European Research Council
Executive Agency

Established by the European Commission

ERC Implementing Arrangements
Call for Expression of Interest
2018

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
715975	**DPC_REPAIR**	**LS1** Molecular and Structural Biology and Biochemistry

Principal Investigator:	**Dr JULIEN PHILIPPE DUXIN**
Host Institution:	KOBENHAVNS UNIVERSITET - DK

Mechanism of DNA-protein cross-link repair in S phase

DNA-protein cross-links (DPCs) are common DNA lesions caused by endogenous, environmental, and chemotherapeutic agents. Cells are susceptible to these lesions during S phase, as DPCs impede replication fork progression and are likely to induce genomic instability, a cause of cancer and aging. Despite its relevance to human health, the repair of DPCs is poorly understood. Research on DPC repair has mainly involved testing cellular responses to compounds such as formaldehyde, but these agents induce a wide variety of DNA lesions, and conflicting results have been reported. To overcome these obstacles, I have developed the first in vitro system that recapitulates replication-coupled DPC repair. In this system, a plasmid containing a site-specific DPC is replicated in Xenopus egg extracts. Using this approach, I demonstrated that DPC repair requires DNA replication. When a replication fork encounters a DPC, the DPC is degraded into a peptide-adduct, which allows replication bypass by translesion DNA synthesis. Importantly, these experiments identified a novel proteolytic pathway whose activity is regulated by replication.

This in vitro system now provides a powerful means to identify and characterize the different factors that participate in S phase DPC repair. I speculate that for DPC processing to occur, the protein-adduct must first be detected, then marked for degradation and ultimately degraded. Using a series of complementary strategies, which will take advantage of the in vitro system combined with proteome and genome wide approaches, I seek to uncover the different players that participate in each of these events. This project will enable a detailed mechanistic outlook of a complex multi-step reaction that has not been feasible to achieve using existing methodologies. It will also improve our understanding of how DPCs impact genomic stability and the consequences of not repairing these lesions for human health.

Link to the ERC project webpage:

Keywords of the ERC project: Molecular biology, DNA replication, DNA repair, DNA-protein crosslinks

Keywords that characterize the scientific profile of the potential visiting researcher/s: Molecular biology, Biochemistry, DNA maintenance mechanisms

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
759427	**MisloQC**	**LS1** Molecular and Structural Biology and Biochemistry

Principal Investigator:	**Dr ANTON KHMELINSKII**
Host Institution:	INSTITUT FUR MOLEKULARE BIOLOGIE GGMBH - DE

Dissecting Quality Control Mechanisms of Mislocalized Proteins

Protein quality control systems maintain a functional proteome through detection and removal of abnormal proteins. While typically only misfolded or damaged molecules are thought of as abnormal, recent work has revealed that also mislocalized proteins are subject to quality control. Mislocalized proteins are defined as proteins that fail to reach their native compartment or fail to assemble into their native complex, and thus cannot function normally. Protein mislocalization is a constitutive problem caused by inefficiencies of cellular processes and increases with aging. Proteins can also mislocalize due to mutations, as seen in various metabolic, cardiovascular and neurodegenerative diseases, and some types of cancer.
Despite the ubiquity of protein mislocalization, the systems performing quality control of mislocalized proteins are unknown for most of the proteome because quality control substrates are usually rare, thus difficult to identify, and there is considerable redundancy built into quality control systems. Here, I propose to systematically dissect quality control mechanisms of mislocalized proteins through a combination of molecular biology, genetics, biochemistry and computational biology in yeast and human cells. We will establish a platform for conditional protein mislocalization and apply it (i) to identify quality control substrates proteome-wide, (ii) to dissect redundancies in quality control systems, (iii) to identify the machinery responsible for quality control of mislocalized proteins and (iv) to map the features involved in substrate recognition by the quality control machinery. Finally, we will exploit our findings to selectively target aneuploid cancer cells, which exhibit a high burden of mislocalized proteins. This work will provide a comprehensive picture of quality control systems for mislocalized proteins and shed light on their roles under both normal and perturbed conditions.

Link to the ERC project webpage:

Keywords of the ERC project: protein quality control, aneuploidy, aging, genomics, proteomics

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:
759661	**SPOCkS MS**	**LS1** Molecular and Structural Biology and Biochemistry

Principal Investigator:	**Dr CHARLOTTE UETRECHT**
Host Institution:	HEINRICH-PETTE INSTITUT LEIBNIZ INSTITUT FUER EXPERIMENTELLE VIROLOGIE - DE

Sampling Protein cOmplex Conformational Space with native top down Mass Spectrometry

The main question to be addressed by SPOCk'S MS is how protein complex conformation adapts to local changes, such as processing of polyproteins, protein phosphorylation or conversion of substrates. While labelling strategies combined with mass spectrometry (MS), such as hydrogen deuterium exchange and hydroxyl footprinting, are very versatile in studying protein structure, these techniques are employed on bulk samples averaging over all species present. SPOCk'S MS will remedy these by studying the footprinting and therefore exposed surface area on conformation and mass selected species. Labelling still happens in solution avoiding gas phase associated artefacts. The labelling positions are then read out using newly developed top-down MS technology. Ultra-violet and free-electron lasers will be employed to fragment the protein complexes in the gas phase. In order to achieve the highest possible sequence and thus structural coverage, lasers will be complemented by additional dissociation and separation stages to allow MS^N. SPOCk'S MS will allow sampling conformational space of proteins and protein complexes and especially report about the transient nature of protein interfaces. Constraints derived in MS will be fed into a dedicated software pipeline to derive atomistic models. SPOCk'S MS will be used to study intracellular viral protein complexes, especially coronaviral replication/transcription complexes, which are highly flexible and often resist crystallisation and are barely accessible by conventional structural biology techniques.

Objectives:

- Integrate labelling with complex species selective native MS for time-resolved structural studies
- Combine fragmentation techniques to maximise information content from MS
- Develop software suite to analyse data and model protein complex structures based on MS constraints
- Apply SPOCk'S MS to protein complexes of human pathogenic viruses

Link to the ERC project webpage:

Keywords of the ERC project: Structural mass spectrometry, photon dissociation, coronaviral replication/transcription complexes, instrument development, computational biology

Keywords that characterize the scientific profile of the potential visiting researcher/s: at least two of the above

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
773153	**IMMUNO-PEPTALK**	**LS1** Molecular and Structural Biology and Biochemistry

Principal Investigator:	**Dr CYRIL ZIPFEL**
Host Institution:	UNIVERSITAT ZURICH - CH

Regulation of plant receptor kinase-mediated immunity by endogenous peptides and their receptors

Plant receptor kinases are major pattern recognition receptors (PRRs) that function as part of dynamic multimeric complexes to perceive pathogen-associated molecular patterns or host-derived damage-associated molecular patterns at the plasma membrane (PM). Our long-term objective is to decipher the molecular basis of plant innate immunity and to understand how plant receptor kinases work.

Our recent findings point to an important role of endogenous peptides in the regulation of plant innate immune signaling. The main aim of this proposal is to understand how these endogenous peptides and their corresponding receptors regulate plant innate immune signaling. The central hypotheses of this research are that: (i) a subset of plant endogenous peptides are perceived by receptor kinases to fine-tune dynamically plant innate immune signaling, and thus act as 'phytocytokines'; (ii) these phytocytokines and their receptors regulate the formation of active immune-signaling nanoclusters at the PM; and (iii) phytocytokine receptors participate in the sensory continuum represented by the plant PM and the cell wall to respond dynamically to environmental challenges.

We will pursue the following specific objectives:

(1) decipher the regulation, function, and perception of RALF peptides by malectin-like receptor kinases during immunity;

(2) elucidate the formation, composition, and function of PM immune receptor nanoclusters;

(3) reveal the function of the receptor kinase MIK2 and its ligand(s) in immunity.

Through a balanced combination of straight-forward and high risk/high gain biochemical, biophysical, bioimaging, and genetics approaches, this project will provide groundbreaking insights into the molecular mechanisms underlying the establishment and regulation of plant innate immune signaling, but also into the general mechanisms that control plant receptor kinase functions and by which the myriad endogenous peptides encoded by plant genomes control environmental sensing.

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:
757411	**PUNCTUATION**	**LS2** Genetics, Genomics, Bioinformatics and Systems Biology

Principal Investigator:	**Dr ANDREAS SEBASTIAN MARQUARDT**
Host Institution:	KOBENHAVNS UNIVERSITET - DK

Pervasive Upstream Non-Coding Transcription Underpinning Adaptation

Genomic DNA represents the blueprint of life: it instructs solutions to challenges during life cycles of organisms. Curiously DNA in higher organisms is mostly non-protein coding (e.g. 97% in human). The popular "junk-DNA" hypothesis postulates that this non-coding DNA is non-functional. However, high-throughput transcriptomics indicates that this may be an over-simplification as most non-coding DNA is transcribed. This pervasive transcription yields two molecular events that may be functional: 1.) resulting long non-coding RNA (lncRNA) molecules, and 2.) the act of pervasive transcription itself. Whereas lncRNA sequences and functions differ on a case-by-case basis, RNA polymerase II (Pol II) transcribes most lncRNA. Pol II activity leaves molecular marks that specify transcription stages. The profiles of stage-specific activities instruct separation and fidelity of transcription units (genomic punctuation). Pervasive transcription affects genomic punctuation: upstream lncRNA transcription over gene promoters can repress downstream gene expression, also referred to as tandem Transcriptional Interference (tTI). Even though tTI was first reported decades ago a systematic characterization of tTI is lacking. Guided by my expertise in lncRNA transcription I recently identified the genetic material to dissect tTI in plants as an independent group leader. My planned research promises to reveal the genetic architecture and the molecular hallmarks defining tTI in higher organisms. Environmental lncRNA transcription variability may trigger tTI to promote organismal responses to changing conditions. We will address the roles of tTI in plant cold response to test this hypothesis. I anticipate our findings to inform on the fraction of pervasive transcription engaging in tTI. My proposal promises to advance our understanding of genomes by reconciling how the transcription of variable non-coding DNA sequences can elicit equivalent functions.

Link to the ERC project webpage:

Keywords of the ERC project: non-coding RNA, Transcription, Chromatin, Genomics, systems biology

Keywords that characterize the scientific profile of the potential visiting researcher/s: non-coding RNA, Transcription, Chromatin, Genomics, systems biology, yeast, plant

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
679146	**EpigenomeProgramming**	**LS2** Genetics, Genomics, Bioinformatics and Systems Biology

Principal Investigator:	**Dr CHRISTOPH BOCK**
Host Institution:	CEMM - FORSCHUNGSZENTRUM FUER MOLEKULARE MEDIZIN GMBH - AT

An experimental and bioinformatic toolbox for functional epigenomics and its application to epigenetically making and breaking a cancer cell

Epigenetic alterations can be detected in all cancers and in essentially every patient. Despite their prevalence, the concrete functional roles of these alterations are not well understood, for two reasons: First, cancer samples tend to carry many correlated epigenetic alterations, making it difficult to statistically distinguish relevant driver events from those that co-occur for other reasons. Second, we lack tools for targeted epigenome editing that could be used to validate biological function in perturbation and rescue experiments.
The proposed project strives to overcome these limitations through experimental and bioinformatic methods development, with the ambition of making and breaking cancer cells in vitro by introducing defined sets of epigenetic alterations. We will focus on leukemia as our “model cancer” (given its low mutation rate, frequent defects in epigenetic regulators, and availability of excellent functional assays), but the concepts and methods are general. In Aim 1, we will generate epigenome profiles for a human knockout cell collection comprising 100 epigenetic regulators and use the data to functionally annotate thousands of epigenetic alterations observed in large cancer datasets. In Aim 2, we will develop an experimental toolbox for epigenome programming using epigenetic drugs, CRISPR-assisted recruitment of epigenetic modifiers for locus-specific editing, and cell-derived guide RNA libraries for epigenome copying. Finally, in Aim 3 we will explore epigenome programming (methods from Aim 2) of candidate driver events (predictions from Aim 1) with the ultimate goal of converting cancer cells into non-cancer cells and vice versa.
In summary, this project will establish a broadly applicable methodology and toolbox for dissecting the functional roles of epigenetic alterations in cancer. Moreover, successful creation of a cancer that is driven purely by epigenetic alterations could challenge our understanding of cancer as a genetic disease.

