elites accommodate or exclude during regime crises; it pioneers an innovative way of testing this model by observing elite change over time; and it traces the model's causal mechanisms in ongoing processes of regime change.

Link to the ERC project webpage:

Keywords of the ERC project: political elites; regime change; MENA

Keywords that characterize the scientific profile of the potential visiting researcher/s: political elites; regime change

Project ID:	Project Acronym:	Evaluation Panel:
101044069	**PARTISAN**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Markus Wagner**
Host Institution:	Universitaet Wien - AUT

Partisan Prejudice: Origins, Consequences and Remedies in European Multiparty Democracies

Partisan prejudice exists when citizens hold negative attitudes towards party supporters. Such prejudice is widespread: many people have stereotypical views of and dislike the supporters of certain parties, sometimes amounting to outright partisan hostility.

Partisan prejudice is a challenge for liberal democracy. It deepens societal rifts, lowers social trust, weakens the acceptance of elite compromise and leads to discrimination and social ostracism. This challenge is urgent at a time of political division and democratic backsliding. Yet, partisan prejudice is barely studied, particularly in Europe.

PARTISAN will provide a novel theoretical framework and rigorous empirical evidence for understanding partisan prejudice, with the ambition of fundamentally altering how voters and parties are studied in multiparty systems. The theoretical framework posits that objective characteristics of party supporters form the basis of partisan stereotypes, but that these linkages are filtered through individual perceptions and moderated by party- and country-level characteristics.

Based on this framework, this project will provide ground-breaking evidence on the prevalence and origins of partisan prejudice and assess its political and societal consequences, including for political participation, discrimination and social cohesion. PARTISAN will also provide political and societal actors with evidence on three ways to reduce partisan prejudice: interparty contact, recategorization and social norms.

PARTISAN will implement new measurement tools in a new twelve-country survey and in experiments conducted in population-based surveys and in the field. Innovative experimental designs will be used to rigorously assess the origins and consequences of partisan prejudice, as well as potential remedies.

Studying a little-studied phenomenon using diverse methods, PARTISAN will significantly extend our knowledge of partisan prejudice, what effects it has and how its impact can be minimized.

Link to the ERC project webpage:

Keywords of the ERC project: partisanship; polarization; affect; emotions; prejudice; discrimination

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101044852	**IMPACTUM**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Clara Burbano Herrera**
Host Institution:	Universiteit Gent - BEL

ASSESSING THE IMPACT OF URGENT MEASURES IN PROTECTING AT-RISK DETAINEES IN LATIN-AMERICA

Urgent Measures (UMs) are granted by international human rights (HRs) bodies to protect persons in a situation of extreme gravity/urgency. In Latin America, UMs are mostly granted to protect detainees, when their right to life, integrity and/or health are in danger of being violated. When a UM is granted, the state is requested to provide detainees with e.g. immediate access to medical care, drinking water, or sanitation. In such cases, UMs may prompt emergency protective actions that can, in the most extreme circumstances, save the life of the beneficiary of these measures. Though UMs have been issued on thousands of occasions, they have attracted little academic attention. The few studies that exist focus on a doctrinal analysis on compliance. Such studies have several shortcomings in that they primarily examine only procedural legal aspects, and often excessively rely on information provided by HRs bodies themselves. As UMs often face practical, financial and political constraints that shape and limit their implementation, it is crucial to establish a better understanding of how these measures are applied in practice. IMPACTUM moves beyond the traditional legal research questions and methods of analysing UMs. It instead proposes an interdisciplinary study of UMs that: 1) considers the context in which UMs are enforced and how they are applied on the ground; 2) assesses the impacts of UMs on detainees, legal/institutional systems and (inter)national actors; 3) discusses their strengths/limitations; 4) analyses their wider learning effects. With reference to UMs granted by 4 HRs bodies to protect at-risk detainees in 6 Latin American countries, IMPACTUM will develop a critical normative impact framework useful to provide a deeper theoretical analysis, as well as insight into how to formulate UMs to maximise their practical protective effects. IMPACTUM will thus uncover and present new knowledge on emerging issues with UMs that are currently unaddressed in academia.

Link to the ERC project webpage: https://www.humanrightsincontext.be/copy-of-research

Keywords of the ERC project: human rights, persons deprived of liberty, prisons, urgent measures, democracy, rule of law, vulnerable groups

Keywords that characterize the scientific profile of the potential visiting researcher/s: Human Rights

Project ID:	Project Acronym:	Evaluation Panel:
101054122	**SYNCPOL**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Klaus Goetz**
Host Institution:	Ludwig-Maximilians-Universitaet Muenchen - DEU

Synchronised Politics: Multiple Times and Political Power

Democratic policy-makers in Europe's multi-level system grapple with multiple times, since different levels of government, parliaments and administrative agencies follow distinct time rules and time preferences. Time clashes are an ever-present threat. Synchronisation is, therefore, a critical, but very little understood dimension of public policy-making. It is designed to avoid systematic time clashes by structuring the timing, speed, frequencies, sequences, durations and time horizons in policy-making. Over the past decade, simultaneous demands for "faster action", "more time" and "extended time horizons" have pushed multi-level synchronisation in opposing directions. In light of major contestation around synchronisation, SYNCPOL asks: 1) What happens when political demands for "faster action", "more time" and "extended time horizons" challenge synchronisation arrangements in multi-level policy domains? 2) How does the reshaping of synchronisation arrangements alter the vertical and horizontal distribution of political power amongst governments, parliaments and administrative agencies and the types of power in Europe's multi-level system? Drawing on institutionalist theory, SYNCPOL conceptualises synchronisation arrangements as a critical variable that is fundamental to the distribution of political power amongst policy-makers. It rigorously probes hypotheses on this crucial connection employing a mixed-methods design that combines document analysis, interviews, a major survey, dictionary-based text analysis and process tracing. The project examines synchronisation across EU, national and subnational governments, parliaments and administrative agencies, with a focus on six multi-level democracies: Austria, Belgium, France, Germany, Italy, Spain. The analysis covers two policy domains - migration-asylum and public health policy – since the early 2010s. SYNCPOL will generate fundamentally new insights into how time shapes democratic multi-level politics and policy.

Link to the ERC project webpage:

Keywords of the ERC project: time and politics; synchronisation; multi-level decision-making

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101054237	**GLOBALVALUE**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Poul Fritz Kjaer**
Host Institution:	Copenhagen Business School - DNK

Global Value Chain Law: Constituting Connectivity, Contracts and Corporations

Ongoing struggles over vaccine supplies forcefully illustrates the extent to which Global Value Chains (GVCs) serves as central infrastructures of the global economy and global society. While the COVID-19 pandemic might have been a revelation in this respect, the centrality of GVCs dates back to the dawn of colonialism. Both historically and in contemporary times, GVCs produces profound environmental and socio-economic externalities in jurisdictions often incapable of or unwilling to effectively regulate abhorrent working conditions and environmental degradation. Hence, the question of how to legally regulate cross-border economic processes including the capability of democratically organised political processes to effectively regulate GVCs is a central legal problem within fields such as competition, contract and corporate law as well as environmental, human rights and labour law.

Until recently, voluntary soft law measures were the preferred regulatory tools in relation to GVCs. In the last few years, a decisive move towards hard national and EU regulation has however taken place thereby raising the question to what extent this changes the rules of the game. On the backdrop of this development, GLOBALVALUE develops a novel and systematic socio-legal approach to GVC Law. This is done in a threefold manner: Firstly, through a historical sociological reconstruction of GVC Law going back to colonial law countering the currently dominant ahistorical approaches to GVC Law. Secondly, through three comprehensive case studies in relation to the global pharmaceutical, wine and trade fairs industries. Spanning five continents and nine national jurisdictions the case studies will illuminate the effects of contemporary hard and soft law practices of GVC law. Thirdly, through the development of a new concise conceptuality of GVC law with direct implications for our understanding of core legal concepts such as contract, legal order and economic constitutionalism.

Link to the ERC project webpage:

Keywords of the ERC project: Global Value Chains, Global Law, Colonial Law, Globalisation, Economic Law

Keywords that characterize the scientific profile of the potential visiting researcher/s: Lawyer; antropologist; sociologist; political economy

Project ID:	Project Acronym:	Evaluation Panel:
101054745	**DigitalHRGeneration3**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Yuval Shany**
Host Institution:	The Hebrew University Of Jerusalem. - ISR

Three Generations of Digital Human Rights

The proposed research program explores different strategies developed in the digital age within and outside international human rights law to respond to new needs, interests, risks and challenges brought about by transition of inter-personal interactions, social activities and regulatory schemes from offline to online environments. It investigates the development in recent years of three generations of digital human rights: adaptation of existing rights and their manner of application to online environments (e.g., online privacy), the creation of new digital rights (e.g., right to access the Internet) and the introduction of new rights and duty holders (e.g., virtual persons and online platforms exercising quasi-sovereign power), as well as the development of alternative protection avenues based on private ordering, including rights by design and community standards, Internet governance and multi-stakeholder arrangements. The ERC project will examine these paradigmatic normative, institutional and theoretical developments, and the policy choices behind them from five methodological perspectives: (1) historical study of the evolution of digital human rights and of choices made by norm-entrepreneurs and law-makers between different protection frameworks; (2) analytical study of protection gaps, overlaps and conflicts across traditional and digital human rights and alternative arrangements; (3) comparative study juxtaposing developments in the field of digital human rights against analogous development in international human rights law, with a view to identifying paradigms of normative and institutional change; (4) empirical analysis through interviews of the perceived effectiveness and legitimacy in the eyes of stakeholders of the said developments ; (5) Evaluation of the developments under theories of rights, global governance, business ethics and corporate responsibility and rational choice.

Link to the ERC project webpage:

Keywords of the ERC project: digital human rights

Keywords that characterize the scientific profile of the potential visiting researcher/s: law and technology, theory of rights, new human rights

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
771217	**MISFIRES**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Susi Geiger**
Host Institution:	University College Dublin, National University Of Ireland, Dublin - IRL

Misfires and Market Innovation: Toward a Collaborative Turn in Organising Markets

MISFIRES opens up new theoretical and empirical horizons for analysing and innovating 'concerned markets', where multiple actors' interests, values and concerns clash. It asks how actors can engage with a market's failures to challenge its organisation and make it more collaborative, more open to civic values and to social or political concerns. Concerned markets are contested by diverse actors with equally diverse perspectives and value measures. Evaluating such a market's efficiency is as much of an illusion as redesigning its inner workings on a blackboard. We need new conceptual frameworks to understand how to innovate concerned markets from the inside to make them 'better' (as defined by concerned actors), and we urgently need empirical insights into how collaborative action in markets with such social and political stakes may translate into market change. MISFIRES relies on science and technology studies, pragmatic sociology and critical market studies to shift thinking around market organisation from failure and design to collaboration and experimentation. I devise an ethnographic and participatory inquiry to explore how a market's failures can lead us to markets that are more attentive to and accommodating of the concerns they create. I choose three exemplary contested markets in healthcare (licensing of antiretroviral drugs, Hepatitis C pricing, and the sale of DNA information) and two emergent controversies to investigate the activities concerned actors undertake, and the instruments and devices they experiment with, to re-organise that market. MISFIRES will comprehensively map, engage in, and conceptualise this collaborative turn in organising markets. With this, MISFIRES will guide new academic and policy thinking by establishing how:
1) concerned actors voice and mobilise around the notion that a market has 'failed' them;
2) concerned actors seek to negotiate and address market failures;
3) this process may lead to 'better' markets.

Link to the ERC project webpage: https://misfires.ucd.ie/

Keywords of the ERC project: sociology of markets; social movements; healthcare, pharmaceutical sector; STS

Keywords that characterize the scientific profile of the potential visiting researcher/s: sociology of markets; social movements; healthcare, pharmaceutical sector; STS

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
805425	**WorkFREE**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Neil Howard**
Host Institution:	University Of Bath - GBR

Slavery, Work and Freedom: What Can Cash Transfers Contribute to the Fight for Decent Work?

WorkFREE builds on the widespread empirical observation that everywhere people who are stuck in indecent, exploitative or 'unfree' work nevertheless choose that work because doing so represents their best available option, and asks a simple yet potentially revolutionary question: What happens if we just give them money? It will answer this question by creating a world-first social experiment, administering 18 months of unconditional cash transfers (UCTs) to four communities typically associated with that work and contrasting findings from them with those from parallel control communities. WorkFREE will thus become the first project anywhere to combine research on cash transfers (CTs) with that on labour (un)freedom. It will also innovate methodologically, employing a unique combination of ethnography, surveys, and participatory qualitative techniques. This will allow the WorkFREE team – myself (the PI), a post-doctoral economist and two anthropology PhD students – to answer a question at the heart of the UN Sustainable Development Goals (SDGs): What can cash transfers contribute to the fight for decent work? It will further enable the co-creation of grounded theory around concepts central to the SDGs, including freedom, slavery, consent, coercion, vulnerability, exploitation, emancipation and (in)decent work. This, in turn, could call into question prevailing, hegemonic theorisations of these concepts, along with mainstream approaches to generating those theorisations and the policies with which they are associated. In this way, WorkFREE will push the empirical, theoretical and political boundaries at the intersection of development studies, labour studies, social theory and social policy. Given its focus and approach, it will also contribute to cognate debates around Social Protection (SP) and Unconditional Basic Income (UBI), positioning Europe at the forefront of contemporary efforts to achieve social justice in globalised market society.

Link to the ERC project webpage: https://www.work-free.net/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
817577	**HONORLOGIC**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Ayse Uskul**
Host Institution:	University Of Sussex - GBR

The Cultural Logic of Honor and Social Interaction: A Cross-Cultural Comparison

Understanding (un)willingness to coordinate with others, to compromise when faced with different choices, or to apologize for transgressions is crucial as these behaviors can act as strong facilitators or inhibitors of important interpersonal processes such as negotiations and coalition building. These behaviors play a major role when individuals from different cultural backgrounds work together to solve disputes or address joint challenges. Yet, we know little about what these behaviors mean in different cultural groups or how they are approached. With HONORLOGIC, I aim to initiate a step-change in our understanding of cultural variation in these important domains of social behavior by providing unique, multimethod, comparative and converging evidence from a wide range of cultural groups. I will answer the question "How do cultural groups that promote honor as a core cultural value approach coordinating with others, reaching compromise, and offering apologies?" by integrating insights from social/cultural psychology, behavioral economics, and anthropology. I will do this by collecting quantitative data using economic games, experiments, and surveys from Spain, Italy, Greece, Turkey, Cyprus, Lebanon, Egypt and Tunisia, as cultural groups where honor has been shown to play a defining role in individuals' social worlds. I will also run the proposed studies in the US, the UK, Japan and Korea to provide a broader comparative perspective.

HONORLOGIC will produce transformative evidence for theories of social interaction and decision making in psychology, economics, and evolutionary science by (a) producing innovative theory and data with an interdisciplinary and multi-method approach, (b) increasing the diversity of the existing evidence pool, (c) testing established theoretical assumptions in new cultural groups, and (d) contributing to capacity building in under-researched cultural groups in psychological research.

Link to the ERC project webpage: honorlogic.org

Keywords of the ERC project: honor, culture, interpersonal interactions

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
819533	**INSCONS**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Simcha Jong**
Host Institution:	Universiteit Leiden - NLD

Addressing Global Challenges through International Scientific Consortia (INSCONS); Case studies in biomedicine, the geosciences, and nuclear fusion research

INSCONS is a groundbreaking, large-scale examination of the organisational dynamics of international scientific consortia (ISCs) and the interactions of these consortia with broader scientific communities, national bureaucracies, and industry. ISCs are very complex organisations with work being carried out at geographically dispersed sites, and involving international stakeholder groups from across the realms of science, policy, and industry. As these ISCs are becoming more important in efforts to address global challenges in areas such as health, the environment, and clean energy, our understanding of the distinctive organizational dynamics governing these consortia has lagged behind. Accordingly, there is a pressing need for novel organisational theory and frameworks that will advance our understanding of ISCs. INSCONS is an ambitious effort to address this need, using a comparative, interdisciplinary approach. Three case studies of large, international ISCs in nuclear fusion research, biomedicine, and the geosciences are at the core of INSCONS. The INSCONS project will examine four aspects of these ISCs. It will 1) Map the internal organisational dynamics of ISCs using interviews, bibliometric network analyses, and ethnographic field studies on everyday work in ISCs. 2) It will study ISCs' interactions with the broader scientific community by conducting a survey among researchers in the scholarly fields ISCs operate in, and by analysing these fields' co-authorship networks. 3) It will examine the (inter)national political processes and bureaucratic wrangling shaping ISCs. 4) It will examine relationships of dependency and influence between ISCs and industry through case studies as well as analyses of patenting and publication activities. Taken together, the project outputs of INSCONS will bring into clear focus the sociology and politics, as well as the operational complexities that govern this important, new organisational form in contemporary science.

Link to the ERC project webpage: www.inscons.eu

Keywords of the ERC project: Science of science; international collaboration; R&D; technology management; organisation of science

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
833196	**POLAR**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Markus Gangl**
Host Institution:	Johann Wolfgang Goethe Universitaet Frankfurt Am Main - DEU

Polarization and its discontents: does rising economic inequality undermine the foundations of liberal societies?

The project will examine the relationship between economic inequality and societal openness, one of the foundational elements of liberal society. Specifically, the project will provide new empirical evidence on the purportedly negative relationship between inequality and social mobility, support for democracy, and social cohesion in the West. The challenge addressed by the project is foremost empirical: for each dimension of openness, there are straightforward theoretical arguments to link rising inequality with declining openness. In each case, there is widely-known evidence to support a negative relationship in bivariate cross-sectional cross-country data. In each case, however, the best available research has regularly failed to confirm the negative relationships in longitudinal designs that sought to identify the causal impact from within-country changes in inequality. To possibly reconcile the discrepancies, the project will create four new multilevel databases that combine survey microdata across more than 30 countries and over observation windows possibly extending back to the 1970s to gain leverage for an encompassing and stringently longitudinal empirical analysis. The newly constructed databases will be used for a detailed decomposition of inequality trends, a disaggregated description of trends in social mobility, social cohesion and support for democratic governance, and for a differentiated causal analysis of the role of economic inequality for societal openness in the West. The latter rests on suitable multilevel regression specifications that distinguish between mechanical, power- and composition-dependent mechanisms and that involve temporal lags, effect thresholds, systematic treatment effect heterogeneity, and appropriate controls for concomitant trends in order to provide valid effect estimates, but also to contextualize effect occurrence and to possibly identify societal and institutional sources of resilience.

Link to the ERC project webpage: https://polar-project.org/

Keywords of the ERC project: economic inequality, social mobility, fairness, social cohesion, political participation, trust in institutions, cross-national comparison, survey data, multilevel modelling, longitudinal research design

Keywords that characterize the scientific profile of the potential visiting researcher/s: social stratification, political sociology, economic inequality, quantitative social research, cross-nationally comparative research, survey data

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Project ID:	Project Acronym:	Evaluation Panel:
834587	**EMOTIONACCULTURATION**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Batja Mesquita**
Host Institution:	Katholieke Universiteit Leuven - BEL

Emotional Acculturation: Emotions as Gateways to Minority Inclusion

International migration has often been referred to as one of the major challenges of the 21st century. Numbers of immigrants have been increasing, but social integration of migrants and their children is lagging at the detriment of immigrant minorities themselves and often resulting in conflict within receiving societies. EmotionAcculturation investigates the role of emotions, as key processes of interaction, for immigrant minorities' social inclusion, and their wellbeing. It builds on research showing that, in each culture, emotions are socialized to fit the most valued kinds of relationships, and that the prevalent emotions, therefore, vary across different cultures. I postulate that misfit of the emotions of immigrant minorities with the typical majority emotions compromises interactions, and that this will hamper their social integration, and therefore their opportunities in the larger society. I study how and when emotional acculturation forms an important gateway to the social inclusion and wellbeing of immigrant minority individuals. The grant is organized around three Objectives: to better understand 1) the nature of emotional acculturation, 2) its conditions, and 3) its outcomes. I adopt a multi-method approach, following large numbers of immigrant minority and majority participants over time, in their everyday lives, and in real-time interactions in the laboratory. The project will span two receiving national contexts with different diversity climates (Belgium, California). It will shed light on understudied micro-processes involved in minority inclusion, and their social and health consequences. EmotionAcculturation offers a novel approach to psychological acculturation that goes beyond attitude change. Moreover, by studying emotional change beyond childhood, it also contributes to our understanding of how emotions are constructed through relational engagements, and how they facilitate social coordination and cohesion.

Link to the ERC project webpage: https://project-reach.org

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
864137	**GREENTEENS**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Sander Thomaes**
Host Institution:	Universiteit Utrecht - NLD

Understanding and Unleashing Adolescents' Eco-Friendly Behavior

The world faces an unprecedented environmental crisis, and human activity is its root cause. This poses a call to action for psychology and the social sciences more broadly. GREENTEENS proposes that our adolescents—a segment of the population whose collective behavior will shape the future of the planet—can play a vital role in creating a more sustainable world. Adolescents, however, are "closet idealists": As a group, they care about the environment but often fail to act on their concerns. The aim of the proposed research is to develop a new approach to understanding and promoting adolescents' eco-friendly behavior. It will generate new understanding of what keeps adolescents from engaging in eco-friendly behavior, and devise methods to help youth contribute to a sustainable future for themselves and generations to come.

I have developed a new hypothesis for this project: the "Motive-Match Hypothesis". It casts adolescents' eco-friendly behavior as driven by their personal motives. Based on the hypothesis, I will design methods to transform the way adolescents construe eco-friendly behavior, from a low-priority chore to an activity that embodies what they deeply care about—developing autonomy and gaining peer status.

Building on my international network, I will pursue the research aim using a cross-national investigation involving adolescents (age 12-17) from The Netherlands, Colombia, and China. The project will integrate longitudinal research to understand how adolescents' eco-friendly behavior develops over time, with experiments to understand how adolescents' core motives can be harnessed as powerful motivating force for eco-friendly behavior. GREENTEENS will advance the science of adolescent behavior change beyond the state of the art. The payoff of the research promises to be high: It will yield fundamental understanding of what drives adolescents' eco-friendly behavior and help improve pro-environmental policies targeting millions of youth worldwide.

Link to the ERC project webpage: https://www.uu.nl/en/research/greenteens

Keywords of the ERC project: pro-environmental behavior; psychology; adolescents

Keywords that characterize the scientific profile of the potential visiting researcher/s: developmental psychology; social psychology; sustainability

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
864519	**PUBLICGOOD**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Daniel Balliet**
Host Institution:	Stichting Vu - NLD

Ecological Origins of Cross-Societal Variation in Cooperation

Societies that contain widespread cooperation can solve problems of public good provision and resource conservation, yet many societies fail to display the cooperation necessary to solve these problems. A puzzle facing the social sciences is understanding the origin of cross-societal variation in cooperation. Strikingly, multiple disciplines propose the same, not yet established, explanation: ecological conditions, such as subsistence, environmental hazards, and relational mobility, determine how people are interdependent (i.e. how actions affect own and others' outcomes), and interdependence can be the mechanism through which diverse ecologies shape a culture of cooperation. For example, rice versus wheat production plausibly has led to more versus less dependence on others, which then led to different cultures (e.g. values, beliefs, and norms) that affect strategies of when and how people cooperate. I use a multi-discipline, multi-method approach to answer three questions about whether ecologies indeed create different interdependence, and how this leads to variation in culture and cooperation. Do ecologies create different kinds of interdependence? I measure the interdependence and cooperation people experience across different ecologies in 10 contemporary small-scale societies, among rice and wheat farmers in China, and in over 200 societies documented in the ethnographic record. Can interdependence cause differences in culture and cooperation? I use agent-based models and experiments to study how variation in interdependence can cause different norms of cooperation. Does variation in interdependence relate to culture and cooperation? I apply experience sampling to measure interdependence and cooperation in daily life across 35 societies that vary in culture. The ground-breaking innovation of this project is establishing interdependence as a common mechanism through which diverse features of the ecology shape cross-societal differences in culture and cooperation

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: Cooperation, interdependence, culture

Project ID:	Project Acronym:	Evaluation Panel:
864616	**HEALIN**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Iñaki Permanyer**
Host Institution:	Centre D Estudis Demografics Consorcio Con Personalidad Publica Creado Por Generalitat Catalunya - ESP

Healthy lifespan inequality: Measurement, trends and determinants

Despite its widespread use and popularity, life expectancy (LE) has two shortcomings. First, its definition only takes into consideration mortality levels, thus ignoring the health status of those who remain alive. Second, LE is an average that does not explain how length of life is distributed across the population. These limitations have generated two strands of research (i.e. the study of 'health expectancies' (HE) and 'lifespan inequality' (LI)) that, so far, have developed independently from each other. The overarching objective of the HEALIN project is to bring together these research avenues into a coherent whole to get a more comprehensive understanding of contemporary population health dynamics. To attain this goal, I put forward the new concept of 'healthy lifespan inequality' (HLI), which is designed to investigate the extent to which healthy lifespans are unequally distributed across the population.

The HEALIN project will (i) investigate the trends and determinants of HLI, (ii) assess whether the specific ages and causes that drive changes in HLI are the same ones determining the changes in LE, HE and LI indicators, and (iii) investigate how these indicators behave across and within countries and socio-economic groups. In addition, the project aims at making innovative contributions to the measurement of co-morbidity and to our understanding on how the latter can in turn influence the measurement of health expectancy and healthy lifespan inequality. To attain these objectives, the project will develop path-breaking analytical methods inspired in the models applied for the study of inequality and multidimensional poverty. Besides traditional socio-economic and health data sources, the project will complementary draw from the vastly underutilized health registers for the entire population in Catalonia (7.5 million residents). Their huge size and micro-level design allow investigating trends in HLI and co-morbidity with unprecedented detail.

Link to the ERC project webpage:

Keywords of the ERC project: health inequality, ageing, life expectancy, healthy life expectancy, lifespan inequality, global inequality

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
884927	**SIMTIC**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Orla Muldoon**
Host Institution:	University Of Limerick - IRL

A Social Identity Model of Trauma and Identity Change: A Novel Theory of Post-Traumatic Stress, Resilience and Growth

This project will develop a new social paradigm for trauma research that will allow us to understand post-traumatic stress and facilitate post-traumatic resilience and growth. This new paradigm holds that changes in social identities – the sense of self we derive from being part of valued groups – are at the heart of post traumatic outcomes. This breakthrough project will develop a synergistic model explaining how physiological, clinical and socio-political consequences of stress and trauma result from changes in the nature, extent and quality of social identities. Ground-breaking theory will be supported by ground-breaking methods. (1) Changes in group membership and identification and identity resources will be linked to objective measures of stress and trauma. Since, to date, emerging evidence of health benefits of group memberships and social identities have largely been demonstrated using subjective measures, this methodological advance is both novel and important. (2) Causal effects of positive and negative change in social identities on stress and trauma outcomes will be examined using longitudinal and experimental approaches, working in both laboratory and community contexts. (3) Qualitative studies will explore whether changes in social identities are associated with post traumatic growth at the personal level as well as the novel idea that trauma can effect change and growth in social identities. (4) Finally, a large scale survey will assess whether trauma, via enhanced social identification, can drive progressive social change. This new paradigm will transform the conceptualization of trauma from individual to social; deepen our understanding of the physiological and psychological implications of stress and trauma; and link the personal effects of stress and trauma to its wider social and political consequences.

Link to the ERC project webpage:

Keywords of the ERC project: Social identity , trauma, groups, growth, psychology

Keywords that characterize the scientific profile of the potential visiting researcher/s: Social identity, social psychology, politics psychology

Project ID:	Project Acronym:	Evaluation Panel:
947867	**SAMCOM**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Vita Peacock**
Host Institution:	King'S College London - GBR

Surveillance and Moral Community: Anthropologies of Monitoring in Germany and Britain

Surveillance—the mediated monitoring of human behaviour for some intended purpose—has become part of the structure of European life. As ubiquitous monitoring technologies transform every new relationship that they mediate, there is grave concern that the social gains of past centuries will be lost, as states and large corporations use these technologies to expand and entrench their own power. Scholars of surveillance have been following these developments since the 1970s, but recently have faced the paradox that most surveillance now takes place with the active collaboration of the surveilled. Moreover, the enthusiasm for self-monitoring popularized through smart technologies has been met by many surveillance scholars with bewilderment. Why would people choose to enter relationships objectively deemed to be coercive?

This project takes a new approach to how we understand surveillance. I embark on the first sustained inquiry into the association between surveillance and moral community, between practices of 'watching over' and the presence of a group of people who share a commitment to certain goods. By ethnographically investigating the role that surveillance technologies play in realizing four different types of good—care, health, safety and citizenship—within four different communities—the family, the interest group, the circle of intimates, and the nation—this research explores how surveillance proliferates not as a lever in power relations, but by being harnessed to forms of human welfare.

The gains of this project are substantial. To surveillance studies I import insights from anthropology, offering a comparative and embedded approach that situates surveillance as a social relationship. I also initiate a major conversation about surveillance in anthropology. Finally I develop the concepts of 'moral' and 'immoral' monitoring, achieving greater public clarity on those forms of surveillance that support collective welfare, and those that threaten to harm it.

Link to the ERC project webpage: www.samcom.uk

Keywords of the ERC project: surveillance; anthropology; digital culture; morality

Keywords that characterize the scientific profile of the potential visiting researcher/s: anthropology; surveillance studies; digital humanities

Project ID:	Project Acronym:	Evaluation Panel:
949754	**HUNTING**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Sanne Kruikemeier**
Host Institution:	Universiteit Van Amsterdam - NLD

Hunting for Voters: The Impact of Data-Driven Campaigning on Democracy

Data-driven political campaigns are on the rise. Concerns have been voiced that practices like online political microtargeting techniques are harmful for democracy. These concerns grew after the unexpected outcome of the US presidential elections in 2016, the Brexit vote in the UK, and several recent elections in Europe. However, it is unclear if data-driven campaigns using online microtargeting techniques are an actual threat to democracy. The project will focus on the consequences of data-driven targeting and digital persuasion. In light of ongoing political and societal turmoil, investigating how citizens may be persuaded in a changing media landscape has never been of more importance. The overarching objective of this project is to identify the conditions and the extent to which data-driven online political microtargeting affect citizens' attitudes and opinions, and eventually voting behavior. The project addresses three research questions: To what extent and under which conditions does data-driven political targeting have a beneficial impact, and under which conditions a harmful impact on democracy? And how can the beneficial effects trump the harmful effects? The project is novel as it systematically analyses the impact of data-driving campaigning, providing a theoretical dual-processing model, while using a mixture of research methods and a comparative perspective. As a whole, the project will offer a deeper understanding of the global impact of online data-driven targeting techniques during elections in several countries.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
950672	**SYNTHLIVES**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Filipe Calvao**
Host Institution:	Fondation Pour L Institut De Hautes Etudes Internationales Et Du Developpement - CHE

Synthetic Lives: The Futures of Mining

The global extractive industry is undergoing three critical transformations: first, the advent of synthetic or lab-grown minerals, impacting the mining industry and the extraction of resources from nature; second, the creation of fully automated mining operations, seeking to render human work redundant or accessory to that of bots, drones, and other autonomous machines; third, the introduction of digital data and disintermediation technologies for mining management and traceability. Taken together, these innovations anticipate a future of mining that replaces nature with synthetic substances, human labor with intelligent machines, and intermediaries with unmediated accountability. This project responds to these changing conditions with a novel conceptualization of the emergent relationship entangling synthetic and natural objects, humans and machines, material and digital spaces: Synthetic Lives. It asks: What is the role of humans and non-human nature in increasingly synthetic, automated, and digital mining economies? This research innovates by bringing together three related areas of scholarly enquiry: i) resource materialities, to destabilize the divide between nature and culture; ii) mediation and technology, to problematize the separation between humans and machines; iii) algorithmic governance and digital transparency in mining sites, to untangle how material and digital properties are co-produced. Through a multi-sited and multi-methods study, it contributes to these fields of research in three case studies: synthetic laboratories, automated mines, and digital and data-driven mining processes. Interlacing these three foci, Synthetic Lives assists policy-making on environmental, employment, and social-digital issues, and inaugurates a debate of anthropological import: What are the political, epistemological, ecological, and economic consequences of a future that promises to be entangled in synthetic properties, autonomous machines, and digital technologies?

Link to the ERC project webpage:

Keywords of the ERC project: Mining, Extractive Industries, Future, Digitalisation, Automation, Labor, Nature

Keywords that characterize the scientific profile of the potential visiting researcher/s: Anthropology, Sociology, Environment, Extractive Industries, Digitalisation, Automation, Labor, Nature

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101001420	**RESEDA**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Maria Melchior**
Host Institution:	Institut National De La Sante Et De La Recherche Medicale (Inserm) - FRA

RESilience to Early Developmental Adversity: can children's environment help them overcome the odds?

Socioeconomic inequalities in children's neurodevelopment and mental health are observed from early onwards and widen over time. Moreover, children whose parents are immigrant, particularly if they belong to ethnic minority groups, may be especially vulnerable. Yet there are important inter-individual differences in development, implying the possibility of resilience. My project will examine the consequences of multiple forms of socioeconomic adversity in children's family and broader social environment with regard to their neurodevelopment and mental health, testing the role of social supports as sources of resilience. Specifically, I will rely upon longitudinal data collected from the ELFE child cohort study, a nationally representative sample of 18 321 children born in France in 2011 and followed-up to age 10.5 years, which will be linked with longitudinal administrative and geographical information characterizing neighbourhoods of children's school and residence, as well as healthcare use data. Potential resilience factors will include familial (e.g. relations between the child and his/her mother and father, grandparents' involvement) and contextual social supports (e.g. childcare prior to school entry, neighborhood social capital). Lifecourse patterns of adversity and resilience at each level of analysis will be identified using statistical methods developed for high-dimensional data and their influence on children's development will be ascertained applying methods that strengthen causal inference (e.g. propensity scores). The results will help clarify 1) the ways in which lifecourse patterns of exposure to adversity in the family and children's broader social environment can influence neurodevelopment and mental health, particularly among children of immigrants; 2) familial and collective factors that can help children overcome the odds and should be promoted.

Link to the ERC project webpage:

Keywords of the ERC project: epidemiology; mental health; children; social determinants;

Keywords that characterize the scientific profile of the potential visiting researcher/s: social sciences; psychology; health geography

Project ID:	Project Acronym:	Evaluation Panel:
101002163	**IDENTITIES**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Elisabetta Crocetti**
Host Institution:	Alma Mater Studiorum-Universita Di Bologna - ITA

Managing Identities in Diverse Societies: A Developmental Intergroup Perspective with Adolescents

Ethnic and cultural diversity has sharply increased in modern societies due to migration processes. However, the implication of this for adolescents facing the core task of developing their identities are still mostly unknown. For both adolescents without and with a migrant background (e.g., recent refugees, second-generation immigrants) growing up in societies with increasing levels of diversity can be challenging, as they have to manage their identities acknowledging that how they address the core question "who am I?" could be the result of a dynamic process based on multiple and diverse social interactions.

The IDENTITIES project adopts a cross-fertilization approach, integrating developmental and social-psychological models, to provide a ground-breaking knowledge on the processes leading to the well-being of adolescents with and without a migrant background. By proposing a multidimensional ecological developmental intergroup perspective, the project aims to examine:

(1) how intergroup experiences in ecological contexts (from parents, friends, school, and leisure microsystems to cultural macrosystems) influence the development of adolescents' (personal, social, and human) identities;

(2) how the interplay of identities affects adolescents' (physical, psychological, and social) well-being;

(3) how intergroup experiences in multiple ecological contexts influence adolescents' well-being disentangling direct and indirect effects (mediated by identities).

To achieve these aims, a longitudinal study with 2,250 adolescents from two cohorts will be conducted, including multiple annual, monthly, and daily assessments and applying a multi-informant design (with quantitative data collected from adolescents, parents, teachers, school principals, municipal administrators, archives, and non-invasive medical devices) and it will be complemented by a case study with a narrative approach conducted with 50 adolescents who have lived abroad for at least three months.

Link to the ERC project webpage: https://site.unibo.it/identities/en

Keywords of the ERC project: adolescence, relationships, identities, well-being, longitudinal

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101002726	**WAVEMATTERS**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Ignacio Farias**
Host Institution:	Humboldt-Universitat Zu Berlin - DEU

Urban vibrations: How physical waves come to matter in contemporary urbanism

Cities are critical zones where the intermingling of environmental processes, infrastructural arrangements and human lives is increasingly apparent and disputed. Physical waves, particularly heat radiation, sound waves and radio frequencies, constitute major environmental disturbances that invisibly cross the urban built environment affecting bodies, human and nonhuman, in harmful and uncertain ways. By asking how they come to matter, this project explores how waves become associated to specific bodies and environments, as well as how they become matters of public concern and design intervention. To answer these questions, this project entails extended ethnographic fieldwork at key locations where ur-ban projects aimed at mitigating the urban heat island effect, abating environmental noise and building 5th generation wireless communication networks are currently unfolding. Following techno-scientific researchers, city officials, professional consultants, affected groups and concerned residents, the project will address two major research problems: 1. How bodily exposure is done in practice, paying attention to both knowledge production and controversies concerning wave-related exposure, as well as to how individuals learn to be affected by and bodily attune to physical waves. 2. How waves problematize forms of urban coexistence leading to design interventions that reassemble (and disassemble) urban en-vironments, as well as to practices of imagining other possible urban environments. A unique feature of this project is its emphasis on expanding conventional ethnographic research by means of multimodal collaborations with actors from the field, thus actively engaging in multimedia forms of knowledge pro-duction, prototyping or community building. This is indeed crucial to reassessing the material politics of the Anthropocene as entailing contested practices of materializing abstract or imperceptible environmen-tal disturbances.

Link to the ERC project webpage: https://www2.hu-berlin.de/stadtlabor/project/urban-vibrations/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101002973	**POPCLIMA**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Raya Muttarak**
Host Institution:	Alma Mater Studiorum-Universita Di Bologna - ITA

Population Dynamics under Global Climate Change

This study is the first to comprehensively address the impacts of climate change (CC) on population trends. Existing studies on population and CC focus either on the effects of population growth on CC or on identification of populations at risks to climatic hazards. There is virtually no literature on the mechanisms and the extent to which CC affects and will affect demographic outcomes. It is even not clear whether CC may increase or decrease fertility, mortality and migration. Being the first study to comprehensively and systematically address this issue, this project is very timely given that CC impacts have already been felt and are forecast to be much stronger in the future.

The project has four main objectives: 1) to study the way (direction and extent) in which CC influences demographic outcomes; 2) to examine the differential impacts of CC on subgroups of populations; 3) to identify the mechanisms through which CC influences demographic outcomes; 4) to forecast future population dynamics under climate change.

The project will analyse fertility, mortality and migration separately, using a variety of methodologies and datasets. Results from these analyses will then be used to inform the population projections under future CC scenarios. Our methodological approach is innovative. We will utilise and combine geo-referenced climate, demographic and socioeconomic data from different data sources (surveys and social media data) at the individual-, regional and country-level. Structural equation models are employed to identify the causal pathways and machine learning method is used to handle large-scale data.

Results will be particularly important for: 1) helping the scientific community in building more realistic scenarios about populations trends under the rapid pace of CC; 2) informing the international debate over the social costs of CC; and 3) providing a set of estimations useful to design better social and environmental policies.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101018262	**CONSPIRACY_FX**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Karen Douglas**
Host Institution:	University Of Kent - GBR

Consequences of conspiracy theories

The rise of conspiracy theories is often framed as a cause of various social ills such as declining public trust in democracy, the growing allure of populist and extremist politics, and the rejection of scientific consensus in favour of hearsay and fake news. However, the extent to which conspiracy theories contribute to these problems is not clear. Despite hundreds of academic articles on this topic in recent years, and significant interest in conspiracy theories in both academic and non-academic circles, there has never been a systematic investigation of their consequences. In fact, we know very little about when, how, and why conspiracy theories affect the decisions and wellbeing of individuals and societies.

The current project will address this issue, pulling together a team of three postdoctoral researchers, two PhD students, one Masters student, and senior collaborators from a range of academic disciplines. To discover when and how conspiracy theories are influential, three sub-projects will each focus on one of the key contexts in which conspiracy theories have shown the most potential to shape people's beliefs and behaviours: politics, vaccination, and climate change. To understand why conspiracy theories are influential, a fourth sub-project will focus on the consequences of conspiracy theories for the persons who spread them, concentrating in particular on the use of conspiracy theories by politicians and other elites.

A project on this scale, and with this level of sophistication, has never been attempted before. It will adopt a mixed-methods approach using archival and social media analyses, interviews, cross-sectional and longitudinal surveys, and experiments (including attitude, behavioural, cognitive/neuropsychological and physiological techniques). This project will move significantly beyond the state-of-the-art in the literature to identify when, how, and why conspiracy theories matter.

Link to the ERC project webpage: https://research.kent.ac.uk/conspiracy-fx/

Keywords of the ERC project: conspiracy theories, conspiracy beliefs, social psychology, political psychology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101019284	**TWICEASGOOD**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Susan Banducci**
Host Institution:	The University Of Exeter - GBR

Twice as Hard, Half as Good? Women Candidates' Experience of Sexism on the Campaign Trail

How does sexism affect women's pathway to political office? Scholars have claimed that voter sexism is over because women candidates win elections at the same rate as men. However, the emergence of a gender equality backlash, misogynistic social media campaigns and the continued under-representation of women in political office globally, indicate a need to re-examine whether sexism acts as a barrier to women's representation. To better understand political representation, therefore, it is important to understand how and under which conditions sexism by voters, media and political parties, actual and anticipated, can lead women candidates to alter campaign behavior and strategies.

For the proposed programme of research in TWICEASGOOD, we reconceptualize the "gender penalty" faced by women candidates to take into account the sexism, threats of violence that they face online, through social media, in the traditional media and in face-to-face encounters. We aim to understand the extent of these types of sexism as well as the ways in which women candidates anticipate and counter them, by being "twice as good", in order to achieve electoral success. To better understand how encounters of "everyday sexism" on the campaign trail, both online and offline and in the media, shape women's campaign efforts and chances at electoral success, we propose an ambitious five-year programme of research that captures candidate experiences of sexism and assesses their impact on electoral outcomes. To capture how sexism is experienced "everyday" on the campaign trail, we used a mixed-methods approach, bringing together participant-observation of candidates on the campaign trail in four countries with quantitative media analysis, candidate surveys and a battery of items administered in Round 11 of the European Social Survey to create a cross-national sexism index. This rich data will generate new insights about the causes of women's continued under-representation in politics.

Link to the ERC project webpage: https://politics.exeter.ac.uk/twiceasgood/

Keywords of the ERC project: gender, elections, society, sexism

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101041788	**AfDevLives**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Yonatan N. Gez**
Host Institution:	Iscte - Instituto Universitário De Lisboa - PRT

The Afterlives of Development Interventions in Eastern Africa (Kenya, Tanzania, Mozambique)

International development involves ideologies and activities ostensibly directed towards the improvement of well-being of populations in the Global South. Mainstream development interventions emphasize forward-looking ideas of progress and advocate for novelty. In so doing, however, the sector is often myopic, as evidenced by countless unintended consequences that stretch beyond interventions' official life cycle. Whether deemed success or failure, such interventions leave behind a long trail of tangible and intangible traces.

Project AfDevLives explores how development interventions' representational and material remains are experienced, employed, and re-appropriated by local actors over time, and how such active immanence of the past affects people's life-worlds. It weaves together three temporal gazes: prospective (development's blueprints); retrospective (sediments of the past, shorthanded as interventions' 'afterlives'); and present-time lived experience. Consciously de-centering formal development discourse and temporalities, the project develops and applies a phenomenological framework oriented around embodiment and intertwinement of people, objects, and space.

Using an interdisciplinary approach centered on social anthropology, research will be conducted in Kenya, Tanzania, and Mozambique, neighbouring Eastern African countries that are among the highest recipients of development aid and whose past and present balance continuities and ruptures. The project will unfold via an iterative process involving four complementary work packages: Movement, Image, Storytelling, and Synthesis. Working across work packages, countries, and case studies, the project will pursue three categories of objectives: conceptual (methodological toolkit), empirical (based on extensive ethnographic fieldwork), and practical (aimed at the development sector, local heirs of interventions, and the public at large). The project will result in a robust set of outputs.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101042028	**AFFIRMRelationships**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr David Doyle**
Host Institution:	Stichting Vumc - NLD

Implications of Gender-Affirming Hormone Therapy for Psychosocial Functioning and Social Relationships of Transgender People

Transgender health is an area of increasing focus for researchers and medical practitioners across Europe, in part due to rapidly escalating numbers of people identifying as transgender. A crucial oversight in this area is that very little research has examined how gender-affirming hormone therapy, the most common form of medical intervention for transgender people, shapes psychosocial functioning and ultimately social relationship experiences. Given the paramount importance of social relationships to health and well-being, evidence for psychosocial effects of gender-affirming hormone therapy is vital to ensuring health equity for transgender people, who suffer from alarmingly high rates of social disruption and suicide risk. I draw together independent strands of research on biological effects of hormones from social neuroendocrinology and health influences of psychological and sociocultural factors from social psychology and epidemiology to propose a novel biopsychosocial model linking gender-affirming hormone therapy to psychosocial functioning in transgender people. Drawing upon this model, I propose a programme of research involving four complementary work packages, triangulating across a variety of novel and cutting-edge research methods. This work will be guided by three key aims: A) to isolate causal pathways from a biopsychosocial model linking gender-affirming hormone therapy to psychosocial functioning, B) to empower transgender people to give voice to their own personal and relational experiences in the context of gender-affirming hormone therapy, and, C) to guide policy and practice for gender identity services in line with the informed consent model, directing focus to the improvement of psychosocial functioning and social relationship outcomes. This interdisciplinary programme of research will sit at the forefront of gender-affirming healthcare and treatment for transgender people.

Link to the ERC project webpage:

Keywords of the ERC project: transgender; hormones; psychosocial; relationships; identity; discrimination; health

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101045424	**FOODCIRCUITS**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Seth Holmes**
Host Institution:	Instituto De Ciencias Sociais Da Universidade De Lisboa - PRT

Food Circuits: Hidden Connections between Migrants and Societies

Most fruit and vegetables required and enjoyed by European and North American societies would not be possible without the planting, harvesting and transporting performed by migrant labourers. Yet, the contribution of migrants to crucial food systems is generally hidden in the experience of buying and consuming food. In this project, I take asparagus from Germany, oranges from Spain and strawberries from California as the vantage points from which to see connections between migrants and societies as well as the ways in which those connections become invisibilized. I focus on embodied experiences in food circuits in order to understand the labour of producing and transporting food and the process of consuming and incorporating food into oneself. Tracing asparagus, oranges and strawberries through their circulation, I investigate the embodied experiences of migrant farm labourers – who are treated simultaneously as essential, disposable and sometimes prohibited; supply chain workers – who are made up increasingly of migrants and work under tight delivery time constraints; and consumers – who eat with diverse intentions of survival, enjoyment, identity and ethics. I propose a new way of seeing social and embodied connections between migrants and societies – through the beauty, brutality and necessity of food. With FOODCIRCUITS, I will provide novel contributions on three primary fronts:

(i) developing a theory of connections between migrants and societies – including on embodied levels – by following fruit and vegetables as they circulate from the hands that pick them, through the arms that deliver them to the mouths that eat them;

(ii) re-conceptualizing the ways in which indirect connections between different categories of people are invisibilized through the infrastructures and processes of producing, transporting and consuming food;

(iii) expanding collaborative methods and ethics in field research across steep social and power hierarchies.

Link to the ERC project webpage:

Keywords of the ERC project: Ethnography, Migration, Labor, Food Systems, Embodiment, Health

Keywords that characterize the scientific profile of the potential visiting researcher/s: Ethnography, Critical, Anthropology, Sociology, Geography, History, Health

Project ID:	Project Acronym:	Evaluation Panel:
101045473	**DecouplingIT**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Steffen Dalsgaard**
Host Institution:	It University Of Copenhagen - DNK

Decoupling IT? A Global Comparative Ethnography of the Role of IT in the Mitigation of the Climate Crisis

Climate change is one of the biggest existential issues of our time, and there is little global agreement on how to deal with it. Governments and private sector industries argue that 'decoupling' economic growth from carbon emissions is the best way to reduce climate impact while still maintaining a healthy economy. Yet, how to do so remains an unsolved question. Most proponents of decoupling see IT as playing a central role, whereas critics argue that IT itself is entangled with incessant capitalist growth and has a large and often unacknowledged climate impact. In addition, IT solutions frequently have the side-effect of creating new and unforeseen problems – social or climatic. The challenge of decoupling is thus broader than the management of the relationship between the economy and the climate. As much as decoupling is about how we imagine the climate crisis can be solved with technologies, trusting that they can create the changes we need, it is also about the cultural value of lifestyles that we do not want to change. The DecouplingIT Project thus approaches decoupling as a matter of how sociocultural change is generated in the spaces between IT, climate change and capitalism. We study these spaces through ethnographic explorations of how IT professionals and enterprises articulate climate change as a problem in demand of IT-generated change, and in particular how they practically deploy IT with the climate in mind. While both climate change and IT are manifested in globally diverse ways, their interrelationship must be studied comparatively with attention to how particular conditions in different locations give rise to disparate responses. Consequently, we conduct research in distinct but conceptually connected 'climate-IT-hubs' each facing climate change in their own ways. This addresses a major theoretical gap in qualitative social science research, namely how global change is driven through the intersecting roles of IT, climate change and capitalism.

Link to the ERC project webpage:

Keywords of the ERC project: anthropology, climate change, digital technologies, ethnography

Keywords that characterize the scientific profile of the potential visiting researcher/s: anthropology, climate change, digital technologies, ethnography, sociology

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101054654	**SINGLETON**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Dimitri Mortelmans**
Host Institution:	Universiteit Antwerpen - BEL

Singleton trajectories. Understanding new life course paths of young adults.

The intellectual challenge that the Singleton project will tackle is identifying the relationship formation pathways of young adults in industrialized countries. This project departs from the currently couple centred research approach of young adulthood in which developmental pathways always seem to lead to Mount Marriage or Cohabitation Hill. In contrast, we argue that there is a fundamental hidden relationship pathway in young adulthood where individuals might be experiencing difficulties in finding the right partner, maintaining a relationship or where they make a deliberate choice to remain single and for longer periods.
This Singleton trajectory is characterized by a sequence of relatively short-lived committed relationships. The central question addressed in the Singleton project is therefore why, how, when and for whom this relationship trajectory manifests itself. Accordingly the project has four interrelated aims. A first aim is the empirical description of the share of Singletons in three birth cohorts. Second, the project will look at the internal dynamics of relationship formation, maintenance and dissolution from a multi-actor perspective to identify differences between young adults. In the third objective, the project will look into how social networks, educational trajectories and career prospects influence the development of relationship trajectories in young adulthood. A final aim will look at the macro level and incorporate the rise of a “single culture” as part of a new explanatory framework for understanding the Singleton trajectory. Methodologically, we apply a Longitudinal Explanatory Mixed Methods model (2 quantitative and 2 qualitative waves) concentrating on 3 cohorts in young adulthood. This project innovates on a theoretical and methodological level by integrating theories from various fields (demography, sociology and developmental psychology), redefining determinants and launching a much needed new research tradition in Single Studies.

Link to the ERC project webpage:

Keywords of the ERC project: singleness,emerging adulthood, longitudinal

Keywords that characterize the scientific profile of the potential visiting researcher/s: family sociology, family dynamics, social demography

Project ID:	Project Acronym:	Evaluation Panel:
101054741	**BeyondGenderBinary**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Daphna Joel**
Host Institution:	Tel Aviv University - ISR

Challenging the gender binary: Empirically unravelling the limitation of the male-female categories

The ultimate goal of this project is to free science and society from the unfounded dogma of sex categories as all-encompassing dichotomies, and to promote a world in which the male-female categories are restricted to the domains in which they have been shown to play a central role (e.g., reproductive medicine), rather than a-priori assumed to do so (e.g., mind and brain). According to the modern normative view of sex and gender (the 'gender binary'), each of two biological sexes (male/female) is associated with a typical, coherent gender identity (man/woman), sexual attraction towards the 'other' sex, a set of psychological and behavioral characteristics (masculinity/femininity), and the neural substrates on which these rely ('male'/'female' brains). In the past decade I led a scientific research project challenging the binary view of human brains. Using diverse analytical tools, we discovered that brains are not 'female' or 'male' but rather comprised of unique 'mosaics' of female-typical and male-typical features. On the basis of the mosaic framework, the multi-level analysis tools we developed, and my expertise in psychology, the proposed research project will use self-reports and indirect measures to collect rich data from large and diverse samples on the four psychological components of the gender binary (psychological characteristics, gender identity, attitudes towards the sexed body, and sexuality) and their interrelations to discover how they are best described when freed from the dogmatic binary framework. Focusing also on the experiences of presumably 'typical' populations (i.e., cisgender, heterosexual individuals) we will map variability in domains assumed to be homogenous and advance thinking about nonconformity as a matter of diversity rather than pathology. More broadly, the proposed research project will undermine the ancient categorization of humans into men and women and the unjust gendered social order this categorization helps maintain.

Link to the ERC project webpage: https://gendermosaic.tau.ac.il/

Keywords of the ERC project: gender, mosaic, gender identity, gender dysphoria, body dysphoria

Keywords that characterize the scientific profile of the potential visiting researcher/s: measures of nation-level gender equality

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101055089	**ANIMAPOLIS**	**SH3** The Social World and Its Diversity

Principal Investigator:	**Dr Rivke Jaffe**
Host Institution:	Universiteit Van Amsterdam - NLD

Political Animals: A More-than-Human Approach to Urban Inequalities

ANIMAPOLIS aims to understand the role of animals in the formation of urban inequalities, asking: How do animals' interactions with humans and infrastructures co-produce the unequal distribution of risks and resources across urban spaces and populations? It focuses on two critical urban domains, security and public health, that are often characterized by stark inequalities, and takes the role of key animals within these domains – dogs and rats, respectively – as a unique analytical entry-point.

Urban inequalities are not only produced and transformed by people. Security dogs have been socialized to identify threatening individuals on the basis of classed and raced markers. Rats pose a public health risk, and thrive in low-income areas with decaying sanitation infrastructure. Urban scholars have recently begun to highlight the importance of infrastructures and technologies in configuring access to essential goods and services. While this research has provided key insights into how non-human entities mediate social relations, it has largely overlooked how animals, too, may co-produce inequalities.

While dogs and rats clearly play a role within security and public health, we know little about how they mediate urban inequalities related to these societal challenges. This project investigates such mechanisms by focusing first, on dogs' and rats' distinct biological specificities and cultural imaginations, and second, on the spatial, material and affective dimensions of their interactions with humans and infrastructure. The research design develops a two-way qualitative comparison, between different urban contexts and between different animals, through multispecies ethnographies of animal-human-infrastructure dynamics in Amsterdam and Philadelphia.

The project's more-than-human approach extends theoretical and methodological innovations within urban anthropology, geography and human-animal studies in order to open new horizons on the study of urban inequalities.

Link to the ERC project webpage:

Keywords of the ERC project: animal geographies; multispecies ethnography; anthropology of infrastructure

Keywords that characterize the scientific profile of the potential visiting researcher/s: urban geography; anthropology; multispecies

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
726251	**STYDS**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Bence Nanay**
Host Institution:	Universiteit Antwerpen - BEL

Seeing things you don't see: Unifying the philosophy, psychology and neuroscience of multimodal mental imagery

When I am looking at my coffee machine that makes funny noises, this is an instance of multisensory perception – I perceive this event by means of both vision and audition. But very often we only receive sensory stimulation from a multisensory event by means of one sense modality. If I hear the noisy coffee machine in the next room (without seeing it), then how do I represent the visual aspects of this multisensory event?

The aim of this research project is to bring together empirical findings about multimodal perception and empirical findings about (visual, auditory, tactile) mental imagery and argue that on occasions like the one described in the last paragraph, we have multimodal mental imagery: perceptual processing in one sense modality (here: vision) that is triggered by sensory stimulation in another sense modality (here: audition).

Multimodal mental imagery is rife. The vast majority of what we perceive are multisensory events: events that can be perceived in more than one sense modality – like the noisy coffee machine. And most of the time we are only acquainted with these multisensory events via a subset of the sense modalities involved – all the other aspects of these events are represented by means of multisensory mental imagery. This means that multisensory mental imagery is a crucial element of almost all instances of everyday perception, which has wider implications to philosophy of perception and beyond, to epistemological questions about whether we can trust our senses.

Focusing on multimodal mental imagery can help us to understand a number of puzzling perceptual phenomena, like sensory substitution and synaesthesia. Further, manipulating mental imagery has recently become an important clinical procedure in various branches of psychiatry as well as in counteracting implicit bias – using multimodal mental imagery rather than voluntarily and consciously conjured up mental imagery can lead to real progress in these experimental paradigms.

Link to the ERC project webpage: bencenanay.com

Keywords of the ERC project: Mental imagery, perception

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
758473	**THEMPO**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Liuba Papeo**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

The missing link between Perception and Cognition: The case of multiple-person scenarios

Seeing persons among other persons interacting with each other and trying to understand what is happening is a fundamental task for our daily life. How the brain manifests the representational and integrative capacity necessary for this function is beyond our current understanding. THEMPO sees in the study of multiple-person scenarios an opportunity to address how human cognition deals with real-word social interactions and, more generally, how the information process is devised to go from a perceptual representation of entities (e.g. bodies) to a representation of the abstract relations that pull those entities together into a structured unit (i.e. a social event). Multiple-person scenarios are thus a case study to address the missing link between perception and higher cognition, and to understand how early visual perceptual representations make contact with relational/symbolic representations. THEMPO will pursue different levels of explanation, defining the sequence of information-processing stages involved, and their implementation in the brain in terms of large-scale network organization (functional, causal and hierarchical relations among perceptual and non-perceptual neural processes). It will further study the neural (linear and/or nonlinear) operations to transform perceptual information along the way toward abstraction. This will be accomplished by combining fine cognitive manipulations, imaging and neurostimulation techniques (fMRI, TMS), and advanced analytical approaches based on multivariate analyses of neural response patterns to define the operations behind neural activity in humans. THEMPO will culminate in the formulation of a model that will serve as a test bed to address individual variations in perceptual and neural combinatorial operations and, possibly, uncover the roots of altered social cognition. THEMPO is designed to build upon itself, from relatively simple stages to high-risk, high-gain objectives, as a safeguard to success.

Link to the ERC project webpage: www.liubapapeo.com

Keywords of the ERC project: Cognitive science, cognitive neuroscience, fMRI, social neuroscience, vision science, EEG, infants cognition, cognitive development, spatial cognition, eye tracking, language, motor cognition

Keywords that characterize the scientific profile of the potential visiting researcher/s: fMRI, EEG, eye tracking, cognitive science, cognitive neuroscience computational models, DNNs, ANNs

Project ID:	Project Acronym:	Evaluation Panel:
802885	**OPIOIDREWARD**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Siri Leknes**
Host Institution:	Universitetet I Oslo - NOR

How distress alters opioid drug effects and abuse liability

As the opioid epidemic escalates, we must ask: why are opioids so addictive? Non-human animal research links addiction with the powerful relief opioids can offer to animals in distress. In humans, epidemiological and clinical studies converge upon social stressors and a poor social support network as key risk factors for addiction. Despite this, it is currently unknown how pre-drug distress might alter opioid drug effects. Tremendous resources are dedicated to charting how people feel after taking a drug, sidestepping the potentially profound influence of how people feel before they take the drug. Here, I will turn the current approach on its head. Using acute social distress induction before morphine administration in healthy humans, I will create a human model to determine the psychological, physiological and brain underpinnings of how social stressors increase opioids' abuse liability.

First, I will test the hypothesis that pre-drug distress enhances drug wanting (self-administration) but not drug liking (self-report) compared to drug effects in a control condition. Second, I will use opioid blockade to confirm or falsify the hypothesis that opioid drugs 'hijack' brain mechanisms underpinning social support. Third, I will determine to what extent opioid drug effects are dopamine-dependent by blocking dopamine before morphine administration. I will also apply computational modelling and functional imaging to elucidate the underlying brain mechanisms. Thus, the proposal offers a powerful new methodology for resolving hotly debated questions on the independent contributions of opioids and dopamine for reward and abuse liability.

In sum, the project aims to achieve a breakthrough in our understanding of how a pre-drug social distress state can alter opioid drug mechanisms. The mechanistic understanding arising from this project could have profound implications for science, as well as for clinical care and new policies designed to contain the opioid epidemic.

Link to the ERC project webpage:

Keywords of the ERC project: pain, reward, stress, opioid, addiction, mood, emotion, brain

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
804360	**INSENSE**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Clayton Hickey**
Host Institution:	The University Of Birmingham - GBR

Incentive salience in human cognition during health and disorder

Incentive salience is a form of motivation for reward that is triggered by environmental cues. These come to be 'wanted': they create an urge or craving for approach and consumption that influences choice and guides action. Stimuli imbued with incentive salience are thought to become salient, attention-drawing, and impossible to ignore, and a leading theory of addiction proposes that drug stimulation of the brain's reward system may create intense and abnormal incentive salience for drug-related stimuli. Consistent with this, work with animals has linked incentive salience to signaling in mesocorticolimbic brain systems, and the release of nigrostriatal dopamine in particular. But direct investigation of incentive salience in human cognition is sparse, and the application of ideas from animal research to our understanding of human incentive salience has led to pervasive ambiguity and misunderstanding. The objective of INSENSE is therefore to use cutting-edge tools from cognitive neuroscience to a.) characterize the computational and neural substrates of human incentive salience, and b.) determine how failures in these systems underlie addictive human behaviour. This is accomplished through the combined use of techniques like transcranial electrical stimulation, psychopharmacology, electroencephalogram, multivariate pattern analysis of functional magnetic resonance data, and computational modelling in order to index, characterize, and manipulate the neural representation of naturalistic reward-associated stimuli.

Link to the ERC project webpage: www.cognitionlab.org

Keywords of the ERC project: cognitive neuroscience, fMRI, EEG, attention, reward, motivation, perception

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
804388	**wHiSPER**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Alessandra Sciutti**
Host Institution:	Fondazione Istituto Italiano Di Tecnologia - ITA

investigating Human Shared PErception with Robots

Perception is a complex process, where prior knowledge is incorporated into the current percept to help the brain cope with sensory uncertainty. A crucial question is how this mechanism changes during interaction, when the brain is faced with two conflicting goals: either optimizing individual perception by using internal priors, or maximizing perceptual alignment with the partner, by limiting the reliance on individual priors. wHiSPER proposes to study for the first time how visual perception of space and time is modified during interaction, by moving the investigation to an interactive shared context, where two agents dynamically influence each other. To allow for scrupulous and systematic control during interaction, wHiSPER will use a humanoid robot as a controllable interactive agent. The research will be articulated along five main objectives: i) determine how being involved in an interactive context influences perceptual inference; ii) assess how perceptual priors generalize to the observation of other's actions; iii) understand whether and how individual perception aligns to others' priors; iv) assess how is it possible to enable shared perception with a robot and v) determine whether perceptual inference during interaction is modified with aging, when lowered sensory acuity could increase priors relevance. To these aims wHiSPER will exploit rigorous psychophysical methods, Bayesian modeling and human-robot interaction, by adapting well-established paradigms in the study of visual perception to a novel interactive context. In several experiments the humanoid robot and the participants will be shown simple temporal or spatial perceptual stimuli that they will have to perceive either to reproduce them or to perform a coordinated joint action (as passing an object). The measures of the reproduced intervals and of the kinematics of the actions will allow to quantify through Bayesian modeling how social interaction influences visual perception.

Link to the ERC project webpage: https://whisperproject.eu/

Keywords of the ERC project: human-robot interaction, perception, mutual understanding, spatial perception, temporal perception

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
818070	**METABODY**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Aikaterini Fotopoulou**
Host Institution:	University College London - GBR

METABODY: Body Metacognition, Mentalization and Metamorphosis

We live in a socio-economic world that affords us with increasing options and technologies to control and present our bodily appearance to others, including by managing our eating habits, or by digital and even surgical body modification. These proliferating phenomena raise the age-old question of how we negotiate the balance between the invariance and invention of our identity. Addressing this question in relation to modern body image phenomena requires a radical new way of studying the concept of body image. METABODY proposes the novel concept of Body Imagining to capture the idea that our body image is not a fixed representation in the brain, but rather a dynamic inference based on prior expectations and new information. Studying the balance between prior beliefs and new information could thus hold the key to understanding modern body image phenomena. Moreover, existing studies have failed to investigate the metacognitive level of these inferences. METABODY will test the novel hypothesis that body image disturbances are not the result of biases merely in the 1st order ability to perceive one's body, but also in the 2nd order ability to evaluate the reliability of these perceptions in given contexts. Specifically, three empirical work-packages will study how individuals balance their own embodied experience against: (1) external perspectives on the body during multisensory perception (Body Metacognition), (2) social perspectives during interpersonal encounters (Body Mentalizing) and (3) future and ideal body perspectives during decisions about body modification options with uncertain outcome (Body Decision Making). Ultimately, METABODY will address in innovative ways the timely question of how we negotiate the balance between the invariance and invention of our identity in a time when changing the body is offered as an easy way to change the self.

Link to the ERC project webpage: https://www.katfotlab.com/projects/metabody-study/

Keywords of the ERC project: embodied mentalisation; body modification; eating disorders; interoception; metacognition

Keywords that characterize the scientific profile of the potential visiting researcher/s: embodied mentalisation; body modification; eating disorders; interoception; metacognition; parental brain

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Project ID:	Project Acronym:	Evaluation Panel:
818521	**DISCONNECTOME**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Michel Thiebaut De Schotten**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Brain connections, Stroke, Symptoms Predictions and Brain Repair

Every year a brain stroke will impair approximately 2 million Europeans. Notwithstanding recent progress, many of these individuals will have persistent cognitive deficits, impacting their personality, degrading their quality of life and preventing their return to work. Early identification of anatomical predictors of brain recovery may significantly reduce the burden of these deficits on patients, their families and wider society, while also leading to the discovery of new targets for treatments.

I have pioneered the development of imaging techniques that allow for the exploration of the relationship between brain disconnection and neuropsychological syndromes. With these tools, I aim to demonstrate that the structural organisation of the human brain's connections is the common denominator supporting functional specialisation and, when damaged, neuropsychological disorders.

Building on my expertise, I plan to (1) establish an atlas mapping the function of white matter for the entire human brain, (2) fractionate the stroke population according to disconnection profiles, (3) predict neuropsychological symptoms based on disconnection profiles, and (4) characterise and manipulate the fine biology involved in the disconnection recovery.In so doing, this project will introduce a paradigm shift in the relationship between brain structure, function and behavioural/cognitive disorders. I will deliver a comprehensive biological model of the neurocircuitry that supports neuropsychological syndromes, which will gather the modular organisation of primary idiotypic functions with the integrative organisation of highly associative levels of functions. In the long term, this project will allow me to determine if measures of brain 'connectivity' can be translated into advanced standard procedures that provide for a more personalised medicine, that focuses upon rehabilitation and improving the prediction of symptom recovery, while providing new targets for pharmacological treatment.

Link to the ERC project webpage: www.bcblab.com

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
819455	**DREAM**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Raquel Fernandez**
Host Institution:	Universiteit Van Amsterdam - NLD

Distributed dynamic REpresentations for diAlogue Management

Our ability to communicate using language in conversation is considered the hallmark of human intelligence. Yet, while holding a dialogue is effortless for most of us, modelling this basic human skill by computational means has proven extremely difficult. In DREAM, I address this challenge by establishing a new computational model of a dialogue agent that can learn to take part in conversation directly from data about language use. DREAM stands at the crossroads of the symbolic and the sub-symbolic traditions regarding the nature of human cognitive processing and, by extension, its computational modelling. My model is grounded in linguistic theories of dialogue, rooted in the symbolic tradition, but exploits recent advances in computational learning that allow the agent to learn the representations that it manipulates, which are distributed and sub-symbolic, directly from experience. This is an original approach that constitutes a paradigm shift in dialogue modelling --- from predefined symbolic representations to automatic representation learning --- that will break new scientific ground in Computational Linguistics, Linguistics, and Artificial Intelligence. The DREAM agent will be implemented as an artificial neural network system and trained with task-oriented conversations where the participants have a well-defined end goal. The agent will be able to integrate linguistic and perceptual information and will be endowed with the capability to dynamically track both speaker commitments and partner-specific conventions, leading to more human-like and effective communication. Besides providing a breakthrough in our capacity to build sophisticated conversational agents, DREAM will have substantial impact on our scientific understanding of human language use, thanks to its emphasis on theory-driven hypotheses and model analysis.

Link to the ERC project webpage: https://dmg-illc.github.io/dream/

Keywords of the ERC project: Natural Language Processing, Linguistics, Computational Psycholinguistics, Dialogue, Conversational Agents

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
820213	**ThinkAhead**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Giovanni Pezzullo**
Host Institution:	Consiglio Nazionale Delle Ricerche - ITA

Thinking Ahead: human planning from a predictive processing perspective

Humans have an impressive ability to form action plans in several domains of cognition; for example, planning routes to goals in spatial navigation, or the necessary steps to assemble complex objects, alone or together with other persons. However, the computations that underlie human individual and social planning remain largely unknown.

This proposal aims to explain the ways humans face three key forms of uncertainty arising in planning domains; namely, uncertainty about task structure, action sequences, and the contributions of self and others to cooperative plans. To this aim, it advances a radically new theory about human planning, within a Bayesian approach that has been successfully adopted to explain uncertainties arising in perception and control. The theory under scrutiny is that humans plan using probabilistic inference based on hierarchical predictive codes (HPCs): compressed information or task abstractions that afford a powerful form of uncertainty-minimization, by highlighting salient junction points of the problem at hand, analogous to saliency maps for visual search.

The methodology will combine empirical and computational modeling methods, to systematically validate the hypotheses of HPC theory about human planning in the face of uncertainties. A cornerstone of the methodology consists in conducting model-based analyses of human participants' behavior while they solve navigation-and-building tasks, alone or in dyads. This approach will permit us to compare the predictions stemming from HPC with those of alternative planning theories and ultimately, to understand the computations that underlie human planning.

This ambitious proposal will produce groundbreaking advancements in our understanding of a high-level executive function - planning - while also contextualizing it within the influential theory of predictive processing. Our results will have important implications for psychology, neuroscience, philosophy, AI and robotics.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
835263	**SPRINT**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Amalia Arvaniti**
Host Institution:	Stichting Radboud Universiteit - NLD

Speech Prosody in Interaction: The form and function of intonation in human communication

Intonation, the modulation of voice pitch, is essential for communication as it conveys information that helps listeners make inferences about the pragmatic intent of the speaker. Despite increased understanding of intonation's importance, there is little agreement even about essential aspects of its structure and meaning. This is in large part because research has focused either on the form of intonation, often taking a reductive approach to meaning, or has concentrated on meaning but without full scrutiny of form. Crucially, most research has eschewed the study of intonational variability, seeing it as a problem, rather than a natural facet of speech production that needs to be understood and accounted for. Examining all three aspects in tandem is critical for understanding how intonation is structured and functions in communication: considering meaning in the study of intonational form (i.e. phonetics and phonology) can help delimit intonational categories and uncover the limits of within-category variability; in turn, a robust understanding of form will lead to insights into intonational pragmatics. The present proposal will take exactly this integrative approach, based on the PI's recent research, to examine intonational phenomena attested in English and Greek that have vexed researchers for some time (uptalk, high accents, question tunes). Two varieties per language will be studied, Standard Southern British, Bristol English, Standard Athenian, and Corfiot Greek. Their systematic differences with respect to the phenomena under investigation will allow me to examine cross-linguistic differences, and dialectal variation and its role in communication. The investigation will involve phonetic and pragmatic analysis and modelling, followed by series of behavioural and neurophysiological experiments. Together, these methods will shed light onto the realization, structure and function of intonation, and lead to a robust model of intonational phonology and pragmatics.

Link to the ERC project webpage: sprintproject.io

Keywords of the ERC project: prosody, intonation, communication, speech production, speech perception, pragmatics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
864461	**FriendOrigins**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Lauren Brent**
Host Institution:	The University Of Exeter - GBR

The Evolutionary Origins of Friendship: A Cross-Species Comparison and Experimental Approach

Friendship is crucial for human health and well-being. People who are socially isolated have a greater risk of heart disease than heavy smokers, drinkers, and the obese, and halting social isolation's ongoing rise is a growing priority for public health and political policy. But coming to grips with our need for friends and the consequences we face in their absence requires we not only look at how friendship is manifested in contemporary societies but to its origins in our evolutionary past. Yet, the evolutionary origins of friendship and the degree to which friendship's components reflect human specializations are unclear. Studying nonhuman primates allows us to identify the causes and consequences of friendship in evolutionary time and the extent of its human uniqueness. Nevertheless, we know surprisingly little about the contexts that drove friendly social bonds to emerge, whether friendship-relevant cognitive abilities reflect primate universals, and the reasons why evolution allows social isolation to persist despite being detrimental. In this project, I will conduct a series of landmark studies to reveal critical insights into the evolutionary origins of friendship. I will generate an unparalleled cross-species dataset on the best-known taxa of group-living primates, the macaques, and will perform innovative social experiments on a unique macaque population. I have three key aims: (1) to test the environmental forces driving variation in social bonds across species; (2) to establish whether having information on the friendships of unrelated others is a uniquely human skill; and (3) to test whether social isolation is the result of competitive exclusion. Friendship may be one of the most important strategies humans have for surviving in large groups. Understanding friendship from an evolutionary perspective is therefore a critical component of understanding what it means to be human. The proposed project represents a major step forward in that endeavour.

Link to the ERC project webpage: https://www.friendorigins.com/

Keywords of the ERC project: social relationships; social networks; friendship; social evolution

Keywords that characterize the scientific profile of the potential visiting researcher/s: behavioural ecology, anthropology, sociology, social psychology, evolutionary medicine, evolutionary biology, ethology, zoology

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Project ID:	Project Acronym:	Evaluation Panel:
864694	**FACEDIFF**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Bridget Waller**
Host Institution:	The Nottingham Trent University - GBR

Individual differences in facial expressivity: Social function, facial anatomy and evolutionary origins

Communicating with others via the face is crucial for navigating our social world. Deficits in facial expression production can have debilitating effects on social interaction, characterising several clinical conditions such as autism spectrum disorder, schizophrenia and Parkinson's disease. Despite this, we know surprisingly little about individual differences in facial expressivity in the typical population, what causes these differences and whether such differences impact on individual lives. In part, this could be due to an historical focus on the universal nature of facial expression, assigning individual difference to random 'noise', rather than an evolutionarily relevant characteristic. The FACEDIFF project will diverge from this classic approach and test the novel hypothesis that individual differences in facial expressivity equip individuals' differentially to engage with their social environment: expressivity has a benefit (social engagement) but also a cost (over-exposure and thus risk of being cheated by others) and is related to the size and quality of an individual's social network. FACEDIFF will combine psychological, anatomical and cross-species methods to provide the first thorough interdisciplinary investigation of individual differences. First, individual variation in production and perception of facial expressions will be measured via laboratory experiments and in relation to social network size and quality. Second, variation in human facial musculature will be documented through cadaveric dissection and existing MRI databases. Third, facial expressivity will be examined in a primate model to determine whether patterns are unique to humans. This project will be the first to provide a comprehensive and interdisciplinary perspective on individual differences in facial expression and will stimulate new theories on the function and evolution of individual differences in humans.