Link to the ERC project webpage: http://epigenomics.cemm.oeaw.ac.at

Keywords of the ERC project: Medical Epigenomics; Bioinformatics & Machine Learning / Artificial Intelligence; Single-cell Sequencing; Cancer Immunology; CRISPR Technology

Keywords that characterize the scientific profile of the potential visiting researcher/s: Wet-lab and/or computational biology, biomedicine. Open to interdisciplinary ideas and directions

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
716024	**GLYCONOISE**	**LS2** Genetics, Genomics, Bioinformatics and Systems Biology

Principal Investigator:	**Dr CHRISTOPH RADEMACHER**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DE

Emergent properties of cell surface glycosylation in cell-cell communication

The surface of every living cell is covered with a dense matrix of glycans. Its particular composition and structure codes important messages in cell-cell communication, influencing development, differentiation, and immunological processes. The matrix is formed by highly complex biopolymers whose compositions vary from cell to cell, even between genetically identical cells. This gives rise to population noise in cell-cell communication. A second level of noise stems from glycans present on the same cell that disturb the decoding of the message by glycans binding receptors through competitive binding. Glycan-based communication is characterized by a high redundancy of both glycans and their receptors. Thus, noise and redundancy emerge as key properties of glycan-based cell-cell communication, but their extent and function are poorly understood.
By adapting a transmitter-receiver model from communication sciences and combining it with state-of-the-art experimental techniques from biophysics and cell biology, we will address two fundamental questions: What is the role of the redundancy in glycan-based communication? How much ‚noise' can it tolerate, before the message is lost?
To do so, we first establish a simplified model system for glycan-based communication. Biophysical rate constants are determined for lectin-glycan interactions and expanded to glycosylated microparticles that trigger a biological response in lectin expressing receiver cells. Next, single cell glycomes are reconstructed from ultra-high dimensional flow cytometry data using lectin mixtures enabled by recent advancements in instrumentation and glycobioinformatics software. Glycomes accessible on single cell level allow replacing the microparticles with transmitter cells and employ a cell-cell interaction model. Our transmitter-receiver model is used to quantify the noise and reveals how redundancy provides robustness of messaging by cell surface glycans in cellular communication.

Link to the ERC project webpage:

Keywords of the ERC project: Glycobiology, information theory, cell-cell communication, carbohydrates, Glycomics

Keywords that characterize the scientific profile of the potential visiting researcher/s: Glycobiology, single particle tracking, information theory, CRISPR, cell-cell communication, lectins, carbohydrates, Glycomics, flow cytometry, single cell analysis

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
773089	**METACELL**	**LS2** Genetics, Genomics, Bioinformatics and Systems Biology

Principal Investigator:	**Dr THEODORE ALEXANDROV**
Host Institution:	EUROPEAN MOLECULAR BIOLOGY LABORATORY - DE

Metabolism of a cell pictured by single-cell approach

Every cell is unique. Metabolites define the composition of each cell and play key roles in essential intracellular processes of energy production and uptake, signaling, regulation, and cell death. Obtaining metabolite signatures of individual cells and linking them to cellular phenotypes is of paramount importance for a holistic understanding of these processes. This requires high-throughput single-cell metabolomics that is not generally attainable due to the limited sensitivity, low throughput, and disruptiveness of state-of-the-art metabolomics methods.

I propose to develop a spatial single-cell metabolomics approach for human cell culture systems. The approach will be based on using metabolite imaging mass spectrometry and will provide metabolite profiles of individual cells and metabolite signatures of single-cell phenotypes identified by light microscopy. With this approach developed, I will investigate the link between the intracellular metabolism and single-cell phenotype and focus on the following questions: How is the intracellular metabolism linked to cellular heterogeneity? How high is the variation of essential metabolites in a cell population? How do the energy metabolism and lipids biosynthesis change through the cell cycle and infection stages? What is the metabolic response to inflammatory signals?

I will scale up the analysis to discover novel cell phenotypes both in the cell culture systems and in big metabolite imaging mass spectrometry data from various biological systems provided to us by our collaborators and the community, and representing billions of cells.

My project will enable spatial single-cell metabolomics on a large scale and will provide yet lacking capacity for investigating and visualizing the intracellular metabolism on a single-cell level. It will advance our molecular understanding of key biological processes and pave the way to discoveries of molecular mechanisms of inflammation, cancer, and infection.

Link to the ERC project webpage:

Keywords of the ERC project: spatial single-cell metabolomics

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:
639478	**AuxinER**	**LS3** Cellular and Developmental Biology

Principal Investigator:	**Dr JÜRGEN KLEINE-VEHN**
Host Institution:	UNIVERSITAET FUER BODENKULTUR WIEN - AT

Mechanisms of Auxin-dependent Signaling in the Endoplasmic Reticulum

The phytohormone auxin has profound importance for plant development. The extracellular AUXIN BINDING PROTEIN1 (ABP1) and the nuclear AUXIN F-BOX PROTEINs (TIR1/AFBs) auxin receptors perceive fast, non-genomic and slow, genomic auxin responses, respectively. Despite the fact that ABP1 mainly localizes to the endoplasmic reticulum (ER), until now it has been proposed to be active only in the extracellular matrix (reviewed in Sauer and Kleine-Vehn, 2011). Just recently, ABP1 function was also linked to genomic responses, modulating TIR1/AFB-dependent processes (Tromas et al., 2013). Intriguingly, the genomic effect of ABP1 appears to be at least partially independent of the endogenous auxin indole 3-acetic acid (IAA) (Paque et al., 2014).

In this proposal my main research objective is to unravel the importance of the ER for genomic auxin responses. The PIN-LIKES (PILS) putative carriers for auxinic compounds also localize to the ER and determine the cellular sensitivity to auxin. PILS5 gain-of-function reduces canonical auxin signaling (Barbez et al., 2012) and phenocopies abp1 knock down lines (Barbez et al., 2012, Paque et al., 2014). Accordingly, a PILS-dependent substrate could be a negative regulator of ABP1 function in the ER. Based on our unpublished data, an IAA metabolite could play a role in ABP1-dependent processes in the ER, possibly providing feedback on the canonical nuclear IAA-signaling.

I hypothesize that the genomic auxin response may be an integration of auxin- and auxin-metabolite-dependent nuclear and ER localized signaling, respectively. This proposed project aims to characterize a novel auxin-signaling paradigm in plants. We will employ state of the art interdisciplinary (biochemical, biophysical, computational modeling, molecular, and genetic) methods to assess the projected research. The identification of the proposed auxin conjugate-dependent signal could have far reaching plant developmental and biotechnological importance.

Link to the ERC project webpage:

Keywords of the ERC project: plant growth, auxin, endoplasmic reticulum

Keywords that characterize the scientific profile of the potential visiting researcher/s: cell biology, plant development, developmental genetics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
759282	**CELL HORMONE**	**LS3** Cellular and Developmental Biology

Principal Investigator:	**Dr ALEXANDER JONES**
Host Institution:	THE CHANCELLOR MASTERS AND SCHOLARS OF THE UNIVERSITY OF CAMBRIDGE - UK

Bringing into focus the cellular dynamics of the plant growth hormone gibberellin

During an organism's development it must integrate internal and external information. An example in plants, whose development stretches across their lifetime, is the coordination between environmental stimuli and endogenous cues on regulating the key hormone gibberellin (GA). The present challenge is to understand how these diverse signals influence GA levels and how GA signalling leads to diverse GA responses. This challenge is deepened by a fundamental problem in hormone research: the specific responses directed by a given hormone often depend on the cell-type, timing, and amount of hormone accumulation, but hormone concentrations are most often assessed at the organism or tissue level. Our approach, based on a novel optogenetic biosensor, GA Perception Sensor 1 (GPS1), brings the goal of high-resolution quantification of GA in vivo within reach. In plants expressing GPS1, we observe gradients of GA in elongating root and shoot tissues. We now aim to understand how a series of independently tunable enzymatic and transport activities combine to articulate the GA gradients that we observe. We further aim to discover the mechanisms by which endogenous and environmental signals regulate these GA enzymes and transporters. Finally, we aim to understand how one of these signals, light, regulates GA patterns to influence dynamic cell growth and organ behavior. Our overarching goal is a systems level understanding of the signal integration upstream and growth programming downstream of GA. The groundbreaking aspect of this proposal is our focus at the cellular level, and we are uniquely positioned to carry out our multidisciplinary aims involving biosensor engineering, innovative imaging, and multiscale modelling. We anticipate that the discoveries stemming from this project will provide the detailed understanding necessary to make strategic interventions into GA dynamic patterning in crop plants for specific improvements in growth, development, and environmental responses.

Link to the ERC project webpage:

Keywords of the ERC project: gibberellin, phytohormone distribution, cell growth, differential growth

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:
772437	**CHROMABOLISM**	**LS3** Cellular and Developmental Biology

Principal Investigator:	**Dr STEFAN KUBICEK**
Host Institution:	CEMM - FORSCHUNGSZENTRUM FUER MOLEKULARE MEDIZIN GMBH - AT

Chromatin-localized central metabolism regulating gene expression and cell identity

Epigenetics research has revealed that in the cell's nucleus all kinds of biomolecules–DNA, RNAs, proteins, protein posttranslational modifications–are highly compartmentalized to occupy distinct chromatin territories and genomic loci, thereby contributing to gene regulation and cell identity. In contrast, small molecules and cellular metabolites are generally considered to passively enter the nucleus from the cytoplasm and to lack distinct subnuclear localization. The CHROMABOLISM proposal challenges this assumption based on preliminary data generated in my laboratory. I hypothesize that chromatin-bound enzymes of central metabolism and subnuclear metabolite gradients contribute to gene regulation and cellular identity.
To address this hypothesis, we will first systematically profile chromatin-bound metabolic enzymes, chart nuclear metabolomes across representative leukemia cell lines, and develop tools to measure local metabolite concentrations at distinct genomic loci. In a second step, we will then develop and apply technology to perturb these nuclear metabolite patterns by forcing the export of metabolic enzymes for the nucleus, aberrantly recruiting these enzymes to selected genomic loci, and perturbing metabolite patterns by addition and depletion of metabolites. In all these conditions we will measure the impact of nuclear metabolism on chromatin structure and gene expression. Based on the data obtained, we will model for the effects of cellular metabolites on cancer cell identity and proliferation. In line with the recent discovery of oncometabolites and the clinical use of antimetabolites, we expect to predict chromatin-bound metabolic enzymes that can be exploited as druggable targets in oncology. In a final aim we will validate these targets in leukemia and develop chemical probes against them.
Successful completion of this project has the potential to transform our understanding of nuclear metabolism in control of gene expression and cellular identity.

Link to the ERC project webpage: https://cemm.at/research/funding/international-funding/erc-consolidator-grant-chromabolism/

Keywords of the ERC project: chromatin, chemical biology, nuclear metabolism, epigenetics

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:
647186	**MolCellTissMech**	**LS3** Cellular and Developmental Biology

Principal Investigator:	**Dr GUILLAUME CHARRAS**
Host Institution:	UNIVERSITY COLLEGE LONDON - UK

Molecular and cellular determinants of cell monolayer mechanics

Epithelial monolayers are amongst the simplest tissues in the body, yet they play fundamental roles in adult organisms where they separate the internal environment from the external environment and in development when the intrinsic forces generated by cells within the monolayer drive tissue morphogenesis. The mechanics of these simple tissues is dictated by the cytoskeletal and adhesive proteins that interface the constituent cells into a tissue-scale mechanical syncitium. Mutations in these proteins lead to diseases with fragilised epithelia. However, a quantitative understanding of how subcellular structures govern monolayer mechanics, how cells sense their mechanical environment and what mechanical forces participate in tissue morphogenesis is lacking.
To overcome these challenges, my lab devised a new technique to study the mechanics of load-bearing monolayers under well-controlled mechanical conditions while allowing imaging at subcellular, cellular and tissue resolutions. Using this instrument, my proposal aims to understand the molecular determinants of monolayer mechanics as well as the cellular behaviours that drive tissue morphogenesis. I will focus on four objectives: 1) discover the molecular determinants of monolayer mechanics, 2) characterise monolayer mechanics, 3) dissect how tension is sensed by monolayers, and 4) investigate the biophysics of individual cell behaviours participating in tissue morphogenesis.
Together these studies will enable us to understand how monolayer mechanics is affected by changes in single cell behaviour, subcellular organisation, and molecular turnover. This multi-scale characterisation of monolayer mechanics will set the stage for new theoretical descriptions of living tissues involving both molecular-scale phenomena (cytoskeletal turnover, contractility, and protein unfolding) operating on short time-scales and rearrangements due to cell-scale phenomena (cell intercalation, cell division) acting on longer times.

Link to the ERC project webpage:

Keywords of the ERC project: Cell mechanics, tissue mechanics, optogenetics

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:
759107	**DORMANTOOCYTE**	**LS3** Cellular and Developmental Biology

Principal Investigator:	**Dr ELVAN BOKE**
Host Institution:	FUNDACIO CENTRE DE REGULACIO GENOMICA - ES

Understanding the Balbiani body: A super-organelle linked to dormancy in oocytes

Female germ cells, oocytes, are highly specialised cells. They ensure the continuity of species by providing the female genome and mitochondria along with most of the nutrients and housekeeping machinery the early embryo needs after fertilisation. Oocytes are remarkable in their ability to survive for long periods of time, up to 50 years in humans, and retain the ability to give rise to a young organism while other cells age and die. Surprisingly little is known about oocyte dormancy. A key feature of dormant oocytes of virtually all vertebrates is the presence of a Balbiani body, which is a non-membrane bound compartment that contains most of the organelles in dormant oocytes and disappears as the oocyte matures.

The goal of this proposal is to combine genetic and biochemical perturbations with imaging and the state of the art proteomics techniques to reveal the mechanisms dormant oocytes employ to remain viable. My previous research has shown that the Balbiani body forms an amyloid-like cage around organelles that could be protective. This has led me to identify the large number of unanswered questions about the cell biology of a dormant oocyte. In this proposal, we will study three of these questions: 1) What is the metabolic nature of organelles in dormant oocytes? 2) How does the Balbiani body disassemble and release the complement of organelles when oocytes start to mature? 3) What is the structure and function of the Balbiani body in mammals? We will use oocytes from two vertebrate species, frogs and mice, which are complementary for their ease of handling and relationship to human physiology.

By studying the Balbiani body, this proposal will provide fundamental insights into organisation and function of organelles in oocytes and the regulation of physiological amyloid-like structures. More generally, the proposed experiments open up new avenues into the mechanisms that protect organelles from ageing and how oocytes stay dormant for many decades.

Link to the ERC project webpage: https://www.crg.eu/en/programmes-groups/boke-lab

Keywords of the ERC project: Oocyte, Dormancy, Balbiani body , metabolism

Keywords that characterize the scientific profile of the potential visiting researcher/s: metabolism, mitochondria, ovary, oocytes

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
648521	**PanCaT**	**LS4** Physiology, Pathophysiology and Endocrinology

Principal Investigator:	**Dr DIETER SAUR**
Host Institution:	KLINIKUM RECHTS DER ISAR DER TECHNISCHEN UNIVERSITAT MUNCHEN - DE

Next-generation in vivo models for improved pancreatic cancer therapies

Maintenance and drug resistance of pancreatic ductal adenocarcioma (PDAC) depends on cancer cell intrinsic mechanisms and a stroma that supports tumor growth. Mouse models of human PDAC have provided important insights into the evolution of this highly lethal tumor, but there are no models that allow secondary genetic manipulation of autochthonous tumors, the tumor microenvironment or the metastatic host niche once the tumor has formed.

We generated an inducible dual-recombinase system by combining Flp/frt and Cre/loxP. This novel PDAC model permits spatial and temporal control of gene expression enabling unbiased genetic approaches to study the role of tumor cell-autonomous and non-autonomous functions in endogenous cancers. This tool provides unparalleled access to the native biology of cancer cells and their hosting stroma, and rigorous genetic validation of candidate therapeutic targets. We performed tumor cell-autonomous and non-autonomous targeting, uncovered hallmarks of human multistep carcinogenesis, validated genetic tumor therapy, and showed that mast cells in the tumor microenvironment, which had been thought to be key oncogenic players, are in fact dispensable for tumor formation.

In the proposed research program, we will 1) develop and further improve next-generation PDAC models, 2) deploy these systems to identify and target key features of PDAC maintenance in tumor cells and their microenvironment, and 3) discover mechanisms of treatment resistance. The application of cutting edge genetic engineering and screening technologies will allow us to address biological questions that could not be addressed before. The PanCaT project will open new horizons for the functional understanding of pancreatic cancer biology with a strong impact on clinical management and prognosis of PDAC patients. It will also produce a unique set of highly versatile and widely applicable genetic tools that will facilitate the study of PDAC at an organismal level.

Link to the ERC project webpage:

Keywords of the ERC project: pancreatc cancer

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:
675014	**TransGen RNA**	**LS4** Physiology, Pathophysiology and Endocrinology

Principal Investigator:	**Dr JAN-WILHELM KORNFELD**
Host Institution:	SYDDANSK UNIVERSITET - DK

Transgenerational regulation of glucose metabolism by noncoding RNAs

Obesity and T2D affect large populations and cause a decline in life expectancy if untreated. The pandemic proportion of obesity and inaptitude of anti-obesity approaches reflect our limited understanding of its complex environmental and genetic etiology. Genome-wide association studies revealed that disease-associated risk variants are often situated in those 98% of the genome not encoding for proteins. This noncoding genomic space yet does not reflect 'Junk DNA' but gives rise to >10,000 noncoding RNAs like microRNAs and long, noncoding RNAs (lncRNAs) that implicated in control of glucose metabolism and energy homeostasis also by the applicant (Kornfeld et al. Nature 2013).
LncRNAs were paraphrased as 'Dark matter of the genome' due to their tissue-specific and dynamic expression that contrast their poorly understood role in gene regulation. In the 1st part of this proposal, we ask if lncRNAs regulate glucose metabolism and are involved in the obesity-associated dysregulation of insulin signaling in the liver, the major glucoregulatory organ in mammals. Using RNA-Seq and novel lncRNA prediction algorithms, we observed that obesity alters expression of 28 annotated and 15 hitherto unknown lncRNAs in two mouse models of obesity. To identify lncRNAs causally controlling glucose metabolism, we established a siRNA screening system that allows functional interrogation of >650 lncRNAs. These in vitro findings serve as entry for the generation of lncRNA knockout mice that are metabolically phenotyped. In the 2nd part, we hypothesize that germline ncRNAs could control the transgenerational consequences of paternal obesity as shown for lower organisms. This builds upon unpublished findings from our lab showing that obesity profoundly changes expression of germline ncRNAs. In-vitro fertilization and intergenerational breedings will trace the legacy of paternal obesity across generations and reveal ncRNAs involved in this 'Lamarckian' control of glucose metabolism.

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

Keywords of the ERC project: Noncoding RNAs, Metabolism, Obesity, Type 2 Diabetes, Transgenerational Epigenetics

Keywords that characterize the scientific profile of the potential visiting researcher/s: Computational Biology, Epigenetics, Mouse Transgenesis

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
771704	**NoMePaCa**	**LS4** Physiology, Pathophysiology and Endocrinology

Principal Investigator:	**Dr GUIDO BOMMER**
Host Institution:	UNIVERSITE CATHOLIQUE DE LOUVAIN - BE

Novel Metabolic Pathways in Cancer

Metabolic adaptations in central carbon metabolism play a key role in cancer. Yet, the success of therapeutic interventions in major pathways has been limited, although some of the changes have been known to exist for almost 100 years.

Biochemical textbooks present intermediary metabolism as something canonical, and the molecular identity of most enzymes required for the production of known intermediary metabolites is indeed known. Yet, the function of many putative enzymes is still unknown, indicating that novel metabolic pathways containing so far unknown metabolites exist.

We have recently discovered a novel metabolic pathway containing two metabolites that have never been described before. Preliminary data indicate that this pathway might play an important role in a group of cancers sharing specific mutations. Furthermore, genetic inactivation of a component of this pathway in mice is compatible with normal development, indicating that pharmacological inhibition should be well tolerated.

In the present project, we will use a multi-dimensional approach combining biochemical, genetic and pharmacological techniques, to identify missing components of this metabolic pathway and assess its role in cellular metabolism and cancer development. In the process of this, we will develop tools that will allow us to test whether this pathway can be targeted in vivo. Thus, our work will lead to the description of a novel metabolic pathway, should reveal novel regulatory circuits and might open novel therapeutic avenues in cancer and beyond.

Link to the ERC project webpage:

Keywords of the ERC project: novel metabolic pathways in cancer and beyond

Keywords that characterize the scientific profile of the potential visiting researcher/s: Interest in biochemistry, bioinformatics, metabolomics or hematology. Good command of the English language. Motivation to try something new and willingness to take a risk.

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
772649	**UB-RASDisease**	**LS4** Physiology, Pathophysiology and Endocrinology

Principal Investigator:	**Dr ANNA SABLINA**
Host Institution:	VIB - BE

The ubiquitin system in RAS-driven disease

The RAS pathway is the most frequently activated signaling node in human disease. Despite intensive efforts, effective therapeutic strategies for RAS-driven disease remain daunting. Elucidation of the mechanisms of RAS activation promises to lead toward novel therapeutic approaches to inhibit RAS activity, and may permit identification of patients who might benefit from RAS pathway inhibitors. Our preliminary studies show that reversible ubiquitylation controls RAS activity by altering its interaction network, thus representing a conceptually novel mechanism of RAS regulation. Our initial steps towards the understanding of the RAS ubiquitylation machinery have shown that positive regulators of RAS ubiquitylation are frequently mutated or down-regulated in RAS-driven diseases, whereas negative regulators are commonly up-regulated. These striking initial results suggest that dysregulation of RAS ubiquitylation may be an alternative mechanism that drives RAS activation in human disease.

Here, we aim to elucidate the role of the ubiquitin system in RAS-driven disease. We will unravel the molecular machinery controlling RAS ubiquitylation and ascertain alterations of the identified machinery in RAS-driven disease. To assess the functional impact of these alterations, we will create genetically modified mouse models and CRISPR-engineered human cell models. We will employ cutting-edge proteomic approaches to determine how disease-associated dysregulation of RAS ubiquitylation perturbs RAS interactions and signalling. Using a synthetic biologic approach, we will obtain insights into mechanisms by which ubiquitylation modulates RAS interactions. It is significant that, in contrast to the majority of known RAS regulators, the ubiquitin enzymes are “druggable”, which implicates them as promising targets for inhibiting RAS activity. Thus, our studies could lead to new ways of defeating RAS-driven disease.

Link to the ERC project webpage: https://www.vibcancer.be/anna-sablina

Keywords of the ERC project: ubiquitin system, RAS, cancer, genetic disorders

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:
787171	**POLICE**	**LS4** Physiology, Pathophysiology and Endocrinology

Principal Investigator:	**Dr ANDREAS VILLUNGER**
Host Institution:	MEDIZINISCHE UNIVERSITAT INNSBRUCK - AT

The PIDDosome in Centrosome and Ploidy-Surveillance

Tight control of the number of chromosome sets in a cell (ploidy) is fundamental for normal development and organismal health. Most cells in our body are diploid, yet, some cells, including cardiomyocytes or hepatocytes require a balanced increase in ploidy for proper function. Polyploidization is accompanied by an accumulation of centrosomes, structures needed for nucleating the mitotic spindle and ciliogenesis. Extra centrosomes, however, promote aneuploidy in proliferating cells by causing errors in chromosome segregation, underlying a series of human pathologies, most notably cancer and premature ageing. How polyploidization is controlled in organogenesis and how errors in ploidy control contribute to disease is poorly understood.