Link to the ERC project webpage: https://facediff.co.uk

Keywords of the ERC project: Facial expression, communication, psychology, anatomy, evolution, primates, macaques

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
865568	**GutBrainGABA**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Bhismadev Chakrabarti**
Host Institution:	The University Of Reading - GBR

Mapping the impact of gut microbiota on brain and behaviour through the lens of GABA

Human beings are over 99% genetically identical. It seems striking therefore, that 1% of this genetic difference accounts for the large extent of individual variations seen in human behaviour and brain function. One promising alternative source of individual differences is the resident bacteria in the gastrointestinal tract, which is 40-90% distinct between different individuals. Bacteria in the human gut outnumber human cells, and account for nearly 10 times as much DNA as that from human cells. Some gut bacteria have been shown to produce Gamma Amino Butyric Acid (GABA) and serotonin (5-HT), molecules that function as neurotransmitters in the human brain. However, it is not known whether their production in the gut has any impact on behavioural and brain function. This project takes a biochemically informed approach to address this gap in knowledge through focussing on GABA, whose function as a neurotransmitter is well characterised, and which can be assayed directly or through proxy measures of brain and behaviour. The first work package of this project in human adults will investigate whether the population of gut bacteria capable of producing GABA can modulate brain levels of GABA (measured directly using Magnetic Resonance Spectroscopy), as well as performance in tasks that depend on GABA-ergic activity. The second work package will test the impact of ingesting bacteria known to produce GABA (packaged as a custom-made probiotic) over a period of four weeks, on the same brain and behavioural measures. Together, these studies will answer a fundamental question of whether the population of gut bacteria capable of producing GABA, as well as its modulation by probiotics, has any impact on the level GABA in the brain and its function. This interdisciplinary proposal brings together approaches from psychology, neuroscience, and gut microbiology to chart a new research frontier in understanding individual differences in human behaviour and brain function.

Link to the ERC project webpage: www.gutbrain.bhismalab.org

Keywords of the ERC project: gut brain axis, human, individual differences, psychology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
866533	**CORTIGRAD**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Daniel Margulies**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Cortical gradients of functional integration

Historically, cognitive neuroscience has focused on discrete, mutually exclusive modules or networks, however, current network-level descriptions of brain organization fail to account for integrated features of cognition. I recently described a principal gradient in cortical connectivity that reflects how activity from primary sensory/motor areas is integrated into transmodal regions of the default-mode network. This novel line of research led me to hypothesize that coherent aspects of cognition are an emergent property of a whole brain architecture consisting of multiple zones of integration. In particular, I hypothesize that each region of transmodal cortex is the apex of a zone of integration that is anchored by multiple unimodal cortical regions. To investigate the mechanism that allows abstract representations to form in transmodal systems, I first propose structural studies to investigate covariance in zone geometry across healthy adults, how zones have emerged through evolution and how they change across the lifespan. I will then explore the functional consequence of zones of integration for higher-order human cognition. I will examine if individual differences in cognition emerges from variation in the architecture of different zones, and how brain activity is altered when simple decisions depend on integrating information from multiple zones. Finally, I will examine how the absence of input from a sensory modality (through congenital deafness or blindness) alters the structure and function of transmodal regions in a zone-specific manner. By describing how the spatial layout of the cortex shapes its functions, this research provides a radically new framework for understanding the structural constraints that underpin the integrated nature of human cognition.

Link to the ERC project webpage: https://www.neuroconnlab.org

Keywords of the ERC project: neuroanatomy, cerebral cortex, connectivity, neuroimaging

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
883892	**PainPersist**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Christian Büchel**
Host Institution:	Universitaetsklinikum Hamburg-Eppendorf - DEU

Psychobiological mechanisms of pain persistence

Persistent or chronic pain is a key medical and societal problem. In the last decades, biomedical research has undertaken enormous efforts to develop treatments for persistent pain, but the results have been disappointing. This project proposes a radical shift, namely to target the early development of pain persistence and to investigate psychological interventions directed at negative expectations, control and reward in experimental long-term pain studies. A methodological work package will develop novel tools, such as MR spectroscopy of the spinal cord, to track metabolic changes related to persistent pain, and to identify the mechanisms of the proposed interventions. All studies are guided by an integrative model outlining how psychological factors, such as negative expectations and loss of control, can affect the development of pain persistence, and more importantly, how to counteract this process. We will, for example, augment the perception of pain decreases by expectations or use reward manipulations to reinstantiate the effectiveness of the pain modulatory system. Finally, the model proposes that the inability to control pain leads to a state of helplessness. Consequently, the role of helplessness will be investigated and we will test interventions with the goal to allow subjects to regain control over their pain. This will be possible, through the development of a novel pain assessment device, which can be used to detect spontaneous pain decreases and prompt the subject to perform an action (i.e. self-administer a putative treatment). Through the illusion of control, subjects perceive that their action is causal for the pain relief, even though it is actually pain reductions that trigger their action. In the future, this will also allow treatment of patients in which pain is already persistent, and allow them to regain perceived control over, and hence reduce, their pain.

Link to the ERC project webpage: https://sites.google.com/view/buechellab/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
885220	**SignMorph**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Adam Schembri**
Host Institution:	The University Of Birmingham - GBR

The dynamics of sign language grammar: Morphology, language change, iconicity, and social structure in signing communities

SignMorph aims to address two of the most fundamental questions in the language sciences: how much do the languages of the world resemble each other and how do they differ, and what factors account for both the cross-linguistic similarities and the differences? SignMorph will provide answers to these questions about the nature of human language through a focus on the sign languages of deaf communities. This project will also be the first to focus on key aspects of the grammar across three distinct subtypes of signing communities: (1) established macro-community sign languages used across an entire national deaf community, (2) established micro-community sign languages which are languages in smaller communities within a nation state, and (3) emerging sign languages which are sign languages that have only begun to emerge in the late 20th century. The driving research question is: sign languages are natural languages, but what kind of languages are they? SignMorph aims to better understand similarities and differences in the grammar of sign languages, and how these are shaped by language-internal and language-external factors. The factors to be investigated in the study include (1) the role of iconicity in mapping grammatical meanings onto form, (2) the relatively recent emergence of sign languages, and how their short history has impacted on the processes which create grammatical structure, and (3) the sociolinguistic structure of signing communities, particular the effect of the large proportion of child to child (rather than parent to child) transmission of sign languages, varying ages of first language acquisition, and variation in interaction individuals have with native signers through their social networks. The study of this distinctive combination of characteristics in sign languages means that this project will make a vital contribution to an understanding the human language capacity more generally.

Link to the ERC project webpage: www.signmorph.net

Keywords of the ERC project: sign language linguistics, linguistics

Keywords that characterize the scientific profile of the potential visiting researcher/s: sign language linguist, gesture studies researcher, linguist, anthropologist

Project ID:	Project Acronym:	Evaluation Panel:
948356	**KNOWLEDGELAB**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Mona Simion**
Host Institution:	University Of Glasgow - GBR

Knowledge-First Social Epistemology

This highly ambitious project proposes a new research programme for social epistemology.

Social epistemology investigates the epistemic effects of social interactions: e.g., how we gain knowledge from social sources (others' testimony, the media), how we should respond to disagreement, how groups (scientific teams, organisations) can know. It is among the most thriving areas in contemporary philosophy.

However, there is little agreement concerning the best methodological approach to social epistemological issues. Individualism puts the individual first; it asks: 'What are the epistemic responsibilities of individuals in social settings?' Its main weakness is that it is too demanding to be empirically plausible: according to Individualism, the individual has to do most of the work in separating reliable from unreliable sources. In contrast, Socialism puts the social factor first; it asks: 'How does the social environment need to be for individuals to acquire justified beliefs?' On this view, individuals need to do more or less epistemic work, depending on the social norms in force at the context. Socialism is too permissive, in that it licences socially accepted but epistemically irresponsible behaviour.

KNOWLEDGELAB develops a novel methodology for social epistemology, one that puts knowledge first; it starts with the function of social epistemic interactions, i.e. that of generating knowledge. It asks: 'How should we proceed in social epistemic interactions in order to generate knowledge?' KNOWLEDGELAB employs this novel methodology in the service of the epistemology of testimony, disagreement and groups, and develops the first integrated account of the epistemology of mass media in the literature. This framework is highly relevant in the context of a globalized society, replete with both easy-access information and misinformation: it is more important than ever to know what separates trustworthy sources of information from untrustworthy ones.

Link to the ERC project webpage: https://www.knowledgelab-research.com

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
948891	**TweakDreams**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Giulio Bernardi**
Host Institution:	Scuola Imt (Istituzioni, Mercati, Tecnologie) Alti Studi Di Lucca - ITA

Tweaking dreams: non-invasive modulation of the level and content of mental activity during sleep

Sleep and wakefulness have traditionally been regarded as two mutually exclusive states characterized by differences in consciousness and responsiveness to the environment. However, the last two decades of research have demonstrated that sleep is actually a locally regulated phenomenon and that cortical islands of sleep- and wake-like activity can often coexist across distinct brain areas. Intriguingly, this mosaic of activity is also directly related to the presence and content of mental activity during sleep. In line with this, many sleep disorders, including insomnia and arousal disorders, are associated with significant local alterations in the balance between wake- and sleep-like activity. In spite of these considerations, the classical view of sleep as a uniform global state is still dominant in both basic and clinical research. Moreover, it remains unclear whether the occurrence of local wake-like activity is related to specific physiological functions of sleep.

The objective of this project is to progress towards a deep understanding of the mechanisms that regulate sleep at a local level through the exploitation of known properties of the thalamocortical system. At the core of the proposal is the idea that particular sensory-stimulation protocols may allow to directly modulate sleep intensity in a local, region-specific manner. Such approaches could be used to non-invasively perturbate regional sleep-related brain activity, thus allowing to investigate the causal consequences on sleep mentation, subjective sleep quality and sleep-related functions, including learning and memory. Of note, the same approaches could also find application in counteracting alterations of local sleep regulation in pathological conditions.

Knowledge gathered within the project could yield potential breakthroughs in numerous key applications of tremendous clinical, social and economic interest including treatment of sleep disorders and prevention of sleepiness-related accidents.

Link to the ERC project webpage:

Keywords of the ERC project: high-density EEG, sleep, dream, sensory stimulation

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
949242	**COLOURCODE**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Jenny Bosten**
Host Institution:	University Of Sussex - GBR

The Mind's Eye: Decoding Colour Experience

The most extraordinary products of the human mind are personal, subjective experiences such as the qualitative experience of the redness of red, yet the question of what process or processes in the brain give rise to conscious experiences remains one of the greatest scientific mysteries. The COLOURCODE project will use colour as a model system to tackle important questions necessary to approach an answer. First, COLOURCODE aims to elucidate the representation of colour in the human brain that underlies how colours appear and are experienced. Second, it aims to provide the first investigation of how the precise timing of rhythmic neural activity represents colour and drives colour perception and experience. Third, by measuring how individuals perceive colour differently from one another, the project aims to determine how colour experience is constrained by the number and type of sensors in the eye and information received from the external world. COLOURCODE will use an innovative combination of psychophysics and individual differences, along with a diverse suite of neuroscience methods including electroencephalography (EEG), steady state visually evoked potentials, functional magnetic resonance imaging (fMRI) and transcranial magnetic stimulation (TMS). COLOURCODE will provide the most detailed characterisation yet of how a stimulus attribute is represented by the human brain, driving a greater understanding of representation in neuroscience. Determining for the first time the encoding capacity of rhythmic brain activity will cause a paradigm shift in vision science as it is not part of existing theoretical models. COLOURCODE's theoretical advances and methodological innovations will lead us closer to answering one of the most formidable questions in science and philosophy - the question of what processes give rise to conscious perceptual experiences.

Link to the ERC project webpage:

Keywords of the ERC project: colour perception, cortical colour representation, subjective experience, individual differences

Keywords that characterize the scientific profile of the potential visiting researcher/s: neuroimaging, colour science, psychophysics

Project ID:	Project Acronym:	Evaluation Panel:
950159	**VOIMA**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Attila Andics**
Host Institution:	Eötvös Loránd Tudományegyetem - HUN

Voice and speech perception across mammals: a comparative study of humans, dogs and pigs

Vocalizations of any mammal carry prominent cues about the inner states and identity of the vocalizer. Voice is also a prevalent channel for humans' recently emerged communication system, speech. Recent evidence suggests that certain human auditory brain specializations and mechanisms, relevant for voice and speech perception, reflect abrupt shifts in human capacities compared to other primates. Do these brain specializations for voice and speech perception reflect human-specific predispositions and are thus human-unique, or are they the consequence of rapid evolutionary adaptations or developmental accommodations of the ancient voice perception system to recent demands imposed by the presence of speech? I hypothesize that in general voice perception mechanisms are conserved across mammals, and provide a neuronal niche in which specializations for human voice and speech perception may arise also in non-humans. The case of companion animals provides an unparalleled model system to study the possible evolutionary and experiential effects of the presence of speech on the mammalian voice perception system. Dogs and pigs are phylogenetically distant, highly vocal species that live, when kept as companions, with humans. VOIMA combines ethology and brain imaging (EEG/fMRI/HD-DOT) to compare voice and speech processing in humans, dogs and pigs: WP1 seeks evidence for selective processing of conspecific voices, human voice, and speech. WP2 explores the mechanisms and specific sensitivities for inner state coding, voice identity recognition and vocalizer normalization, from con- and heterospecific voice. WP3 tests how sensitivities to human voice and speech emerge across dog breed types, in neonate dogs, pigs, wolves and wild boars, and in input-manipulated developing dogs. Revealing how adaptation to the human social niche shapes domestic mammals' voice perception, this project will provide new insights on how speech shaped human voice perception.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/950159

Keywords of the ERC project: canine neuroscience, comparative brain imaging, dog EEG, dog fMRI, dog HD-DOT, language evolution, mammalian voice processing, speech perception

Keywords that characterize the scientific profile of the potential visiting researcher/s: interest in psycholinguistics, neuroimaging data analyst, neuroimaging expert, NIRS expert, strong background in cognitive science, strong background in statistics, strong programming skill

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Project ID:	Project Acronym:	Evaluation Panel:
101001062	**CONNECT**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Martijn Van Den Heuvel**
Host Institution:	Stichting Vu - NLD

Connecting cross-condition patterns of brain connectivity towards a common mechanism of mental conditions and prediction connectomics

The brain is one of the most complex living systems we know and has an enormous capacity to regulate our physiology, behaviour and cognition. 30% of the European population however has to deal with a mental challenge, ranging from depression to burnout to psychosis, etcetera. These conditions are traditionally seen as separate disorders, but there is growing evidence that many mental conditions share overlap in terms of their genetics and symptomatology. The brain mechanisms behind this cross-disorder overlap reflecting a common biological factor of mental conditions remains unknown. One of the key problems is that the current field is centralised around 'single-condition examinations', lacking specificity and selectivity of macroscale mechanisms, leaving us blind for which brain attributes play a common versus a unique role across and within mental conditions. The goal of CONNECT is to find an underlying shared biological mechanism of mental conditions: I hypothesise that the organizational principles of the healthy brain network form a common network system for shaping relationships across disorders. With CONNECT I want to map the total brain space of cross-disease relationships to disentangle shared and specific mechanisms of cognitive function and disease disfunction. I want to build (WP0) a large multi-disorder MRI database to compare (WP1) brain fingerprints across a wide range of conditions. I will (WP2) develop a mechanistic framework to fundamentally describe cross- condition interactions and model the shared mechanisms of involvement of brain networks in brain function. This model will be leveraged into (WP2/3) a comprehensive connection catalog that systematically maps for all circuitry their common vs unique role in cognitive functions and their subsequent involvement in the spectrum of mental conditions. Disentangling disease-common from disease-specific effects, I will use Machine Learning to pave the way for (WP4) 'prediction connectomics'.

Link to the ERC project webpage:

Keywords of the ERC project: connectivity, disorder, brain, MRI, genetics

Keywords that characterize the scientific profile of the potential visiting researcher/s: data science, network science, mathematics, genetics, neuroimaging

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101001592	**ConflictedPrediction**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Clare Press**
Host Institution:	Birkbeck College - University Of London - GBR

Resolving the Perceptual Prediction Paradox

Our sensory receptors are bombarded with noisy, continuous streams of information. From these streams, our brains must construct percepts that are (1) veridical representations of the world, and (2) informative – i.e., highlighting what we did not already know. Cognitive science has suggested that our brain meets these challenges by using probabilistic expectations to shape our perceptual experiences. However, there are currently two broad classes of theory concerning how expectations shape perception, that are both supported by large bodies of evidence and mutually incompatible: some theories propose that we upweight what we expect to generate veridical representations, whereas others propose that we downweight what we expect to privilege the most 'newsworthy' information.

ConflictedPrediction will test a new theory addressing and solving this paradox for the first time, to determine how perception can be rendered both veridical and informative. I propose that probabilistic knowledge pre-emptively biases perception towards what is likely, to generate largely veridical experiences rapidly. However, if the input is particularly surprising, catecholamine release – acting to aid learning – reactively enhances perception of these inputs by modulating sensory gain. This perceptual enhancement will generate a clearer estimate of these highly unexpected events to guide model-updating.

To test the theory, ConflictedPrediction will use temporally- and spatially- sensitive neural measures (EEG, MEG, 7T fMRI), in combination with computationally derived parameters of perception and unexpectedness. This interdisciplinary project therefore will unify understanding of perception and learning across typically isolated scientific domains. Its findings will chart a new research frontier for understanding how the brain surmounts key computational challenges, enabling us to survive and thrive in a challenging sensory world.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101018523	**REVOLT**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Samir Okasha**
Host Institution:	University Of Bristol - GBR

Representing Evolution

A central part of scientific enquiry involves constructing representations of the world. Representations can take many forms, including diagrams, taxonomies, verbal descriptions, physical models, and abstract mathematical models. Thus a diagram of the solar system, a taxonomy of Alpine flora, a ball-and-stick model of a chemical substance, and a mathematical model of the spread of a disease are all examples of representations. Different though they are, each of these scientific constructs aims to represent some system in the world (the "target system") and can be assessed for how well they achieve this aim.

The aim of my project is to examine how biological evolution has been represented – diagrammatically, verbally and mathematically – in the scientific literature, past and present. A further aim is to examine representations of evolution in the context of pedagogy and science communication. "Biological evolution" is taken to include the process of descent with modification that Darwin first described; the mechanisms that drive the evolutionary process such as natural selection; and the products to which the process has given rise, such as adaptation and diversity. Scientists have constructed representations of each of these elements in their quest to understand how evolution works. My project will offer a systematic study of these representations from an overarching philosophical perspective.

The importance of the project lies in its integrative ambition. The project will bring together philosophical ideas about the nature of representation and idealization, linguistic ideas about metaphor and analogy, psychological ideas about reasoning and cognitive biases, and educational ideas about science communication. By drawing on such a diverse range of ideas, the project will deepen our understanding of how evolution is, has been, and should be represented. The results will of interest to both philosophers of science and scientific practitioners.

Link to the ERC project webpage: https://representingevolution.xyz/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101018805	**MediCoDe**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Markus Ullsperger**
Host Institution:	Otto-Von-Guericke-Universitaet Magdeburg - DEU

The Medial Frontal Cortex in Cognitive Control and Decision Making: Anatomy, Connectivity, Representations, Causal Contributions

Cognitive control enables humans to flexibly adapt their behavior for goal achievement. Despite intensive research we still miss an overarching understanding of cognitive control and its main underlying structure, the posterior medial frontal cortex (pMFC). This is due to insufficient consideration of pMFC neuroanatomy, its subregions and individual variability; low sensitivity of conventional group-level studies; diffuse use of multiple methods and paradigms in disparate studies impeding differentiation of general cognitive-control principles from study idiosyncrasies; sparsity of causal evidence in humans.

This project proposes a radical shift in tackling these issues by two novel approaches:

A) Within-subject multimodal dense sampling and representational modeling considering individual neuroanatomy will provide a fine-grained spatiotemporal mapping of representations of cognitive-control and decision-making variables to connectivity-based pMFC subregions and enable discriminating between competing theories. The rationale is that representations of latent constructs of cognitive control must generalize across tasks and contexts. In multiple sessions behavior, fMRI, EEG, eye movements and autonomic reactions are recorded while participants perform tasks enabling to estimate cognitive control variables (CCV) from behavior and computational models. Representational similarity analysis of CCVs across tasks and modalities in a regression framework will identify signatures of core theoretical components of cognitive control.

B) A novel stimulation method using low-intensity transcranial focused ultrasound (tFUS) noninvasively modulates neuronal activity in deep brain structures with excellent spatial resolution. tFUS combined with EEG and fMRI will causally test the necessity of CCV representations in pMFC and its network for adaptive behavior.

The project will open up new research avenues to address individual differences and pathological changes in cognitive control.

Link to the ERC project webpage:

Keywords of the ERC project: cognitive neuroscience, human medial frontal cortex, cognitive control, transcranial ultrasound stimulation

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101039378	**NONMANUAL**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Vadim Kimmelman**
Host Institution:	Universitetet I Bergen - NOR

Fundamentals of formal properties of nonmanuals: A quantitative approach

Sign languages, in addition to using the hands, also use positions and movements of other articSign languages, in addition to using the hands, also use positions and movements of other articulators: the body, the head, the mouth, the eyebrows, the eyes and the eyelids, to convey lexical, grammatical, and prosodic information. This linguistic use of the nonmanual articulators is known as nonmanuals. Contrary to current assumptions in the field of sign linguistics, this project proposes the hypothesis that all sign languages use the same basic universal building blocks (nonmanual movements) but that each language is different in how it combines these building blocks both sequentially and simultaneously. Languages also differ in the regularity, frequency, and the alignment properties of the nonmanuals. In order to test this hypothesis, the project will investigate formal properties of nonmanuals in five geographically, historically, and socially diverse sign languages using data from published naturalistic corpora of the sign languages, Computer Vision for extracting measurements of the movement of nonmanual articulators, and a statistical technique of Functional Data Analysis for a quantitative comparison of dynamic nonmanual contours. This will result in the first quantitative formal typology of nonmanuals grounded in naturalistic corpus data. The novel methodology proposed in this project requires testing, adjustment, and development, which constitutes an important component of the project. The developed methodological pipeline will be a secondary output enabling large-scale reliable quantitative research on nonmanuals in future. Finally, the established typology of formal properties of nonmanuals in the five sign languages will serve as basis for a cross-modal comparison between nonmanuals and prosody/intonation in spoken languages in order to separate truly universal features of the human linguistic capacity from the effects of the visual vs. auditory modalities.

Link to the ERC project webpage: http://vadimkimmelman.com/nonmanual/

Keywords of the ERC project: sign language

Keywords that characterize the scientific profile of the potential visiting researcher/s: sign language, computer vision

Project ID:	Project Acronym:	Evaluation Panel:
101039433	**KNOW-THYSELF**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Isabel Thielmann**
Host Institution:	Max Planck Gesellschaft Zur Foerderung Der Wissenschaften E.V. - DEU

Increasing Self-Knowledge to Promote Moral Behavior

The functioning of societies and the quality of interpersonal relationships heavily depend on moral behaviors such as fairness, cooperation, and honesty, whereas immoral behaviors bear tremendous societal costs. A long-standing puzzle facing the social sciences and the humanities is how to promote moral behavior. The prevalent approach is to modify the situation, e.g., through implementing rewards for moral and sanctions for immoral behavior or through nudging. Community and organizational policies invariably resort to such interventions to foster moral action. However, situation-based approaches are distinctly limited: they inhibit more consistent behavior change that extends to situations where the intervention is absent, and they often fail or even backfire.

In KNOW-THYSELF, I pursue a person-centered approach that can more widely and sustainably promote moral behavior than existing approaches. I draw on a yet unexploited resource for desirable behavior change rooted in ancient Greek philosophy: self-knowledge, defined as an accurate representation of what one is like. In the moral domain in particular, self-knowledge is restricted by self-enhancement – the pervasive bias to see oneself more favorably than implied by one's actions. I propose that increasing self-knowledge about moral character can promote moral behavior across contexts and even give rise to long-term change of personality traits that underlie moral action.

Adopting a multi-disciplinary perspective and combining rigorous experiments with cutting-edge field methods (e.g., experience sampling), I address three key challenges:

(1) How to advance self-knowledge most effectively

(2) Increase self-knowledge to promote moral behavior

(3) Increase self-knowledge to initiate long-term personality change

Tackling these challenges offers ground-breaking insights for theory, research, and practice into how self-knowledge can be advanced and utilized to boost moral behavior – in the short- and long-term.

Link to the ERC project webpage:

Keywords of the ERC project: self-knowledge; moral behavior; prosociality; ethical decision-making; personality; volitional personality change; moral character

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101039712	**COREDIM**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Martin Hebart**
Host Institution:	Max Planck Gesellschaft Zur Foerderung Der Wissenschaften E.V. - DEU

Uncovering the core dimensions of visual object representations

Our ability to interact with our visual world is a remarkable feat: Despite drastic changes in their visual appearance, we can effortlessly make sense of thousands of objects and carry out meaningful actions on them. To understand the nature of our visual representations that underlie this ability, a central goal of cognitive neuroscience is to determine the properties – or dimensions – that make up our representational space of objects. While much progress has been made at identifying the building blocks of visual processing in brain and cognition, our scientific understanding of visual representations remains fundamentally limited by (1) our ability to capture the complexity and variability of our visual world for determining the dimensions underlying our object representations and (2) the difficulty in disentangling visual and semantic contributions to these representations. COREDIM is an ambitious, interdisciplinary program that aims at overcoming these limitations and provide a detailed, interpretable characterization of the core dimensions underlying visual object representations. To reach this goal, COREDIM capitalizes on extensive, targeted sampling of behavioral and neuroimaging data and cutting-edge artificial intelligence methods that allow the identification of interpretable representational dimensions. Project 1 aims at uncovering the core representational dimensions of objects across ventral visual cortex, using a biologically-inspired neural network model tailored to each individual's functional neuroanatomy and trained to identify the most informative stimuli. Project 2 will identify the relative role of vision and semantic knowledge in shaping our core representational dimensions, through experimental manipulations at the level of the stimulus, task, and with cross-species comparisons. Together, COREDIM promises to transform our understanding of visual processing, laying the foundation for a comprehensive characterization of visual cortex function.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101039782	**Dreamscape**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Francesca Siclari**
Host Institution:	Koninklijke Nederlandse Akademie Van Wetenschappen - Knaw - NLD

The Electrophysiological Landscape of Dreams

Why and how do we dream? Although this question has fascinated humankind since the earliest ages, it remains largely unanswered. Each night, when we fall asleep, we progressively disengage from the external world until we cease to perceive it and to act upon it. Despite this sensorimotor disconnection, in our dreams we perceive and act, and although we do so in a purely imaginary world, our experiences bear so much resemblance with the real world that we almost invariably take them for real. How does the brain create such a real-world analogue, and why? Based on my previous work, in which I identified a neural signature of dreaming, I propose to answer this question by studying a set of electroencephalographic (EEG) potentials, which not only occur spontaneously during sleep, but in a similar form also during wakefulness, as part of reactions to unexpected environmental stimuli. The overarching objective of this proposal is to understand the precise role of these brain potentials in the generation of dreams. Specifically, I will 1) provide a systematic characterization of these potentials in the sleeping and waking brain, 2) clarify their relation to arousal systems, 3) assess how they relate to sensory and motor features of dreams and 4) manipulate them to causally affect dreams. To achieve these aims, I will employ a unique combination of cutting-edge experimental approaches, including 256-channel-high-density EEG sleep recordings combined with controlled sensory stimulations, serial awakening paradigms, pharmacological manipulations, closed-loop acoustic slow wave modulation and movement analyses in neurological patients who act out their dreams. These projects will contribute to the basic understanding of how and why we dream, with implications for the fields of consciousness, neuroscience and neuropsychiatry. They will also provide technological and pharmacological tools to manipulate sleep and dreams, with clinical relevance for patients with sleep disorders.

Link to the ERC project webpage:

Keywords of the ERC project: dream sleep consciousness

Keywords that characterize the scientific profile of the potential visiting researcher/s: postdocs in the field of neuroscience, computer science, neuropsychology, neurology

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Project ID:	Project Acronym:	Evaluation Panel:
101040049	**STARTDIALOG**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Lorenz Demey**
Host Institution:	Katholieke Universiteit Leuven - BEL

Towards a Systematic Theory of Aristotelian Diagrams in Logical Geometry

Aristotelian diagrams, such as the square of opposition, have been widely used throughout the history of philosophy and logic. Nowadays, they also have several applications in other disciplines that are concerned with logical reasoning, such as psychology, linguistics and computer science. However, many of the applications of Aristotelian diagrams suffer from substantial problems, often due to a lack of understanding of the intricate logical properties of these diagrams. Consequently, the tremendous heuristic potential of Aristotelian diagrams has remained vastly underappreciated thus far.

The overarching goal of the STARTDIALOG project is to develop a unified theory of Aristotelian diagrams. We will use a radically new research strategy to accomplish this goal, viz. developing a systematic typology of Aristotelian diagrams in close interplay with a comprehensive diagram database. This empirically informed typology will systematically organize all our (existing and new) knowledge about Aristotelian diagrams, similarly to the role of Mendeleev's periodic table of the elements in chemistry. This will enable us to clarify and solve many of the issues that currently surround the applications of these diagrams, and thereby lead to a more accurate understanding of their methodological importance.

This unified theory will allow us to move beyond the specific details of any given application, and to study Aristotelian diagrams as objects of independent interest. This will constitute a major breakthrough in logical geometry, i.e. the theoretical investigation of Aristotelian diagrams. However, because of the widely interdisciplinary use of these diagrams, the scientific impact of the STARTDIALOG project will reach far beyond the boundaries of logical geometry: its results will be relevant for other philosophical logicians as well, for philosophers in general, and ultimately, for all researchers who make use of Aristotelian diagrams in their research on logical reasoning.

Link to the ERC project webpage: https://www.lorenzdemey.eu/startdialog

Keywords of the ERC project: logic, philosophical logic, history of logic

Keywords that characterize the scientific profile of the potential visiting researcher/s: logicians, historians of logic

Project ID:	Project Acronym:	Evaluation Panel:
101040276	**HearingHands**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Hans Rutger Bosker**
Host Institution:	Stichting Radboud Universiteit - NLD

How Hands Help Us Hear

Human communication in face-to-face conversations is inherently multimodal, combining spoken language with a plethora of multimodal cues including hand gestures. Although most of our understanding of human language comes from unimodal research, the multimodal literature suggests that hand gestures are produced in close synchrony to speech prosody, aligning for instance with stressed syllables in free-stress languages like English. Furthermore, prosody plays a vital role in spoken word recognition in many languages, influencing core cognitive processes involved in speech perception, such as lexical activation, segmentation, and recognition. Consequently, viewing gestural timing as an audiovisual prosody cue raises the possibility that the temporal alignment of hand gestures to speech directly influences what we hear (e.g., distinguishing OBject vs. obJECT). However, research to date has largely overlooked the functional contribution of gestural timing to human communication. Therefore, HearingHands aims to uncover how gesture-speech coupling contributes to audiovisual communication in human interaction. Its objectives are [WP1] to chart the PREVALENCE of the use of gesture-speech coupling as a multimodal prominence cue in production and perception across a typologically diverse set of languages; [WP2] to capture the VARIABILITY in production and perception of gesture-speech coupling in both neurotypical and atypical populations; [WP3] to determine the CONSTRAINTS that govern gestural timing effects in more naturalistic communicative settings. These objectives will be achieved through cross-linguistic comparisons of gesture-speech production and perception, neuroimaging of multimodal integration in autistic and neurotypical individuals, and psychoacoustic tests of gestural timing effects employing eye-tracking and virtual reality. Thus, HearingHands has the potential to revolutionize models of multimodal human communication, delineating how hands help us hear.

Link to the ERC project webpage: https://hrbosker.github.io

Keywords of the ERC project: speech perception, gesture-speech integration, audiovisual, prosody, multimodal

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101040439	**REASONS F1RST**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Benjamin Kiesewetter**
Host Institution:	Humboldt-Universitat Zu Berlin - DEU

The Structure of Normativity

Some of the core fields of philosophy – including moral philosophy, value theory, and epistemology – are, at their heart, concerned with normative questions: questions about what is good or bad, right or wrong, justified or unjustified. These questions concern the content of judgements that human beings are constantly making and that structure our way of thinking, feeling, and acting. But while there is wide agreement in contemporary philosophy that normative judgements form a unified and important category of human thought, philosophers still struggle to understand what normativity actually is.

One highly attractive hypothesis is that normativity can be analysed in terms of reasons – i.e. in terms of the factors that count in favour of or against actions or attitudes. But the systematic exploration of this Reasons-First Approach is still lacking. REASONS F1RST aims to undertake this much-needed investigation. Fostering multidisciplinary conversations, the project will explore the Reasons-First Approach on a large scale. It seeks to address recent challenges to the Reasons-First Approach and to show that it prevails over alternative approaches to understanding normativity. REASONS F1RST thus pursues a twofold objective: (i) to assess the merits and demerits of the Reasons-First Approach compared to alternative proposals and (ii) to work out in detail how different normative phenomena – including values, obligations and rights, the justification of beliefs, as well as appropriateness norms for emotions – can be explained in terms of reasons.

Led by a PI of international renown and building on the work of a multidisciplinary research team, REASONS F1RST aims at nothing less than a fundamental understanding of one of the most important concepts of contemporary philosophy. It promises to yield groundbreaking results that will have a substantial impact on philosophy and far beyond.

Link to the ERC project webpage:

Keywords of the ERC project: normativity, reasons

Keywords that characterize the scientific profile of the potential visiting researcher/s: normativity, reasons

Project ID:	Project Acronym:	Evaluation Panel:
101040534	**CODEC**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Rogier Kievit**
Host Institution:	Stichting Radboud Universitair Medisch Centrum - NLD

COgnitive Dynamics in Early Childhood

Cognitive ability, measured through standardized tests, provides a highly predictive measure of lifespan outcomes including academic achievement, job success, as well as mental and physical health. However, these cognitive snapshots omit a crucial aspect of cognitive ability: Short term variability in cognitive performance. Individuals with more variable performance are more likely to be mis-stratified into schools or careers with potential lifelong consequences, and more likely to perform at levels that necessitate intervention for periods of time. Moreover, variability reflects a promising early warning marker of adverse outcomes, above and beyond mean performance. However, the challenges involved in measuring variability have left crucial questions unanswered: Is variability a single trait, or does it have distinct factors? What are the neural and behavioural determinants of cognitive variability? What is the association between short term variability and long-term outcomes? In this unique longitudinal design using gamified versions of classic cognitive domains I will measure variability across a range of tasks at multiple levels of temporal resolution: months, days, occasions and trials. 600 children (200 in the neuroimaging arm) will be measured for period of three years. Once per year they will take part in a burst: A week where they will be measured three times a day. I will use using cutting edge methodology to understand the behavioural, neural and environmental mechanisms of variability, as well as the longitudinal consequences of variability on cognitive development and the emergence of mental health symptomatology such as ADHD. By combining the strengths of deep phenotyping with cutting edge quantitative modeling, I will be able to test and develop theories of cognitive development, demonstrate the role of brain structure and function in supporting cognitive dynamics and determine the effect of cognitive variability on developmental outcomes.

Link to the ERC project webpage:

Keywords of the ERC project: cognitive development, cognitive fluctuation, structural equation modeling, timeseries modeling

Keywords that characterize the scientific profile of the potential visiting researcher/s: structural equation modeling, psychometrics, SEM, cognitive variability, cognitive development, R, structural MRI

Project ID:	Project Acronym:	Evaluation Panel:
101043071	**MODEL TRANSFER**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Catherine Herfeld**
Host Institution:	Gottfried Wilhelm Leibniz Universitaet Hannover - DEU

Model Transfer and its Challenges in Science: The Case of Economics

How can a single model be used to study predator-prey interactions in biology, the growth of cancer in medicine, and the business cycle in economics? And how is this practice supposed to contribute to progress in science? To answer those questions, we need to understand how models are transferred across domains. While model transfer is one of the most pertinent phenomena in modern science, philosophers have not yet given it due attention. Our project will fill this lacuna in a ground-breaking way: we will provide a comprehensive philosophical investigation of model transfer, its challenges, and its implications for scientific progress by innovatively combining approaches from philosophy and history of science with computational methods that are themselves new to philosophy. Because the literature so far neglects model transfer in the social sciences, we will focus on economics as an exemplary case that provides insights for the social and natural sciences alike. The main objectives of this project are to: (1) develop methodological and conceptual tools to study model transfer across scientific domains; (2) apply those tools to philosophically investigate model transfer and its challenges in science; (3) explore the implications of our results for the relationship between model transfer and scientific progress. This project will place model transfer upfront on the philosophical agenda. Thereby, our research will impact an extensive literature on scientific models and modelling in philosophy of science and the social sciences. By applying computational methods to study model transfer, it will push their use in empirical philosophy of science and Integrated History and Philosophy of Science. It will challenge established philosophical concepts of progress in light of such model transfers. Finally, it will inform scientific and science policy debates about how to overcome challenges to model transfer so that progress in model-based science can be ensured.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: computational methods, philosophy of economics, history of economics, models in science, modeling

Project ID:	Project Acronym:	Evaluation Panel:
101043344	**SPEEDY**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Benjamin Morillon**
Host Institution:	Institut National De La Sante Et De La Recherche Medicale (Inserm) - FRA

Defining an integrated model of the neural processing of speech in light of its multiscale dynamics

This interdisciplinary project will define an integrated model of speech processing by recording, modelling and manipulating neural oscillatory dynamics during perception of speech defined as a multiscale temporal signal. Dominant models of speech perception describe its underlying neural mechanisms at a static neuroanatomical level, neglecting the cognitive algorithmic and neural dynamic levels of description. These latter can only be investigated by considering the temporal dimension of speech, which is structured according to a hierarchy of linguistic timescales (phoneme, syllable, word, phrase). Recent advances in behavioural paradigms, computational modelling, and neuroimaging data analysis make it now possible to investigate the cognitive algorithms and neural dynamics subtending the processing of speech. To define an integrated model of speech perception, this project seeks to: 1. record neural activity in humans with magnetoencephalography and intracranial recordings during perception of continuous speech; 2. quantify linguistic information at each timescale of speech with a computational model; and 3. estimate their respective and shared neural correlates with multivariate and directed connectivity analyses. Feasibility is ensured by an in-house access to neuroimaging and intracranial recordings as exemplified in the data on Figure 1 of this proposal. This project will critically test whether neural oscillations play a fundamental role in the computational processes of perception and cognition. It will define the mapping between speech and neural timescales and reveal how information is transferred and combined along the linguistic computational processing hierarchy. It will overall specify -in terms of the nature of the information processed and of the dynamical hierarchical organization- the respective contributions of left and right hemispheric ventral and dorsal auditory pathways in speech processing.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101044626	**eSYMb**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Kristian Tylén**
Host Institution:	Aarhus Universitet - DNK

The Evolution of Early Symbolic Behavior

Understanding the unique evolutionary trajectory taken by the human species is impossible without appreciation of our special capacities for symbolic cognition and behavior. But how did these capacities evolve during the late Middle Palaeolithic? Within only the last couple of decades, early milestones in human symbolic behavior have been continuously revised as new excavations across the globe challenge previous long-held assumption. However, at the same time we have made little progress in our understanding of past symbolic behaviour and the mechanisms by which it evolved. As tools of the mind, symbols are constituted by the intangible cognitive processes they evoke in pragmatic use contexts, which are inaccessible to the standard methods of archaeology or genetics. With eSYMb, I will establish a novel integrative framework for the systematic investigation of early symbolic evolution directly frontloading records from archaeology in experimental investigations and computational modelling based on state-of-the-art methods from the cognitive sciences. Starting from the assumption that symbolic artefacts evolve adaptively over time to better fulfil their intended functions, I will investigate these structural changes and their cognitive implications to inform inferences about their past use. The framework will thus establish transparent, data-driven methods and criteria to test – for the first time - concrete hypotheses about early human symbolic behaviour from 6+ archaeological sites from the late Middle and early Upper Palaeolithic (~150.000 – 12.000 years ago) based on measures critical to symbolic cognition and behaviour. In summary, the objective of eSYMb is to bring systematic scientific rigour to the investigation and interpretation of early human symbolic behaviour particularly from.