We recently demonstrated that the "PIDDosome" complex polices centrosome numbers in mammalian cells, alerting the tumor suppressor p53 in response to extra centrosomes. This is achieved by inactivating MDM2, the key-inhibitor of p53, by targeted proteolysis. MDM2-processing is mediated by caspase-2, a neglected member in a protease family that controls cell death and inflammation, activated in the PIDDosome.

This exciting finding allows examining the consequences of deregulated ploidy and centrosome number in development and disease without interfering with p53, nor the cell fusion or cytokinesis machineries. This puts us in pole position to carry out an integrative study that aims to develop the PIDDosome as a new therapeutic target in cancer, related inflammation and in regenerative medicine. To meet this aim, we will define

(i) the relevance of the PIDDosome in aneuploidy tolerance of cancer

(ii) the role of the PIDDosome in controlling sterile inflammation and immunity

(iii) the PIDDosome as a key-regulator of organ development and regeneration

POLICE will open new lines of research at the interface of cell cycle, cell death & inflammation control and promote the PIDDosome as new target in our efforts to improve human health.

Link to the ERC project webpage:

Keywords of the ERC project: Caspases, p53, cell cycle, organogenesis, inflammation apoptosis

Keywords that characterize the scientific profile of the potential visiting researcher/s: postdoctoral fellows, PhD students

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
639050	**Troy Stem Cells**	**LS4** Physiology, Pathophysiology and Endocrinology

Principal Investigator:	**Dr BON-KYOUNG KOO**
Host Institution:	INSTITUT FUER MOLEKULARE BIOTECHNOLOGIE GMBH - AT

Troy+ stomach stem cells in homeostasis, repair and pathogenesis

The adult mammalian stomach can be divided into three distinct parts: From the proximal fore-stomach over the corpus to the distal pylorus. Due to constant exposure to mechanical stress and to hostile contents of the lumen, highly specialized cell types have to be constantly reproduced in order to maintain the function of the gastrointestinal tract. Recently, the applicant identified Troy+ chief cells as a novel stem cell population in the corpus epithelium. Troy+ chief cells displayed a very low proliferation rate indicating their quiescent nature compared to other known gastro-intestinal tract stem cells. Interestingly, these stem cells can actively divide upon tissue damage, suggesting distinctive statuses under conditions of homeostasis and injury.
As Troy+ stomach stem cells exhibit interconvertible characteristics i.e. quiescent and proliferative, they represent a unique model of adult stem cells with which we can study 1) the dynamics of stem cell propagation in homeostasis and regeneration and the underlying mechanism of this switch by analysing molecular and epigenetic profiles. Subsequently, by analysing mRNA expression profiles and epigenetic changes in Troy+ stem cells between homeostasis and injury repair, we will generate a list of genes with potentially interesting functions in cell fate decisions. We will therefore investigate 2) the stomach stem cell programme in homeostasis and regeneration using in vitro and in vivo functional genetics. Lastly, we will characterise 3) human stomach stem cells in normal and pathological conditions.
Here we pursue three main aims:
- Investigating Troy+ stem cell dynamics during homeostasis and injury repair
- Unmasking the stomach stem cell programme using in vitro and in vivo functional genetics
- Characterising human stomach stem cells

Link to the ERC project webpage: https://www.imba.oeaw.ac.at/research/bon-kyoung-koo/

Keywords of the ERC project: Intestine, Stomach, Adult Stem Cells, CRISPR, Organoids

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:
648038	**LONGHEART**	**LS4** Physiology, Pathophysiology and Endocrinology

Principal Investigator:	**Dr THOMAS THUM**
Host Institution:	MEDIZINISCHE HOCHSCHULE HANNOVER - DE

Exploring selected long non-coding RNAs as diagnostics and therapeutic targets for heart failure

Despite clinical advances, diseases of the cardiovascular system are the most common cause of morbidity and mortality in the EU with currently 50 million people suffering from heart failure. These important challenges call for a better understanding of underlying mechanisms to enable development of innovative, effective diagnostic and therapeutic strategies for heart failure. Cardiac stress such as myocardial infarction or hypertension leads to cellular "remodeling" of the left ventricle resulting in heart failure. Protein-coding genes originate from only 1.5% of the genome, whereas the larger remaining portion is often transcribed to non-coding RNAs, of which functional importance is still ill understood. We pioneered a role of small microRNAs as diagnostics and therapeutic targets for heart failure (Nature, 2008; Nature Comm, 2012, J Clin Invest, 2014). We now will focus on the larger fraction of long non-coding RNAs (lncRNAs) and their functional roles, as well as diagnostic and therapeutic use in heart failure. The proposal has the following interconnected objectives: a) identify novel functional relevant cardiac remodeling-associated lncRNAs; b) characterise key lncRNA cardiac targetomes; c) investigate lncRNA-paracrine mechanisms and the diagnostic and prognostic potential of cardiac-derived extracellular lncRNAs using large clinical cohorts; and d) discover their therapeutic potential to prevent cardiac remodeling in clinically relevant animal models. Innovative molecular and cell-based methods, a unique lncRNA-shRNA library, genetic animal models and availability of large clinical biobanks will form the basis for a successful strategy. LONGHEART will lead to ground-breaking new insight into the role of lncRNAs in the heart. These findings will firmly establish lncRNA-based mechanisms to identify fundamentally novel diagnostic and therapeutic entry points for a most serious clinical important disorder in dire need for new diagnostic and therapeutic paradigms.

Link to the ERC project webpage:

Keywords of the ERC project: heart failure, cardiovascular disease, ips-cells, Crispr-Cas, noncoding RNAs

Keywords that characterize the scientific profile of the potential visiting researcher/s: molecular and translational science in cardiovascular disease

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
759006	**TRANSREG**	**LS4** Physiology, Pathophysiology and Endocrinology

Principal Investigator:	**Dr ATAMAN SENDÖL**
Host Institution:	UNIVERSITE DE LAUSANNE - CH

Dissecting the role of Translational Regulation in Tumorigenesis

The control of translation is a key determinant of protein abundance, which in turn defines cellular states. The impact of translational regulation may be even greater during the transition from homeostasis to malignancy, as revealed by the surprisingly low correlations between mRNA and protein levels in human cancer databases. This raises the intriguing possibility that through an ability to generate aberrant downstream networks of translational regulators, oncogenic drivers might impose altered protein synthesis programs that become the driving force for tumor formation and malignant progression.

We recently unveiled a hitherto unappreciated role for upstream open reading frame (uORF) translation in tumorigenesis and unearthed a novel switch from conventional EIF2 initiation factor-mediated to alternative EIF2A-mediated uORF translation. These observations suggest that uORFs constitute an exciting new frontier in the field of translational regulation with the potential to fundamentally impact cellular fate.

Here, I propose to systematically analyze the function of uORFs during tumorigenesis. First, we will conduct an in vivo CRISPR/CAS9-based screen in mice to elucidate the role of thousands of uORFs in development, differentiation and upon oncogenic transformation. Second, focusing on select uORFs surfacing in the screen, we will document their role during tumor initiation and progression. Third, we will develop novel tools to detect uORF translation in vivo, exploit them to monitor uORF translation during different stages of tumorigenesis, gain mechanistic insight into their function and finally test the relevance of these findings in human cancer. Collectively, these approaches will provide unprecedented and comprehensive insight into the function of uORFs, unravel new paradigms in the control of gene expression and expose novel strategies for cancer diagnostics and treatment.

Link to the ERC project webpage:

Keywords of the ERC project: Cancer, Stem cells, Gene expression regulation, Translational control, 5'UTR biology, Functional genomics

Keywords that characterize the scientific profile of the potential visiting researcher/s: Background in RNA biology, bioinformatics, stem cell biology, cancer biology, molecular biology, CRISPR or any related discipline would be of special interest, but not mandatory.

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
639272	**SurfaceInhibition**	**LS5** Neurosciences and Neural Disorders

Principal Investigator:	**Dr KOEN VERVAEKE**
Host Institution:	UNIVERSITETET I OSLO - NO

The role of 5HT3a inhibitory interneurons in sensory processing

How do cortical circuits process sensory stimuli that leads to perception? Sensory input is encoded by complex interactions between principal excitatory neurons and a diverse population of inhibitory cells. Distinct inhibitory neurons control different subcellular domains of target principal neurons, suggesting specific roles of different cells during sensory processing. However, the individual contribution of these inhibitory subtypes to sensory processing remains poorly understood. This is mainly due to the technical challenges of recording the activity of identified cell types in-vivo, in response to quantified sensory stimuli. Therefore, I propose a novel approach based on four pillars: 1) An optically accessible circuit in the superficial layers of the cortex, comprised of inhibitory cells expressing the serotonin receptor 5HT3a, and the distal dendrites of pyramidal neurons. 2) A novel combination of electrophysiology and 3D two-photon imaging to simultaneously record the activity of morphologically identified 5HT3a cells and their dendritic targets. 3) A head-fixed perceptual decision task, whereby mice use their whiskers to determine the location of an object, allowing an accurate description of the sensory stimulus. 4) The integration of experimental data and computer models to gain mechanistic insights into circuit functions. The 5HT3a cells and the distal dendrites of pyramidal neurons receive 'top-down' contextual information from other cortical areas that is essential for constructing meaningful perceptions of sensory stimuli. Thus I hypothesize that 5HT3a cells influence sensory perceptions by controlling the excitability of the pyramidal cell distal dendrites that integrate top-down and sensory input. Thus, I will not only reveal novel functions of inhibitory neurons, I will also shed light on how top-down and sensory input is integrated, and I will provide novel methods to test the functions of other cell types in normal mice and disease models.

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:
640093	**LOCOMOUSE**	**LS5** Neurosciences and Neural Disorders

Principal Investigator:	**Dr MEGAN CAREY**
Host Institution:	FUNDACAO D. ANNA SOMMER CHAMPALIMAUD E DR. CARLOS MONTEZ CHAMPALIMAUD - PT

Cerebellar circuit mechanisms of coordinated locomotion in mice

A remarkable aspect of motor control is our seemingly effortless ability to generate coordinated movements. How is activity within neural circuits orchestrated to allow us to engage in complex activities like gymnastics, riding a bike, or walking down the street while drinking a cup of coffee? The cerebellum is critical for coordinated movement, and the well-described, stereotyped circuitry of the cerebellum has made it an attractive system for neural circuits research. Much is known about how activity and plasticity in its identified cell types contribute to simple forms of motor learning. In contrast, while gait ataxia, or uncoordinated walking, is a hallmark of cerebellar damage, the circuit mechanisms underlying cerebellar contributions to coordinated locomotion are not well understood. One limitation has been the difficulty in extracting quantitative measures of coordination from the complex, whole body action of locomotion. We have developed a custom-built system (LocoMouse) to analyze mouse locomotor coordination. It tracks continuous paw, snout, and tail trajectories in 3D with unprecedented spatiotemporal resolution and it has allowed us to identify specific, quantitative locomotor elements that depend on intact cerebellar function. Here we will combine this quantitative behavioral approach with electrophysiology and optogenetics to investigate circuit mechanisms of locomotor coordination. We will 1) Optogenetically silence the output of cerebellar subregions to understand their distinct contributions to locomotion. 2) Record from identified neurons and correlate their activity with specific locomotor parameters. 3) Optogenetically stimulate defined cell types to investigate circuit mechanisms of coordinated locomotion. These experiments will establish causal relationships between neural circuit activity and coordinated motor control, a problem with important implications for both health and disease.