Link to the ERC project webpage: https://cc.au.dk/esymb

Keywords of the ERC project: Cognitive Science, Archaeology, Experiments, Symbolic Evolution, Artefacts

Keywords that characterize the scientific profile of the potential visiting researcher/s: Quantitative methods, statistical modelling, computer vision, rock art, archaeology

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101045195	**BANG**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Abbie Hantgan-Sonko**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

The Mysterious Bang: A Language and Population Isolate Unlocks the Secrets of Interior West Africa's Lost Ethnolinguistic Diversity

Species are often the most diverse at their origins, and all modern humans can trace their origins back to Africa. Our ability to communicate through language defines us; every human being speaks (or signs) at least one language. We may never know when our current forms of language were first spoken, or what speakers sounded like, but we can be assured that primordial languages were spoken in Africa. Yet, a paradox presents itself with respect to the apparent lack of linguistic heterogeneity in Africa: the languages comprise only four of the world's more than 150 families. Isolates, languages with no known living relatives, represent the missing links between today's homogeneity and the past's diversity.

Bangime may represent the only confirmed language isolate spoken today in interior West Africa. Its speakers, the Bangande, have resisted genetic admixture with neighboring populations for upwards of 9.000 years. The root of their eponym [BANG], means 'hidden' or 'secret' in surrounding Dogon languages whose linguistic and genetic ancestors are almost as mysterious.

ERC-BANG will search for evidence of contact or inheritance between Bangime and a hitherto unexplored set of West African languages and populations using computationally-supported methods. Our research team will conduct an in-depth study of culturally significant and historically relevant loan words, so that a statistician can incorporate these findings into stochastic models of language diffusion. A geneticist will process the entire Bangande genome to compare with West African populations from a wider range than thus far considered. Together, we will perform a character-based Bayesian phylogenetic analysis of the Dogon languages to estimate the time depth of the group in order to test settlement hypotheses and proposed migration patterns. Completion of this project will uncover traces of vanished ethnolinguistic varieties in West Africa, and our methods can be replicated to solve similar questions.

Link to the ERC project webpage: https://radiofreeafrica.wordpress.com/erc-bang

Keywords of the ERC project: language isolates; computational linguistics; historical linguistics; language and genetics

Keywords that characterize the scientific profile of the potential visiting researcher/s: genetic isolates; phylogenetics; African languages; interdisciplinary research; human settlement

Project ID:	Project Acronym:	Evaluation Panel:
101054532	**CHEMCONTROL**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Roshan Cools**
Host Institution:	Stichting Radboud Universitair Medisch Centrum - NLD

Balancing brain chemicals for boosting meta-control

Cognitive control enables us to flexibly adapt behaviour to achieve our goals given a constantly changing environment. It is a hallmark of the human mind and exquisitely vulnerable in health and disease. Cognitive control often implies goal-directed instrumental effort to inhibit unwanted, yet hardwired or overlearnt biases, and is commonly associated with the prefrontal cortex (PFC) and dopamine (DA). However, the mechanisms of the broader construct of flexible cognitive control remain unclear. The urgency of addressing this is evidenced by robust predictive associations between flexible control and consequential life outcomes for health, wealth and well-being.

CHEMCONTROL approaches the problem from a novel angle, reconceptualizing it as meta-level decision-making between distinct control strategies. I propose to shift attention away from the classic focus on instrumental effort, implicating PFC and DA, towards a richer meta-control framework that takes into account outcome controllability. CHEMCONTROL radically upgrades the value of an opponent, cognitively effortless strategy that releases hardwired Pavlovian biases, implicating serotonin (5-HT). It redefines PFC function as making meta-level decisions between expensive dopaminergic versus frugal serotonergic strategies based on estimating outcome controllability.

We have recently validated a computational procedure for quantifying controllability estimates. I will combine this procedure with (i) high-resolution fMRI to compare neural activity in DA and 5-HT systems and (ii) novel PET designs to compare DA and 5-HT release. Next, I will use (iii) psychopharmacology and (iv) ultrasound neuromodulation, to causally manipulate key model components. CHEMCONTROL will unravel the mechanisms of (boosting) meta-control, revolutionizing strategies for promoting efficacy and resilience in a rapidly changing world.

Link to the ERC project webpage:

Keywords of the ERC project: chemical neuromodulation, cognitive control, stress, dopamine, serotonin

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101055060	**EXPERIENCE**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Axel Cleeremans**
Host Institution:	Universite Libre De Bruxelles - BEL

Are you experienced? An exploration into the functions and value of consciousness

Why would we do anything at all if the doing was not doing something to us? In other words: What is consciousness good for? Here, reversing classical views according to which subjective experience is a mere epiphenomenon that affords no functional advantage, I propose that the core function of phenomenal experience is to enable subject-level valuation: "What it feels like" is endowed with intrinsic value. Thus, I argue that it is only in virtue of the fact that conscious agents experience things and care about those experiences that they are motivated to act in certain ways and that they prefer some states of affairs vs. others. Conscious experience functions as a mental currency of sorts that makes it possible for agents to compare vastly different states of affairs in a common subject-centred mental quality space — a feature that explains that consciousness is unified. While my previous work was focused on the how question of consciousness, here, I propose to focus on the even more challenging question of the why of consciousness. EXPERIENCE will address this issue by pursuing a rich interdisciplinary program rooted in integrative philosophy of mind and in innovative cognitive neuroscience methods applied to the interactions between affect and consciousness in perception and action. The project is articulated over four work packages, each addressing a specific claim: (1) Subjective experience has intrinsic value, (2) The phenomenal field is valenced, (3) All intentional action is motivated by subjective experience & (4) Subjective experience has functional effects. EXPERIENCE is high-risk, for the function of subjective experience is largely unexplored territory, and high-gain, for it promises to question entrenched distinctions and to move the scientific approach of conscious a step closer to what we all know: That subjective experience matters. In fact, in many respects, it is the only thing that matters, as without it, life would simply not be worth living.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
724317	**ARCTIC CULT**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Richard Powell**
Host Institution:	The Chancellor, Masters And Scholars Of The University Of Cambridge - GBR

ARCTIC CULTURES: SITES OF COLLECTION IN THE FORMATION OF THE EUROPEAN AND AMERICAN NORTHLANDS

The Arctic has risen to global attention in recent years, as it has been reconfigured through debates about global environmental change, resource extraction and disputes over sovereign rights. Within these discourses, little attention has been paid to the cultures of the Arctic. Indeed, it often seems as if the Circumpolar Arctic in global public understanding remains framed as a 'natural region' - that is, a place where the environment dominates the creation of culture. This framing has consequences for the region, because through this the Arctic becomes constructed as a space where people are absent. This proposal aims to discover how and why this might be so.

The proposal argues that this construction of the Arctic emerged from the exploration of the region by Europeans and North Americans and their contacts with indigenous people from the middle of the eighteenth century. Particular texts, cartographic representations and objects were collected and returned to sites like London, Copenhagen, Berlin and Philadelphia. The construction of the Arctic thereby became entwined within the growth of colonial museum cultures and, indeed, western modernity. This project aims to delineate the networks and collecting cultures involved in this creation of Arctic Cultures. It will bring repositories in colonial metropoles into dialogue with sites of collection in the Arctic by tracing the contexts of discovery and memorialisation. In doing so, it aspires to a new understanding of the consequences of certain forms of colonial representation for debates about the Circumpolar Arctic today.

The project involves research by the Principal Investigator and four Post Doctoral Researchers at museums, archives, libraries and repositories across Europe and North America, as well as in Greenland and the Canadian Arctic. A Project Assistant based in Oxford will help facilitate the completion of the research.

Link to the ERC project webpage: https://www.arcticcultures.org/

Keywords of the ERC project: Arctic; cultures; cultural practices; histories; geographies; museums; collections; archives; indigenous peoples

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
819459	**NovelEchoes**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Koen De Temmerman**
Host Institution:	Universiteit Gent - BEL

Novel Echoes. Ancient Novelistic Receptions and Concepts of Fiction in Late Antique and Medieval Secular Narrative from East to West

This project offers the first comprehensive reconstruction and interpretation of receptions of ancient novels (1st-4th cent. AD) in (Greek, Arabic and western vernacular) secular narrative from Late Antiquity and the early Middle Ages. Novel Echoes follows up from the ERC Starting Grant project Novel Saints (on hagiography). It does so by taking ancient novelistic receptions towards entirely new, unexplored horizons.

Our knowledge about the early history of the novel is incomplete. Receptions of ancient novels have been studied for periods from the 11th and 12th cent. onwards but not systematically examined for preceding eras – much to the detriment of the study of both narrative (then and later) and the history of fiction. This project pursues the hypothesis that different secular, narrative traditions in this period were impacted (directly or indirectly) by ancient novelistic influences of different kinds and adopted (and adapted) them to various degrees and purposes; and that, since the ancient novel is a genre defined by its own fictionality, its reception in later narrative impacts notions of truth and authentication in ways that other (often more authoritative) literary models (e.g. Homer and the Bible) do not.

Novel Echoes strikes a balance between breath and depth by envisaging three objectives:
1. the creation of a reference tool charting all types of novelistic influence in secular narrative from the 4th to the 12th cent.;
2. the in-depth study of particular sets of texts and the analysis of their implicit conceptualizations of truth, authentication, fiction and narrative;
3. the reconstruction of routes of transmission in both the West and the East.

Given the project's innovative focus, it will enhance our understanding of both the corpus texts and the early history of the novel; place the study of corpus texts on an improved methodological footing; and contribute to the theoretical study of the much-vexed question of how to conceptualize fiction.

Link to the ERC project webpage: https://www.novelsaints.ugent.be

Keywords of the ERC project: Novel, reception, Classics, Late Antiquity, Middle Ages, Byzantine, literature

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
819649	**FACETS**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Massimo Leone**
Host Institution:	Universita Degli Studi Di Torino - ITA

Face Aesthetics in Contemporary E-Technological Societies

FACETS studies the meaning of the face in contemporary visual cultures. There are two complementary research foci: widespread practices of face exhibition in social networks like Facebook, Instagram, Snapchat, and Tinder; and minority practices of occultation, including the mask in anti-establishment political activism (e.g., Anonymous) and in anti-surveillance artistic provocation (e.g., Leonardo Selvaggio). Arguably, the meaning of the human face is currently changing on a global scale: through the invention and diffusion of new visual technologies (e.g., digital photography, visual filters, as well as software for automatic face recognition); through the creation and establishment of novel genres of face representation (e.g., the selfie); and through new approaches to face perception, reading, and memorization (e.g., the 'scrolling' of faces on Tinder). Cognitions, emotions, and actions that people attach to the interaction with one's and others' faces might soon be undergoing dramatic shifts. In FACETS, an interdisciplinary but focused approach combines visual history, semiotics, phenomenology, visual anthropology, but also face perception studies and collection, analysis, and social contextualization of big data, so as to study the cultural and technological causes of these changes and their effects in terms of alterations in self-perception and communicative interaction. In the tension between, on the one hand, political and economic agencies pressing for increasing disclosure, detection, and marketing of the human face (for reasons of security and control, for commercial or bureaucratic purposes) and, on the other hand, the counter-trends of face occultation (writers and artists like Banksy, Ferrante, Sia, or Christopher Sievey / Frank Sidebottom choosing not to reveal their faces), the visual syntax, the semantics, and the pragmatics of the human face are rapidly evolving. FACETS carries on an innovative, cross-disciplinary survey of this phenomenon.

Link to the ERC project webpage: http://www.facets-erc.eu/

Keywords of the ERC project: Face; Digital Studies; Artificial Intelligence

Keywords that characterize the scientific profile of the potential visiting researcher/s: Digital Studies; Artificial Intelligence; Visual Studies

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
819757	**ProtMind**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Thomas Douglas**
Host Institution:	The Chancellor, Masters And Scholars Of The University Of Oxford - GBR

Protecting Minds: The Right to Mental Integrity and The Ethics of Arational Influence

Unlike most traditional forms of behavioural influence, such as rational persuasion, incentivisation and coercion, many novel forms of behavioural influence operate at a subrational level, bypassing the targeted individual's capacity to respond to reasons. Examples include bottomless newsfeeds, randomised rewards, and other 'persuasive' technologies employed by online platforms and computer game designers. They also include biological interventions, such as the use of drugs, nutritional supplements or non-invasive brain stimulation to facilitate criminal rehabilitation.

The ethical acceptability of such arational influence depends crucially on whether we possess a moral right to mental integrity, and, if so, what kinds of mental interference it rules out. Unfortunately, these questions are yet to be addressed. Though the right to bodily integrity is well-established, the possibility of a right to mental integrity has attracted little philosophical scrutiny.

The purposes of this project are to (1) determine whether and how a moral right to mental integrity can be established; (2) develop a comprehensive and fine-grained account of its scope, weight, and robustness, and (3) determine what forms of arational influence infringe it, and whether and when these might nevertheless be justified. It will deploy a tripartite methodology comprising a bottom-up, casuistic approach, drawing on reflective responses to particular interventions; a horizontal approach, in which lessons for mental integrity will be drawn from analyses of the related phenomena of coercion, manipulation, and bodily integrity; and a top-down approach, drawing on theories of moral rights.

The analysis will establish arational influence as a new area of enquiry and yield guidance on controversial novel forms of arational influence including persuasive digital technologies, salience-based nudges, treatments for childhood behavioural disorders, and biological interventions in criminal rehabilitation.

Link to the ERC project webpage: https://ebip-oxford.org/#protecting-minds-section

Keywords of the ERC project: mental integrity, arational influence, nudge, autonomy, self-ownership, rights, neuroethics, philosophy

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
847428	**TiNT**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Garrick Allen**
Host Institution:	University Of Glasgow - GBR

Titles of the New Testament: A New Approach to Manuscripts and the History of Interpretation

The problem this project addresses is that operative modes for interpreting the Greek New Testament (NT) rely upon critical editions, not manuscripts. NT editions are scholarly abstractions that focus on reconstructing an "original" text, and that fail to account for a rich manuscript tradition that preserves evidence for key disciplinary questions. Instead of asking how manuscripts help reconstruct a text, this project examines what manuscripts say about the ways the NT was interpreted by the communities that produced them. This is accomplished by comprehensively analysing the forms and wordings of the title preserved in all non-lectionary NT manuscripts (c. 3500). Titles are malleable paratexts that provide a substantive vector to rethink approaches to the NT by seriously considering contexts of production and interpretation ranging from 2rd century Egypt to modern Mt. Athos, moving beyond the 1st century Roman world. Titles demonstrate that material and paratextual variance in form and design are constitutive aspects of the NT. Adopting New Philology as a methodology, the project critiques dominant approaches by taking each manuscript seriously as evidence for specific reading events, using titles as primary evidence. Titular analysis informs a range of topics, including authorship, locales of production, contexts of use, bibliography, and literary interpretation. The NT is best understood as an omnibus of manuscripts that constitute specific reading events, reflecting the interpretations of the communities that used them. The NT has never been a single reconstructed text, but a collection of texts in specific material and paratextual contexts. Despite the value inherent in the manuscripts, scholarship has focused almost exclusively on the NT's original context of composition. Resisting this trend, the project argues that titles are a rich resource for mapping the interpretation of the NT in contexts overlooked by critical scholarship: its own manuscript matrix.

Link to the ERC project webpage: https://kephalaia.com/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
850760	**LAWHA**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Nadia Von Maltzahn**
Host Institution:	Stiftung Deutsche Geisteswissenschaftliche Institute Im Ausland - Dgia - DEU

Lebanon's Art World at Home and Abroad: Trajectories of artists and artworks in/from Lebanon since 1943

This project takes an ambitious approach to investigating the trajectories of artists and their works in and from Lebanon since its independence in 1943. In the absence of an institutionalised local art history, artists are often stereotyped according to the agendas of labelling institutions. The project proposes a shift of perspective in approaching Lebanon's art world by placing emphasis on the multi-dimensionality of artists' individual trajectories. It investigates (1) the forces that have shaped the emergence of a professional field of art in their local, regional and global contexts, (2) how to rethink the impact of the political, social and economic environment on the art world and its protagonists, Lebanon often being defined by its experience of violence and conflict, (3) how artists are represented in relation to the nation, and (4) how the trajectories of individuals shape the field. The focus will be on artists in and from Lebanon using the forms of painting (Arabic: lawha), sculpture and new media art. The specificity of Lebanon's history after gaining independence from France in 1943 makes it particularly worthwhile to study the power-relations between artists and institutions at home and abroad. The project's objectives are to (1) develop a new approach to rethink artistic production from a cultural-political perspective while placing the trajectory of artists and their works at the centre, (2) re-evaluate the impact of war and migration on a country's artistic production, (3) build a collaborative digital platform and database (DDP) to create a central and open-access repository and innovative tool for future research and preserving Lebanon's cultural heritage, and (4) to connect the scientific cultures of academic research and museums/art institutions. The project's five thematic clusters and DDP will identify new methods on how to interrelate context and artistic production, serving as a model for revisiting art histories in post-colonial contexts.

Link to the ERC project webpage: https://lawha.hypotheses.org

Keywords of the ERC project: decentre, art history, modernity, digital humanities, art system, institutionalisation

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
865863	**AdriArchCult**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Jasenka Gudelj**
Host Institution:	Universita Ca' Foscari Venezia - ITA

Architectural Culture of the Early Modern Eastern Adriatic

During the 15th century, the political process of reducing the Eastern Adriatic, here considered as encompassing what is now littoral of Slovenia, Croatia and Montenegro, to a thin strip of border territories substantially separated from the continental massive to which they belong, reached its conclusion. The insularity of its large natural archipelago, i.e. almost exclusive dependence on the maritime communications, became characteristic even of mainland coastal towns, with lasting consequences. The project explores the impact of this change in the area between 15th and 18th c., focusing on architecture as the most evident materialization of a culture and its transformations. The goal is to examine the architectural culture in question in terms of both consumption and production. Factors such as political and economic consolidation of Venetian and Dubrovnik Republics as well as Habsburg Empire in the area, war and commerce with the Ottomans, but also the quick spread of revival of antiquity and the Catholic Revival, all fuelled the need for architectural creation with certain functional and symbolic characteristics, setting the cultural standards. On the other hand, the economics of production of architecture consisted of interrelated systems of the provision of materials (esp. Istrian stone) and organisation of construction sites, which, given the ease of the sea transport, resulted in an active market for architectural goods. This approach will provide an original contribution to the understanding of cultural practices that not only produced specific buildings, the most significant among which are now listed as World Heritage sites but also put into circulation ancient and modern models, techniques and materials for a European-wide audience. Moreover, it will investigate the trans-border and trans-confessional character of the architectural market, thus providing an innovative model for a study of such phenomena across Europe.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
949628	**JUSTREMIT**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Jonathon Matthew Hoye**
Host Institution:	Universiteit Leiden - NLD

Global Justice and the Remittances Challenge: Confronting the €1 trillion "gap" in the literature

Remittances are the single most important source of global relief for the world's poor, exceeding €1 trillion annually. Remittances outstrip Official Development Assistance by a factor of four and, in 2018, surpassed Foreign Direct Investment for the first time. 1 billion people are directly involved in the remittances economy, including 200 million senders and 800 million receivers. The benefits of remittances for receivers and their communities are broad and deep. Remittances support basic nutritional needs, housing, healthcare, and other critical daily expenses. Often these subsidies are lifelines without which receivers would be destitute. Remittances also improve childhood educational attainment levels, support local and state development and democracy, and serve as insurance against natural and political disasters. One would expect that GJ theory would be analytically able to incorporate remittances and normatively keen to explore the vast potentials for real-world injustice alleviation inherent to them. However, that is not the case. Just the opposite. Liberal GJ theory usually ignores remittances or frames them as harmful, and denies—sometimes denigrates—the agency of remitters. To sloganize: 1 billion people and €1 trillion are missing from the GJ debates. Worse, liberal GJ theorists endorse policies that could reduce remittances and increase harm. What is called GJ is often experienced by the world's poorest as manifest injustice. JUSTREMIT investigates the paradigmatic constraints which make this injustice inevitable and invisible to liberal GJ theory. Then, using both theoretical and ethnographic studies, it constructs an alternative paradigm that rectifies that injustice by putting remittances and the agency of the global poor at the centre of the new paradigm. JUSTREMIT does not simply contribute to GJ theorization, it challenges and reconstructs its foundation while introducing new empirical modes of investigation and opening new policy horizons.

Link to the ERC project webpage:

Keywords of the ERC project: Remittances; Regulations; Migration; Justice

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
949742	**HealthXCross**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Roberta Raffaetà**
Host Institution:	Universita Ca' Foscari Venezia - ITA

Remaking Health in a Microbial Planet by Crossing Space, Time, Species and Epistemic Cultures

Microbiome science is popularizing a symbiotic understanding of health and ecology. What microbiome science now knows is that microbes entangle the health of people and environments; what we don't know is how, in this process, new cultural concepts and practices of health may emerge. This project asks: how does health come to be reconfigured in a world entangled through microbial data? HealthXCross is a multi-sited, comparative ethnographic study of how scientists produce and coordinate knowledge within the Earth Microbiome Project (EMP). EMP is a US-founded and transnational research network to enable the collection, comparison and integration of microbial data across time, space and species in order to produce simulations for intervening in both environmental and human health. HealthXCross is an ethnographic inquiry into the implications of the environment being understood as a body - and viceversa - through the analysis of the tensions between the emancipatory and the dystopian effects of dissolving boundaries between human bodies and environments. With this aim, my project will examine 1) how the technology employed in EMP remakes notions of biological diversity by crossing conventional categorizations (space, time, species), 2) how the disruption of standard knowledge is performed as innovation value by making diverse epistemic cultures work together and 3) how these knowledge-making practices shape new trends in healthcare. HealthXCross will create a participatory design with scientists, who are among stakeholders in the public discourse about what it means to be human and how to live in an entangled planet. My project will offer timely insights into the interplay between knowledge making and the shaping of health practices in times of profound ecological, socio-technical and economic transition. HealthXCross will dramatically advance anthropological understandings of the contradictory but constitutive aspects of living together and being in relation.

Link to the ERC project webpage: https://pric.unive.it/projects/healthxcross/home

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101001478	**PIETRA**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Anne O'Connor**
Host Institution:	National University Of Ireland, Galway - IRL

Religious Translation, the Catholic Church and Global Media: a study of the products and processes of multilingual dissemination.

PIETRA is the first, large-scale, multilingual study of the translation products and processes that underpin communication in global religion. The project focuses on translation practices in the institution of the Catholic Church and the multilingual communication of religious messages against a background of technological change. PIETRA studies an institution with a distinct ideology and a history of multilingualism in order to capture how it has used forms of mass media in its communicative goals. It poses key research questions relating to consistency of message in a large multilingual institution across different languages, cultures and communicative formats. PIETRA analyses the translation processes and products of the Catholic Church across three different media (print, web and social media) and in two different time periods to advance understandings of how multilingual dissemination intersects with technological change and institutional ideology. It significantly expands the study of religious translation from core canonical texts to wider media platforms and multimodal forms of communication, addressing fundamental gaps in the study of the linguistic aspect of online religion. PIETRA combines the latest advances in empirical translation research, data capture and analytics, with sociological and ethnographic investigations to form a model for the analysis of the products and processes of large-scale multilingual dissemination. The innovative methodological design offers a completely new approach to the study of religious translation, on a scale that has not been attempted before. PIETRA introduces four key innovations: it places the issue of language at the heart of discussions of religious communication; it questions the presence of religious translation in a globalised communication circuit; it analyses the impact of the material carrier and media form on translation; and it examines translation practices through an institutional prism.

Link to the ERC project webpage: https://pietra.universityofgalway.ie/

Keywords of the ERC project: Translation, social media, communication, religion, institutional, multilingual

Keywords that characterize the scientific profile of the potential visiting researcher/s: corpus linguistics, multilingual, translation

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101001848	**INTENT**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Thor Magnusson**
Host Institution:	Listahaskoli Islands - ISL

Intelligent Instruments: Understanding 21st-Century AI Through Creative Music Technologies

Artificial Intelligence is becoming increasingly human-like and it is now proficient in a key human activity: musical creativity. But what does this mean? How does creative AI change our notions of art, culture and society? As new machine learning technologies begin to mirror ourselves, we need to look into that mirror and ask how this is changing us. This project takes a pioneering leap in research about AI by answering how new creative AI transforms our relationships with technology and other people.

This ambitious vision is achieved by using music as a platform to establish public understanding of AI. Three respective work packages will develop: 1) instruments with creative AI; 2) human-AI collaboration in music; and 3) sonic instruments as scientific instruments. The project initiates a public discourse on creative AI and develops a theoretical framework describing the transformed notions of self, others and knowledge when we adopt intelligent instruments in our work.

INTENT is interdisciplinary in nature. Applying the methodology of our new research collaboration protocol, we summon researchers from diverse disciplines to conduct frontier science on intelligent instruments as boundary objects. Through open science methods the outcomes will address: a) the role of creative AI in embodied technologies, and b) the understanding and reflection of artificial intelligence in future society.

The PI is an established authority on new instruments and music software development. His interdisciplinary background in music, philosophy and computer science and AI, together with impactful academic leadership roles make him uniquely placed to lead this radical research programme. Grounded equally in technology development and the humanities, the project will benefit diverse disciplines by developing a theoretical framework of creative AI, initiating a discourse around human-centred creative AI, and defining principles of ethical AI design in services and products.

Link to the ERC project webpage: www.iil.is

Keywords of the ERC project: Music, Artificial Intelligence, Instruments, Philosophy of Technology, Big Data, Sonification, Machine Learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: Computer science, Artificial Intelligence, Cognitive Science, Philosophy, Human Computer Interaction, Music, Performance, Media Theory, Software Studies.

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Project ID:	Project Acronym:	Evaluation Panel:
101002243	**MAJLIS**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Ronny Vollandt**
Host Institution:	Ludwig-Maximilians-Universitaet Muenchen - DEU

The Transformation of Jewish Literature in Arabic in the Islamicate World

In pre-modern times, an estimated ninety percent of the Jewish population lived under Muslim hegemony. Over the centuries, these Jews not only adopted the Arabic language for most forms of spoken and written communication, but also integrated concepts and techniques from their intellectual environment, resulting in one of the most extraordinary periods of literary creativity in all of Jewish history. Despite its importance, however, Judaeo-Arabic literature has been under-researched until very recently, due to inaccessible sources, disparate scholarly traditions and political antagonism.

The overall aim of MAJLIS is to explore comprehensively for the first time the fundamental way in which the adoption of Arabic transformed Jewish literature from the 9th to the 11th century. The project focuses on the Arabic literature of the Qaraites, a Jewish intellectual movement whose religious and scholarly center, the Academy of Jerusalem, played a catalytic role in these transformation processes. It will proceed by applying state-of-the-art digital tools to analyze manuscripts produced in the Academy with the aim of (1) tracing changes in Jewish literature and contrasting them to rabbinic literary models, especially with regard to how the texts were composed, produced, authored, and organized into a knowledge framework; (2) identifying the dominant scholars and analyzing their geographical origins, professional networks and institutional integration; and (3) comparing the Academy and its literature to non-Jewish literature and non-Jewish institutions of the time.

By bringing together unique expertise covering Judaic as well as Islamic studies at a time when the sources have become available to an unprecedented degree, MAJLIS will not only fundamentally add to our understanding of the history of Jewish literature, but also demonstrate that Jewish heritage in the Near East is of transcommunal and transnational importance.

Link to the ERC project webpage: https://www.jewisharabiccultures.fak12.uni-muenchen.de/majlis/

Keywords of the ERC project: Jewish Studies, Judaeo-Arabic literature, Jewish Literature, Digital Humanities

Keywords that characterize the scientific profile of the potential visiting researcher/s: Jewish Studies, Judaeo-Arabic literature, Jewish Literature, Digital Humanities

Project ID:	Project Acronym:	Evaluation Panel:
101019419	**Expanding Agency**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Kathleen James-Chakraborty**
Host Institution:	University College Dublin, National University Of Ireland, Dublin - IRL

Expanding Agency: Women, Race and the Global Dissemination of Modern Architecture

Expanding Agency will explore the role that women and members of ethnic minorities, primarily African-Americans, played in transmitting modern architecture and design internationally, including within Europe, between 1920 and 1970. Strands devoted to patronage, journalism, entrepreneurship, and institution building will offer alternatives to accounts that focus primarily on architects. This will expand our understanding of who had agency in this important story and more generally in the shaping of the built environment. Taking a global approach that stresses comparisons across continents will also help build a more nuanced understanding of how architecture, landscape architecture, interior decoration, and the design of furnishing are transformed by new ideas that emanate from a multiplicity of sources. This in turn can help support a more diverse profession that, in the wake of #metoo and Black Lives Matter, is better prepared to engage with a broad public, including to address such social challenges as the integration of migrants and sustainability.

Link to the ERC project webpage: https://expanding-agency.com

Keywords of the ERC project: modern architecture; gender; design history; women; race

Keywords that characterize the scientific profile of the potential visiting researcher/s: modern architecture; gender history; women; race

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101020304	**DEMBIB**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Bernd Schipper**
Host Institution:	Humboldt-Universitat Zu Berlin - DEU

From Texts to Literature: Demotic Egyptian Papyri and the Formation of the Hebrew Bible

With the discovery of numerous papyri in Egyptian Demotic script during the last two decades, a whole new corpus of Egyptian literature has become available. Based on 25 years of research of the Principle Investigator (PI) on Egypt and the Hebrew Bible, this project, for the first time ever, correlates the newly accessible Demotic papyri with Biblical literature. Since the Demotic literature comes from the exact historical period when the Hebrew Bible received its final form – the Persian and Hellenistic Age – the Egyptian papyri are nothing less than the extra-Biblical evidence Biblical scholarship has asked for over decades. Like the Hebrew Bible, the Demotic literature is rooted in a scribal culture, and thus displays significant parallels to Biblical literature.

The DEMBIB project aims 1) to investigate the structural parallels in Demotic literature and the Hebrew Bible; 2) to identify the compositional strategies of Demotic and Biblical literature; and 3) to contextualize these literary characteristics in the socio-historical situation of the 6th–3rd c. BCE when a scribal elite in Egypt and "Israel" faced similar challenges such as a changing socio-cultural environment and a marginalization of traditional temples.

The groundbreaking character of DEMBIB lies in: 1) the cross-cultural comparison of newly discovered Egyptian papyri and the Hebrew Bible; 2) the analysis of similar literary processes in Egyptian Demotic and Biblical literature; 3) the understanding of the dynamics between a distinct scribal culture and its socio-historical context.

The main goal of DEMBIB is to offer a new paradigm for the understanding of the transformation of textual traditions into complex forms of literature in Egypt and Israel during the Persian and Hellenistic Period. By doing so, one of the most crucial questions in Hebrew Bible scholarship today should be answered: the intellectual and historical context for the final formation of the Hebrew Bible.

Link to the ERC project webpage: https://www.theologie.hu-berlin.de/en/dembib

Keywords of the ERC project: Hebrew Bible, Ancient Egypt, Demotic Papyri

Keywords that characterize the scientific profile of the potential visiting researcher/s: Scribal technique, Hellenistic Period, Persian Period, Historiographic texts from the Hebrew Bible

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101021262	**TextDiveGlobal**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Warren Boutcher**
Host Institution:	Queen Mary And Westfield College, University Of London - GBR

Textuality and Diversity: A Literary History of Europe and its Global Connections, 1545-1659

This five-year programme of investigation of 52 textual corpora includes Mesoamerican codices, Jesuit neo-Latin plays, popular songs, Kongolese documents in Portuguese, Cervantes' works, examples of live speech from archives, and many others. It will produce an interdisciplinary literary history of Europe and its global connections for the period between the mid-sixteenth and mid-seventeenth centuries. The Reformation had fragmented Christendom into differing religious identities. Europeans were multiplying encounters with peoples and cultures in the Americas, Africa, and Asia. TextDiveGlobal challenges the legacy of nineteenth-century European literary-historical scholarship insofar as it durably organised the textual heritage connected with Europe from the perspective of distinct western European national literary canons and histories, and the comparisons and relations between them. Using analytical and linguistic-geographical criteria, it selects a wide and multilingual range of textual objects and forms both made and encountered by Europeans, in relation to spaces from Mexico to China, and events from the Church Council of Trent (1545) to the diplomatic Treaty of the Pyrenees (1659). The objective is to understand how textual and sociocultural diversity inform one another in different contexts and regions of this multifarious world. The methodology is a global-historical anthropology of texts grouped into corpora assembled on four interrelated principles: works, forms, spaces, events. Outputs include a two-volume summa (Oxford University Press), a database of information and images relating to the corpora, and a series of seminars across the USA and Europe. In each of five year-long phases of the research, a sub-team of experts and PDRFs will meet with the PI across the year, in weekly meetings and in two formal workshops. There will be small peer review groups across the phases; all events and draft chapters will be available to the whole group online.

Link to the ERC project webpage: https://www.qmul.ac.uk/textdiveglobal/

Keywords of the ERC project: Transregional European and global literary history in the sixteenth and seventeenth centuries

Keywords that characterize the scientific profile of the potential visiting researcher/s: Text and literary historians with an interest in Europe and its global connections in the early modern period

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101039904	**EXILED-EMPIRICISTS**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Sander Verhaegh**
Host Institution:	Stichting Katholieke Universiteit Brabant Universiteit Van Tilburg - NLD

Exiled Empiricists: American Philosophy and the Great Intellectual Migration

In the 1930s, hundreds of European academics fled to the United States, escaping the quickly deteriorating political situation on the continent. Among them were a few dozen philosophers from a variety of different schools: logical empiricists, phenomenologists, and critical theorists. Especially the first group would have a tremendous impact on American philosophy. Although the local intellectual climate had been dictated by distinctively American traditions such as pragmatism, U.S. philosophers soon began to advance views that were heavily indebted to the empiricists, thereby transforming the American philosophical landscape.

Historians have reconstructed the fate of the exiled empiricists. Still, little attention has been paid to the American context in which their movement came to full bloom. This is remarkable since any account of the empiricists' success requires an explanation of why the Americans were so susceptible to their views. What explains the surprisingly positive reception of logical empiricism? And why were the Americans more receptive to empiricism than to phenomenology or critical theory? This project shifts the perspective from the migrant philosophers to the local philosophical climate by 1) quantitatively analyzing thousands of American journal publications and 2) qualitatively examining the archives of dozens of key U.S. philosophers and institutions.

Today, it seems natural to carve up the philosophical landscape into an 'analytic' and a 'continental' tradition. Yet few philosophers realize that this deeply engrained distinction is relatively new; it first became popular in the United States in the years after the intellectual migration. In studying the unique American melting pot of philosophical schools (e.g. pragmatism, logical empiricism, phenomenology, critical theory), this project offers a broader, unifying perspective on 20th-century philosophy, thereby transcending the school-based barriers that have often shaped its historiography.

Link to the ERC project webpage: https://exiledempiricists.com/

Keywords of the ERC project: Logical empiricism; pragmatism; American philosophy; computational history of philosophy; history of philosophy of science; history of analytic philosophy

Keywords that characterize the scientific profile of the potential visiting researcher/s: Logical empiricism; pragmatism; American philosophy; computational history of philosophy; history of philosophy of science; history of analytic philosophy

Project ID:	Project Acronym:	Evaluation Panel:
101040059	**NoJoke**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Mirco Göpfert**
Host Institution:	Johann Wolfgang Goethe Universitaet Frankfurt Am Main - DEU

Humour as an epistemic practice of the political present

Something weird is happening in politics. Satirical parties, comedic journalism and memeification are gaining more and more traction; the slippages between parody and sincerity, play and earnestness, real and fake, ridicule and seriousness have proliferated at a dizzying rate. Global entanglements, new technologies, and the surge in populist politics are producing a cacophony of intricate cognitive, social, and economic dissonances bordering on the absurd. The underlying hypothesis of NoJoke is that these dissonances, and the comical reactions produce, have become formative phenomena of the political present; they have seeped into the social fabric and into the ways in which people appropriate their lifeworlds and make sense of themselves and others as political actors.

The practice of humour, NoJoke argues, can help us to make sense of the political present; it offers a unique methodology of discovery, a specific education by attention with regards to dissonances that elude conventional academic methods. Bringing together insights from the anthropology of politics and the political, from studies on humour, satire and laughter, and from anthropological advances in ontology, epistemology and methodology, NoJoke will conduct research with humour and humourists, and not merely on them, and establish a radically new approach to the study of the political present. Through a long-term comparative study with caricaturists, comedians, writers of satire, satirical politicians and comedic journalists in Berlin, Brussels, Budapest, Caracas, Johannesburg and the Iranian diaspora, it will follow three objectives: (1) to explore the intrusion of humour and humourists into the field of politics; (2) to articulate a theory of humour as an epistemic practice ? a mode of perception, creation and anticipation ? in and of the political present; (3) to launch an alternative practice of academic knowledge production by converting the heuristic of punchlines into a practice of theory.

Link to the ERC project webpage:

Keywords of the ERC project: humour, epistemic practice, satirical activism, satirical parties, investigative satire, politics

Keywords that characterize the scientific profile of the potential visiting researcher/s: satirical activism, satirical parties, investigative satire, humour

Project ID:	Project Acronym:	Evaluation Panel:
101040535	**PEA**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Enrico Terrone**
Host Institution:	Universita Degli Studi Di Genova - ITA

The Philosophy of Experiential Artifacts

Ancient Greeks used one word, techne, to designate both technical and artistic practices. It is only in modern times that art gained autonomy, becoming the object of one philosophical discipline: aesthetics. However, the emergence of mass media, and then of digital media, has brought art close to technology, challenging its autonomy. In this situation, some basic philosophical questions about art regain centrality: Why art? What is art for? What is the role of art in a technological society like ours? The traditional answer stresses the uniqueness of art, pointing to the essential difference between artworks and technical artifacts. The increasing interchange between art and technology, however, encourages us to question this statement, pursuing an alternative strategy. The hypothesis is that artworks belong to a technical kind which has been overlooked so far: the kind of experiential artifacts whose function consists in triggering experiences. Art is severed from technology only if one focuses on artifacts such as drills or lathes whose function consists in producing concrete effects. Yet, once experiential artifacts have been recognized, one can fruitfully connect art to technology, rethinking forms of art as techniques for generating different types of experiences. The PEA project launches the philosophy of experiential artifacts as a new area of inquiry in which the relationship between art and technology can be properly theorized, thereby offering a new conceptual toolbox for historical and empirical research. This will be done through a fourfold methodology in which aesthetics and the philosophy of mind analyze the experiences that experiential artifacts are meant to trigger, while metaphysics and the philosophy of technology investigate the structure in virtue of which they perform this function. PEA will thus reconceptualize artworks as technical artifacts that we value for the way in which they enable us to enrich, share and coordinate our experiences.

Link to the ERC project webpage: https://pea.unige.it/

Keywords of the ERC project: art, technology, aesthetics, artifacts, phenomenology, metaphysics

Keywords that characterize the scientific profile of the potential visiting researcher/s: philosophy of mind, metaphysics, aesthetics, cognitive science, art, artifacts

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101041853	**TAMP**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Tamer Nawar**
Host Institution:	Rijksuniversiteit Groningen - NLD

Truth in Ancient and Medieval Philosophy

While it is sometimes suggested that we are living in a 'post-truth' age wherein the concept of truth is increasingly less relevant, truth nonetheless remains a central concept in science, ethics, and ordinary life. However, what precisely is truth? One common view, the so-called 'correspondence theory of truth', maintains that truth is simply correspondence with the facts. However, such a view faces a number of difficulties and potential objections. For instance, what exactly is correspondence? And what exactly are facts? Moreover, if truth is simply correspondence then why it is the case that correspondence comes in degrees whereas truth is usually agreed not to? And how should we deal with certain semantic paradoxes, such as liar paradoxes, which suggest that our conceptions of truth are internally inconsistent?

The notion that truth consists in correspondence goes back to antiquity and the Middle Ages. However, although past philosophers discussed the nature of truth in significant detail and with considerable philosophical sophistication, our understanding of past theories of truth is surprisingly limited and we lack a clear idea of how notions of truth developed in later antiquity or in the Arabic and Latin medieval traditions. This project will offer the first focused and systematic examination of philosophical conceptions of truth in ancient and medieval philosophy. It will examine the origins, motivations, and challenges faced by conceptions of truth in this period and how these challenges led to the development of alternative theories of truth. By holistically examining both 'major' and 'minor' figures and texts in this period and combining metaphysical approaches to truth with logical and semantic approaches, this project will offer us a better understanding of a central philosophical issue across the Greek, Arabic, and Latin traditions and greater insight into an extremely rich but often neglected period of philosophy.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101042052	**ORE**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Veli-Matti Karhulahti**
Host Institution:	Jyvaskylan Yliopisto - FIN

An Ontological Reconstruction of Gaming Disorder: A Qualitative Meta-Phenomenological Foundation

Videogames have become one of the most prevalent forms of cultural production around the world. While their role in teaching and physical culture ("esports") keeps growing, the health debates on videogame play, or gaming, culminated in 2019 with the World Health Organization's historical decision to add "gaming disorder" to the International Classification of Diseases. This made gaming, next to gambling, the first and only cultural product with a diagnostic category of addictive use. The above echoes a greater conflict between culture and human development: how can science address potential problems in intensive technology use, when intensive use is also globally integrated into healthy everyday living? To build a foundation for answering this question, I pursue a Meta-Phenomenological Taxonomy of intensive gaming on three levels of lived experience: play, health, and design interaction. The taxonomy is "meta-phenomenological" in the sense that it is structured on the experiences of intensively gaming individuals. These experiences surface in distinct sociocultural contexts in interaction with specific videogame designs, which are the studied meta-areas. This interdisciplinary project is cross-cultural, longitudinal, and qualitative. Participants with and without health problems (n=240) will be followed for three years in South Korea, Slovakia, and Finland. In collaboration with clinical experts, phenomenological interviews are carried out with diaries that include gaming activity logs. The design structures of the videogames in the participants' lives are analyzed to map out the phenomenological forest of health and play with specific design interactions. The elements are refined into a taxonomy that not only serves as a new foundation for "gaming disorders" but also situates such instances in the colorful spectrum of diverse lives and designs at large—providing grounds for sustainable future theory development at the intersection of health, culture, and design.

Link to the ERC project webpage: https://ore.jyu.fi

Keywords of the ERC project: qualitative research; cross-cultural psychology; open science; medical philosophy; digital games

Keywords that characterize the scientific profile of the potential visiting researcher/s: qualitative methods; mental health; psychiatry; media; technology

Project ID:	Project Acronym:	Evaluation Panel:
101042729	**PhiSci**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Paul Michael Kurtz**
Host Institution:	Universiteit Gent - BEL

Philology as Science in 19th-Century Europe

Philology once defined what it meant to be scientific – and it may yet once again. Increasingly a broad array of scholars using digital methods cite the historical accomplishments of philology as a model for systematic study around unwieldy and heterogenous textual corpuses. Despite this renewed interest, there is still no systemic account for the huge range of activity and aegis, data and networks, that propelled philology to its status as a model or even the 'queen of science' in C19 Europe. In drawing on history of science, media studies, information studies and diverse textual methods, this project offers that holistic account of how and why philology as a 'science in the making' achieved such extraordinary success. It articulates the widely sought yet unachieved bridge that would permit rigorous interdisciplinary exchange between philology – its historical and contemporary iterations – and present-day endeavors in the fields of digital humanities, critical data studies, infrastructure studies and de/post-colonial studies. PhiSci takes philology seriously as a science and gives it the kind of treatment that has dominated history of science for the last generation. Pioneering a novel account of philology from the French Revolution to First World War, it pursues a central question: How did local ensembles of protocols, representation, instrumentation and cooperation consolidate into robust programs for the genesis of stable knowledge and knowledge communities? It gives special attention to heterogeneity and universality in key concepts and practices and to physical aspects like media and infrastructure: elements undervalued or rarely grasped in terms of their epistemic work for producing data, evidence and facts. PhiSci will thus explain how philology operated as a relational system that – in the diversity of its data and perpetual flux in its projects and personnel –projected unity that enabled it to wield a scientific authority greater than the sum of its parts.

Link to the ERC project webpage: https://research.flw.ugent.be/en/projects/phisci-philology-science-19th-century-europe

Keywords of the ERC project: History of Science, History of Knowledge, Philology, 19th Century, European History

Keywords that characterize the scientific profile of the potential visiting researcher/s: History of Knowledge, History of Humanities, Intellectual History, Cultural History, 19th century

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101044300	**BeInf**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Aaron Butts**
Host Institution:	Universitaet Hamburg - DEU

Beyond Influence: The Connected Histories of Ethiopic and Syriac Christianity

The innovative BeInf project interrogates the connected histories of Ethiopic and Syriac Christianity in their various complexities and nuances. It accomplishes this task through a series of five discrete, but complementary case studies addressing: 1. Aramaic loanwords in Ethiopic; 2. the so-called Nagran Episode, in which the sixth-century Aksumite ruler Kaleb intervened on behalf of Syriac Christians who were being persecuted in the Arabian peninsula; 3. the Ethiopic Abba Gärima Gospels, including especially their illumination programs; 4. the hagiography of the Nine Saints, who are alleged to have brought about a "second christianisation" of Ethiopia in the late fifth and early sixth centuries; 5. the Ethiopic reception of Syriac literature. BeInf's innovation is multifaceted. It adopts a multi-disciplinary approach that brings together methods that are traditionally categorized as distinct and disconnected, including especially art history, linguistics, manuscript studies, philology, textual studies, and history. In addition, it rejects area studies and unites fields that have traditionally been isolated and siloed off in problematic ways. Finally, it proposes to move beyond influence as an analytical category for analysing connections, contacts, exchanges, and the actors and cultural brokers responsible for them and instead adopts a methodological and theoretical stance inspired by "connected history", especially in the sense of histoire croisée. With these innovations, BeInf is positioned to make significant, long-lasting contributions to the field of Ethiopic Studies, both in content and in concept, while also serving as a paradigm-shifting model for other projects in the humanities addressing areas of inquiry that have traditionally been dominated by ill-framed questions of influence and that are primed to move beyond influence to explore connected histories with all their nuance, complexity, and texture through a multi-disciplinary approach.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101044619	**China Fashion Power**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Ho Lun Tommy Tse**
Host Institution:	Universiteit Van Amsterdam - NLD

Fashioning Power through South-South Interaction: Re-thinking Creativity, Authenticity, Cultural Mediation and Consumer Agency along China-Africa Fashion Value Chains

The project investigates how, in the context of the Belt and Road Initiative, China's global power is manifested, negotiated and resisted in people's daily life in a South-South setting using fashion as an exemplary case. Fashion is recognised as a significant economic force globally and one of the most poignant indicators of cross-cultural exchange. By critically examining China-Africa networks of fashion production, trade and consumption, this project will theorise how fashion is created, circulated, valuated, and consumed in and through Global Souths Value Chains (Guangdong-Nairobi-Maputo), dissecting complex dynamics and expressions of power. Using a multi-disciplinary, multi-method, multi-sited, and multi-scalar approach, the following questions frame this project and its four subprojects: 1) How are everyday fashion products designed and produced in China for African markets; 2) How do Chinese and Africans interact to valuate and trade fashion products for Kenyan and Mozambican markets; 3) How and by whom are cultural differences negotiated and mediated in the marketplace; and 4) What values, meanings and "power" do African consumers derive from consumption, and what ideas and constraints are imposed on them? This project's major contribution is threefold. Theoretically, it will move beyond a Western-centric epistemology to map the chains, restraints and materialities of China's power expansion through fashion. Methodologically, this project will synergistically collect and triangulate empirical information along complete South-South commodity chains through multi-sited ethnography, semiotic and visual analysis, individual and focus group interviews, and wardrobe archival studies. Empirically, it will provide evidence of how Chinese-African fashion industries impact upon the social, cultural, economic and affective lives of African consumers in the context of increasing globalisation, digitalisation, consumerism, and China's ambition abroad.

Link to the ERC project webpage: https://www.chinaafricafashionpower.org/

Keywords of the ERC project: Africa, authenticity, China, consumption, creativity, cultural mediation, e-commerce, everyday fashion, ethnography, Global South, global value chains, Kenya, marketplace, Mozambique, South-South interactions, visual analysis, wardrobe study

Keywords that characterize the scientific profile of the potential visiting researcher/s: Africa, authenticity, China, consumption, creativity, cultural mediation, e-commerce, everyday fashion, ethnography, Global South, global value chains, Kenya, marketplace, Mozambique, South-South interactions, visual analysis, wardrobe study

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Project ID:	Project Acronym:	Evaluation Panel:
101053296	**TIDA**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr Klaus Corcilius**
Host Institution:	Eberhard Karls Universitaet Tuebingen - DEU

Text and Idea of Aristotle's Science of Living Things

Text and Idea of Aristotle's Science of Living Things (TIDA) pursues two objectives, one philosophical, the other philological, both of which can only be achieved in tandem: subjecting Aristotle's treatise on the soul, the De Anima (DA), and related treatises, to a new and comprehensive philosophical interpretation, while making available the original Greek texts in a way that complies with the standards of contemporary textual criticism. Philosophically, the aim is to replace the interpretive approach that governed philosophical discussions around the DA for the past 5 decades with a more coherent and philosophically more informative interpretation. According to the received approach, the argument of the DA falls into the domain of 'philosophy of mind'. This assumption, fruitful though it was for our understanding of many of the DA's arguments, obfuscates the main aim and purpose of the treatise. TIDA shows how the DA is not concerned with the philosophy of mind as such, but with defining the first principle of the science of living things; we show how the DA divides explanatory labour with the other treatises pertaining to that science, and – most importantly – what the resulting scientific theory of living things has to say about the issues of the philosophy of mind. Philologically, the goal is to produce reliable critical editions of the relevant texts, print and digital, which we – astounding as it might seem – still do not possess. As the constitution of the texts will depend on the philosophical evaluation of alternative manuscript readings, only the closest collaboration between textual critics and philosophers will yield progress. There is reason to expect improved original texts and a genuinely new and more informative perspective on Aristotle on the mind. In effect, TIDA consists in a five-year interdisciplinary research team, designed to give future philosophical and philological work on Aristotle's science of living things a new and lasting foundation.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
770548	**HRP-IAEA**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Maria Rentetzi**
Host Institution:	Friedrich-Alexander-Universitat Erlangen Nurnberg - DEU

Living with Radiation: The Role of the International Atomic Energy Agency in the History of Radiation Protection

This project addresses the central question of how the International Atomic Energy Agency, a diplomatic and political international organization, came to dominate scientific institutions with a long tradition in radiation protection. Despite the importance of international organizations for the development of postwar science there is no work on the history of radiation protection in relation to the development of the IAEA. The project addresses this lacuna in a groundbreaking way: it analyses what is usually treated as a strictly techno-scientific issue—how best to protect us from ionized radiation—using methods from history, philosophy, and sociology of science, and in the context of international history. The main hypothesis is that scientific knowledge about radiation protection has been shaped by diplomatic, social, economic, and political concerns. This approach casts new light on important aspects of postwar history of science, combining attention to state actors, science diplomacy, and the roles played by international organizations. Given the enormous interest in radiation protection the time is ripe for providing a comprehensive social, historical, and political study of the role of the IAEA in the field.

The main objectives of the project are:

• to retrace the international history of radiation protection after World War II, focusing especially on the Technical Assistance Programs of the IAEA;

• to investigate the role of the IAEA in sponsoring knowledge production in the field of radiation protection in competition with other regulatory agencies; and

• to analyze the standardization of instruments, objects, procedures, and technical vocabulary as the main strategy used by the IAEA for guiding radiation protection worldwide.

The project advocates a "diplomatic turn": diplomacy becomes analytical category in history of science. Highly interdisciplinary it brings together expertise from several disciplines, promising a significant advancement across them.

Link to the ERC project webpage:

Keywords of the ERC project: Nuclear diplomacy, radiation protection history

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
817564	**CLIOARCH**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Felix Riede**
Host Institution:	Aarhus Universitet - DNK

Cliodynamic archaeology: Computational approaches to Final Palaeolithic/earliest Mesolithic archaeology and climate change

Late Pleistocene/early Holocene Europe is said to be the ideal laboratory for the investigation of human responses to rapidly changing climates and environments, migration and adaptation. Yet, pinpointing precisely how and why contemporaneous Final Palaeolithic/earliest Mesolithic (15,000-11,000 years BP) foragers migrated, and which environmental or other factors they adapted to – or failed to – has remained remarkably elusive. At the core of ClioArch is the radical but, in light of research-historical insights, necessary hypothesis that the current archaeological cultural taxonomy for this iconic period of European prehistory is epistemologically flawed and that operationalisations and interpretations based on this traditional taxonomy – especially those that seek to relate observed changes in material culture and land-use to contemporaneous climatic and environmental changes – are therefore problematic. Hence, novel approaches to crafting the taxonomic building blocks are required, as are novel analyses of human|environment relations in this period. ClioArch's premier ambition is to provide operational cultural taxonomies for the Final Palaeolithic/earliest Mesolithic of Europe and to couple these with interdisciplinary cultural evolutionary, quantitative ecological methods and field archaeological investigations beyond the state-of-the-art, so as to better capture such adaptations – almost certainly with major implications for the standard culture-historical narrative relating to this period. In so doing, the project will pioneer a fully transparent and replicable – and eminently transferable – methodology for the study of the impacts of climate change and extreme environmental events in deep history. In turn, such a quantitative understanding of past adaptive dynamics will position archaeology more centrally in contemporary debates about climate change, environmental catastrophe and their cultural dimensions.

Link to the ERC project webpage: http://cas.au.dk/en/ERC-clioarch/

Keywords of the ERC project: archaeology; climate change; Palaeolithic; cultural evolution

Keywords that characterize the scientific profile of the potential visiting researcher/s: Behavioural ecology; computational archaeology; palaeoanthropology; cultural evolution

Project ID:	Project Acronym:	Evaluation Panel:
818843	**LUBARTWORLD**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Claire Zalc**
Host Institution:	Centre National De La Recherche Scientifique Cnrs - FRA

Migration and Holocaust: Transnational Trajectories of Lubartow Jews Across the World (1920s-1950s)

Migrations are a central issue of the modern period, particularly since World War One. At the same time, the implementation of a systematic policy of categorization, discrimination, persecution, and extermination of European Jews is one of the major events of the first half of the 20th century. How should the relations between these two histories be understood? The goal of this project is to explore the links between migration and the Holocaust from a transnational microhistorical perspective.

To this end, it will implement an original method: producing the collective biography of the Jewish inhabitants from the Polish shtetl of Lubartow from the 1920s to the 1950s, whether they emigrated or stayed behind, whether they were exterminated or survived the Holocaust. This research will, for the first time, reconstruct the trajectories of a group of persecution victims across the different places they travelled through, which is possible today thanks to new access to an impressive body of archives and the affordances of the digital humanities. The methodological and archival challenge is immense. This transnational collective biography explores the directions of individual journeys, the diversity of fates, as well as the connections between those who remained and those who left.

By doing so, the LUBARTWORLD project addresses some prominent theoretical issues: the dynamics of a social structure drawn into a major disruption, the variability of social categorizations in diverse national and political contexts, and the complex making of identities. From an epistemological point of view, it will develop innovative ways of reconstructing and analyzing life-course information. Although the project begins with Lubartow, it leads to the world in its globality. Lubartow residents crisscrossed the globe, and their trajectories outline and embody in their own way the upheavals of Europe's relations with the world before, during, and after the Holocaust.

Link to the ERC project webpage: https://lubartworld.cnrs.fr

Keywords of the ERC project: migration, Holocaust, transnational, quantification, history

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
834087	**COMMIOS**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Ian Armit**
Host Institution:	University Of York - GBR

Communities and Connectivities: Iron Age Britons and their Continental Neighbours

Recent breakthroughs in ancient DNA and isotope analysis are transforming our understanding of diversity, mobility and social dynamics in the human past. COMMIOS integrates these cutting-edge methods on a scale not previously attempted, within a ground-breaking interdisciplinary framework, to provide a radically new vision of Iron Age communities in Britain (800 BC – AD 100) within their wider European context.

At the broad scale, we will conduct the first concerted programme of genome-wide ancient DNA analysis on Iron Age populations anywhere in the world (c. 1000 individuals in the UK, 250 in Europe), mapping genetic clusters to shed light on ancient populations themselves and on their relationships to modern genetic patterning. Together with isotope analysis, and underpinned by both osteoarchaeological and cultural archaeological approaches, this will also enable us to directly address critical issues of population movement and inter-regional connectivity in Iron Age Europe. We will utilise the power of these new scientific methods to examine the structure and social dynamics of Iron Age societies in Britain, including household and kin-group composition, the identification of familial relationships, gender-specific mobility, and the development of social inequalities. Previously the preserve of cultural anthropologists studying recent societies, we will draw these questions into the archaeological domain, opening up new areas of enquiry for prehistoric societies.

The scope and scale of the project represents a new departure for European archaeology, made possible by the coming-of-age of new analytical methods. Many of these have been pioneered by the project team, which comprises world-leaders in the fields of ancient DNA, isotope analysis, osteoarchaeology, chronological modelling and cultural archaeology. Although focussed on Iron Age Britain, the project will establish a new benchmark for future analyses of other regions and periods in Europe and beyond.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
850709	**PANTROPOCENE**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Patrick Roberts**
Host Institution:	Max Planck Gesellschaft Zur Foerderung Der Wissenschaften E.V. - DEU

PANTROPOCENE: Finding a Pre-industrial, Pan-tropical 'Anthropocene'

Tropical forests are globally recognised as biodiversity hotspots and environments that are crucial for climate regulation, landscape stability, and the carbon cycle. Local deforestation can have regional and global feedbacks and 20th-21st century human actions in tropical forests are seen as a key part of the 'Anthropocene' – or the anthropogenic domination of earth systems. It remains an open question, however, as to whether pre-industrial human impacts on these environments had similar earth systems effects. 15th to 18th century European colonial empires drew together long-separated Old and New World ecologies, with implications for species distributions, demography, and land management in the tropics. This followed millennia of indigenous activities with possible regional and global cumulative results. Yet, we have no concrete understanding of how pre-industrial impacts varied spatially and temporally, what they meant for local sustainability, and how they compare to modern human impacts. The PANTROPOCENE Project addresses these questions by taking the Spanish Empire as a frame of reference for using archaeological, historical, and palaeoenvironmental data to build 'pan-tropical' spatial characterisations of pre-colonial, colonial, and industrial land-use. Undertaking novel palaeoecological and landscape survey fieldwork in the Philippine Archipelago, the often-neglected centre of the Spanish East Indies, the project will bring new data together with existing records, notably from the Neotropics, to ensure full tropical coverage of the Spanish Empire. The results will be factored into climate, geomorphological, and atmospheric models to determine how changing pre-industrial technology, subsistence, and administration had regional and global feedbacks on occupied human environments, informing understandings of the pace and threat of contemporary land-use changes in the context of endemic Island Southeast Asian biodiversity and the tropics more broadly.

Link to the ERC project webpage: https://www.pantrop.com

Keywords of the ERC project: Archaeology, History, Colonialism, Tropical Forests, Land Use, Earth Systems

Keywords that characterize the scientific profile of the potential visiting researcher/s: Earth Systems Science, Palaeoenvironmental Research, History, Archival Research, Archaeology, Palaeoecology

Project ID:	Project Acronym:	Evaluation Panel:
851053	**Back2theFuture**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Jeroen Puttevils**
Host Institution:	Universiteit Antwerpen - BEL

Back to the Future: Future expectations and actions in late medieval and early modern Europe, c.1400-c.1830

From the eighteenth century onwards, the future was considered as open, uncertain and constructible – the way we tend to perceive the future today. In contrast, early modern Europeans believed that the future was beyond the control of man. The aim of this project is to challenge such grand narratives on past futures, which are generally highly linear and focused on modernity, have a fuzzy chronology and thin empirical base, biased by learned text. Moreover, these hypotheses fail to do justice to the presence and interplay of various (multi)temporalities and do not link future expectations to the concrete actions of men and women in the past. Most historians simply ignore the topic, since past futures are extremely hard to find in the written record. Hence, they focus on the actions of men and women in the past rather than their motivations.
To gain more insight in how people in the past thought about the future and how this affected their actions, this project draws on a highly innovative combination of close and distant reading methods of more than 15,000 letters written in (varieties of) Italian, German, French, Dutch and English by and to European merchants in the period 1400-1830. These practical documents enable us to reconstruct different types of future thinking of these merchants and to assess how these thoughts powered their actual behaviour. Better still, they also shed light on the future expectations of their non-merchant correspondents: their wives, children and other family members, clerks, clergy, nobles, craftsmen, etc. A comparative analysis of the letters from these different social groups, written in several languages, in a variety of European regions and during distinct moments, allows us to identify the impact/speed of potential agents of change that loom large in the literature (capitalism, the Reformation, probability calculus, and the Enlightenment) more carefully. With this methodology, we will be able to provide fine-grained explanations.

Link to the ERC project webpage: https://www.uantwerpen.be/en/projects/back-to-the-future/

Keywords of the ERC project: history of the future; medieval, early modern history

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
851733	**IsoCAN**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Jonathan Santana**
Host Institution:	Universidad De Las Palmas De Gran Canaria - ESP

Isolation and Evolution in Oceanic Islands: the human colonisation of the Canary Islands

The Canary Islands were settled 2,000 years ago by farming populations from North Africa representing the westernmost limits of Eurasian human colonisation until European contact with the Americas. This is a superlative example of colonisation because the first colonists remained isolated until the arrival and colonization of Europeans in the 15th century AD. When Europeans arrived, Canarian populations spoke distinct dialects and did not have the seafaring skills needed to navigate between islands.

The colonisation of the Canary Islands is an example of adaptation and sustainability because people were able to create anthropogenic landscapes capable of supporting increasing human populations on diverse and isolated island ecologies with a low density of food resources. Nevertheless, how first colonisers transformed pristine islands into domestic landscapes to make islands more habitable for humans remains unresolved.

IsoCAN project will explore the first colonisation of the Canary Islands from the beginning of the Common Era to the 15th century AD, which represent the last expansion of the Mediterranean farming package, This project will (1) establish the chronology of the initial colonisation of the Canary Islands; (2) determine the geographic origins and the genetic variability of the human population, domesticates (animals and plants) and parasitic species (insects); (3) define the process of adaptation and resilience of the first settlers; and (4) investigate human impact on landscape and the management of natural resources.

This set of evidence will enable us to investigate two transcendental questions: how do humans colonise new territories, and what are the cultural and biological adaptations? This ambitious project will provide insights about the adaptive mechanisms through which isolated and fragile insular ecosystems were successfully colonised by human societies, focusing on social complexity, subsistence practices and landscape transformation.

Link to the ERC project webpage:

Keywords of the ERC project: island archaeology, colonization, human dispersal, bioarchaeoloy, biological anthropology, human-environment interactions, coastal archaeology

Keywords that characterize the scientific profile of the potential visiting researcher/s: archaeology, colonization, coastal, island, human-environment interactions

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
853539	**ANTIGONE**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Anna Maria Stagno**
Host Institution:	Universita Degli Studi Di Genova - ITA

Archaeology of shariNg pracTIces: the material evidence of mountain marGinalisatiON in Europe (18th- 21st c. AD)

The main aim of the ANTIGONE project is to investigate how the disappearance of practices for managing shared environmental resources played a role in the abandonment and political marginalisation of European mountain areas from the 18th c onwards. The legacy of these processes can be seen in population levels in these areas, and in the worsening of their natural and cultural heritage. Current policies – aiming to promote their 'heritagisation' – do not seem likely to be more effective, in the long-term, as development interventions than the drive for rationalisation in the 19th c. and modernisation in the 20th c. A new historical perspective is needed which addresses the process of abandonment and marginalisation in its entire complexity. ANTIGONE will analyse the critical period from the 18th to the 21st c. and provide new insights into the links between individuals, communities, central States and landscape, grounded in a new understanding of the relationship between practices, resources and objects.

By means of archaeological, historical, environmental, ethnological analyses, and through the comparison of case studies from European mountain areas, ANTIGONE aims to verify if alleged 'improvement' practices involved not just changes in management technique, but also contributed to decline in the sharing of work, time and space, with knock-on effects on the social dimension of the whole historic system.

Through its multidisciplinary approach ANTIGONE aims at provide: new knowledge on the historical mechanisms underlying the abandonment of mountain and, more broadly, rural areas, as a key to understanding marginalisation; new knowledge on landscapes, practices and their features; a new methodological toolbox for interdisciplinary investigations driven by archaeology; a new role for archaeology, beyond the acknowledged one as a heritage science; new contributions to community based policies for local sustainable development and landscape management.

Link to the ERC project webpage:

Keywords of the ERC project: Environmental resources archaeology, sharing practices, archaeology and history of the commons

Keywords that characterize the scientific profile of the potential visiting researcher/s: rural archaeology, rural history, post-colonial and the colonial studies, historical ecology, environmental archaeology, environmental history

Project ID:	Project Acronym:	Evaluation Panel:
864358	**AMI**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Kristiina Mannermaa**
Host Institution:	Helsingin Yliopisto - FIN

Animals Make identities. The Social Bioarchaeology of Late Mesolithic and Early Neolithic Cemeteries in North-East Europe

AMI aims to provide a novel interpretation of social links between humans and animals in hunter-gatherer cemeteries in North-East Europe, c. 9000–7500 years ago. AMI brings together cutting-edge developments in bioarchaeological science and the latest understanding of how people's identities form in order to study the relationships between humans and animals. Grave materials and human remains will be studied from the viewpoint of process rather than as isolated objects, and will be interpreted through their histories.

The main objectives are

1) Synthesize the animal related bioarchaeological materials in mortuary contexts in North-East Europe,

2) Conduct a systematic multimethodological analysis of the animal-derived artefacts and to study them as actors in human social identity construction,

3) Reconstruct the individual life histories of humans, animals, and animal-derived artefacts in the cemeteries, and

4) Produce models for the reconstruction of social identities based on the data from the bioanalyses, literature, and GIS.

Various contextual, qualitative and quantitative biodata from animals and humans will be analysed and compared. Correlations and differences will be explored. Intra-site spatial analyses and data already published on cemeteries will contribute significantly to the research. Ethnographic information about recent hunter-gatherers from circumpolar regions gathered from literature will support the interpretation of the results from these analyses.

The research material derives from almost 300 burials from eight sites in North-East Europe and includes, for example, unique materials from Russia that have not previously been available for modern multidisciplinary research. The project will make a significant contribution to our understanding of how humans living in the forests of North-East Europe adapted the animals they shared their environment with into their social and ideological realities and practices.

Link to the ERC project webpage: https://www.helsinki.fi/en/researchgroups/animals-make-identities

Keywords of the ERC project: human-animal relations, Hunter-gatherers, foragers, Mesolithic graves, biological life histories, identities, ornaments

Keywords that characterize the scientific profile of the potential visiting researcher/s: human-animal relations, feathers in archaeology, social identities, animals in graves, ornemnets, meaning of ornaments, ceremonies, ritual practices, burial practices

Project ID:	Project Acronym:	Evaluation Panel:
883758	**GloCoBank**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Catherine Schenk**
Host Institution:	The Chancellor, Masters And Scholars Of The University Of Oxford - GBR

Global Correspondent Banking 1870-2000

The overall objective of GloCoBank is to analyse the changing shape of international banking networks across the 20th century using an innovative methodology that allows greater specificity and inclusion than ever before. The bilateral correspondent banking network that will be uncovered by GloCoBank was the structure on which the global financial system was built and on which the trade and specialization that drove global development was based, but we know very little about it. When merchants settled accounts across borders, they did so through transfers from the merchant's bank to the customer's bank. From the time of the telegraph in the late 19th century, the contraction of time and space was accomplished by sending telegraph messages from the buyer's home bank to an agent in the seller's country to transfer funds to the seller's bank. These interbank connections remain the underlying architecture of the global payments system but we do not have a complete sense of how they were built, managed or how they changed over time. Existing literature on global payments relies on official data on capital flows that are exclusively available at a national level which prevents an analysis by type of bank, sub-national region, or more specific location. Moreover, these national data on bank flows are also consistently available for most countries only from 1960, which truncates our ability to assess the changing geography of international banking during periods of upheaval such as wars, economic crisis or depression. To date there has been no comprehensive data source to accomplish this. GloCoBank will create and analyse a new set of data and combine it with extensive archival research, which will allow a much more granular assessment of the patterns and dynamics of international banking and payments. The data will capture the links between thousands of individual banks involved in international payments through bilateral correspondent banking contracts across 130 years.

Link to the ERC project webpage: https://glocobank.web.ox.ac.uk

Keywords of the ERC project: Economic History; History of International Banking; History of Globalisation; International Financial Centres; International Banking Networks; Financial History; Business History; Global Payments System

Keywords that characterize the scientific profile of the potential visiting researcher/s: Economic History; History of International Banking; History of Globalisation; International Financial Centres; International Banking Networks; Financial History; Business History; Global Payments System

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Project ID:	Project Acronym:	Evaluation Panel:
885040	**CROSSREADS**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Jonathan Prag**
Host Institution:	The Chancellor, Masters And Scholars Of The University Of Oxford - GBR

Text, materiality, and multiculturalism at the crossroads of the ancient Mediterranean

'Crossreads' will offer the first coherent account of the interactions and interplay of linguistic and textual material culture in ancient Sicily over a period of 1,500 years. Sicily was a multilingual, multicultural region at the crossroads of the ancient Mediterranean, colonised and invaded repeatedly by Phoenicians, Greeks, and Romans. History has traditionally prioritised literary texts, creating a Helleno- and Romanocentric narrative, which often relegates the island to a footnote. However, the inhabitants, native and immigrant, did write and those texts survive, engraved on a variety of durable materials – the practice of epigraphy. These texts embrace a broad socio-economic range, across public and private life. Proceeding from an unparalleled unification and exploitation of all the texts from the island (7th cent. BCE – 7th cent. CE) in a single corpus, 'Crossreads' will combine the insights from the collected corpus with the insights and analysis resulting from three major subprojects. These will explore the historical linguistics of the texts, the social, economic and practical materiality of the stone texts, and the physical forms of the writing systems employed – and interactions between all these aspects. Building upon a successful pilot project (I.Sicily), 'Crossreads' will bring all these inscribed objects together for the first time in a comprehensive, open-source, digital corpus using international standards to encode text, images and contextual data. The project pioneers the use in ancient epigraphic studies of new digital tools in palaeography and linguistic annotation, and offers the first petrographic analysis of the use of stone on the island. No such analysis has been attempted on this scale nor across this range of material, and it promises unparalleled insights into the cultural interactions at the heart of the Mediterranean, between Greek East and Latin West, North Africa, indigenous voices, and others.

Link to the ERC project webpage: https://crossreads.web.ox.ac.uk/

Keywords of the ERC project: Ancient History, Epigraphy, Digital Humanities, Petrography, Palaeography, Linguistics, Sicily

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
885285	**ECOINT**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Glenda Sluga**
Host Institution:	European University Institute - ITA

Twentieth-Century International Economic Thinking, and the Complex History of Globalization

Today globalization, the integration of the world's economies, is blamed for crises of corporate excess, gaping economic inequality and revived populist nationalisms; to understand its complex history is more pressing than ever. ECOINT advances an innovative approach to the study of the struggles over economic ideas that have fashioned the paths to globalization. It shifts our focus from international economic thought as an unanchored field of ideas, to 'international economic thinking', generated in and through institutional sites distinctive to the 20th century: intergovernmental organisations and associated international non-governmental organisations. ECOINT adds to the history of globalization important but understudied economic thinkers, namely mid-level and 'non-intellectual' intellectuals, many of them women, working with and in these organizations, from 1919 until 2001. Hence, ECOINT provides a nuanced history of twentieth century international economic thinking and imaginaries, while making a unique contribution to understanding of the international 20th century. Above and beyond, ECOINT will ask: What difference did women economic thinkers make in the course of globalization? And what was the role of business, operating through INGOs?

Using largely neglected private and public archives, ECOINT will produce a capstone global history of international economic thinking, and social history of women economic thinkers in international institutions. It will capture the extent and breadth of international economic thinking at major IGOs— particularly the UN Regional Economic Commissions in Europe, Latin America, Asia and the Pacific, and Africa—and the INGOs the International Federation of Business and Professional Women and International Chamber of Commerce. Within five years, ECOINT will have mapped the range of international economic thinking, the impact of women and business in the complex history of globalization.

Link to the ERC project webpage: https://www.ecoint.org/projects

Keywords of the ERC project: ECONOMIC INTERNATIONAL HISTORY

Keywords that characterize the scientific profile of the potential visiting researcher/s: HISTORIAN

Project ID:	Project Acronym:	Evaluation Panel:
885418	**AFRAB**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Benedetta Rossi**
Host Institution:	University College London - GBR

African Abolitionism: The Rise and Transformations of Anti-Slavery in Africa

The historiography of Euro-American abolitionism is so vast that it has a history of its own (Brown 2006). By contrast, research on African abolitionism is a narrow field focused primarily on European anti-slavery activities. It presupposes that when Europe abolished slavery in Africa, Africans became abolitionists. This conclusion is unfounded. Many general questions have never been asked: When and where did African abolitionist movements develop? Who are the main ideologues of African abolitionism? How did abolitionism spread, among which groups? What forms of political struggle did African anti-slavery give rise to? While individual African abolitionists and regional movements have attracted limited attention, there is no major review of the phenomenon on a continental scale. AFRAB fills this gap. It contributes to African and global history and slavery studies by analyzing and comparing African abolitionist ideas and anti-slavery movements, the long-term consequences of European abolitionism, and the resilience of pro-slavery discourses.