Link to the ERC project webpage: careylab.org

Keywords of the ERC project: locomotion, cerebellum, mouse

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:
681607	**SolutionSleep**	**LS5** Neurosciences and Neural Disorders

Principal Investigator:	**Dr PENNY LEWIS**
Host Institution:	CARDIFF UNIVERSITY - UK

Understanding creativity and problem solving through sleep-engineering

Innovative problem solving is critical for all spheres of organised endeavour, including science and industry, and thus forms the cornerstone of a successful society. Such creative thinking often requires suppression of preconceptions and restructuring of existing knowledge. Pioneering work has shown that sleep facilitates problem solving, but exactly how, and which sleep characteristics are important, remain to be determined. We know that recent experiences are replayed in sleep, and that in Slow Wave Sleep (SWS) this replay integrates new knowledge with old. The role of such replay in Rapid Eye Movement (REM) sleep, a stage which is strongly linked to creativity, is unknown. Here, I propose a model which combines physiology, behavioural studies, and computational modelling to make testable predictions about the complimentary contributions of memory replay in REM and SWS to problem solving. I will test this model through explicit manipulation of memory replay in sleep. I will use a very recently developed technique to explicitly trigger memory replay, a pioneering method for quantifying this replay, and cutting-edge approaches for manipulation of neural oscillations during sleep. I expect two key results: first, I will uncover the principles of how memory replay in REM and SWS combines with specific neural oscillations to promote both long-term memory and creative problem solving. This will involve development of a computational model which will enable optimised experimental design, paving the way for efficient future investigation of how to enhance innovation through manipulation of sleep. Second, I will develop methods for boosting key sleep processes in a selective, targeted manner. Immediate consequences will include a translational project to facilitate everyday problem solving. My findings will revolutionist the understanding of sleep and how it impacts upon some of our most important cognitive abilities—memory and problem solving.

Link to the ERC project webpage: http://www.cardiff.ac.uk/research/explore/research-units/neuroscience-and-psychology-of-sleep-lab-naps

Keywords of the ERC project: sleep, memory, replay, creativity

Keywords that characterize the scientific profile of the potential visiting researcher/s: computational modelling, classifiers, EEG, oscillations

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
683209	**PRIORS**	**LS5** Neurosciences and Neural Disorders

Principal Investigator:	**Dr JAIME DE LA ROCHA**
Host Institution:	CONSORCI INSTITUT D'INVESTIGACIONS BIOMEDIQUES AUGUST PI I SUNYER - ES

Neural circuit dynamics underlying expectation and their impact on the variability of perceptual choices

Just as our experience has its origin in our perceptions, our perceptions are fundamentally shaped by our experience. How does the brain build expectations from experience and how do expectations impact perception? In a Bayesian framework, expectations determine the environment's prior probability, which combined with stimulus information, can yield optimal decisions. While the accumulation-to-bound model describes temporal integration of sensory inputs and their combination with the prior, we still lack electrophysiological evidence showing neural circuits that integrate previous events adaptively to generate advantageous expectations.

I aim to understand (1) how circuits in the cerebral cortex integrate the recent history of stimuli and rewards to generate expectations, (2) how expectations are combined with sensory input across the processing hierarchy to bias decisions and (3) whether the dynamics of the expectation can dominate neuronal and choice variability. I will train rats in a new auditory discrimination task using predictable stimulus sequences that, once learned, are used to compute adaptive priors that improve discrimination. I will perform population recordings and optogenetic manipulations to identify the brain areas involved in the computation of priors in the task. To reveal the circuit mechanisms underlying the observed dynamics I will train a computational network model to classify fluctuating inputs and, by adapting its dynamics to the statistics of the stimulus sequence, accumulate evidence across trials to maximize performance. The model will generalize the accumulation-to-bound model by integrating information across various time scales and will partition choice variability into that caused by the dynamics of the prior or by fluctuations in the stimulus response. My proposal points at a paradigm shift from viewing neuronal variability as a corrupting source of noise to the result of our brain's inevitable tendency to predict the future.

Link to the ERC project webpage: neuro.fcrb.es/delaRochaLab/

Keywords of the ERC project: decision making, priors, electrophysiology, neural circuit, expectations, behavior, perception, computational network model.

Keywords that characterize the scientific profile of the potential visiting researcher/s: machine learning, animal and human behavior, psychophysics, computational modeling, electrophysiology, optogenetics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
715148	**CoSI**	**LS5** Neurosciences and Neural Disorders

Principal Investigator:	**Dr EWELINA KNAPSKA**
Host Institution:	INSTYTUT BIOLOGII DOSWIADCZALNEJ IM. M. NENCKIEGO POLSKIEJ AKADEMII NAUK - PL

Functional connectomics of the amygdala in social interactions of different valence

Understanding how brain controls social interactions is one of the central goals of neuroscience. Whereas social interactions and their effects on the emotional state of an individual are relatively well described at the behavioral level, much less is known about neural mechanisms involved in these very complex phenomena, especially in the amygdala, a key structure processing emotions in the brain.

Recent investigations, mainly on fear learning and extinction, have shown that there are highly specialized neuronal circuits within the amygdala that control specific behaviors. However, a high density of interconnections, both among amyg¬dalar nuclei and between amygdalar nuclei and other brain regions, and the lack of a predictable distribution of functional cell types make defining behavioral functions of the amygdalar neuronal circuits challenging. Therefore, to understand how different neuronal circuits in the amygdala produce different behaviors tracing anatomical connections between activated neurons, i.e., the functional anatomy is needed.

Published data and our preliminary results suggest that within the amygdala there exist different neuronal circuits mediating social interactions of different valence (positive or negative affective significance) and that circuits controlling social and non-social emotions differ. Combining our recently developed behavioral models of adult, non-aggressive, same-sex social interactions with the methods of tracing anatomical connections between activated neurons, we plan to identify neural circuitry underlying social interactions of different emotional valence. This goal will be achieved by: (1) Characterizing functional anatomy of neuronal circuits in the amygdala underlying socially transferred emotions; (2) Examining role of the identified neuronal subpopulations in control of social behaviors; (3) Verifying role of matrix metalloproteinase-9-dependent neuronal subpopulations within the amygdala in social motivation.

Link to the ERC project webpage: http://knapskalab.eu/index.php/en/

Keywords of the ERC project: socially transferred emotions, positive and negative emotions, emotional contagion, amygdala

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:
758604	**ENTRAINER**	**LS5** Neurosciences and Neural Disorders

Principal Investigator:	**Dr RAFAEL POLANIA**
Host Institution:	EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH - CH

Enhancing brain function and cognition via artificial entrainment of neural oscillations

Neural oscillations are ubiquitous in the human brain and have been implicated in diverse cognitive functions to support both neural communication and plasticity. Their functional relevance is further supported by a large number of studies linking various cognitive deficits (e.g., attention deficit hyperactivity disorder, ADHD) with abnormal neural oscillations. However, this field of research faces two important problems: First, there is only correlative, but no causal evidence linking cognitive deficits to abnormal neural oscillations in humans. Second, there is virtually no theory-driven mechanistic approach that generates insights into how oscillations within and across neural networks are linked to human behavior. In this project, I propose to take decisive steps to provide a long-needed neurophysiological characterization—via (1) computational modelling, (2) electrophysiological measures, and (3) novel non-invasive manipulations of cortical rhythms—on how neural oscillations contribute to two types of cognitive processes that are fundamental for many aspects of human behavior: attention and short-term memory. I will go a step further by demonstrating that it is possible to augment performance in these cognitive functions with the design of non-invasive brain stimulation protocols individually tailored to the theory-driven neurocomputational characterizations and electrophysiological signatures of each individual. This will result in the applied goal of deriving new neuro-computational assays that can detect deviant network interactions causally related to cognitive functions, which is key for then renormalizing those functions in neuropsychological conditions such as ADHD. Thus, if successful, my proposed work will ultimately result in novel, low-cost, and painless non-invasive neural interventions for a wide range of neuropsychological disorders tied to abnormal neural oscillations.

Link to the ERC project webpage: http://decision.ethz.ch/

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:
770841	**DEEPEN**	**LS5** Neurosciences and Neural Disorders

Principal Investigator:	**Dr BRICE BATHELLIER**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FR

Deciphering deep architectures underlying structured perception in auditory networks

The principles of sensory perception are still a large experimental and theoretical puzzle. A strong difficulty is that perception emerges from networks of recurrently connected brain areas whose activity and function are poorly approximated by current generic mathematical models. These models also fail to explain many of the fundamental structures effortlessly identified by the brain (shapes, objects, auditory or tactile categories). I here propose to establish a new approach combining high-throughput population recoding methods with a tailored theoretical framework to derive computational principles operating throughout sensory systems and leading to biologically structured perception. This approach follows on the recent mathematical proposal, suggested by Deep Machine Learning methods, that complex perceptual objects emerge through series of simple nonlinear operations combining increasingly complex sensory features along the sensory pathways. Starting with the mouse auditory system as a model pathway, we will recursively extract, with model-free methods, the main nonlinear sensory features encoded in genetically tagged output and local neurons at different processing stages, using optical and electrophysiological high density recording techniques in awake animals. The role of these features in perception will be identified with behavioural assays. Specific intra- and interareal feedback connections, typically not included in Deep Leaning models, will be opto- and chemogenetically perturbed to assess their contribution to precise nonlinearities of the system and their role in the emergence of complex perceptual structures. Based on these structural, functional and perturbation data, a new generation of well-constrained and predictive sensory processing models will be built, serving as a platform to extract general computational principles missing to link neural activity to perception and to fuel artificial neural networks technologies.

Link to the ERC project webpage: https://www.bathellier-lab.org/

Keywords of the ERC project: Neuroscience; hearing ; deep neural networks ; neural computation ; auditory system

Keywords that characterize the scientific profile of the potential visiting researcher/s: data scientist ; neurobiologist

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
770951	**CLAUSTRUM**	**LS5** Neurosciences and Neural Disorders

Principal Investigator:	**Dr AMI CITRI**
Host Institution:	THE HEBREW UNIVERSITY OF JERUSALEM - IL

The Claustrum: A Circuit Hub for Attention

Our senses face a constant barrage of information. Hence, understanding how our brain enables us to attend to relevant stimuli, while ignoring distractions, is of increasing biomedical importance. Recently, I discovered that the claustrum, a multi-sensory hub and recipient of extensive neuromodulatory input, enables resilience to distraction.

In my ERC project, I will explore the mechanisms underlying claustral mediation of resilience to distraction and develop novel approaches for assessing and modulating attention in mice, with implications for humans. Transgenic mouse models that I identified as enabling selective access to claustral neurons overcome its limiting anatomy, making the claustrum accessible to functional investigation. Using this novel genetic access, I obtained preliminary results strongly suggesting that the claustrum functions to filter distractions by adjusting cortical sensory gain.

My specific aims are: 1) To delineate the mechanisms whereby the claustrum achieves sensory gain control, by applying in-vivo cell-attached, multi-unit and fiber photometry recordings from claustral and cortical neurons during attention-demanding tasks. 2) To discriminate between the functions of the claustrum in multi-sensory integration and implementation of attention strategies, by employing multi-sensory behavioral paradigms while modulating claustral function. 3) To develop validated complementary physiological and behavioral protocols for adjusting claustral mediation of attention via neuromodulation.

This study is unique in its focus and aims: it will provide a stringent neurophysiological framework for defining a key mechanism underlying cognitive concepts of attention, and establish a novel platform for studying the function of the claustrum and manipulating its activity. The project is designed to achieve breakthroughs of fundamental nature and potentially lead to diagnostic and therapeutic advances relevant to attention disorders.

Link to the ERC project webpage: citrilab.com

Keywords of the ERC project: Claustrum Neuroscience Attention Neurophysiology Slice in-vivo Behavior

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

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
789128	**SENSATIONAL TETHERS**	**LS5** Neurosciences and Neural Disorders

Principal Investigator:	**Dr GARY LEWIN**
Host Institution:	MAX-DELBRUCK-CENTRUM FUR MOLEKULAREMEDIZIN - DE

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: ion channels, somatosensation, molecular neurobiology, electrophysiology, neurophysiology, mouse genetics

Keywords that characterize the scientific profile of the potential visiting researcher/s: Molecular neurobiology, electrophysiology neurosciences

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
682345	**EPITOR**	**LS5** Neurosciences and Neural Disorders

Principal Investigator:	**Dr STEPHANIE BAULAC**
Host Institution:	INSTITUT NATIONAL DE LA SANTE ET DE LA RECHERCHE MEDICALE - FR

NEUROBIOLOGY OF EPILEPSY GENES

Ion channel genes have long been linked to Mendelian focal epilepsies, but my recent finding of frequent mutations in DEPDC5 opens completely new perspectives. DEPDC5 is an inhibitor of the mTORC1 (mammalian target of rapamycin) signaling pathway, the master regulator of cell proliferation and growth. Mutations of this gene are found in a wide spectrum of focal epilepsy syndromes, with or without cortical malformations. I propose to examine the links between DEPDC5 and the mTORC1 pathway in cortical development and the genesis of epileptic activity.