Link to the ERC project webpage:

Keywords of the ERC project: abolition, abolitionism, slavery, emancipation, Africa

Keywords that characterize the scientific profile of the potential visiting researcher/s: abolition, abolitionism, slavery

Project ID:	Project Acronym:	Evaluation Panel:
948152	**NOTA**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Alexandra Baneu**
Host Institution:	Universitatea Babes Bolyai - ROU

Note-taking and Notebooks as Channels of Medieval Academic Dissemination across Europe

Note-taking is a common intellectual practice. In academia, it is a universal endeavor that we share with students since the origin of the universities. Yet no one has focused on this practice as an original and independent object of research that, once investigated, will bring innovation and expand our knowledge of European intellectual history. Project NOTA is an ambitious enterprise, rooted in the discovery that decoding medieval notebooks produced in the context of late medieval universities will reveal invisible aspects of the process of producing scientific knowledge, of the European networking of scholars, and of the dynamic circulation of texts. Stemming from the Faculty of Theology during the 14th and 15th centuries, when paper invaded the university as an accessible material support, the student's notebooks constitute the ideal laboratory in which we can investigate how knowledge was formed and disseminated by means of note-taking. It was one of the superior faculties, meaning that the note-takers had reached intellectual maturity, offering notes of better quality than those of students in the liberal arts. Proposing a unique corpus of Latin manuscripts, project NOTA will launch creative reflections on the motivation and the technical aspects involved in producing notebooks. The project will combine interdisciplinary approaches (doctrinal, codicological and paleographical) and will impact the present state of the art by showing the potential of data that can be obtained by deciphering the practice of note-taking. New concepts will be launched (classification of notebooks, technical practices), traces of unknown authors and texts will be identified, and connections between scholars, institutions and texts will be established, fully justifying the recognition of notebooks as a new subject in the field of intellectual history and as an element of cultural identity shared by universities all around Europe.

Link to the ERC project webpage: https://nota-erc.com

Keywords of the ERC project: notebooks, note-taking, medieval universities, medieval disputes, medieval academic exercises

Keywords that characterize the scientific profile of the potential visiting researcher/s: notebooks, note-taking, medieval universities,

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Project ID:	Project Acronym:	Evaluation Panel:
949367	**EVERYDAYISLAM**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Corisande Fenwick**
Host Institution:	University College London - GBR

Becoming Muslim: Cultural Change, Everyday Life and State Formation in early Islamic North Africa (600-1000)

The Muslim conquests of North Africa in the 7th century transformed the everyday lives of communities– between 800-1000, the region experienced an economic 'Golden Age', visible in the growth of urban populations, intensified exchange across a vast trading system and the introduction of new agricultural practices and technologies. New social-religious norms underpinned the development of a distinctly 'Islamic cultural package' marked by the spread of new aesthetics, public and private architecture and Muslim dietary practices. Despite significant recent advances, much of our knowledge continues to reflect the experience of rulers and elites, rather than the bulk of the population. Our understanding of the timing and process of these innovations is hampered by a reliance on later literary sources, monumental architecture and the high arts, the absence of high-resolution archaeological data and an incomplete understanding of what these changes meant for the people living on the ground. Through new excavations and scientific analysis using state-of the-art methods, legacy datasets and written sources, this project will explore the underlying reasons for the spread of Islamic way of life in North Africa between ca. 600-1000 CE. In so doing, this project aims to make a paradigmatic shift in scholarly understanding of the impact of Muslim rule by focusing on local populations, their houses and their everyday practices. It will take a comparative approach and study long-term changes in housing, agriculture, diet and technology in three key regions: 1) the central Medjerda valley in Tunisia, the famed granary of Roman and Islamic Africa; 2) the fertile Sebou Basin in Morocco, at the centre of the Idrisid state; 3) the Saharan oasis belt of the Wadi Draa in Morocco, on the margins of settled life. The ambitious objective is to rewrite the history of Muslim rule and the Islamisation of daily life from the perspective of the communities living through this pivotal period.

Link to the ERC project webpage:

Keywords of the ERC project: Archaeology; history; medieval; Islamic; north africa

Keywords that characterize the scientific profile of the potential visiting researcher/s: Archaeologist; historian

Project ID:	Project Acronym:	Evaluation Panel:
949639	**SOCMED**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Dora Vargha**
Host Institution:	Humboldt-Universitat Zu Berlin - DEU

Socialist Medicine: An Alternative Global Health History

Socialist Medicine: An Alternative Global Health History
The project pioneers a new history of global health that, for the first time, incorporates the socialist world - a constellation of countries in a fluctuating political, economic and military nexus distinct from the capitalist West. It identifies the particular health cultures produced by socialism (in all its variety) and explores the impact of socialist internationalism in co-producing global health in the 20th century. The proposed project pioneers a new history that will not only transform our knowledge of historical processes, but will further our understanding of ideas, practices and processes that current global health structures have been built on.
Global health histories are framed mainly through American, colonial and liberal perspectives, even as some contributions of the socialist world, e.g. in smallpox eradication, have been acknowledged. The omission of socialist contexts, however, distorts our understanding of what global health is. Many parts of the socialist world, like China or Czechoslovakia, provided different approaches to international and global health, e.g. in rural health or epidemic management. Although there was not one socialist template, diverse framings of socialist medicine played major roles in shaping and contesting global practices.
A systematic analysis of socialist medicine and international health through global case studies integrates missing expert networks, political agendas, public health models and diplomatic agreements in global health history. This work, in turn, allows us to rethink concepts such as socialism, medical aid, solidarity, development, socialist medical research and health provision.

Link to the ERC project webpage:

Keywords of the ERC project: history of global health; socialism; history of science

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
950414	**CALIPHALFINANCES**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Marie Legendre**
Host Institution:	The University Of Edinburgh - GBR

The Finances of the Caliphate: Abbasid Fiscal Practice in Islamic Late Antiquity

This project offers an ambitious new account of a seminal period in Islamic history. It will for the first time provide a view from below on Abbasid fiscal history through a study of papyrus documents in Greek, Coptic and Arabic written in Egypt, a field in which the PI is a leading scholar. The Abbasids were the second longest ruling dynasty in Islamic history (750-1258). The first centuries of their rise to power are of key importance for the history of Islam, as the earliest surviving literary texts written by Muslims (religious, legal and fiscal treatises, grammars and poetry) were composed at this time and in their capital, Baghdad. They have been the preferred sources for scholars working on this period. As a result, our current view of Abbasid state structures is a view from the top. State policies, however, were not decided by the caliphal centre and Baghdadi administrators alone. CALIPHAL FINANCES will refocus scholarship on the totality of Abbasid administration. It will be the first large-scale research project on Abbasid administrative and fiscal history to make use primarily of documentary sources. Egyptian papyri are concerned with everyday arrangements for fiscal collection in secondary urban centres and villages of the Nile valley. Capitalising on this material, the project will study the organisation of tax collection, tax rates and categories of taxpayers. The project team will trace how provincial revenues reached the caliph, incorporating information found in provincial chronicles with that in the papyri. Connections between administrators and local elites, religious and linguistic communities, their convergence on fiscal questions, their loyalty or resistance to the caliphate will all be assessed. In a field largely dominated by religious history, CALIPHAL FINANCES will renew our understanding of the dynamics of change in pre-modern state structures on polycentric and interactive systems, with a focus on the complexity of local agency.

Link to the ERC project webpage: https://www.ed.ac.uk/literatures-languages-cultures/islamic-middle-eastern/research/caliphal-finances

Keywords of the ERC project: Abbasid, taxation, empire, economy, papyrus, state, elites, discourses

Keywords that characterize the scientific profile of the potential visiting researcher/s: history, Abbasid, literature, documents, coinage, economy

Project ID:	Project Acronym:	Evaluation Panel:
950610	**MOBILE**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Guy Jacobs**
Host Institution:	The Chancellor, Masters And Scholars Of The University Of Cambridge - GBR

Movement networks and genetic evolution among tropical hunter-gatherers of island Southeast Asia

Human evolution has been punctuated by a handful of behavioural transitions driving greater social complexity – examples include the use of tools, language and farming. The shift from hunting and gathering to agriculture specifically involved a series of new co-evolutionary relationships with other species, including domesticates, diseases, and our own microbiome. Unusually, these transitions are also ongoing. Those few hunting and gathering groups that remain are near-universally experiencing radical changes in mobility and diet as they interact more intensely with their settled, agricultural neighbours. MOBILE will study the impacts of mobility on biological diversity and evolution in some of the last remaining hunter-gatherers in rapidly developing Southeast Asia, an under-studied cradle of human evolution. The project will generate spatially embedded social networks from Indonesian hunter-gatherer communities at various stages of the lifestyle transition. It will combine this data with multi-species genomics and detailed simulations to understand how social interactions maintain community biological diversity in small, traditional societies, and how movement redistributes variation allowing for adaptation over rapid, intra-generational time scales. MOBILE will unify the genetic study of diversity, demography and natural selection at microgeographic scales using simulations and novel remote sensing mobility data, enriching our understanding of tropical forest hunter-gatherers and of the role of mobility as a force in human evolution more broadly.

Link to the ERC project webpage:

Keywords of the ERC project: microbiome, social network, mobility, genetics, evolution

Keywords that characterize the scientific profile of the potential visiting researcher/s: computational modelling, bioinformatics, microbiome, evolutionary genetics, simulation

Project ID:	Project Acronym:	Evaluation Panel:
101000991	**IberLAND**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Manuel Bastías Saavedra**
Host Institution:	Max Planck Gesellschaft Zur Foerderung Der Wissenschaften E.V. - DEU

Beyond Property: Law and Land in the Iberian World (1510-1850)

The experience of empire decisively shaped the institution of private property in land. From a global perspective, however, the history of this institution is far from straightforward. While European scholarship places the advent of individual property rights in the late 18th century, scholarship on Asia, Africa, and the Americas often attributes the onset of the paradigm of private property to the arrival of Europeans in the 16th century. This discrepancy of almost 300 years is difficult to reconcile. If Europeans had not yet experienced it themselves, how could they introduce the paradigm of proprietary rights across the world during the process of colonization? IberLAND revisits these incongruent historiographical narratives by studying the development of land tenure regimes in the African, American, Asian, and European territories of the Portuguese and Spanish empires. IberLAND takes a unique approach to the study of land tenure by departing from traditional approaches that assume that Europeans 'invented' ideas of private property and then 'transplanted' them to their overseas possessions. By contrast, IberLAND aims to construct a non-Eurocentric history of the development of land tenure from a global perspective. The research approach cuts across traditional research frontiers not only by integrating diverse regional historiographies but also by combining European and colonial (legal) history. The project will focus on six case studies and build on extensive research in local archives. The research will be strongly interdisciplinary and will gain insights from global, legal, and ethno-history in dialogue with legal theory, postcolonial studies, and decolonial perspectives. By providing a decentered history of land tenure, IberLAND should influence research in the fields of law, anthropology, and history, and provide a global perspective of law for an interconnected world in which conflicts about land use and extractivism are becoming increasingly important.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101001429	**DoSSE**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Erin Thomas Dailey**
Host Institution:	University Of Leicester - GBR

Domestic Slavery and Sexual Exploitation in the Households of Europe, North Africa, and the Near East, from Constantine to c. AD 900 / AH 287

The sexual exploitation of the unfree within the households of the late- and post-Roman world profoundly affected wider society in ways that necessitate a large-scale, multi-contextual collaborative investigation.

During this transformative period, Christianity established itself as the defining institution of the Latin West and Greek East; complex Islamicate societies emerged in the Near East, North Africa, and Spain; and Jewish communities developed a unique network across the region. As dynamic forces swept across these diverse societies and overturned longstanding customs, beliefs, and practices, the household stood firm as the fundamental unit of social organisation – a microcosm in which identities (male/female, slave/free, adult/child, local/foreign) were formed and reinforced.

Unfree people living in these domestic contexts were particularly vulnerable to violence and exploitation. Neither was this incidental to their condition. The shame associated with their sexual use at the hands of those who held power over them helped maintain the institution of domestic slavery and stabilise wider social hierarchies during an era of headlong change, though in ways that are only poorly understood.

This research project will reconstruct the motivations and justifications behind the sexual exploitation of domestic slaves, identify how the lived experience in the household shaped the content of our sources, reveal how a common Roman inheritance impacted later practices, and explain the similarities and differences found within Muslim, Christian, and Jewish communities across the region. By approaching the sexual exploitation of slaves as a social practice with its own particular logic and rationale, and by analysing the whole of the greater Mediterranean world as a single, interconnected cultural zone, this project will overcome divides in scholarship to dramatically advance our understanding of slavery and wider society from the 4th to 9th centuries.

Link to the ERC project webpage: https://www.dosseproject.com/

Keywords of the ERC project: Late Antiquity, Domestic Slavery, Sexual Exploitation, Christianity, Islam, Judaism

Keywords that characterize the scientific profile of the potential visiting researcher/s: Historian

Project ID:	Project Acronym:	Evaluation Panel:
101001835	**STRADA**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Leif Scheuermann**
Host Institution:	Universitaet Trier - DEU

Simulation of Transport between the Adriatic Sea and the Danube

Even though transport had a bad reputation in the discourse of the Roman elites, in recent research it became evident, that it had a vital impact on the prosperity of the Roman economy and thus on the long-term existence of the Roman Empire. Therefore, it is an absolute desideratum to explore Roman inland transport transdisciplinary, combining recent technological developments with experimental data and profound historical research to gain the most realistic transport times. The objective of STRADA is the development of a dynamic computer-based simulation system for water and land borne transport between the Adriatic Sea and the Danube.

Thereby, STRADA is geared to three aims:

a) the study of the spatial and temporal interconnectivity between Roman Italy and the Danube frontier, for gaining a better understanding of the economic cohesion of the Roman Empire,

b) the analysis of the influence of environmental factors on the ancient transport system,

c) and the introduction of dynamic simulations into historical research.

For the implementation, the project will focus on three closely interwoven strands: The exact reconstruction of the ancient land- and water-routes, the experimental determination of the performance of the used land- and water-borne means of transport under changing environmental conditions, and the development of a time-related simulation system including local fine granular topography and historical weather data, different means of transport (water- and land-based) with different loads, the fatigue of the actors as well as necessary rests and loading times.

STRADA will follow a modular design that will ease the sustainable use and a future extension of the simulation system. The chosen research area covers a wide range of landscapes from the Mediterranean lowlands, followed by different kinds of alpine regions, to a central European river landscape, which makes it easy adapt¬able to other times and places.

Link to the ERC project webpage: https://strada.uni-trier.de/

Keywords of the ERC project: Simulation technology, ancient history, archaeology

Keywords that characterize the scientific profile of the potential visiting researcher/s: digital archaeology, digital ancient history

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101001889	**REVIVE**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Sireen El Zaatara**
Host Institution:	Eberhard Karls Universitaet Tuebingen - DEU

Tracing Hominin Occupations of and Migrations through the Levant: Reviving Paleolithic Research in Lebanon

Our species evolutionary success story is intriguing. For over a century, we have been trying to formulate a narrative for the evolutionary and migration steps our ancestors took and made us who we are today. Several decades ago, our narrative for our lineage's dispersals from our place of origin, Africa, across the globe, was based on two separate big waves: one with Homo erectus at ca. 1 million years ago and the second with modern humans 60-50 thousand years ago. However, recent archaeological, paleoanthropological, and genetic evidence has forced us to alter this narrative to one which favors more dynamic geographic movements of hominins over several millions of years. Yet, although we seem to have now framed the overall picture of our narrative, its details remain mostly blurred leaving many chapters unfinished and their events highly debated, particularly those related to the number and timing of the dispersal events, the specific hominin taxa involved in each, and the effects of factors like technology, climate, and interactions among hominin populations, in shaping these events. As the bridge that connects Africa to the rest of the world, the Levant is an ideal place to look for answers. At its heart is Lebanon, a small country exceptionally rich in Paleolithic archaeological material reminiscent of a dense hominin occupation spanning the entirety of this period. Yet, Lebanon's rich Paleolithic record remains undiscovered and its potential is mostly forgotten since Paleolithic archaeological exploration in the country was forcefully stopped in its early infancy by the outbreak of the civil war (1975). REVIVE, a highly ambitious, groundbreaking project, will form the first ever large-scale and systematic archaeological/paleoanthropological project to be conducted on Lebanon's Paleolithic. It will, finally after 45 years, revive Paleolithic research in the country and use its wealthy record to start filling in the gaps in our ancestors' dispersals narrative.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101002330	**DEEPMED**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Lino Camprubí**
Host Institution:	Universidad De Sevilla - ESP

Discovering the Deep Mediterranean Environment: A History of Science and Strategy (1860-2020)

Few geographical spaces have been more relevant to human life and more intensively theorized than the Mediterranean Sea. Today, this sea poses some of the most pressing challenges and opportunities for European economic, security, and environmental policies. Answers to how to manage the region depend on ideas and perceptions of integration and division of the basin and its peoples. But the Mediterranean as a spatial concept has radically changed in the last 160 years as humans have gained access to its depths, unveiling an underwater world to discover, exploit, and navigate. The Mediterranean has become a volume.

DEEPMED is the first historical account of the discovery of the deep Mediterranean environment. Its main hypothesis is that science and strategy jointly made the Mediterranean depths into an object of analysis and a political space, which in turn shaped science and strategy in the region. DEEPMED pursues three specific objectives: 1) identifying the actors and contexts that enabled perceptions and practices of depth in the Med; 2) describing how natural and human time-scales interact in this body of water, and 3) tracking key conceptual landmarks defining the uniqueness and representativeness of the Mediterranean volume vis à vis the global ocean.

DEEPMED is the first basin-scale step in a novel approach to oceanic history that incorporates analyses of deep and bottom layers of the Sea to gauge the causes and effects of the historical emergence of depth. This requires an innovative interdisciplinary, transnational and digital methodology. The project identifies overarching trajectories of human engagement with Mediterranean depths from the mid-19th century to the present, including contrasting timelines and perspectives. The availability of digital tools for creating a database that facilitates geospatial and visual analyses make the project timely. The current security and environmental Mediterranean crises make it essential.

Link to the ERC project webpage: http://grupo.us.es/deepmed/

Keywords of the ERC project: history of science and technology, Mediterranean, environment, ocean

Keywords that characterize the scientific profile of the potential visiting researcher/s: data mining, HGIS, geovisor, maritime history, oceanography, history of science

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101002357	**RELEVEN**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Tara Andrews**
Host Institution:	Universitaet Wien - AUT

Re-evaluating the Eleventh Century through Linked Events and Entities

The aim of the RELEVEN project is to develop and test new ways for digital data about historical phenomena to be created and curated so that it is most useful to historians, and to apply these methods to a methodologically challenging yet very significant aspect of medieval history. The approach is to re-frame both existing and new historical data as assertions, often sourced but always linked to an authority; this allows data to be manipulated according to source and authority, and also allows assertions themselves to be linked depending on whether they corroborate, depend on, or conflict with each other. The novel aspect of this methodology is that it takes to its logical conclusion something that historians all readily acknowledge and that is especially apparent for pre-modern history: that there are very few, if any, simple and undisputed facts. A related challenge is the contextualisation and reuse of existing online data for the period, to avoid its going to waste.
The approach is tested by taking a broad trans-regional approach to the history of the late 11th century (c. 1030–1095), centred broadly in the eastern half of Christendom but incorporating developments elsewhere, especially in the newly Christianised kingdoms of central Europe. The looming weight of the First Crusade at the century's end means that while certain regional or proto-national narratives—particularly for western Europe—are well-developed, they tend to obscure the larger trans-regional trends of communication and contact, particularly in eastern Christendom. By drawing upon the depth of scholarship and the plethora of digital resources that have emerged for this period in sub-disciplines such as prosopography, textual scholarship, corpus-based research, and archaeology, and by framing this scholarship in terms of assertions whose authority is traceable, it will become possible to look at the history not just from "the eastern perspective", but from several.

Link to the ERC project webpage: https://releven.univie.ac.at

Keywords of the ERC project: digital humanities, medieval history

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101019509	**Reginfra**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Hilde De Weerdt**
Host Institution:	Katholieke Universiteit Leuven - BEL

Regionalizing Infrastructures in Chinese History

RegInfra analyses how infrastructures such as city walls, roads, and bridges contributed to regional and empire-wide integration, and equally how they contributed to countervailing trends including local tensions, local autonomy, and cross-border regional formations in late imperial Chinese history (ca. 1000-1800). At a time when the People's Republic of China is heavily investing in domestic and cross-continental infrastructures, we aim to map, compare, and critically analyse the material infrastructures on which Chinese polities of the past have been constructed.

Key objectives include:

• mapping the appearance and disappearance of large-scale infrastructures on an open access spatial analysis platform based on the digital annotation of the extant textual and archaeological record;

• conducting comparative spatial analyses of the distribution of infrastructure features, their construction, maintenance, breakdown, uses and cultural meanings, and developing a regional history of infrastructures on this basis;

• comparing data derived from the historical textual record and from modern archaeological reports and modelling processes of infrastructure development and decline;

• publishing research in the fields of history, digital archaeology, and infrastructure studies that will substantially revise existing historiographies on the nature, durability, and efficacy of material infrastructures and contribute to emerging historiographies that place socio-economic and cultural developments in regional contexts and cross-border contact zones;

• developing an event-based digital annotation method that will be made available for use in various languages;

• developing a method for the automated extraction of data on infrastructure in Chinese archaeological reports including an ontology and a machine learning model

Through these activities we aim to foster broader debate about the past and present uses and meanings of historical infrastructures and their digitization.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101020478	**NGIPALAJEM**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Marta Mirazon Lahr**
Host Institution:	The Chancellor, Masters And Scholars Of The University Of Cambridge - GBR

The evolutionary landscape of modern human origins in Africa

Our understanding of the origins of our species, Homo sapiens, has undergone a major shift. New fossils, dates and genomic studies have consolidated our African origin. Yet, they also indicate a deeper past, involving multiple events. These events stretch to nearly three quarters of a million years ago (Ma), and take the problem of modern human origins into an entirely different climatic and ecological context. From 1.4 Ma, climate dynamics changed, initiating a 1 million-year period (EMPT) during which, besides greater climatic variability, there is a prolonged arid phase, profoundly affecting African environments. By the end of the EMPT, the structure of the large mammal community in East Africa had changed significantly. The first modern humans are part of this change. The recognition of this older, drier context for the evolution of our species drives NGIPALAJEM. The proposed research aims to establish major empirical benchmarks to answer big questions. First, building on new hominin discoveries in Turkana, NGIPALAJEM will undertake extensive fieldwork to add more specimens to the scarce hominin fossil record of this period. Second, it will increase the large vertebrate fossil record from Turkana, and carry out inter-site eco-morphological and palaeoproteomic comparative analyses to throw light on the wider evolutionary dynamics of ecological communities, and investigate the role human predation may have played in shaping modern African faunas. Third, new fossils, such as the new small Middle Pleistocene Turkana hominins that will be described as part of the project, show that the range of hominin phenotypic diversity in the MP is greater than expected, and so novel morphometric and analytical techniques will be applied to the African hominin fossil record of the last million years. The outcomes of NGIPALAJEM will bring a new understanding of how the evolution of our species is part of a broader and longer African evolutionary landscape.

Link to the ERC project webpage: https://palaeotrails.org/current-projects/ngipalajem/

Keywords of the ERC project: human evolution, hominin fossils, Quaternary fauna, MSA, ESA-MSA transition, Africa, Kenya, Turkana

Keywords that characterize the scientific profile of the potential visiting researcher/s: palaeoanthropologist, palaeontologist, palaeolithic archaeology, palaeoproteomics

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101021098	**NEWORLDatA**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Simone Turchetti**
Host Institution:	The University Of Manchester - GBR

Negotiating World Research Data: A science diplomacy study

Research data are vital components of any scientific enterprise and the introduction of more inclusive world data exchange practices is a decisive factor, locally and globally, in strengthening capacity for research and innovation and tackling societal challenges. Yet we now comparatively little about what international negotiations have paved the way to the current global system of research data circulation and exchange. NEWORLD@A aims to provide the first comprehensive survey about the sets of science diplomacy exercises that have contributed to shape the current world data exchange system. This study will pioneer transnational research collaborations in order to successfully reconstruct these key historical transitions, also enmeshing non-Western narratives in the study of research data negotiations. Through an original combination of quantitative and qualitative methods, the study will first map existing networking patterns of data circulation and reveal existing imbalances in the world distribution of research data centres. It will then chart the international legal infrastructure that supports this distribution. It will also identify the historical determinants for the shape of world data exchange networks through an investigation of relevant archival documents across the world discussing the relevant negotiations and decision-making processes. They study will focus in particular on interactions between: non-governmental and governmental transnational organizations such as those under the aegis of ICSU and UNESCO; Western and Eastern blocs in the context of the Cold War science race; and Global North and South nations in the uses of research data for development purposes. Shedding new light on how these interactions have shaped the current research data circulation system will finally provide the analysis needed to inform current policy provisions on how to make these systems more inclusive and responsive to global challenges.

Link to the ERC project webpage: https://neworldata.org

Keywords of the ERC project: data, science diplomacy, 20th century history, history of science and technology, international relations

Keywords that characterize the scientific profile of the potential visiting researcher/s: science diplomacy, international relations, history of science and technology

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101021361	**BACKWARD**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Enrico Cappellini**
Host Institution:	Kobenhavns Universitet - DNK

Overcoming the frontiers of biomolecular studies on human history and adaptation using palaeoproteomics

BACKWARD will address major unsettled debates about African and Asian extinct hominid phylogeny, by developing and deploying a new generation of palaeoproteomic workflows, relying on the most advanced mass spectrometry and bioinformatic solutions currently available. Ancient DNA (aDNA) sequencing revolutionised our knowledge on evolution, migration and admixture of archaic and anatomically modern humans. However, no hominid aDNA older than ~0.4 million years has been retrieved yet. Ancient proteins instead survive much longer than aDNA, enabling molecular-based phylogeny beyond the limits of aDNA degradation. Recently, mass spectrometry (MS)-based ancient protein sequencing, i.e. palaeoproteomics, convincingly demonstrated its transformative value, enabling molecular-based evolutionary reconstructions for species that went extinct millions of years ago. BACKWARD will use palaeoproteomics to address: (i) the phylogenetic relationships among South African early hominins, and (ii) the hominid palaeobiodiversity in Southeast Asia; two topics debated for generations, and further complicated by recent finds. This knowledge will also provide the evolutionary scaffolding needed to correctly identify and correlate the series of processes that defined human brain expansion and reorganization. BACKWARD will also screen large sets of morphologically non-informative isolated fossil fragments of bones and teeth, to identify the species and sex of the organism from which they originated. Some of these solutions will be commercially re-purposed to deliver superior performance in public and private analytic laboratories for diagnostics in forensic medicine, and in the food or pharmaceutical industry. As a key BACKWARD feature, the unique contribution provided by each participating institution will be integrated in a strong partnership to transform palaeoanthropology, palaeontology, palaeoecology and archaeology once again, as aDNA did over the last twenty years.

Link to the ERC project webpage:

Keywords of the ERC project: Palaeoproteomics, human evolution, ancient proteins, palaeontology, paleoanthropology

Keywords that characterize the scientific profile of the potential visiting researcher/s: proteomics, mass spectrometry, ancient proteins, ancient biomolecules

Project ID:	Project Acronym:	Evaluation Panel:
101039060	**PalaeOrigins**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Amaia Arranz Otaegui**
Host Institution:	Universidad Del Pais Vasco/ Euskal Herriko Unibertsitatea - ESP

Tracing the Epipalaeolithic origins of plant management in southwest Asia

The transition from foraging to farming represents one of the most transcendental shifts in the history of humanity. Decades of research in southwest Asia have shown that this process culminated with the development of Neolithic agricultural systems c. 10 ka cal. BP. Yet, how it started, that is, how hunter-gatherers became, for the first time, engaged with the management of plants, continues to be largely undetermined. Palaeorigins aims to fill this major gap of knowledge. Benefiting from the exceptional Epipalaeolithic archaeobotanical materials that are now available (c. 23-11 ka cal. BP), it will ask: To what extent were Epipalaeolithic hunter-gatherers managing the land and the plant resources around them? Did climatic factors trigger plant resource intensification, or were cultural dynamics, like the need for specific foodstuffs, that first motivated plant-food production? To achieve such an ambitious aim PalaeOrigins will pioneer a holistic and high-resolution approach to study the plant-based subsistence. It will use a unique combination of traditional and most novel archaeobotanical materials, state-of-the-art stable isotope analyses, computational science, and theoretical models to: 1) Reconstruct the distribution and availability of plant resources during the environmental shifts of the late Pleistocene and the early Holocene; 2) Determine how plant procurement strategies, land uses and management activities articulated during the Epipalaeolithic period; and 3) Define hunter-gatherers' food culture, assessing their plant-food selection, processing and consumption practices. Taken together, PalaeOrigins will move beyond traditional Neolithic-centred paradigms to explain the origins of plant-food production. It will open up new research horizons, merging science and theory, to elucidate the nature of the human-environment interactions that paved the way to agriculture, and ultimately, changed the course of our history.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: archaeobotany, Palaeolithic, domestication, food, environment

Project ID:	Project Acronym:	Evaluation Panel:
101039920	**AFREXTRACT**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Iva Pesa**
Host Institution:	Rijksuniversiteit Groningen - NLD

Environmental Histories of Resource Extraction in Africa: Understanding Cultural and Political Responses to Environmental Transformation

Resource extraction industries have propelled environmental transformation across Africa, most notably between 1950 and 2020. The undeniably dramatic effects of mining and oil drilling on landscapes and lifeworlds have elicited radically divergent cultural and political responses, from apparent acquiescence to violent protest and accusations of ecocide. Yet the nature of the relationship between environmental change and human response in African localities remains extremely poorly conceptualised. AFREXTRACT addresses this gap by analysing how various actors in three emblematic sites - the Witwatersrand, the Copperbelt and the Niger Delta - have experienced and responded to environmental change. The first study to investigate this comprehensively and comparatively, AFREXTRACT demonstrates that insights from environmental history, political ecology and environmental humanities are crucial to topical debates about coloniality/decoloniality and the Anthropocene.

Our main objectives are: 1) to identify the causal factors informing human response to environmental transformation through three in-depth case studies (gold mining in South Africa; copper mining in Zambia; oil drilling in Nigeria); 2) to analyse how cultural expression (specifically literature and music) has made sense of environmental change; 3) to conceptualise varieties of environmentalism beyond a binary of resistance and resignation. AFREXTRACT will combine archival research with oral history, literary analysis and ethnomusicology to document changing values regarding the environment. A new analytical framework will facilitate engagement with global discussions about extractivism, colonialism/postcolonialism, environmental inequality and climate change. As resource extraction and its toxic legacies are set to continue, a historical understanding of these issues is imperative.

Link to the ERC project webpage: www.rug.nl/let/afrextract

Keywords of the ERC project: Environmental history; Africa; mining; oil drilling; literature

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101040152	**STONE-MASTERS**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Paweł Nowakowski**
Host Institution:	Uniwersytet Warszawski - POL

Masters of the stone: The stonecutters' workshops and the rise of the late antique epigraphical cultures (third-fifth century AD)

The STONE-MASTERS project aims at exploring one of the most startling problems in the global history of research on collective memory and commemorative practices - the transformation of Roman Imperial epigraphic traditions in the later 3rd c. AD, and the subsequent rise of the so-called epigraphic cultures of Late Antiquity. The problem has been passionately debated since the 1980s, but so far no definite conclusions have been reached. In this project, the PI argues that the main reason for the transformation is to be ascribed to the dissemination of changes in the elite's approach to epigraphy by the workshops of stonecutters and mosaicists, and that only a thorough study of workshops can provide us with a complete understanding of the processes underpinning this same transition. So far, epigraphists of the Roman period have had few instruments to draw upon for the purposes of pursuing synthetic workshop studies, and have been overwhelmingly captivated by other strands: the quantitative research, the study of the self-representation, the visibility of inscriptions, and the "viewers' culture". The PI maintains that a significant leap in our understanding is, however, attainable through the building of a highly regionalized network/stemma of workshops, which will identify workshops of origin for all the inscriptions from the 3rd-5th c., and through applying the methodologies of workshop studies developed for other craftsmanships and periods (in particular for early Greek vase painters, and for scribes and scriptoria) which the PI will adapt to the needs of the Graeco-Roman epigraphy. Assuming that these new methodological lenses will redefine the field and re-focus our attention on the actual actors behind the production of epigraphy - artisans and workshops - as primary agents of top-to-bottom cultural transfer, then we can anticipate an entire restructuring of our understanding of the way artisans disseminated elitist culture in the lower echelons of society.

Link to the ERC project webpage: https://historia.uw.edu.pl/en/research-project/masters-of-the-stone-the-stonecutters-workshops-and-the-rise-of-the-late-antique-epigraphical-cultures-third-fifth-century-ad-stone-masters-2/

Keywords of the ERC project: Roman epigraphy, Greek epigraphy, archaeology, history of art, workshops, artisans, style identification, manuscripts

Keywords that characterize the scientific profile of the potential visiting researcher/s: epigraphy, history of art, workshop and style identification

Project ID:	Project Acronym:	Evaluation Panel:
101040297	**GOING VIRAL**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Marie Louise Herzfeld-Schild**
Host Institution:	Universitat Fur Musik Und Darstellende Kunst Wien - AUT

Going Viral: Music and Emotions during Pandemics (1679-1919)

Within day of Covid-19 reaching Europe in early 2020, music had emerged as one of the most prominent media for emotional engagement with the effects of lockdown, sickness and grief. Its remarkable primacy for expressing, navigating and shaping emotional pandemic experiences was quickly picked up by researchers and journalists who showed an immediate interest in finding evidence both for the role of music in past pandemics and for continuities across time. It quickly transpired, though, that they lacked established categories, shared methodologies and sufficient historical knowledge to describe and to compare the phenomenon adequately.

The study of music in pandemics, and especially of its emotional significance, is both underdeveloped and urgently needed - and has the potential to constitute a major new field of research on music, emotions and pandemics alike.

GOING VIRAL will be the first study to provide a comparative history of the imbrication of music in the emotional experiences of pandemics.

Its major research aims are

- to develop an innovative conceptualisation and methodology for studying music and emotions across history, building on the equally well-regarded approaches "musicking as social practice" and "emotions as embodied practices";
- to generate ground-breaking historical knowledge about music's emotional dimensions in three major pandemics - the Plague, Cholera and Spanish Flu - in Vienna beginning in the 17th century, highlighting both difference and continuity;
- to provide a solid conceptual, methodological and historical foundation for comparative studies on music, emotions and pandemics across a vast range of disciplines.

GOING VIRAL's results will not only be applicable in related historical settings but also enable a meaningful interdisciplinary discourse with the social and natural sciences about music end emotions in pandemics, including Covid-19.

Link to the ERC project webpage: https://goingviral.hypotheses.org/

Keywords of the ERC project: music; emotions; pandemics; history; plague; cholera; spanish flu

Keywords that characterize the scientific profile of the potential visiting researcher/s: history of emotions; history of medicine; music history; musicology

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Project ID:	Project Acronym:	Evaluation Panel:
101041245	**MATRIX**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Vera Aldeias**
Host Institution:	Universidade Do Algarve - PRT

Into the Sedimentary Matrix: Mapping the Replacement of Neanderthals by early Modern Humans using micro-contextualized biomolecules

The demise of Neandertals and the peopling of Europe by anatomically modern humans (AMH) occurred, geologically speaking, in the blink of an eye. While we know that Neandertals and AMH interbred, how and where this interaction occurred remains unresolved. Now that humans can be fingerprinted from the aDNA they left behind in sediments, high-resolution site formation studies are essential to establish microstratigraphic integrity and to reconstruct the human past at finer scales.

MATRIX will zoom into the sedimentary matrix at an unprecedented resolution using aDNA, but also proteins and lipids stored in archaeological sediments, in order to: 1) find the identity of past hominins in well-preserved micro-contexts, 2) reconstruct both their behaviors (diet, use of fire) and environments they lived in, and 3) contribute to rewriting what happened at the time of Neandertal disappearance by integrating high-resolution molecular and microscopic records. We will focus on seven selected sites distributed throughout Europe and with established aDNA preservation. We will assess the microstratigraphy of deposits from ~50 to 40,000 years BP by studying intact archaeological samples in 2D and 3D micromorphological views. We will obtain aDNA data at a micro-scale, and couple it with bone proteins and lipids from organic-rich sediment samples, all extracted from intact micromorphological samples. The project aims to achieve, for the first time, an integration of biological, behavioral, and environmental information of archaeological deposits at a mm- and sub-mm stratigraphic scale.

Pioneering the application of microarchaeological techniques linked with contextualized molecular data, while setting a rigorous basis for their interpretation, MATRIX will greatly improve our understanding of the migration of AMH into Eurasia and, eventually, to our inhabiting of the entire world.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101042034	**BE4COPY**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Marius Buning**
Host Institution:	Universitetet I Oslo - NOR

Before Copyright: Printing Privileges and the Politics of Knowledge in Early Modern Europe

BE4COPY examines the long-term history of printing privileges from a cross-disciplinary and European perspective. These privileges provided exclusive rights for the production of books and images: they can be considered one of the precursors of what we now call 'copyrights'. Introduced around 1470, shortly after the invention of the printing press, privileges were abolished around 1789, when new notions of ownership emerged alongside new ideas about political representation. The BE4COPY project studies the changing nature of the printing privilege over the course of these turbulent 300 years. The intimate relationship between legal frameworks and the politics of knowledge is the primary focus of the project. Although numerous studies have examined printing privileges in their local context, there are to date no historical studies that have examined how different European systems of printing privileges were interrelated. BE4COPY will change that and thus contribute to a better understanding of the origins of copyrights as a specific form of shared European heritage. It does so by (1) examining the distribution of printing privileges on a European scale, exposing existing trade routes and political alliances, and (2) rethinking the relationship between legal protection and political interests. How did shifting discourses of expertise and stewardship influence the proprietorship of intellectual creations' How did the interplay between law, economy, and politics shape the production of knowledge? And how did 'authorship' and 'ownership' eventually emerge in that context as twin categories? BE4COPY employs an innovative archive-based approach centred around the cross-cutting themes of 'Censorship and Promotion', 'Travelling Ideas and People', and 'Authorship and Readership'. The project adds a new layer to our evolving understanding of copyright and opens up new perspectives regarding the question of how knowledge was produced and shared in early modern Europe.

Link to the ERC project webpage: https://www.hf.uio.no/iakh/english/research/projects/before-copyright/index.html

Keywords of the ERC project: early modern; history of knowledge; legal history

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101042252	**CLIMASAT**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Gemma Cirac-Claveras**
Host Institution:	Universitat Autonoma De Barcelona - ESP

Remote-Sensing Satellite Data and the Making of Global Climate in Europe, 1980s-2000s.

Answers to how to manage the urgent climate crisis depend on perceptions of global climate. Knowing how they came to be is necessary to open up new possibilities about ways to face it. CLIMASAT aims at establishing a truly comprehensive narrative that integrates various spheres of knowledge to understand how global climate discourses, policies and practices came into being in the approximate 1980s-2000s Europe.

To do so, CLIMASAT substantially places the production, circulation and use of data generated with Earth-orbiting satellites at the centre of historical analysis. Indeed, since the 1980s, much of our scientific, practical and political knowledge about global climate has been increasingly compiled with satellite data, in a process of constitutive co-production. Then processes of data production, circulation and use may have played a role in knowledge-making. CLIMASAT identifies 5 interrelated spheres of knowledge involved in satellite data production, circulation and use: science and technology, economy, regulation, communication, and diplomacy. It sets out the hypothesis that it was through their mutual intersections, as they materialised in processes of data production, circulation and use, that certain perceptions and actions about global climate were collectively negotiated, shared, maintained and used. It focuses the empirical analysis on 3 European satellite programs (Meteosat, Topex/Poseidon, ERS) that provided data on extreme weather events, sea level, and ozone. It demands an interdisciplinary methodology grounded on material and transnational history.

In times of growing public concern regarding our actions on the climate crisis, CLIMASAT delivers unparalleled information and critical analysis about how satellite data-informed perceptions of global climate were made, which is relevant not only for researchers in academia but also for policy-makers and engaged citizens.

Link to the ERC project webpage:

Keywords of the ERC project: history of science and technology - STS - environmental history - satellite data history - climate history

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101043939	**UseFool**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Lucia Raggetti**
Host Institution:	Alma Mater Studiorum-Universita Di Bologna - ITA

Knowledge and manipulation of nature between usefulness and deception in the Arabo-Islamic tradition (9th-15th century)

The UseFool project studies the knowledge and manipulation of nature applied to entertainment and fraud, as described in the Arabic technical literature dealing with the practice of charlatans and performers along the streets and in the markets. At the core of UseFool's textual corpus are four Arabic handbooks composed between the 6th/12th and the 9th/15th century, combined with other sources, such as the handbooks for the inspector of the market that focus on artisanal impostures. The project will reconstruct the refined technical notions mastered by marginal social groups, showing how the lightly dismissed 'popular knowledge' was actually a form of 'street science'. The project's goal is to write a new chapter in the cultural, social, and material history of knowledge looking through the lens of Arabic technical literature. UseFool proposes a new interdisciplinary approach to its sources: this begins from a philological and textual analysis that focuses on their technical contents, expands to the reconstruction of the material dimension of the procedures through hands-on replication, and completes its all-round approach with the re-enactment of the performative and theatrical dimension entailed in the different forms of deception. In this way, UseFool will assess the interaction between the narrative component and actual practice in this textual tradition. The project will also map the sources of this technical literature on deception, in order to reconstruct lines of transmission in a long time span and across different cultures. The project reflects on the roots of the handbooks on entertainment and fraud in the antique and late antique heritage, with the aim of providing a searchable and organized structure to the lore of natural properties. UseFool also expands its horizon to the close relationship between the Arabic and the Latin Mediaeval technical sources, with the aim of deepening our understanding of their transmission in a longue durée perspective.

Link to the ERC project webpage:

Keywords of the ERC project: Mediaeval Arabic Science and Technology, Philology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101045506	**FINISTERRA**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr João Cascalheira**
Host Institution:	Universidade Do Algarve - PRT

Population Trajectories and Cultural Dynamics of late Neanderthals in Far Western Eurasia

In recent years, knowledge of the processes involved in the disappearance of the Neanderthals and the successful expansion of our species across Eurasia has substantially increased. Still, the spatiotemporal variability of the presumed mechanisms behind Neanderthals' demise – climate change, fragile demography, inter-species competition – makes it very challenging to evaluate the replacement at a continental scale. The Iberian Peninsula, due to its cul-de-sac position and the role of its southern regions as one of the last refugia for the Neanderthals, represents an ideal natural setting for testing models of cultural and demographic trajectories leading to the final disappearance of those populations. FINISTERRA seeks to expand this framework by implementing an integrative, interdisciplinary, multi-scale approach to the archaeological and paleoenvironmental records associated with late Neanderthals in southwestern Iberia. Supported by an unprecedented combination of geoarchaeological, chronological, and paleoecological evidence, FINISTERRA will specifically (1) provide a detailed characterization of late Neanderthal adaptive systems, presenting high-resolution data on the timeline of events leading to their final disappearance; (2) investigate the presence of the so-called early warning signals of Neanderthals' collapse through the use of cutting-edge quantitative analyses of cultural and demographic trajectories; (3) explore alternative hypotheses of a gradual or sudden loss of Neanderthals' resilience by considering the impacts of climate change and the spread of modern humans into western Eurasia. The results of this project will have crucial implications for our understanding of the factors contributing to the demise of our sister species, which ultimately were key components for our own success and uniqueness.

Link to the ERC project webpage: www.finisterra.icarehb.com

Keywords of the ERC project: Neanderthals, Climate change, Population trajectories, Collapse

Keywords that characterize the scientific profile of the potential visiting researcher/s: Neanderthals, Climate change, Population trajectories, Collapse

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101045643	**ALPGEN**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Hannes Schroeder**
Host Institution:	Kobenhavns Universitet - DNK

Ancient genomics and the population history of the Circum-Alpine region

The prehistoric pile dwellings in and around the Alps constitute one of the most important archaeological archives of human prehistory. Dating from around 5000 to 500 BC, there are over 1000 known sites in the region, 111 of which are listed on UNESCO's World Heritage List. The sites are mainly located under water, on lake shores, along rivers, or in wetlands, offering exceptional conditions for the preservation of organic materials like wood, plant remains, animal bones, artefacts, and even textiles. Because of their exceptional preservation, the archaeological remains from those sites give us a unique window into the lives of prehistoric people and the development of early agrarian societies in Central Europe. However, despite the rich material evidence from the settlements, we know relatively little about the people who lived there. This is because there are no burials directly associated with the lake settlements, which has precluded the study of ancient DNA, for example. Luckily, there are other sources of ancient DNA, including ancient "chewing gums" which provide a rich of ancient human and host-associated microbial DNA as we recently demonstrated. In this project we will sequence ancient DNA and other biomolecules from ancient "chewing gums" found at lake settlements in and around the Alps to shed new light on the lives of the Alpine communities that settled there between 5000 and 500 BC. With access to over 300 specimens from archaeological sites north and south of the Alps, we have the unique opportunity to study their interactions and the demographic and cultural changes that characterised the transition from the Neolithic to the Bronze Age in Central Europe. In addition, the project promises to offer new insights into peoples' health and the composition of their oral microbiome, as well as their diet and subsistence strategies. Together, the proposed research will provide us with a richer understanding of the pile-dwelling communities of Central Europe.

Link to the ERC project webpage: www.alpgen.eu

Keywords of the ERC project: archaeology, ancient DNA, genomics, metagenomics, microbial ecology

Keywords that characterize the scientific profile of the potential visiting researcher/s: archaeology, bioarchaeology, ancient DNA, metagenomics

Project ID:	Project Acronym:	Evaluation Panel:
101052761	**DISPERSALS**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Nuno Bicho**
Host Institution:	Universidade Do Algarve - PRT

Dispersals, resilience, and innovation in Late Pleistocene SE Africa

Genetic evidence suggests that successful modern human migration out of Africa is believed to have started c. 70,000 years ago, populating the whole world, at different rates and times. This incredible voyage took place because of human's unique resilience, versatility, and innovation, both biological and cultural, to external stimuli, including ecological and environmental changes.

The main objective of DISPERSALS is to investigate the migration and dispersal dynamics of early Homo sapiens in Africa and archaeologically evaluate the genetic model that southern African human populations were the genesis of the successful out-of-Africa some 70,000 years ago. This will be accomplished by investigating cultural and biological continuity/discontinuity issues and human population movements in the last c. 100,000 years in the poorly studied Limpopo and the Save river basins, central Mozambique, an area mediating the two key regions of human development, i.e., southern and eastern Africa.

DISPERSALS will compare the human occupation and ecology between central Mozambique and eastern and southern Africa using a multi-scale approach based on the study of regional diachronic cultural traits. It will reconstruct regional population patterns, followed by comparative quantitative population genetics combined with GIS computational network analyses. The results will be then integrated through Agent-based modeling, based on the incremental creation, elimination, or reorientation of network links to simulate a quantitative framework to study the evolution of population dispersal across southern-eastern Africa. The project will be crucial in providing ground-breaking high-resolution archaeological, chronological, and paleoenvironmental data. DISPERSALS will deliver a fundamental perspective on the key processes that triggered migrations and dispersals within Africa and out-of-Africa which ultimately resulted in the human diaspora over the entire planet.

Link to the ERC project webpage:

Keywords of the ERC project: Middle Stone Age, Paleolithic, Africa Stone Age, Mozambique,

Keywords that characterize the scientific profile of the potential visiting researcher/s: Archaeology, Human evolution

Project ID:	Project Acronym:	Evaluation Panel:
101054647	**CivilWars**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Robert Gerwarth**
Host Institution:	University College Dublin, National University Of Ireland, Dublin - IRL

The Age of Civil Wars in Europe, c. 1914-1949

In the first half of the twentieth century, Europe experienced an unparalleled number of civil wars resulting in millions of deaths. Civil war, as much as inter-state war, was a defining feature of the period for many European societies, from Ireland in the west and Russia in the east, to Finland in the north and Spain and Greece in the south. Since the 1990s, a rich and increasingly sophisticated body of literature has emerged on individual incidents of civil war, ranging from military studies to social and cultural analyses. However, remarkably little comparative work has been undertaken on civil wars in this period. Even fewer studies have explored the connections between them – be it transfers of people, ideas, or practices – beyond their ideological tropes. This has resulted in a tacit assumption of exceptionalism, whereby each civil war is assumed to have been unique and self-perpetuating without any serious attempt to explain why that was so. This project challenges exceptionalist approaches to civil war. While it recognises that significant differences in causes, forms, and/or aftermaths existed between individual civil wars, it argues that those civil wars can only be fully understood as a phenomenon within a pan-European context. The project will therefore investigate the origins, courses, and legacies of European civil wars through a fully integrated team of scholars with complementary expertise on the Russian, Finnish, Irish, Spanish and Greek cases. This will enable comparison between these different conflicts, but it will also go beyond the nation-centric tendencies of comparative approaches to arrive at a better understanding of what made the first half of the twentieth century an era of civil wars in Europe.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101054659	**Tied2Teeth**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Leslea Hlusko**
Host Institution:	Centro Nacional De Investigacion Sobre La Evolucion Humana - ESP

Expanding our understanding of human evolution through pleiotropy

Teeth dominate the fossil and bioarchaeological records because they consist mostly of inorganic material. Consequently, dental anthropology has long been essential in our investigation of the human past. Variation in the anatomy of teeth is instrumental for differentiating species, identifying biological affinities between populations, making inferences about dietary adaptations, and timing key developmental life stages. However, recent advances in genetics, genomics, and developmental biology undermine many assumptions built into anthropologists' study of the dentition by revealing extensive pleiotropy—when one gene influences more than one anatomical structure simultaneously. However, this is not a setback but rather an advantage. In this project, we will use the pleiotropies that involve teeth to open windows to the evolution of human anatomies far beyond the dentition.

I will employ three methodological approaches that utilize pleiotropy to probe different aspects of human paleobiology. The first approach will use quantitative genetic analyses to calibrate the extent to which cranial evolution is genetically correlated with dental evolution. In the second approach, we will employ large historical morphological datasets combined with the modern insight from genome-wide-association-studies (GWAS) to explore how the evolution of soft-tissue anatomy may have driven changes in the dentition. Finally, we will turn to the fossil record. Using traits that were defined using a pleiotropic approach, we will test the hypothesis that environmental selection influenced dental variation during two key time periods within the evolution of genus Homo.

This project modernizes the study of the human past by incorporating the phenomenon of dental pleiotropy. By combining these three different approaches and a range of time scales, we turn the conundrum of pleiotropy into a powerful tool for studying human evolution.

Link to the ERC project webpage: https://www.lesleahlusko.org/the-erc-project-tied2teeth/

Keywords of the ERC project: evolution, humans, dentition, pleiotropy, paleontology, quantitative genetics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101054963	**OPEN BORDERS**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Borut Klabjan**
Host Institution:	Znanstveno-Raziskovalno Sredisce Koper - SVN

Cold War Europe Beyond Borders. A Transnational History of Cross-Border Practices in the Alps-Adriatic area from World War II to the present.

This project aims to rethink the history of Cold War Europe by examining the development of transnational cross-border cooperation from the end of World War II to the present. Overcoming traditional narratives of a clear-cut European separation symbolised by the Berlin Wall, a decentralised analysis of recent European history will show us that the question of a divided continent should be reframed. The final objective is to challenge a dichotomous vision of two separate Europes, “East” and “West”, from a new, border perspective. To this end, a highly qualified team of senior and junior scholars under my guidance will focus on the Alps-Adriatic region, a historical area that is now shared by Austria, Italy, Slovenia and Croatia. This case involves a relatively narrow geographical area but an unusually broad typological range of subjects. During the Cold War it was divided among socialist but non-aligned Yugoslavia, capitalist but neutral Austria, and NATO and EEC member Italy. Its development from the "southern end" of the Iron Curtain in 1946 to the "most open border" during the Cold War and a precursor to present-day Schengen Europe, represents a paradigmatic case to study an alternative attitude towards borders, frontiers and boundaries. Drawing on Cold War and borderland studies, social history and the history of European integration, which up till now have not found common ground, our innovative conceptual elaboration will demonstrate the interplay between top-down politics and bottom-up initiatives, thus offering a new, and more nuanced history of Cold War Europe from the border perspective. Reconsidering the European past from this transnational angle, both in terms of geographic and methodological perspectives, will allow us to rediscover the human face of European integration and will offer us a new platform for contemporary discussions on sovereignty, territoriality and belonging and on the future role of borders in Europe and in the world.

Link to the ERC project webpage:

Keywords of the ERC project: Borders. Cold War, Europe, History, Everyday life, cross-border cooperation

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101039222	**SUperSAFE**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Carmelo D'Agostino**
Host Institution:	Lunds Universitet - SWE

SUrrogate measures for SAFE autonomous and connected mobility

SUperSAFE "SUrrogate measures for SAFE autonomous and connected mobility" will address the problem of the safety evaluation of the interaction between conventional vehicles and connected and automated vehicles (CAVs). The project builds on the notion that vehicle automation is posing new risks that the traditional accident-based and proactive safety analysis methods are unable to investigate. In SUperSAFE, I will select the relevant variables drew on the newly identified risks posed by CAVs, and with these I will develop a new proactive method based on surrogate measures of safety for studying the effects of the physical and digital infrastructure on the interaction between road users in a mixed-mobility environment. Also considering the benchmarks for cities' liveability and transport sustainability that include road casualties as a primary factor, the European White Paper on Transport calls to reach zero fatalities by 2050 following Vision Zero's policy (zero serious casualties). Recent statistics indicate a reduction of traffic accidents but also that this development has slowed and additional efforts are required. At the same time, CAVs are already a reality. Tendency towards vehicle automation is even more evident in the European policies which encourage member states to push with the introduction of vehicles with advanced driver assistance systems. However, the road towards full automation is still not open because there is a fear of crashes/injuries and low acceptance of potential CAV accidents. This is mainly because the CAVs' behaviour vis-a-vis the conventional vehicles on the road and the digital and physical infrastructure is still unknown. To meet these rapidly approaching needs, I propose SUperSAFE, which will contribute to attaining the aforementioned European goals by developing a scientifically rigorous method of estimating risk based on the road users' real needs to improve traffic safety in the transition period to fully automated driving.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101039222

Keywords of the ERC project: Traffic Safety, Automated vehicles, Surrogate Measures of Safety, Extreme Value Theory

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101039376	**INFLUX**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Peter Sögaard Jörgensen**
Host Institution:	Stockholms Universitet - SWE

Emerging pests and pathogens as a novel lens for unravelling social-ecological cascades

Emerging pests and pathogens (EPPs) are an increasingly disruptive force to human society that can cause large social and ecological changes far beyond their initial site of emergence. Three forces contribute to this growing challenge now and in the foreseeable future: first, potential EPPs are more likely to come in to first contact with human habitats as human land use expands. Second, denser human trade and travel networks mean that EPPs are more likely to emerge in new regions. Third, human technology, such as biocidal agents, increases risks for re-emergence. Understanding how EPPs cascade across scales in social-ecological systems is therefore an urgent priority, but no formal approach currently exists for analysing the ripple effects at scale, from their seeding to their lasting societal imprints. This project aims to fill this gap in sustainability science for society.

The INFLUX project will test the hypothesis that EPPs commonly cascade to interact with large-scale social and environmental challenges and that small differences in social-ecological conditions in turn influence the likelihood and nature of EPP cascades. I will test this hypothesis by leveraging a comparative, mixed-methods research design to assemble a large database for up to 1600 EPPs, encompassing microbial pathogens as well as arthropod and plant pests. Specifically, four objectives will be pursued, which are to understand:

1. The drivers of emergence risk and their connections to human environmental sustainability and social conditions.
2. The types of cascades that result from action aimed at governing EPPs.
3. The lasting impacts EPPs have on societies and the conditions under which they arise.
4. The feedbacks from 3.-1. including through implications for social equity and environmental sustainability.

INFLUX constitutes a major step in situating EPPs in the field of sustainability science, and for developing societal capacity to navigate a future characterized by them

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Link to the ERC project webpage:

Keywords of the ERC project: Social-ecological systems, Cascading dynamics, Emerging pests and pathogens, Emerging infectious diseases, Sustainability

Keywords that characterize the scientific profile of the potential visiting researcher/s: environmental social scientist, computational social scientist, data scientist, media scientist, policy scientist

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101039455	**SEGUE**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Clémentine Cottineau**
Host Institution:	Technische Universiteit Delft - NLD

Urban Economic SEGregation: integrating explanatory mechanisms across geographical scales to compare remediatory policies in silico

The uneven concentration of people and economic resources in cities hampers the well-being and opportunities of poorer citizens and represents a threat to social cohesion. It is considered a major policy challenge by researchers and international institutions alike. My aim with the SEGUE project is to identify and model the combination of economic, geographical and demographical drivers of urban economic segregation in order to better understand its dynamics and to better assess possible remediatory policies. The existing literature on urban segregation mainly explains urban economic segregation with sociological and intra-city factors (resource accessibility, social networks, contextual effects and the urban form) but also acknowledges a link with the evolution of economic inequality. The existing literature on economic inequality, by contrast, mainly focuses on factors operating at the national and individual levels (selective migration, assortative mating, family inheritance, education). My project addresses this gap by spatialising the national and individual explanations of economic inequality relating to residential mobility or the tax and education system, and by integrating these into a simulation model of urban segregation. This model will be calibrated with a uniquely rich source of exhaustive and longitudinal individual data from the Netherlands. Its analysis will produce new insights about the interaction between drivers of economic inequality and segregation in cities and will provide a cost-effective tool to compare policies to reduce urban economic segregation at different scales of action (local, urban, national), ex ante (i.e. within the virtual laboratory of a simulation) instead of in situ with costly and risky experiments. The results obtained from the research should also open new perspectives to study various forms of inequality and facilitate the study of economic segregation in other national contexts.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101043931	**REBOUNDLESS**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Daniela Pigosso**
Host Institution:	Danmarks Tekniske Universitet - DNK

Towards the prevention of rebound effects within complex socio-technical systems

Society´s most well-intended efforts to solve sustainability challenges have not yet achieved the expected gains due to rebound effects, which are unintended consequences of interventions that arise due to induced changes in system behaviour.

Rebound effects are widely acknowledged, but fundamental scientific gaps hamper their prevention. REBOUNDLESS aims to develop the reboundless design theory, a paradigm shift in design science that will establish the scientific knowledge for preventing rebound effects by:

- Explaining systemic rebound effect mechanisms triggered by sustainable design strategies.
- Modelling and simulating the magnitude of rebound effects arising from design decisions.
- Enabling the design of resilient systems by means of reboundless design strategies.

The reboundless design theory will provide novel methodologies, simulation models and strategies for the design of reboundless solutions (i.e. products, product/service-systems and socio-technical systems that are resilient to rebound effects).

Building on the strong foundation of systems theory, REBOUNDLESS is uniquely positioned to bridge the interdisciplinary gap in the interplay of sustainable design and rebound effects, qualitative and quantitative models, engineering and social sciences, theory and practice.

The reboundless design theory will be the starting point of a prominent research field, with extensive applicability within and beyond sustainable design (e.g. sustainability assessment, sustainability transitions, policy-making).

Never before has there been a stronger global focus on solving the pressing sustainability challenges, but the expected positive societal impact will not be achieved unless rebound effects are prevented.

Building on my 15-year track-record on sustainable design theory and practice, REBOUNDLESS will give me the opportunity to enable the urgently needed shift towards the design of sustainable and resilient systems.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101044076	**FAST**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Floortje Alkemade**
Host Institution:	Technische Universiteit Eindhoven - NLD

Fostering social tipping dynamics to Accelerate Sustainability Transitions

Staying within a maximum global warming of 1.5 degrees requires an acceleration of the transition to a low carbon society. Current theory views such sustainability transitions as inevitably slow as they require interdependent changes throughout socio-technical systems. The observation that energy transition scenarios systematically underestimate the diffusion of key technologies challenges this view. Existing models that form the basis for energy transition scenarios do not include the positive feedbacks resulting from the interactions between civil society and energy transitions. Yet these interactions have been identified as important drivers and barriers of energy transitions, and as crucial in triggering the social tipping dynamics that can accelerate the energy transition. Social tipping dynamics in energy transitions occur when a small change or intervention has a large effect on emission reductions. To date, some examples of social tipping dynamics have been identified, but both a systematic understanding of the mechanisms underlying social tipping dynamics and an evaluation of their potential policy leverage is missing.
The overall objective of the FAST project is to explain and model social tipping dynamics and interventions in energy transitions.
This requires a model that explains how the social factors influencing sustainability transitions scale up to realize social tipping dynamics. To this end I will use a novel combination of bottom-up agent-based modelling and top-down diffusion modelling to capture the interactions in socio-technical systems that create tipping dynamics. This will bridge the qualitative field of sustainability transitions and the quantitative field of energy transitions modelling. A team consisting of the PI, 3 PhD students, a postdoc and a research assistant will conduct the proposed study over five years. This is the first study that systematically integrates social tipping dynamics in quantitative models of energy transitions.

Link to the ERC project webpage:

Keywords of the ERC project: social tipping points

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101044703	**EUNICE**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Massimo Tavoni**
Host Institution:	Politecnico Di Milano - ITA

Debiasing the uncertainties of climate stabilization ensembles

Mathematical models have become central tools in global environmental assessments. To serve society well, climate change stabilization assessments need to capture the uncertainties of the deep future, be statistically sound and track near-term disruptions. Up to now, conceptual, computational and data constraints have limited the quantification of uncertainties of climate stabilization pathways to a narrow set, focused on the current century. The statistical interpretation of scenarios generated by multi-model ensembles is problematic due to availability biases and model dependencies. Scenario plausibility assessments are scant. Simplified, single-objective decision criteria frameworks are used to translate decarbonization uncertainties into decision rules whose understanding is not validated.

EUNICE aims to transform the methodological and experimental foundations of model-based climate assessments through quantification and debiasing of uncertainties in climate stabilization pathways. Our approach is threefold: construct, consolidate and convert. We first apply simulation and statistical methods for extending scenarios into the deep future (beyond the current century and status quo), quantifying and attributing deep uncertainties. We consolidate model ensembles through machine learning and human ingenuity to eliminate statistical biases, pin down near-term correlates of long-term targets, and identify early signals of scenario plausibility through prediction polls. Finally, we use decision-theoretic methods to convert model-generated maps of the future into resilient recommendations and experimentally test how to communicate them effectively. By advancing the state of the art in mathematical modelling, statistics, and behavioural decision-making, we strengthen the scientific basis of climate assessments, such as those of the IPCC. The approach and insights of EUNICE can be applied to other high-stakes environmental, social and technological evaluations.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101052787	**CORESIDENCE**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Albert Esteve**
Host Institution:	Universitat Autonoma De Barcelona - ESP

Intergenerational Coresidence in Global Perspective: Dimensions of Change

Radical transformations in the family are occurring across the globe. Decades of demographic, economic and cultural change have brought about great changes in family life and households. The CORESIDENCE project investigates a crucial, although unanticipated, facet of these transformations: the global rise of intergenerational coresidence (IgC) among adult children and their parents. This shift is occurring in a variety of demographic, economic and cultural contexts and appears to run counter to expectations that intergenerational coresidence would gradually decline with modernization and cultural change. The primary objective of the CORESIDENCE project is to determine the dimensions of variations in and the rise of intergenerational coresidence around the world and investigate how these trends are related to demographic, social, economic, and cultural/attitudinal factors. To achieve this goal, I will (i) use recent big microdata, which describe family change for more than half a billion people representing more than 120 countries worldwide; (ii) harmonize existing longitudinal data to examine pathways to intergenerational coresidence in six countries representing different norms and forms of intergenerational coresidence (India, Japan, Mexico, Senegal, Spain and the Netherlands). This study will be the largest comparative study of the family and of family change ever undertaken. CORESIDENCE will test social theory by analyzing, for the first time, variation in family forms on several geographic scales and time spans to understand the background factors that drive these changes and theorize about the role of the family in the twenty-first century.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101052998	**DATASTORIES**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Rob Kitchin**
Host Institution:	National University Of Ireland Maynooth - IRL

Data Stories: Producing stories about and with property and planning data

Planning and property data are the key evidence base for how cities are understood, planned and developed, informing public perception, guiding investments, and shaping policy. Yet, little critical attention has been paid to planning and property data and their lifecycles, circulation, politics, power and use in policy and stakeholder decision-making. This lacuna raises two important challenges that require redress if the validity of analysis, interpretation and decision-making is to be improved. First, transforming the ontological and epistemological understanding of planning and property data amongst those that utilise them. Second, fostering a reflexive approach to data politics and power in organisations that produce, share and use planning and property data. DATASTORIES will tackle these challenges by conducting research in a creative, highly engaged way with key stakeholders across three domains (state, business, NGOs/civil society). It will develop an innovative methodological approach that blends social science and research-creation methods, working with creative writers and artists, to map an entire data ecosystem (Dublin, Ireland), unpack data assemblages and produce a variety of data stories. 12 in-depth case studies will produce 36 data stories about and with planning and property data. The project will produce four key advances: new knowledge about the evidence-base for planning and property and its use; critical insight into the politics and praxes of data; novel research-creation methods and an assessment of their efficacy; and an extended conception of data stories and an understanding of their production and utility for different audiences. DATASTORIES will produce three ground-breaking impacts: conceptual – transforming the epistemology of planning and property research; applied – positively influencing the data processes and practices of key stakeholders; methodological – validating research-creation and data stories as social sciences methods.

Link to the ERC project webpage: https://datastories.maynoothuniversity.ie/

Keywords of the ERC project: Planning, housing, property, critical data studies, data ecosystem, data stories, research-creation, evidence base

Keywords that characterize the scientific profile of the potential visiting researcher/s: Human Geography, Planning, Urban Studies, Science and Technology Studies, Critical Data Studies, Media Studies, Critical GIS, Data Science,

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101053836	**SOLROUTES**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Luca Queirolo Palmas**
Host Institution:	Universita Degli Studi Di Genova - ITA

Solidarities and migrants' routes across Europe at large

Unauthorized migration has always been a contentious issue in the EU. Yet, many of the policies adopted thus far have proved ineffective in containing arrivals and blocking circulations of migrants and refugees within the EU. Furthermore, unauthorized migration has continued to challenge EU borders even during the pandemic.
SOLROUTES' core research question is: how can the turbulence, persistence, and intensity of unauthorized movements and of the production of migrants' routes across "Europe at Large" – originating from the externalization of EU borders to non-EU countries – be understood?
The project addresses this challenge from an innovative angle, through an ethnographic exploration of the nexus between unauthorized movements and the networks of solidarity with migrants in transit, which involve actors and practices that have been addressed just recently in migration studies. This will be achieved by exploring and observing 50 crucial nodes in migration routes within Europe, in selected countries on its fringes (Turkey, Tunisia, Morocco) and in the Outermost Regions of the EU (French Guiana, Mayotte).
SOLROUTES will aim to: a) explore the functioning, articulations, and representations of local and trans-local networks which share shelter, knowledge and resources with migrants in transit; b) assess how routes are continuously reshaped by the encounter between unauthorized movements and solidarity networks; c) develop a large-scale multi-sited ethnographic approach based on live and collaborative methods and digital research; d) develop an innovative theory in migrations studies on the nexus between solidarity with migrants in transit and unauthorized movements, contributing to structure the emerging perspective of solidarities studies; e) generate Special Features – a web series, an art exhibit, a graphic novel – linked to the research, offering new narratives for policy makers, local communities, and other relevant audiences in the spirit of public sociology.

Link to the ERC project webpage:

Keywords of the ERC project: ethnography borders migrations autonomy visual sociology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101054259	**CONDJUST**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Dan Brockington**
Host Institution:	Universitat Autonoma De Barcelona - ESP

Conservation Data Justice

CONDJUST will create a new research field, Conservation Data Justice, that bridges three distinct areas of enquiry: conservation prioritisation, political ecology and Data Justice. The former uses data which risk marginalising rural peoples. The latter does not yet examine conservation data. Meanwhile political ecologists do not yet consider Data Justice approaches when tackling conservation prioritisation. CONDJUST will interrogate conservation data and models, and explore the epistemic communities producing them, to develop new theories of socially just, data-driven conservation. It will challenge the colonising tendencies of prioritisation work and seek decolonising alternatives.

CONDJUST is timely because ambitious new global targets seek to safeguard 30% of the planet for conservation by 2030 (and more afterwards). These plans pose risks for rural people because the data and modelling they use can contain diverse forms of bias, exclusion and omission. These risks will grow as more social media data are used in conservation prioritisation. We need insights from Data Justice to understand these dangers, and how they might be counter-acted.

This project has four objectives, each with a corresponding work package. These are:

1. Systematically examine the sources of bias and distortion in conservation data used in global prioritisation work.
2. Use Data Justice thinking in new analyses of biodiversity conservation, and increase our understanding of socially just conservation prioritisation.
3. Critically explore the construction of different epistemic communities in conservation prioritisation, and political ecology, to understand what inhibits and enhances learning between them.
4. Examine how policies responding to prioritisation are shaped by, or resist, the new measures proposed.

These work packages will be pursued by an interdisciplinary team led by the PI and composed of three post-doctoral researchers, two PhDs, an administrator and an advisory board.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101075838	**COeXISTENCE**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Rafal Kucharski**
Host Institution:	UNIWERSYTET JAGIELLONSKI - POL

Playing urban mobility games with intelligent machines. Framework to discover and mitigate human-machine conflicts.

AI-driven technologies are ready to enter urban mobility. They promise relief to the notoriously congested transport systems in pursuing sustainability goals. Since AI already outperforms humans in the most complex games (chess and Go) it is likely to win the urban mobility games as well, outperforming us e.g. in: route choices (to arrive faster), mode choices (to reduce costs), pricing strategies and fleet management (to increase market shares and profits). Tempting us and policymakers to gradually hand over our decisions to intelligent machines.

The consequences of this ongoing revolution are challenging to predict and largely unknown. While the abundance of previous studies proves the positive potential of AI in urban mobility (from autonomous vehicles via optimal routing up to fleet management), the negative impact is overlooked. Conversely, our scenario of interest is the machine-dominated urban mobility system, where (collective) decisions of machine intelligence improve system-wide performance, yet at the cost of humans, now facing e.g. longer travel times, greater monetary costs or being nudged to change natural travel habits into the optimal ones - desired by the machine-centred system.

Such scenarios, however, need to be discovered. To this end, COeXISTENCE embarks on the interdisciplinary expedition inside the virtual environment of urban mobility, where machines and humans play the game for limited resources. In the four pre-identified games I will explore the conflict scenarios, demonstrate them on reproducible case-studies, quantify with proposed measures and finally mitigate with a proposed multi-objective reinforcement learning framework, where machines learn to mitigate conflicts while simultaneously reaching their inherently selfish objectives.

Reaching the projects' objectives will be ground-breaking when new phenomena are discovered and lead to breakthrough when they are mitigated pushing the system towards the synergy of COeXISTENCE.

Link to the ERC project webpage: https://rafalkucharskipk.github.io/COeXISTENCE/

Keywords of the ERC project: reinforcement learning; urban mobility; transportation; AI; ML

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
810131	**PLAMORF**	**SYG** Synergy

Principal Investigator:	**Dr Friedrich Kragler**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DEU

Plant Mobile RNAs: Function, Transport and Features

An essential consequence of multi-cellularity is the need for intercellular and tissue wide communication. As seen with animals, higher plants coordinate metabolic and developmental processes via signals transferred to different body parts. Plants use a dual vascular system consisting of phloem and xylem for long-distance transfer of metabolites and signalling molecules. In contrast to circular systems in animals, transport in flowering plants occurs in the phloem via the cytoplasm of connected cells devoid of nuclei. In addition to small molecules, a remarkably large number of so-called mobile micro RNAs (miRNAs), messenger RNAs (mRNAs), and phloem RNA-binding proteins (RBPs) were identified in the phloem and in chimeric plants. Mobile RNAs and RBPs move through plasmodesmata into and through the phloem to distinct tissues. Thus, mobile RNAs represent an additional class of signalling molecules, raising important questions in the field of intercellular signalling. This project combines the expertise of three research groups in the fields of cell biology/macromolecular transport, mathematical modelling/bioinformatics and phloem function/protein biochemistry. It addresses the questions: How are mobile miRNAs and mRNAs selected for transport? Is this process specific and regulated by RBPs and motifs? What determines their destination? And importantly, how are these signals processed in the destination cells? To address these questions, we will develop predictive models, using novel single cell transcriptomics pipelines to establish cell-type specific RNA transport and motifs (WP1), and studying the structure, affinity, and functions of phloem RBPs to gain insights in the RNA delivery mechanism (WP2). We will combine the advantages of the agronomically important plant oilseed rape to identify phloem RNAs and RBPs with the well-established A. thaliana model that allows us to identify and test cell-specific transported RNA signals and RBPs in a time-efficient manner.

Link to the ERC project webpage: https://plamorf.eu

Keywords of the ERC project: RNA transport, plants, phloem, RNA binding proteins, grafting, RNA motif, plant breeding

Keywords that characterize the scientific profile of the potential visiting researcher/s: RNA transport, plants, phloem, RNA binding proteins, grafting, RNA motif, plant breeding

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
810141	**EuQu**	**SYG** Synergy

Principal Investigator:	**Dr John Tolan**
Host Institution:	UNIVERSITE DE NANTES - FRA

The European Qur'an. Islamic Scripture in European Culture and Religion 1150-1850

"The European Qur'an" (EuQu) will study the place of the Muslim holy book in European cultural and religious history (c.1150-1850), situating European perceptions of the Qur'an and of Islam in the fractured religious, political, and intellectual landscape of this long period. The Qur'an plays a key role not only in polemical interactions with Islam, but also in debates between Christians of different persuasions and is central to the epistemological reconfigurations that are at the basis of modernity in Europe, from Iberia to Hungary. The Qur'an is deeply imbedded in the political and religious thought of Europe and part of the intellectual repertoire of Medieval and Early Modern Europeans of different Christian denominations, of European Jews, freethinkers, atheists and of course of European Muslims. We will study how the European Qur'an is interpreted, adapted, used, and formed in Christian European contexts – often in close interaction with the Islamic world.
EuQu will produce, over a six-year period:

1. A GIS-mapped database of the European Qur'an, containing extensive information about Qur'an manuscripts and printed editions (in Arabic, Greek, Latin, and European vernaculars) produced between 1143 and 1800 as well as prosopographical data about the principal actors involved in these endeavours (copyists, translators, publishers).

2. A series of publications: PhDs, monographs written by postdocs and PIs, special issues of academic journals, and animated digital publications for a wider audience and educational uses. They will make key breakthroughs in their fields, dealing with aspects of the transmission, translation and study of the Qur'an in Europe, on the role the Qur'an played in debates about European cultural and religious identities, and more broadly about the place of the Qur'an in European culture.

3. A major exhibition during the final year of the project, "The European Qur'an" to be held at museums in Nantes, London, Budapest and Madrid.

Link to the ERC project webpage: https://euqu.eu/

Keywords of the ERC project: Europe, cultural history, religion, Islam

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
810182	**SCOPE**	**SYG** Synergy

Principal Investigator:	**Dr Evgeny Rebrov**
Host Institution:	THE UNIVERSITY OF WARWICK - GBR

Surface-COnfined fast-modulated Plasma for process and Energy intensification in small molecules conversion

The SCOPE project will introduce a ground-breaking approach to use renewable energy in three major industrial reactions: 1) N2 fixation, 2) CH4 valorization and 3) CO2 conversion to liquid solar fuels. We will use non-thermal plasma, which has large potential to convert these small (low reactive) molecules under near ambient temperature and pressure, particularly for distributed processes based on renewable energy. The new processes have drastically lower carbon footprint (up to over 90% with respect to current ones). Furthermore, CO2 conversion is crucial for a world-based distribution of renewable energy. However, the selectivity and energy efficiency of plasma technologies for these reactions are too low, making radically new approaches necessary.