My proposal work will combine high-throughput sequencing, in vivo proteomics, biochemistry, electrophysiology, and animal behavior testing (video-EEG). Functional analyses will be made on human postoperative tissue and neuronal cultures from human iPSC and specific rodent models. These approaches will enable me to (1) ask if and how the mTORC1 signaling pathway may contribute to epileptogenesis and seizures in patients with DEPDC5 mutations, (2) attempt to explain the diversity of phenotypes, in particular the presence of cortical lesion by searching for somatic brain mutations in the gene, (3) explore neurobiology pathways and partners of DEPDC5, and (4) identify novel actors for inherited focal epilepsies.

Our results will help us understand the genesis of epileptic networks, and more generally how defects in mTORC1 signaling cascade cause neurologic conditions. We anticipate genetic studies on germline and somatic mutations will have a significant clinical impact for genetic counseling and improved prognosis. The molecules and pathways that will be studied in this proposal differ completely from ion channels and receptors that have been so far associated with focal epilepsies. Thus I hope to provide a new orientation for the field, to identify novel genetic mechanisms and to provide an unbiased route to new molecular therapeutic targets.

Link to the ERC project webpage:

Keywords of the ERC project: Genetics, Epilepsy, mTOR pathway, brain somatic mutations, malformation of cortical development, focal cortical dysplasia, in utero elecotroporation

Keywords that characterize the scientific profile of the potential visiting researcher/s: Genetics, electrophysiology, cell biology

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
726280	**Spontaneous ZeBrain**	**LS5** Neurosciences and Neural Disorders

Principal Investigator:	**Dr GERMAN SUMBRE**
Host Institution:	INSTITUT NATIONAL DE LA SANTE ET DE LA RECHERCHE MEDICALE - FR

Whole-brain dynamics underlying self-generated behaviour

The first behavioural theories conceived the organism as primarily driven by external sensory stimuli. However, the energy associated with momentary demands of the environment represent ~1% of the brain's total energy budget, implying that the intrinsic activity represents a major aspect of the brain's function. Indeed, more recent theories such as cognitivism and embodiment describe the organisms as capable of generating complex behaviours emerging from the brain's intrinsic dynamics.

Past and current studies that investigated the neuronal basis self-generated behaviours mainly focus on the readiness potential (RP) signal, a build-up ramping activity in the premotor cortex, occurring ~ 2 sec before the movement's onset. However, the neuronal mechanisms underlying the generation of self-generated behaviours (how RPs are generated), the involvement of other regions, and how the brain codes the impending movements (activity predictive of the onset and type of movement), still remain poorly understood.

The combination of light-sheet microscopy, optogenetics, and the zebrafish larva model enables monitoring whole-brain dynamics in an intact behaving vertebrate. Moreover, the diverse yet limited and well described repertoire of motor behaviours will enable to perform experiments in more natural unconstrained conditions, in comparison to previous studies, which were structured in trials and limited to one or two behavioural choices. These advantages will allow us to go beyond the current state-of-the-art in the field. More specifically, we propose to investigate the following specific aims:

1) Whole-brain dynamics basis and mechanisms underlying self-generated behaviours.
2) A comparison between the neuronal pathways underlying the initiation of self-generated and sensory induced behaviours.
3) The internal and external modulation of self-generated behaviours.

Link to the ERC project webpage: www.zebrain.biologie.ens.fr

Keywords of the ERC project: neuronal circuit dynamics, big data, optogenetics, light sheet microscopy, zebrafish,self-generated behaviours, volition

Keywords that characterize the scientific profile of the potential visiting researcher/s: two-photon calcium imaging, behaviour, neuronal circuit dynamics, big data, optogenetics, light sheet microscopy,

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
772395	**Acclimatize**	**LS5** Neurosciences and Neural Disorders

Principal Investigator:	**Dr JAN SIEMENS**
Host Institution:	UNIVERSITAETSKLINIKUM HEIDELBERG - DE

Hypothalamic mechanisms of thermal homeostasis and adaptation

Mammalian organisms possess the remarkable ability to maintain internal body temperature (Tcore) within a narrow range close to 37°C despite wide environmental temperature variations. The brain's neural "thermostat" is made up by central circuits in the hypothalamic preoptic area (POA), which orchestrate peripheral thermoregulatory responses to maintain Tcore. Thermogenesis requires metabolic fuel, suggesting intricate connections between the thermoregulatory centre and hypothalamic circuits controlling energy balance. How the POA detects and integrates temperature and metabolic information to achieve thermal balance is largely unknown. A major question is whether this circuitry could be harnessed therapeutically to treat obesity.

We have recently identified the first known molecular temperature sensor in thermoregulatory neurons of the POA, transient receptor potential melastatin 2 (TRPM2), a thermo-sensitive ion channel. I aim to use TRPM2 as a molecular marker to gain access to and probe the function of thermoregulatory neurons in vivo. I propose a multidisciplinary approach, combining local, in vivo POA temperature stimulation with optogenetic circuit-mapping to uncover the molecular and cellular logic of the hypothalamic thermoregulatory centre and to assess its medical potential to counteract metabolic syndrome.

Acclimation is a beneficial adaptive process that fortifies thermal responses upon environmental temperature challenges. Thermoregulatory neuron plasticity is thought to mediate acclimation. Conversely, maladaptive thermoregulatory changes affect obesity. The cell-type-specific neuronal plasticity mechanisms underlying these changes within the POA, however, are unknown.

Using ex-vivo slice electrophysiology and in vivo imaging, I propose to characterize acclimation- and obesity-induced plasticity of thermoregulatory neurons. Ultimately, I aim to manipulate thermoregulatory neuron plasticity to test its potential counter-balancing effect on obesity.

Link to the ERC project webpage: www.siemenslab.de

Keywords of the ERC project: thermoregulation, hypothalamus, homeostasis, temperature detection, energy metabolism

Keywords that characterize the scientific profile of the potential visiting researcher/s: Candidates should have a background or interest in understanding neuronal regulation of bodily homeostasis, such as (but not limited to) temperature-, osmotic-, energy metabolic- homeostasis. Particularly welcome to apply are physicists or engineers (or c

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
772452	**nanoAXON**	**LS5** Neurosciences and Neural Disorders

Principal Investigator:	**Dr JANOS SZABADICS**
Host Institution:	INSTITUTE OF EXPERIMENTAL MEDICINE - HUNGARIAN ACADEMY OF SCIENCES - HU

Nano-physiology of small glutamatergic axon terminals

We will reveal the neuronal mechanisms of fundamental hippocampal and axonal functions using direct patch clamp recordings from the small axon terminals of the major glutamatergic afferent and efferent pathways of the dentate gyrus region. Specifically, we will investigate the intrinsic axonal properties and unitary synaptic functions of the axons in the dentate gyrus that originate from the entorhinal cortex, the hilar mossy cells and the hypothalamic supramammillary nucleus. The fully controlled access to the activity of individual neuronal projections allows us to address the crucial questions how upstream regions of the dentate gyrus convey physiologically relevant spike activities and how these activities are translated to unitary synaptic responses in individual dentate gyrus neurons. The successful information transfers by these mechanisms ultimately generate specific dentate gyrus cell activity that contributes to hippocampal memory functions. Comprehensive mechanistic insights are essential to understand the impacts of the activity patterns associated with fundamental physiological functions and attainable with the necessary details only with direct recordings from individual axons. For example, these knowledge are necessary to understand how single cell activities in the entorhinal cortex (carrying primary spatial information) contribute to spatial representation in the dentate (i.e. place fields). Furthermore, because the size of these recorded axon terminals matches that of the majority of cortical synapses, our discoveries will demonstrate basic biophysical and neuronal principles of axonal signaling that are relevant for universal neuronal functions throughout the CNS. Thus, an exceptional repertoire of methods, including recording from anatomically identified individual small axon terminals, voltage- and calcium imaging and computational simulations, places us in an advantaged position for revealing unprecedented information about neuronal circuits.

Link to the ERC project webpage: http://szabadicslab.koki.hu/

Keywords of the ERC project: neuroscience, hippocampus, axonal recordings, electrophysiology, voltage imaging

Keywords that characterize the scientific profile of the potential visiting researcher/s: electrophysiology, voltage imaging, modelling, anatomy

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
788259	**SVNeuroTrans**	**LS5** Neurosciences and Neural Disorders

Principal Investigator:	**Dr REINHARD JAHN**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DE

Mechanisms of neurotransmitter uptake and storage by synaptic vesicles

Summary
In presynaptic nerve endings, neurotransmitters are stored in synaptic vesicles (SVs) before they are released by exocytosis. SVs contain specific transporters that sequester and concentrate transmitters from cytoplasmic pools. All known vesicular transporters belong to the solute carrier (SLC) superfamily of proteins. They draw the energy for transport from an electrochemical proton gradient created by a V-ATPase across the vesicle membrane. However, despite recent progress it is still largely unclear how synaptic vesicles are filled with hundreds of mM transmitter within less than a minute. Open questions include (1) how exactly transport is linked to the proton gradient and which ions are coupled to solute transport, (2) how two different transmitters can be accommodated by the same SV, and (3) how much transmitter can be loaded into an SV and how the stored transmitter is kept inside and prevented from leaking out.
Here we will focus on the vesicular transporters for glutamate (VGLUTs) and GABA/glycine (VGAT or VIAAT), the main excitatory and inhibitory transmitters in the CNS, and on the vesicular transporter for ATP (VNUT). Primarily we will use biochemical approaches employing purified SVs and artificial vesicles, recombinant proteins (either purified and reconstituted in liposomes or using vesicles isolated from transfected cells), in combination with quantitative in vitro assays, for characterizing the features of transport and storage. To achieve this, we plan to develop advanced methods involving adaptation of new fluorescent probes and microscopic analysis of loading and unloading using microfluidic devices. For these experiments, vesicles will be captured by affinity ligands such as antibodies printed on glass surfaces. This allows for analyzing small numbers of vesicles such as SVs derived from primary cultured neurons or transport vesicles from transfected cells that are tagged and labeled with fluorescent reporters before isolation.

Link to the ERC project webpage: https://cordis.europa.eu/project/rcn/214914_en.html

Keywords of the ERC project: Synaptic vesicles, neurotransmitter transporters, microfluidics, fluorescence reporters, proteoliposomes

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:
637304	**HBV1**	**LS6** Immunity and Infection

Principal Investigator:	**Dr MARCUS DORNER**
Host Institution:	IMPERIAL COLLEGE OF SCIENCE TECHNOLOGY AND MEDICINE - UK

Innate immune responses to human hepatotropic viral infections

Chronic hepatotropic infections including hepatitis B (HBV) and C (HCV) are a major public health concern. Even though both viruses belong to completely distinct families the pathogenesis they elicit is strikingly similar, leading to liver fibrosis and cirrhosis. Treatment for HBV and HCV consists of either direct-acting antivirals or pegylated interferon (IFN) alpha. IFNα and IFNλ share common features in that both, type I and III interferons activate the JAK/STAT signalling pathway and subsequently induce interferon-stimulated genes (ISG). These ISG are what ultimately act as antiviral immune effectors. The receptors for type I and III IFN are however distinctly expressed with IFNαR being more ubiquitously expressed compared to the IFNλ receptor IL28RA. This might also explain the pronounced side effect of IFNα in the treatment of both, HCV and HBV.
Here, we suggest investigating the mechanistic details of type I and type III IFN action on HCV and HBV in vitro and vivo with the goal of uncovering not only the differential ISG induction but furthermore characterise viral immune evasion strategies. Building on our previous success in dissecting the host response to HCV and creating the first immunocompetent mouse model for HCV we aim at using human liver-chimeric mice in combination with single-cell analysis of the antiviral response against HBV and HCV elicited by type I and III IFN. Additionally, we will utilize lentiviral high throughput screening used previously for HCV to identify interferon effector molecules active against HBV. This project will not only provide new insights into the innate immune response to chronic hepatotropic virus infections but also holds the potential of uncovering novel drug targets, aiding in the curative therapy for both, HCV and HBV.

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:
637801	**TWILIGHT**	**LS6** Immunity and Infection

Principal Investigator:	**Dr MICHELLE LINTERMAN**
Host Institution:	THE BABRAHAM INSTITUTE - UK

ToWards Immunisations that Last: the Immunology and Gerontology of Helper T cells

A major accomplishment of modern society is the extension of human life expectancy. However, this creates a new challenge for medical science, to facilitate healthy ageing. With age, the function of the immune system declines, rendering older people more susceptible to infections and less able to benefit from vaccination. Indeed, improving vaccine efficacy is key to reducing infection-related morbidity in older people. To date, the complexity of the ageing process has hindered attempts to fulfil this ambition, and thus innovative approaches are required to better understand the underlying biology.

Vaccination creates protective immunity by inducing the germinal centre (GC) response, an intricate process that generates memory B cells and long-lived antibody-secreting plasma cells. However, the GC response declines with age. Strikingly, it is not B cells that are responsible for the age-dependent decline in the GC response, but the CD4+ T cells and the microenvironment of older individuals. The cellular and molecular mechanisms responsible, however, remain unknown. In the GC there are two subsets of specialised CD4+ T cells, T follicular helper (Tfh) and T follicular regulatory (Tfr) cells, which act in opposition to promote and suppress the response, respectively. I hypothesise that aberrant formation and/or function of Tfh and Tfr cells contribute to impaired GC responses during ageing, and that these cells could be targeted to improve vaccine efficacy. Furthermore, the most prominent age-dependent change in secondary lymphoid tissues is the accumulation of senescent cells, which can modify immune function and tissue structure. I hypothesise that accumulation of senescent cells alters this microenvironment, impairing the response to vaccination. I will test these hypotheses using new mouse models and innovative approaches to human research, in the expectation that the knowledge obtained will promote healthy ageing and uncover novel aspects of GC biology.

Link to the ERC project webpage: https://www.babraham.ac.uk/our-research/lymphocyte/michelle-linterman

Keywords of the ERC project: Germinal centre, T follicular helper cells, Ageing

Keywords that characterize the scientific profile of the potential visiting researcher/s: Germinal centre, T follicular helper cells, Ageing

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
716718	**ALLERGUT**	**LS6** Immunity and Infection

Principal Investigator:	**Dr CASPAR OHNMACHT**
Host Institution:	HELMHOLTZ ZENTRUM MUENCHEN DEUTSCHES FORSCHUNGSZENTRUM FUER GESUNDHEIT UND UMWELT GMBH - DE

Mucosal Tolerance and Allergic Predisposition: Does it all start in the gut?

Currently, more than 30% of all Europeans suffer from one or more allergic disorder but treatment is still mostly symptomatic due to a lack of understanding the underlying causality. Allergies are caused by type 2 immune responses triggered by recognition of harmless antigens. Both genetic and environmental factors have been proposed to favour allergic predisposition and both factors have a huge impact on the symbiotic microbiota and the intestinal immune system. Recently we and others showed that the transcription factor ROR(γt) seems to play a key role in mucosal tolerance in the gut and also regulates intestinal type 2 immune responses.

Based on these results I postulate two major events in the gut for the development of an allergy in the lifetime of an individual: First, a failure to establish mucosal tolerance or anergy constitutes a necessity for the outbreak of allergic symptoms and allergic disease. Second, a certain 'core' microbiome or pathway of the intestinal microbiota predispose certain individuals for the later development of allergic disorders. Therefore, I will address the following aims:

1) Influence of ROR(γt) on mucosal tolerance induction and allergic disorders

2) Elucidate the T cell receptor repertoire of intestinal Th2 and ROR(γt)+ Tregs and assess the role of alternative NFκB pathway for induction of mucosal tolerance

3) Identification of 'core' microbiome signatures or metabolic pathways that favour allergic predisposition

ALLERGUT will provide ground-breaking knowledge on molecular mechanisms of the failure of mucosal tolerance in the gut and will prove if the resident ROR(γt)+ T(reg) cells can function as a mechanistic starting point for molecular intervention strategies on the background of the hygiene hypothesis. The vision of ALLERGUT is to diagnose mucosal disbalance, prevent and treat allergic disorders even before outbreak and thereby promote Public Health initiative for better living.

Link to the ERC project webpage: https://cordis.europa.eu/project/rcn/210908_de.html

Keywords of the ERC project: microbiota, immune tolerance, regulatory T cells, type 2 immunity, dendritic cells

Keywords that characterize the scientific profile of the potential visiting researcher/s: microbiome analysis, metatranscriptome, single cell transcriptome analysis, mucosal barrier immunity

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
742290	**TOLERANCE FOOTPRINT**	**LS6** Immunity and Infection

Principal Investigator:	**Dr LUDGER KLEIN**
Host Institution:	LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN - DE

Clonal Deletion versus Clonal Diversion: Footprints of Self-Tolerance in the T Cell Repertoire

Self-tolerance is a key feature of the immune system; its failure causes autoimmune diseases such as Multiple Sclerosis or Type-1-Diabetes. Remarkably, T cell tolerance operates via two fundamentally different mechanisms: potentially dangerous cells are either eliminated (clonal deletion) or re-programmed to differentiate into regulatory T (Treg) cells (clonal diversion). Paradoxically, both tolerance modes can ensue from self-antigen-encounter in the thymus, and the parameters specifying these opposing cell-fates remain poorly understood. Moreover, the relative contribution of clonal deletion versus clonal diversion to tolerance at the level of diverse immune cell repertoires has not been determined. In particular, the paucity of antigen-specific cells is a major experimental obstacle to unravelling to what extent cells with shared autoreactive specificity, yet different T cell receptors (TCRs), are subject to either mode of tolerance.
Breakthroughs in visualizing minute cohorts of antigen-specific cells, characterizing the TCRs on individual cells and large-scale TCR sequencing now provide a unique opportunity to tackle these challenging questions. Based upon my expertise in thymus biology and T cell selection, I will exploit these technological advances to reveal where and how tolerance either generates 'holes' in the repertoire or diverts cells into a 'benign' sub-repertoire. The main objectives are (i) to identify and classify deleted or diverted TCR-entities through comparing 'uncensored' and 'censored' repertoires in the absence or presence of a disease-relevant autoantigen and (ii) to identify TCR intrinsic features as well as T cell extrinsic determinants that specify clonal deletion versus clonal diversion.
The proposed research elucidates a fundamental aspect of vertebrate immunology, but also has major implications regarding the therapeutic promise of harnessing endogenous, antigen-specific Treg cells in autoimmunity.

Link to the ERC project webpage:

Keywords of the ERC project: Immunology, T cell tolerance, Central tolerance, Regulatory T cells, T cell repertoire

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:
759226	**ANTIViR**	**LS6** Immunity and Infection

Principal Investigator:	**Dr CAROLINE GOUJON**
Host Institution:	INSTITUT NATIONAL DE LA SANTE ET DE LA RECHERCHE MEDICALE - FR

Molecular mechanisms of interferon-induced antiviral restriction and signalling

Interferons (IFNs), which are signalling proteins produced by infected cells, are the first line of defence against viral infections. IFNs induce, in infected and neighbouring cells, the expression of hundreds of IFN-stimulated genes (ISGs). The ISGs in turn induce in cells a potent antiviral state, capable of preventing replication of most viruses, including Human Immunodeficiency Virus type 1 (HIV-1) and influenza A virus (FLUAV). Identifying the antiviral ISGs and understanding their mechanisms of action is therefore crucial to progress in the fight against viruses.

ISGs playing a role in the antiviral state have been identified, such as human MX1, a well-known antiviral factor able to restrict numerous viruses including FLUAV, and MX2, an HIV-1 inhibitor. Both proteins bind to viral components but their detailed mechanisms of action, as well as the consequences of restriction on the activation of the innate immune system, remain unclear. Moreover, our preliminary work shows that additional anti-HIV-1 and anti-FLUAV ISGs remain to identify.

In this context, this proposal seeks an ERC StG funding to explore 3 major aims: 1) unravelling the mechanisms of antiviral action of MX proteins, by taking advantage of their similar structure and engineered chimeric proteins, and by using functional genetic screens to identify their cofactors; 2) investigating the consequences of incoming virus recognition by MX proteins on innate immune signalling, by altering their expression in target cells and measuring the cell response in terms of gene induction and cytokine production; 3) identifying and characterizing new ISGs able to inhibit viral replication with a combination of powerful approaches, including a whole-genome CRISPR/Cas9 knock-out screen.

Overall, this proposal will provide a better understanding of the molecular mechanisms involved in the antiviral effect of IFN, and may guide future efforts to identify novel therapeutic targets against major pathogenic viruses.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: innate immunity, viral sensing, restriction

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
769080	**TCAPS**	**LS6** Immunity and Infection

Principal Investigator:	**Dr VICTORIA COWLING**
Host Institution:	UNIVERSITY OF DUNDEE - UK

mRNA cap regulation and function in CD8 T cells

CD8 T cells are vital for our response to infection, directly killing infected cells and stimulating other cells of the immune system. Major health problems world-wide involve deregulated T cells, including lymphomas, leukaemias, auto-immune disorders and organ transplant rejection. Damaging deficiencies of T cells are found in old-age. T cell development and response to pathogens is driven by regulated transcription and translation, however the mechanisms orchestrating this gene regulation are largely unknown, and are likely provide novel opportunities for therapeutic intervention. Our preliminary data reveals that a potent structure in gene expression, the mRNA cap, which co-ordinates RNA processing and translation initiation, is crucial for the development and activation of CD8 T cells. Regulation of mRNA cap formation is a novel concept in gene regulation in T cells, and also has not been studied in vivo previously. Our findings suggest the existence of an mRNA cap code, in which the different mRNA cap methylations regulate different genes and cellular functions. In TCAPS we will reveal how the mRNA cap code orchestrates CD8 T function. We will determine how the mRNA cap structures are regulated during CD8 T cell differentiation using the latest mass spectrometry technologies. We will determine the role of each mRNA cap methyltransferase in CD8 T cell gene expression during differentiation, using conditional knock-out mice in conjunction with enzyme biochemistry, RNA sequencing and quantitative mass spectrometry. We will determine the biological function of the mRNA cap methyltransferases in CD8 T cell survival and activation using immunological assays. TCAPS will also provide the first insight into the role of the mRNA cap code in vivo. The mRNA cap code is likely to be operational throughout mammalian physiology and therefore TCAPS will contribute significantly to our understanding of regulated gene expression in mammals.

Link to the ERC project webpage: http://www.lifesci.dundee.ac.uk/people/victoria-cowling

Keywords of the ERC project: regulation and function of mRNA cap in T cells

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:
647355	**M-Imm**	**LS6** Immunity and Infection

Principal Investigator:	**Dr SATU MUSTJOKI**
Host Institution:	HELSINGIN YLIOPISTO - FI

Novel etiology of autoimmune disorders: the role of acquired somatic mutations in lymphoid cells

Molecular pathogenesis of most immune-mediated disorders, such as of autoimmune diseases, is poorly understood. These common maladies carry a heavy burden both on patients and on society. Current therapy is non-targeted and results in significant short- and long-term adverse effects.

Large granular lymphocyte (LGL) leukemia is characterized by expansion of cytotoxic T- or NK-cells and represents an intriguing clinical continuum between a neoplastic and an autoimmune disorder. Patients suffer from autoimmune cytopenias and rheumatoid arthritis (RA), which are thought to be mediated by LGL cells targeting host tissues. My group recently discovered that 40-50% of LGL leukemia patients carry in their lymphoid cells acquired, activating mutations in the STAT3 gene – a key regulator of immune and oncogenic processes (Koskela et al, N Engl J Med, 2012). This breakthrough discovery gives insight to the pathogenesis of autoimmune disorders at large.

I present here a hypothesis that a strong antigen-induced proliferation is a mutational driver, which causes somatic mutations in lymphoid cells. When mutations hit key activating pathways, autoreactive cells acquire functional advantage and expand. The target antigen of the expanded clone determines the clinical characteristics of the autoimmune disease induced.

To prove this hypothesis, we will separate small lymphocyte clones from patients with autoimmune diseases and use sensitive next-generation sequencing methods to characterize the spectrum of somatic mutations in lymphoid cells. Further, we will study the function of mutated lymphocytes and examine the mechanisms of autocytotoxicity and end-organ/tissue damage. Finally, we aim to understand factors, which induce somatic mutations in lymphoid cells, such as the role of viral infections.

The results will transform our understanding of molecular pathogenesis of autoimmune diseases and lead to accurate diagnostics and discovery of novel drug targets.

Link to the ERC project webpage: https://www.helsinki.fi/en/researchgroups/hematology-research-unit-helsinki

Keywords of the ERC project: autoimmune disease, somatic mutation, clonal T cell, TCR, rheumatoid arthritis, hematologic, aplastic anemia

Keywords that characterize the scientific profile of the potential visiting researcher/s: immunology, T cell, TCR, bioinformatics, autoantibody

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
638965	**INTESTINANOS**	**LS7** Diagnostic Tools, Therapies and Public Health

Principal Investigator:	**Dr CHRISTEL BERGSTROM**
Host Institution:	UPPSALA UNIVERSITET - SE

Intestinal Lipoidal Nanostructures - A Lipid Bridge to Increased Drug Delivery

My research program explores molecular interplay between drug, dosage form and the complex environment of the gastrointestinal tract (GIT). Drug molecules currently being discovered to cure e.g. CNS diseases, cancer and the metabolic syndrome show poor water solubility and 70-90% of recently discovered drugs have too poor solubility to allow absorption from the GIT. For such compounds the dosage form can significantly improve the absorption. My long-term goal is to establish a computational platform that predicts, from molecular structures and computational tools, the development potential of drug molecules to well-functioning orally administered medicines. A major gap to understand drug performance in the intestine is the poor knowledge of the dynamics of solubilizing lipoidal nanostructures (micelles, vesicles, oil droplets) present in the fluid. This project explores restructuring of these lipid colloids in response to intake of food or dosage forms, enzymatic digestion, absorption and transit along the GIT. Novel experimental tools are developed to reveal the impact of these nanostructures on drug solubilization, supersaturation and likelihood of precipitation in vivo, all being important for drug absorption. The experimental results are fed into in silico models taking use of Molecular Dynamics simulations to develop a computational platform predicting drug performance in the dynamic intestinal milieu. The novel tools designed herein will allow dosage forms that improve performance and increase drug absorption after oral administration to, for the first time, be designed by computational means. The results of this project, in particular the novel in silico tools exploring rearrangement of lipoidal nanostructures, are highly important to related areas such as GIT disease models and food processing but also have wider applications in e.g. studies of intracellular vesicle rearrangements and transport processes in plants.

Link to the ERC project webpage:

Keywords of the ERC project: lipids, dosage form, poorly water-soluble drugs, formulation, virtual intestine, MD simulation

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:
649020	**PAINSTRAT**	**LS7** Diagnostic Tools, Therapies and Public Health

Principal Investigator:	**Dr GIANDOMENICO IANNETTI**
Host Institution:	UNIVERSITY COLLEGE LONDON - UK

Novel neurophysiological techniques to quantify pain and stratify patients

In the last 15 years the advances in understanding the molecular mechanisms of pain have been spectacular. However, despite the >200 genes identified and the dramatic insights on transduction and transmission of nociceptive signals, very little has changed in the diagnosis and treatment of pain, at least in terms of analgesic drugs. Therefore, pain remains a major burden for the society (chronic pain alone costs the EU >€250 bns/yr). The reason is that pain is not a pattern of gene expression, but a state of neuronal activity. Therefore, the translation of mechanistic insights into effective treatments will depend critically on a better understanding of the electrophysiological changes that occur. For this reason, the European Federation of Neurological Society has called for a particular effort to identify reliable laboratory measures of pain, and having an objective biomarker for pain quantification and patient stratification would constitute a major breakthrough in medicine. To date, this need has not been satisfied. The project has two main objectives: (1) Developing neurophysiological biomarkers of pain perception: the main aim being quantification of spontaneous pain for patient management and clinical trials. (2) Developing neurophysiological biomarkers of the susceptibility to develop chronic pain: the main aim being patient stratification, development of prevention strategies, and personalised medicine for pain. We will apply novel analysis techniques to the neurophysiological information obtained using a range of techniques from a large number of healthy volunteers and patients with different types of chronic pain. Importantly, we will longitudinally study patients at high risk of developing chronic pain. We are fully confident that these goals - early diagnosis, identification of high risk patients and facilitating the development of new efficacious treatments through useful clinical trials - will positively impact the well-being of chronic pain patients.

Link to the ERC project webpage: www.iannettilab.net www.iit.it/people/giandomenico-iannetti

Keywords of the ERC project: pain, behavioural neurophysiology, sensorimotor neuroscience, EEG, fMRI

Keywords that characterize the scientific profile of the potential visiting researcher/s: sensorimotor neuroscience, cognitive neuroscience, modelling, peripersonal space

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
649116	**PROGSY**	**LS7** Diagnostic Tools, Therapies and Public Health

Principal Investigator:	**Dr PER SVENNINGSSON**
Host Institution:	KAROLINSKA INSTITUTET - SE

Prosaposin and GPR37 in synucleinopathies

The next breakthrough in the treatment of synucleinopathies, incl Parkinson´s disease (PD), will be aimed at interference of disease progression based on insights into the underlying pathogenic process. The pathological hallmark of PD are Lewy bodies (LBs), in which α-synuclein is the major constituent together with other PD-linked gene products (DJ-1, LRRK2, parkin, and GBA) and aggregated GPR37. GPR37 is exceptional among GPCRs having a high propensity for intracellular receptor accumulation and aggregation leading to neurotoxicity. However, unexpectedly, our results suggest that GPR37 is neuroprotective in dopaminergic when located at the plasma membrane. Consistently, prosaposin (PSAP), and its neurotrophic saposin C-fragment prosaptide, were recently identified as agonists at GPR37. PSAP is a neuroprotective protein that regulates intracellular lysosomal enzyme function, with saposin C being a co-factor of GBA. In addition, we hypothesize that PSAP is secreted following cellular stress and, via membraneous GPR37, cue dopamine neurons to initiate survival pathways. Pivotal to this programme is crystallization and X-ray analysis of the atomic structures of GPR37 in complex with prosaptide, which will grossly facilitate mechanistic understanding and drug development with potential use in diagnosis and treatment. Novel applications and technological advancements of fluorescence correlation spectroscopy will be implemented for matrix detection of single molecule trafficking of GPR37 and will examine whether GPCR multimerization beyond dimer formation may be neurotoxic. Normal and cGPR37KO mice will be virally transduced by α-synuclein to delineate the relative contributions of improved lysosomal function versus GPR37 agonism for neuroprotection by prosaptides. Evolving from the autopsy studies that anti–GPR37 label LBs, we will develop GPR37 ligands as PET tracers for LBs in synucleinopathies.

Link to the ERC project webpage:

Keywords of the ERC project: parkinsons disease, GPCR

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:
671055	**NSETHIO**	**LS7** Diagnostic Tools, Therapies and Public Health

Principal Investigator:	**Dr ROBERT COLEBUNDERS**
Host Institution:	UNIVERSITEIT ANTWERPEN - BE

Nodding Syndrome: a trans-disciplinary approach to identify the cause and decrease the incidence of river epilepsy

Nodding syndrome (NS) is a neurological, incurable syndrome, currently affecting mainly children between 5 and 15 years of age in South Sudan, Uganda and Tanzania. Since 1950, when NS was first described, its cause has remained a mystery. NS is characterized by head-nodding (an atonic form of epilepsy), often followed by clonic - tonic seizures, developmental retardation and faltering growth. In the affected regions, NS is a major public health problem associated with severe socio-economic consequences. After exploratory missions to South Sudan, Uganda and the Democratic Republic of the Congo (DRC), we gathered epidemiological evidence that supports the hypothesis that NS is a disease caused by a pathogen transmitted by blackflies, the vectors that transmit the parasitic worm that causes onchocerciasis. This pathogen could be an unknown neurotropic virus or another pathogen that is transmitted either independently or as a symbiont of the worm. We postulate that this pathogen is able to cause typical NS, but also other forms of epidemic epilepsy. We hypothesise that the same disease is also endemic in other onchocerciasis hyper-endemic regions e.g. in the Mbam valley, Cameroon and the Orientale Province, DRC (where it is referred to as "river epilepsy"). In this project we aim to investigate our hypotheses in South Sudan, Uganda, Tanzania, Cameroon and the DRC with a trans-disciplinary approach including clinical-epidemiological, post-mortem, eco-entomological, and metagenomic studies. We will study the effect of vector control methods and ivermectin distribution on the incidence of river epilepsy. So far a multi-country study on NS was never done and nearly all previous studies were cross-sectional, carried out during short country visits. With this long term research plan we hope to finally discover the cause of NS and detect effective control strategies to decrease the incidence of epilepsy in onchocerciasis endemic areas.

Link to the ERC project webpage: https://www.uantwerpen.be/en/research-groups/global-health-institute/research/research-projects/nsethio-project/

Keywords of the ERC project: onchocerciasis, epilepsy, neglected tropical diseases, public health, disease burden, implementation research, ivermectin, clinical trial

Keywords that characterize the scientific profile of the potential visiting researcher/s: epidemiologist, pathologist, neurologist, entomologist, statistician, social scientist, public health expert, health economist, parasitologist

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
671231	**HEPCIR**	**LS7** Diagnostic Tools, Therapies and Public Health

Principal Investigator:	**Dr THOMAS BAUMERT**
Host Institution:	INSTITUT NATIONAL DE LA SANTE ET DE LA RECHERCHE MEDICALE - FR

Cell circuits as targets and biomarkers for liver disease and cancer prevention

Chronic liver diseases such as liver cirrhosis and hepatocellular carcinoma (HCC) are major challenges for global health. HCC is the second leading and fastest rising cause of cancer death worldwide. The limited availability of therapeutic options reflects our poor understanding of the molecular and clinical mechanisms involved in progression of liver disease. Chronic hepatitis C virus (HCV) infection is a main risk factor for HCC. Although HCC may be avoided by addressing the underlying cause in early stage disease, strategies to prevent HCC in patients with established cirrhosis and advanced fibrosis, in which the risk of HCC persists despite treatment of the underlying cause are lacking. Indeed, even HCV cure does not eliminate the risk of HCC development when advanced fibrosis is already present. Since fibrosis/cirrhosis-driven carcinogenesis is the mechanism of HCC development common to all major etiologies, we propose to use HCV-induced liver disease as a model to decipher the pan-etiology sequence of molecular events underlying disease progression and HCC. Our own data provide solid evidence that HCV infection alters pathways implicated in liver disease progression, including cirrhosis deterioration, HCC development, and overall and liver-specific death. Thus, the molecular investigation of these pathways will identify key cell circuits for the understanding of the pathogenesis of liver disease and HCC in general, and as broadly applicable pan-etiology diagnostic and therapeutic targets. Using a novel patient-derived cell culture model system for liver disease biology combined with advanced functional genomics, novel animal models and clinical investigation, we aim to uncover the cell circuits that are of clinical relevance for liver disease progression and cancer. By providing novel targets and biomarkers for liver disease and HCC prevention, this proposal will have a marked impact on the management and prognosis of patients with liver disease and HCC.

Link to the ERC project webpage: https://www.u1110.inserm.fr/en/content/erc-advanced-grant-hepcir

Keywords of the ERC project: liver disease, hepatocellular carcinoma, genomics, proteomics, mouse model, cell culture, HCV

Keywords that characterize the scientific profile of the potential visiting researcher/s: bioinformatician, computational analyst, single cell RNASeq, hepatocellularcarcinoma

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
677943	**DynaOmics**	**LS7** Diagnostic Tools, Therapies and Public Health