The Project idea is to realize a highly innovative approach for non-thermal plasma symbiosis with catalysis. By inducing excited states in solid catalysts to work in synergy with the excited short-lived plasma species, we introduce a brand new idea for catalyst-plasma symbiosis. In addition, we introduce a fully new concept of nano-/micro-plasma array through a novel electrode design, to generate the plasma at the catalyst surface, thereby overcoming long distance transport. By embedding ferro-magnetic nano-domains in the catalyst support and inducing radiofrequency heating, we create fast temperature modulations directly at the catalyst active sites. Combining these elements, the project will overcome the actual limits and enhance the selectivity and energy efficiency to levels suitable for exploitation. This requires a synergy over different scale elements: nano at catalyst, micro at the level of modelling plasma generated species, milli at the reactor scale and mega at the plant level for sustainability-driven opportunity guidance and impact assessment by Life-Cycle-Assessment. The synergy value derives from the integration of the PI competencies over this entire dimensional-scale level.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/810182

Keywords of the ERC project: non-thermal plasma, photocatalysis, fluidised bed reactors, photonics, TDLAS

Keywords that characterize the scientific profile of the potential visiting researcher/s: non-thermal plasma, photocatalysis, fluidised bed reactors, photonics, optics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
810182	**SCOPE**	**SYG** Synergy

Principal Investigator:	**Dr Annemie Bogaerts**
Host Institution:	UNIVERSITEIT ANTWERPEN - BEL

Surface-COnfined fast-modulated Plasma for process and Energy intensification in small molecules conversion

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Link to the ERC project webpage:

Keywords of the ERC project: plasma, plasma catalysis, CO2 conversion, N2 fixation, CH4 conversion

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
810296	**DECODE**	**SYG** Synergy

Principal Investigator:	**Dr Michael Boutros**
Host Institution:	DEUTSCHES KREBSFORSCHUNGSZENTRUM HEIDELBERG - DEU

Decoding Context-Dependent Genetic Networks in vivo

The evolutionary success of multicellular organisms is based on the division of labor between cells. While some of the molecular determinants for cell fate specification have been identified, a fundamental understanding of which genetic activities are required in each cell of a developing tissue is still outstanding. The DECODE project will develop and apply leading-edge system genetics methods to Arabidopsis and Drosophila, two major model systems from the plant and animal kingdoms to decode context-dependent genetic networks in vivo. To achieve this, DECODE will bring together experimental and theoretical groups with complementary expertise in model organism genetics and cellular phenotyping, single-cell genomics, statistics and computational biology. Building on our combined expertise, we will create functional genetic maps using conditional CRISPR/Cas9-based single- and higher order knockout perturbations in vivo combined with single-cell expression profiling and imaging. Coupled with powerful computational analysis, this project will not only define, predict and rigorously test the unique genetic repertoire of each cell, but also unravel how genetic networks adapt their topology and function across cell types and external stimuli. With more than 3000 conditional knockouts, characterized by at least six million single-cell transcriptome profiles and high-resolution imaging this project will create the largest single-cell perturbation map in any model organism and will provide fundamental insights into the genetic architecture of complex tissues. Analyzing two tissues with divergent organization and regulatory repertoire will enable us to uncover general principles in the genetic circuits controlling context dependent cell behavior. Consequently, we expect that the DECODE project in model organisms will lay the conceptual and methodological foundation for perturbation-based functional atlases in other tissues or species.

Link to the ERC project webpage: www.erc-decode.eu

Keywords of the ERC project: genomics, single-cell biology, context-dependent effects

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
810331	**WATCH**	**SYG** Synergy

Principal Investigator:	**Dr Ruben Nogueiras**
Host Institution:	Universidade de Santiago de Compostela - ESP

Well-Aging and the Tanycytic Control of Health

The survival of an organism depends on energy homeostasis, involving the control of neuroendocrine functions that integrate metabolic feedback and adapt the response of the organism to physiological demands. Tanycytes, specialized glial cells lining the floor of the third ventricle in the median eminence of the hypothalamus, act as linchpins of these processes, dynamically controlling the secretion of neuropeptides by hypothalamic neurons into the pituitary portal circulation and regulating blood-brain and blood-cerebrospinal fluid exchanges, both processes that depend on their morphological plasticity in response to the physiological state. In addition to their barrier properties, they actively shuttle circulating metabolic signals to hypothalamic neurons that control food intake. The overarching goal of WATCH is to synergistically employ state-of-the-art technologies in systems neuroscience, mouse genetics and bench-to-bedside research, to explore the role of these unique and versatile cells, providing new directions in biomarker research and new therapeutic approaches for a variety of disorders that impair well-aging. Our specific aims are:

1. Genetic dissection of the in vivo regulation, pathophysiological function and molecular markers of tanycytes classified according to their anatomical location.
2. Identification of novel heterogeneous, molecularly distinct tanycytes and associated endothelial cells and determining how these characteristics evolve under distinct physiological and pathological conditions.
3. Functional validation of newly classified subgroups of tanycytes and the specific modulation of the activity of these subgroups at the experimental level.
4. Exploration of the functional consequences of pharmacologically activating pathways required for the tanycytic shuttling of metabolic signals on their CSF levels of these factors, hypothalamic activity and cognition in animal models and patients with morbid obesity or age-related cognitive deficits.

Link to the ERC project webpage: https://tanycytes.eu/

Keywords of the ERC project: tanycytes, metabolism

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
810370	**CloudCT**	**SYG** Synergy

Principal Investigator:	**Dr Klaus Schilling**
Host Institution:	Zentrum fuer Telematik e.V. - DEU

Climate CT- Cloud Tomography by Satellites for Better Climate Prediction

Clouds play a lead climatic role, controlling energy fluxes and regulating fresh water distribution. There is an acute need for cloud-resolving and global-climate models that accurately describe and parametrize the physics of warm convective and stratiform clouds, and the clouds' sensitivity to environmental changes. Currently this requirement is not being met due to a gap in observational capabilities. Namely, there is a lack of sufficient sensing tailored to capture the 3D macro and microphysical properties of warm clouds, which are often spatially unresolved. Moreover, current retrievals use a plane-parallel radiative model, which is incompatible with the 3D heterogeneous nature of clouds. These gaps lead to uncertainties in climate models and prediction.

We propose an innovative sensing approach: cloud scattering-tomography, relying on an unprecedented large formation of ten cooperating, small high performance satellites. They will simultaneously image cloud fields from multiple directions, at 50m resolution. Based on this data, the novel tomography approach will seek the 3D volumetric structure of cloud fields, base-to-top profiles of droplets' size and their variance, volumetric distribution of optical extinction and rain indicators. To meet the required pointing accuracy, data size, and coordinated control of such a formation, advanced and innovative space engineering methods are mandatory. We will optimize and validate this approach, based on advanced in-orbit autonomy, distributed computing, networked control and communication in the formation.

This multidisciplinary, synergic approach will establish and test critical and currently unconventional aspects of remote sensing and mathematical retrieval. It will yield a database of 3D macro and micro structure of warm cloud fields, while setting the stage for next-generation distributed spaceborne global observations.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/810370

Keywords of the ERC project: small satellites, satellite formations, Earth observation data processing

Keywords that characterize the scientific profile of the potential visiting researcher/s: small satellites, satellite formations, Earth observation data processing

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
810377	**ConnectToBrain**	**SYG** Synergy

Principal Investigator:	**Dr Gian Luca Romani**
Host Institution:	Università degli Studi 'G. d'Annunzio' Chieti - ITA

Connecting to the Networks of the Human Brain

ConnectToBrain will introduce whole-brain multi-locus transcranial magnetic stimulation (mTMS), in which the brain-stimulating electric-field location, direction, magnitude and timing are controlled electronically based on real-time high-density electroencephalography (hdEEG) information of activity and connectivity in brain networks. The final mTMS apparatus will consist of 50 coils. Superpositions of electric fields produced by the different overlapping coils allow spatiotemporally millimeter- and millisecond-precise stimulus sequences to arbitrary cortical sites without physical movements of the coil set. Spatial targeting of mTMS will be further improved by measuring individual brain conductivity distributions with ultra-low-field MRI. The proposed hdEEG methodology uses a brain–computer interface (BCI) and a computer–brain interface (CBI) in a closed, algorithmically-controlled loop. BCI receives real-time information about brain activity and connectivity from hdEEG, while CBI adapts mTMS to drive brain activity and connectivity into desired directions. ConnectToBrain will allow unprecedented tracking of dynamic changes and reorganization of brain networks in real-time, and network-targeted closed-loop stimulation. This radically novel technology will cause a paradigm shift from current open-loop practice that is only moderately effective in therapy. We will apply ConnectToBrain to reach new levels of efficacy of therapeutic applications. Patients after stroke and with Alzheimer's disease will be tested and treated as models of network disorders.

Our high-risk, high-gain endeavor will reach the ambitious goals only through the Synergy of the 3 PIs, world leaders in their complementary areas of expertise (instrumentation, algorithms, translation). If the project succeeds, we expect the value of societal, health and industrial benefits in Europe to exceed €1 billion annually, not to mention the immense value of alleviating human suffering from brain disorders.

Link to the ERC project webpage:

Keywords of the ERC project: EEG, TMS, REAL-TIME CONNECTIVITY, AI METHODS

Keywords that characterize the scientific profile of the potential visiting researcher/s: EEG, TMS, REAL-TIME CONNECTIVITY, AI METHODS

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
810451	**HERO**	**SYG** Synergy

Principal Investigator:	**Dr Gabriel Aeppli**
Host Institution:	PAUL SCHERRER INSTITUT - CHE

Hidden, entangled and resonating orders

Knowledge of the electronic band structure and a key low energy degree of freedom, chosen from a short list including charge, spin, free electrons and atomic positions, characterizes most crystalline solids with astonishing success. This paradigm underpins not only metallic and insulating behavior, but also superconductivity, the fractional quantum Hall effect and Mott physics where the efficient theoretical approach is always to consider many-body physics only for a single low energy degree of freedom. While much research even over the last 20 years has validated this paradigm, e.g. for graphene, there are examples of quantum matter where it seems to break down, most notably transition metal oxides which host what appear to be many “key” low energy degrees of freedom (order parameters) and even the quasiparticles in the “normal” metallic states do not always behave as ordinary electrons in metals. Our contention is that the truly important degrees of freedom are not awaiting discovery, but rather that the key property of many of these systems is that there are several key degrees of freedom. HERO aims to go beyond the state of the art in accounting for systems with multiple order parameters by considering all of the possibilities offered by quantum mechanics, and taking advantage of exceptional experimental and computational tools such as free electron lasers. We will search systematically for different forms of “Hidden” Order , derived either from correlations between classical order parameters which could even be vanishing due to quantum fluctuations or from external ac drive fields. Quantum multicritical points where different forms of order simultaneously appear near zero temperature will be considered with special attention to the effects of Entanglement between mesoscopic quantum variables associated with the multiple orders. Finally, we will examine the consequences of Resonant level crossings for symmetry-restoring modes associated with different orders.

Link to the ERC project webpage: https://www.psi.ch/en/psd/projects/erc-synergy-project-hero-hidden-entangled-and-resonating-orders

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
810451	**HERO**	**SYG** Synergy

Principal Investigator:	**Dr Alexander Balatsky**
Host Institution:	STOCKHOLMS UNIVERSITET - SWE

Hidden, entangled and resonating orders

Knowledge of the electronic band structure and a key low energy degree of freedom, chosen from a short list including charge, spin, free electrons and atomic positions, characterizes most crystalline solids with astonishing success. This paradigm underpins not only metallic and insulating behavior, but also superconductivity, the fractional quantum Hall effect and Mott physics where the efficient theoretical approach is always to consider many-body physics only for a single low energy degree of freedom. While much research even over the last 20 years has validated this paradigm, e.g. for graphene, there are examples of quantum matter where it seems to break down, most notably transition metal oxides which host what appear to be many "key" low energy degrees of freedom (order parameters) and even the quasiparticles in the "normal" metallic states do not always behave as ordinary electrons in metals. Our contention is that the truly important degrees of freedom are not awaiting discovery, but rather that the key property of many of these systems is that there are several key degrees of freedom. HERO aims to go beyond the state of the art in accounting for systems with multiple order parameters by considering all of the possibilities offered by quantum mechanics, and taking advantage of exceptional experimental and computational tools such as free electron lasers. We will search systematically for different forms of "Hidden" Order , derived either from correlations between classical order parameters which could even be vanishing due to quantum fluctuations or from external ac drive fields. Quantum multicritical points where different forms of order simultaneously appear near zero temperature will be considered with special attention to the effects of Entanglement between mesoscopic quantum variables associated with the multiple orders. Finally, we will examine the consequences of Resonant level crossings for symmetry-restoring modes associated with different orders.

Link to the ERC project webpage:

Keywords of the ERC project: hiddent, entangled order, quantum order, dynamics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
855005	**urbisphere**	**SYG** Synergy

Principal Investigator:	**Dr Andreas Christen**
Host Institution:	ALBERT-LUDWIGS-UNIVERSITAET FREIBURG - DEU

urbisphere - coupling dynamic cities and climate

urbisphere will change how the scientific community conceptualises, characterizes and forecasts cities in the climate system and in urban planning, by developing a radically new approach to integrate multiple dimensions of urban change, their interaction and feedbacks. It aims to forecast and project urban futures and climates in a dynamic framework considering weather, air quality, differential exposure and vulnerability of people at neighbourhood to city scale. It will provide new insights into existing and emerging risks, based on a synergistic effort across disciplines which currently work mostly in parallel. Urban-Surface Models (USM) and Human Exposure and Vulnerability models (HEV) will be developed and coupled to improve the forecasting of exposure, emissions, and intervention potentials in cities. This will transform emergency/risk management, atmospheric forecasting and long-term urban development/adaptation strategies in the urban sphere. The system will use a real-time 4D Smart Urban Observation System (SmUrObS) to provide targeted urban form/function/emissions/exposure data using novel ground and remote sensing technology. The USM-HEV-SmUrObS system will equip us with: 1) a deep understanding of socio-economic dynamics and human behaviour and responses to weather and climate, economic (and other) drivers that transform cities' exposure and vulnerability to climate change-related hazards (like heat); 2) a consistent method that can be scaled from detailed high-resolution modelling of intra-neighbourhood scale characteristics, to climate and socio-economic modelling and assessment at city, regional and global scales; 3) an approach that can inform global climate and global vulnerability and risk modelling; will allow consistent downscaling to the city for decision making for local urban risk and resilience management; and provide information on the dynamic nexus of exposure and vulnerability of people in cities.

Link to the ERC project webpage: http://www.urbisphere.eu

Keywords of the ERC project: Urban climatology, urban meteorology, urban biometeorology, urban metabolism, climate change

Keywords that characterize the scientific profile of the potential visiting researcher/s: Background in urban climate with a special focus on either observational boundary-layer climatology or observational human biometeorology, experience in atmospheric observations and data analysis. Ideally also experience in atmospheric or biometeorologica

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
855005	**urbisphere**	**SYG** Synergy

Principal Investigator:	**Dr Joern Birkmann**
Host Institution:	UNIVERSITAET STUTTGART - DEU

urbisphere - coupling dynamic cities and climate

urbisphere will change how the scientific community conceptualises, characterizes and forecasts cities in the climate system and in urban planning, by developing a radically new approach to integrate multiple dimensions of urban change, their interaction and feedbacks. It aims to forecast and project urban futures and climates in a dynamic framework considering weather, air quality, differential exposure and vulnerability of people at neighbourhood to city scale. It will provide new insights into existing and emerging risks, based on a synergistic effort across disciplines which currently work mostly in parallel. Urban-Surface Models (USM) and Human Exposure and Vulnerability models (HEV) will be developed and coupled to improve the forecasting of exposure, emissions, and intervention potentials in cities. This will transform emergency/risk management, atmospheric forecasting and long-term urban development/adaptation strategies in the urban sphere. The system will use a real-time 4D Smart Urban Observation System (SmUrObS) to provide targeted urban form/function/emissions/exposure data using novel ground and remote sensing technology. The USM-HEV-SmUrObS system will equip us with: 1) a deep understanding of socio-economic dynamics and human behaviour and responses to weather and climate, economic (and other) drivers that transform cities' exposure and vulnerability to climate change-related hazards (like heat); 2) a consistent method that can be scaled from detailed high-resolution modelling of intra-neighbourhood scale characteristics, to climate and socio-economic modelling and assessment at city, regional and global scales; 3) an approach that can inform global climate and global vulnerability and risk modelling; will allow consistent downscaling to the city for decision making for local urban risk and resilience management; and provide information on the dynamic nexus of exposure and vulnerability of people in cities.

Link to the ERC project webpage: http://urbisphere.eu/contact.html

Keywords of the ERC project: adaptation to climate change, vulnerability, risk, urban and spatial planning

Keywords that characterize the scientific profile of the potential visiting researcher/s: spatial and urban planning, climate change adaptation, risk management, infrastructures

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
855158	**ANEUPLOIDY**	**SYG** Synergy

Principal Investigator:	**Dr Nenad Pavin**
Host Institution:	FACULTY OF SCIENCE UNIVERSITY OF ZAGREB - HRV

Molecular origins of aneuploidies in healthy and diseased human tissues

Chromosome segregation errors cause aneuploidy, a state of karyotype imbalance that accelerates tumor formation and impairs embryonic development. Even though mitotic errors have been studied extensively in cell cultures, the mechanisms generating various errors, their propagation and effects on genome integrity are not well understood. Moreover, very little is known about mitotic errors in complex tissues. The main goal of this project is to uncover the molecular origins of mitotic errors and their contribution to karyotype aberrations in healthy and diseased tissues. To achieve our goal, we have assembled an interdisciplinary team of experts in molecular and cell biology, cell biophysics, chromosomal instability in cancer, and theoretical physics. Our team will introduce novel approaches to study aneuploidy (superresolution microscopy, optogenetics, laser ablation, single cell karyotype sequencing) and apply them to state-of-the-art tissue cultures (mammalian organoids and tumoroids). In close collaboration, Tolić will establish assays to detect and quantify error types in cells, and Kops and Amon will use the assays on various healthy and cancer tissues. Tolić and Kops will uncover the molecular origins of errors, their propagation and impact on genome integrity, while Amon will lead the investigation of the mechanisms that ensure high chromosome segregation fidelity in healthy tissues. Interwoven in these collaborations are the efforts of Pavin, who will develop a theoretical model to describe the origin of errors and to quantitatively link chromosome segregation fidelity in single cells and tissues. Model and experiment will continuously inspire each other, to achieve deep understanding of how mitotic errors arise, how they propagate and how they impact on cell populations. Thus, the extensive sets of expertise present in our team will be combined and expanded with novel technologies to tackle the big challenge of the origins of aneuploidy in humans.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
855158	**ANEUPLOIDY**	**SYG** Synergy

Principal Investigator:	**Dr Iva Tolic**
Host Institution:	RUDER BOSKOVIC INSTITUTE - HRV

Molecular origins of aneuploidies in healthy and diseased human tissues

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Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
856416	**DEEP PURPLE**	**SYG** Synergy

Principal Investigator:	**Dr Liane G, Benning**
Host Institution:	HELMHOLTZ ZENTRUM POTSDAM DEUTSCHESGEOFORSCHUNGSZENTRUM GFZ - DEU

DEEP PURPLE: darkening of the Greenland Ice Sheet

The stability of the Greenland Ice Sheet (GrIS) is a threat to coastal communities worldwide. The PIs have changed our understanding of why it darkens during the melt season, becoming increasingly deep purple due to pigmented ice algal blooms in the ice surface, producing more melt and accelerating the GrIS towards its tipping point, and increasing sea level. The next step jump in our understanding of biological darkening will be provided by DEEP PURPLE, which will establish the factors that control ice algal blooms. These factors are essential for modelling of future melting, which require a process-based understanding of blooming. DEEP PURPLE will quantify the synergies between the biology, chemistry and physics of ice algae micro-niches in rotting, melting ice, and examine the combination of factors which stabilise them. State-of-the-science analytical and observational methods will be employed to characterise the complex mosaic of wet ice habitats, dependent on factors such as the hydrology, nutrient status, particulate content and light fields within these continually evolving ice-water-particulate-microbe systems. We will quantitatively assess why and how the fine light mineral dust particulates contained within the melting ice amplify the growth of ice algae. The particulate content and composition of different layers in the GrIS is dependent on age, and so the algae that the melting ice can support may fundamentally change over time. We look back to understand if the ice biome has changed through the Anthropocene via analyse of fjord sediments. The first draft genome of ice algae will show their key adaptations to glacier surface habitats. DEEP PURPLE looks forward by providing the critical field data sets and conceptual models of ice algal growth that will facilitate the next generation of predictive models of sea level rise due to biologically enhanced melting of the GrIS.

Link to the ERC project webpage: https://www.deeppurple-ercsyg.eu/home

Keywords of the ERC project: cryophillic algae; terrestrial microbial snow and ice habitats; carbon and nutrient cycling in the cryosphere

Keywords that characterize the scientific profile of the potential visiting researcher/s: molecular ecologist, environmental chemist (organic or inorganic) with snow or ice chemical focus; algal physiolgy and adaptations to stress; molecular characterization of C in low biomass systems

excellent written and spoke English

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
856432	**HyperQ**	**SYG** Synergy

Principal Investigator:	**Dr Fedor Jelezko**
Host Institution:	UNIVERSITAET ULM - DEU

Quantum hyperpolarisation for ultrasensitive nuclear magnetic resonance and imaging

Many of the most remarkable contributions of modern science to society have arisen from the interdisciplinary work of scientists enabling novel methods of imaging and sensing. Outstanding examples are nuclear magnetic resonance (NMR) and magnetic resonance imaging (MRI) which have enabled fundamental insights in a broad range of sciences extending from Chemistry to the Life Sciences. However, the key challenge of NMR and MRI is their very low inherent sensitivity due to the weak nuclear spin polarisation under ambient conditions. This makes the extension of magnetic resonance to the nanoscale (small volumes) and to the observation of metabolic processes (low concentrations) impossible.

HyperQ will address this challenge with the development of room-temperature quantum control of solid-state spins to increase nuclear spin polarisation several orders of magnitude above thermal equilibrium and thereby revolutionise the state-of-the-art of magnetic resonance. Essential for this development is the synergy of an interdisciplinary team of world leaders in quantum control and hyperpolarised magnetic resonance to enable the development of quantum control theory ("Quantum Software"), quantum materials ("Quantum Hardware"), their integration ("Quantum Devices") and applications to biological and medical imaging ("Medical Quantum Applications"). HyperQ will target major breakthroughs in the field of magnetic resonance, which include chip-integrated hyperpolarisation devices designed to operate in combination with portable magnetic resonance quantum sensors, unprecedented sensitivity of bio-NMR at the nanoscale, and biomarkers of deranged cellular metabolism.

The HyperQ technology will provide access to metabolic processes from the micron to the nanoscale and thereby insights into metabolic signatures of a broad range of disease such as cancer, Alzheimer and the mechanisms behind neurodegenerative disease. This will enable fundamentally new insights into the Life Sciences.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
856488	**SEACHANGE**	**SYG** Synergy

Principal Investigator:	**Dr James Scourse**
Host Institution:	THE UNIVERSITY OF EXETER - GBR

Quantifying the impact of major cultural transitions on marine ecosystem functioning and biodiversity

The seas are changing. Marine conservation seeks to protect valuable habitats but the pristine state of marine ecosystem functioning and biodiversity – that is, the system as it operated before there was any large scale human impact – is conjectural. Conservation management strategies are often based on highly altered ecosystems where the degree of human-induced change is unknown. In SEACHANGE, we propose a structured and systematic approach to the reconstruction of marine ecosystem baselines to quantify the impact of anthropogenic cultural transitions on marine biodiversity and ecosystem functioning. SEACHANGE will address two key questions: 1) What was the nature of long-term changes in prehistoric marine biodiversity and ecosystem functioning over a 3000-year period in NW Europe and the degree of human impact associated with major socioeconomic changes across the Mesolithic-Neolithic boundary? 2) What has been the scale and rate of marine biodiversity loss and changes to ecosystem functioning as a result of fishing intensity and marine habitat loss during the last 2000 years (including the Industrial Transition) in the North Sea and around Iceland, eastern Australia and the west Antarctic Peninsula? To address these questions we will analyse: 1) absolutely-dated annually-resolved bivalve shell series ("sclerochronologies"); 2) marine sediment cores; 3) archaeological midden (waste) materials including shells and bones. We will date these samples precisely and undertake zooarchaeological and palaeoecological, stable isotope geochemical and environmental DNA/DNA metabarcoding analyses. We will compare the data with historical and archival sources, and we will generate numerical ecosystem simulations. We will identify how depleted the current marine environment is compared with that before large scale human impact and what measures are needed, and how long will it take, for marine biodiversity to recover.

Link to the ERC project webpage: seachange-erc.eu

Keywords of the ERC project: Marine conservation; biodiversity; sedimentary DNA; stable isotopes; sclerochronology

Keywords that characterize the scientific profile of the potential visiting researcher/s: sclerochronology; sedimentary isotopes; palaeoceanography

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
856555	**MEET**	**SYG** Synergy

Principal Investigator:	**Dr Alexander Sobolev**
Host Institution:	UNIVERSITE GRENOBLE ALPES - FRA

Monitoring Earth Evolution Through Time

Efforts to reconstruct the early Earth evolution lack critical information on the contents of mobile and volatile elements and their isotope signatures in the mantle and crust. Fortunately, this information is preserved in inclusions of melt in relicts of olivine from komatiites and picrites, and zircons from mafic and felsic rocks. In Aim I, we will use compositions and temperatures of primary mantle-derived melts reconstructed from the study of melt inclusions in olivine from komatiites and picrites to constrain the evolution of mantle composition. We will further study crust-formation, crust-mantle recycling, and crust-hydrosphere exchange based on composition of melt inclusions and host zircons. We will analyse a wide range of volatile elements and their isotopes in homogenized melt inclusions and the elemental and isotopic compositions of host olivines and zircons. The samples come from 24 localities of komatiites and picrites originating at different cratons between 3.7 and 0.06 Ga, and detrital and magmatic zircons with ages from 4.4 Ga to present. We will apply published and new models to constrain the temperatures and compositions of mantle and crustal sources. In Aim II, geodynamic modelling will relate our observations to the evolution of mantle convection, crustal production and recycling, and plate tectonics (PT). We will couple geodynamic modelling with surface and climate models and use derived geochemical proxies to test our hypotheses on the importance of surface processes in evolution of PT. We will thus address several fundamental issues: the rate of crustal growth and recycling through time; the cause and timing of the onset of large-scale subduction and PT, and factors controlling its evolution; concentration and origin of H2O and halogens in the deep mantle, and the extent (if any) of core-mantle interaction. MEET will, therefore, offer an unprecedented look at the evolution of Earth from 4.4 Ga to today, and from the atmosphere to the core.

Link to the ERC project webpage: https://www.isterre.fr/english/research-observation/research-projects/european-projects/article/monitoring-earth-evolution-through-time-meet.html?var_mode=calcul

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: petrology, geochemistry, melt inclusions, olivine, Earth mantle

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
951284	**ENSEMBLE**	**SYG** Synergy

Principal Investigator:	**Dr Laurent Groc**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Structure and functions of the brain extracellular space

Brain research has made tremendous progress over the last few decades in nearly all areas of investigation with the exception of one: the extracellular space (ECS). It is however a key compartment defined as the web-like space between brain cells, filled with a myriad of molecules that enable brain functions and homeostasis. How molecules navigate in the ECS is a very important, yet unsolved, challenge that precludes conceptual advance in brain science and innovation in therapeutics (e.g. immunotherapy). The lack of knowledge is mainly due to the absence of dedicated investigation strategies for such a complex and finely structured biological entity. Our ground-breaking project (ENSEMBLE) will shed light on the conceptual and methodological roadblocks that have prevented us from understanding the fine architecture of the ECS and how molecules navigate within it throughout the brain. We posit that molecular diffusion in the ECS is locally regulated by the properties of the ECS, which is essential for brain functions. Four world-class scientists, L. Groc (molecular neuroscience, CNRS), E. Bezard (systems neuroscience, INSERM), L. Cognet (optics & nanoscience, CNRS), and U.V. Nägerl (neurophotonics, Univ. Bordeaux), team up to develop and apply unconventional investigation approaches, based on original nano-imaging strategies (super-resolution microscopy and carbon nanotube/nanoparticle tracking), to the in vivo brain. Yet, to consider and achieve such an experimental and multidisciplinary tour de force a side-by-side and daily interactive effort is necessary. Thanks to our complementary expertise and geographical proximity, ENSEMBLE will provide a unique opportunity to unveil in vivo the structure and functions of this crucial brain compartment and will offer a new theoretical and experimental framework to manipulate molecule navigation. The ENSEMBLE project will also cross-fertilize the fields of nanoscience, optical imaging, organ pathophysiology and immunotherapy.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
951393	**NanoBubbles**	**SYG** Synergy

Principal Investigator:	**Dr Raphaël Lévy**
Host Institution:	University Paris Sorbonne Nord - FRA

Nano bubbles: how, when and why does science fail to correct itself?

Science relies on the correction of errors to advance, yet in practice scientists find it difficult to erase erroneous and exaggerated claims from the scientific record. Recent discussion of a "replication crisis" has impaired trust in science both among scientists and non-scientists; yet we know little about how non-replicated or even fraudulent claims can be removed from the scientific record. This project combines approaches from the natural, engineering, and social sciences and the humanities (Science and Technology Studies) to understand how error correction in science works and what obstacles it faces, and stages events for scientists to reflect on error and overpromising.

The project's focus is nanobiology, a highly interdisciplinary field founded around the year 2000 that has already seen multiple episodes of overpromising and promotion of erroneous claims. We examine three such "bubbles": the claim that nanoparticles can cross the blood-brain barrier; that nanoparticles can penetrate the cell membrane; and the promotion of the "protein corona" concept to describe ordinary adsorption of proteins on nanoparticles. Findings based on error (non)correction in nanobiology should be generalizable to other new, highly interdisciplinary fields such as synthetic biology and artificial intelligence.

We trace claims and corrections in various channels of scientific communication (journals, social media, advertisements, conference programs, etc.) via innovative digital methods. We examine error (non)correction practices in scientific conferences via ethnographic participant-observation. We follow the history of conferences, journals, and other sites of error (non)correction from the 1970s (before nanobio per se existed) to the present. And we attempt to replicate nanobiological claims and, in case of non-replication, document obstacles to correcting those claims. Finally, we will spark a dialogue within the nanobiology community by organizing workshops and events at c

Link to the ERC project webpage: https://nanobubbles.hypotheses.org/

Keywords of the ERC project: Nanobiotechnology, science and technology studies, conference studies, scientometrics, controversy studies, sociology of science, scientific publishing, cell imaging, blood-brain barrier, endocytosis, text-mining, post-publication
peer review

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
951424	**Water-Futures**	**SYG** Synergy

Principal Investigator:	**Dr Marios Polycarpou**
Host Institution:	UNIVERSITY OF CYPRUS - CYP

Smart Water Futures: designing the next generation of urban drinking water systems

The world population living in urban settlements is expected to increase to 70% of 9.7 billion by 2050. Historically, as cities grew, new water infrastructures followed as needed. However, these developments had less to do with real planning than with reacting to crisis situations and urgent needs, due to the inability of urban water planners to consider long-term, deeply uncertain and ambiguous factors affecting urban development and water demand. These, coupled with increasingly uncertain climate conditions, indicate the need for a more holistic and intelligent decision-making framework for managing water infrastructures in the cities of the future.

This project aims to develop a new theoretical framework for the allocation and development decisions on drinking water infrastructure systems, so that they are socially equitable, economically efficient and environmentally resilient, as advocated by the UN Agenda 2030, Sustainable Development Goals. The framework will integrate real-time monitoring and control with long-term robustness and flexibility-based pathway methods, and incorporate economic, social, ethical and environmental considerations for sustainable transitioning of urban water systems under deep uncertainty with multiple possible futures.

The Water-Futures team will build on synergies from the four research groups, transcending methodologies from water science, systems and control theory, economics and decision science, and machine learning, into an integrated decision and control framework, to be implemented as an open-source research toolbox. The new science outcomes will be applied to three case studies exemplifying different types of urban water systems: a mature, relatively stable system; a mature and rapidly expanding system; and a relatively recent supply system in a developing country with high growth and special challenges, including limited resources, intermittent supply and high water losses.

Link to the ERC project webpage: https://waterfutures.eu

Keywords of the ERC project: smart water distribution networks; systems and control; fault diagnosis; machine learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: smart water distribution networks; systems and control; fault diagnosis; machine learning

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
951541	**Quantropy**	**SYG** Synergy

Principal Investigator:	**Dr Klaus Ensslin**
Host Institution:	EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH - CHE

Entropy in engineered quantum systems - Mesoscopic thermodynamics of correlated quantum states

Quantum systems that have been engineered to host correlated electronic states are of outstanding fundamental and technological interest. Often 'exotic' new quasi-particles emerge, such as Majorana fermions, whose inherent topological robustness forms the basis of a promising approach to quantum computation. Another recent example are sheets of pencil-lead graphene which superconduct with a proper twist between layers.

Thermodynamic probes have been central for characterising new phases of matter in bulk materials. Low-dimensional systems offer greater opportunities for control, but probing their electronic states in a similar way is notoriously difficult, in part because of the small number of electrons involved.

The objective of this project is to overcome this challenge and to develop a unique conceptual and experimental foundation for exploring correlated quantum states in low-dimensional systems by measuring thermodynamic quantities, in particular entropy. Entropy is one of the most fundamental of physical properties, and in recent years has been recognized as a key to understanding systems as diverse as qubits and black holes. Fully exploiting entropy measurements in mesoscopic physics will open up a new window to a mechanistic understanding of correlated quantum states in engineered structures, with promise for ground-breaking novel device paradigms.

Members of the consortium have pioneered some of the few existing approaches to making thermodynamic measurements of low-dimensional systems. In combining our expertise, we will develop, test and explore a versatile suite of thermodynamic probes, and in particular i) demonstrate fractional entropy as an unequivocal observable for exotic states, including Majorana fermions; ii) develop thermodynamic measurement paradigms to probe correlated states in novel materials, in particular twisted bilayer graphene; and iii) achieve the first-time measurement of macroscopic entanglement entropy in solid-state systems.

Link to the ERC project webpage:

Keywords of the ERC project: measuring entropy in mesoscopic quantum devices

Keywords that characterize the scientific profile of the potential visiting researcher/s: mesoscopic physics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
951631	**XSCAPE**	**SYG** Synergy

Principal Investigator:	**Dr Felipe Criado-Boado**
Host Institution:	Agencia Estatal Consejo Superior De Investigaciones Cientificas - ESP

Material Minds: Exploring the Interactions between Predictive Brains, Cultural Artifacts, and Embodied Visual Search

Do the worlds we build alter our own minds and the ways we process information? Do the material structures of our settlements, buildings, roads, and artefacts actively change patterns of thought and attention, so that understanding change in these 'material codes' becomes part and parcel of understanding the emergence of the modern mind?

To answer these questions XSCAPE brings together a unique team from archaeology, vision science, and cognitive philosophy. Using a carefully curated set of materials, spanning a range of cultures and a wide sweep of historic and contemporary settings, we aim to test, for the first time, the hypothesis of materiality-driven cognitive change. To this end we will use a new synergistic methodology that combines multiple real-world case studies with state-of-the-art visual neuroscience, and simple agent-based simulations.

The practical core of the project comprises a series of 41 different world-wide case studies. Together, these will constitute the largest ecological experiment on embodied visual perception ever attempted. A successful Pilot Study (described in detail in the main text) using eye-tracking analysis as applied to the visual exploration of archaeological artefacts already demonstrates the scientific and practical feasibility of our approach. For the simulations, we will use the emerging paradigm known as 'active inference' which describes a principled means of linking perception, attention, and actions (including eye-movements) with cognitive change and learning. This will deliver insights into the fundamental principles that may be guiding materiality-driven cognitive change.

Using this unique combination of archaeological materials, visual neuroscience, and simulation- based studies, XSCAPE will deliver the first fully-integrated framework for understanding the potent yet ill-understood cycles by which we humans make and transform the landscapes, practices, and artefacts that make and transform our minds.

Link to the ERC project webpage:

Keywords of the ERC project: Cognitive sciences, archaeology, neuroarchaeology, materiality, visual cognition, visuality

Keywords that characterize the scientific profile of the potential visiting researcher/s: cognitive sciences, visual cognition,

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
951631	**XSCAPE**	**SYG** Synergy

Principal Investigator:	**Dr Luis Martinez**
Host Institution:	Agencia Estatal Consejo Superior De Investigaciones Cientificas - ESP

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Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
951649	**4-OCEANS**	**SYG** Synergy

Principal Investigator:	**Dr Francis Ludlow**
Host Institution:	THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD, OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN - IRL

Human History of Marine Life: Extraction, Knowledge, Drivers & Consumption of Marine Resources, c.100 BCE to c.1860 CE

4-OCEANS aims to assess the importance of marine life for human societies during the last two millennia. We contend that the harvest of marine resources played a critical, but as yet underappreciated and poorly understood, role in global history. To bridge this gap in our understanding, the four PIs will form an interdisciplinary team combining expertise in marine environmental history, climate history, natural history, geography, historical ecology and zooarchaeology. We will examine when and where marine exploitation was of significance to human society; how selected major socio-economic, cultural, and environmental forces variously constrained and enabled marine exploitation; and identify the consequences of marine resource exploitation for societal development. Through these objectives we will discover how marine resources as novel wealth altered societies throughout history. How might marine wealth have enabled some societies to escape food shortages? How did it trigger long-term socio-economic impacts and ecological consequences? How were marine resources valued, consumed, and energetically transformed? Revealing this history will open a new window on human-nature dynamics of profound importance for understanding developmental trajectories of human societies. 4-OCEANS will transcend the binary distinctions of East and West, global-north and global-south, indigenous and colonial, resource exploitation and wildlife conservation, nature and culture. In doing so, 4-OCEANS will uncover and chart historical trajectories towards sustainable and unsustainable food security and resource extraction, identifying their complex underlying drivers.

Link to the ERC project webpage: https://www.tcd.ie/tceh/4-oceans/

Keywords of the ERC project: environmental history, ocean history, fisheries history, climate history

Keywords that characterize the scientific profile of the potential visiting researcher/s: environmental history, ocean history, fisheries history, climate history

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
951649	**4-OCEANS**	**SYG** Synergy

Principal Investigator:	**Dr Poul Holm**
Host Institution:	IMPERIAL COLLEGE OF SCIENCE TECHNOLOGY AND MEDICINE - GBR

Human History of Marine Life: Extraction, Knowledge, Drivers & Consumption of Marine Resources, c.100 BCE to c.1860 CE

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Link to the ERC project webpage: https://www.tcd.ie/tceh/4-oceans/

Keywords of the ERC project: ecological globalisation, oceans past

Keywords that characterize the scientific profile of the potential visiting researcher/s: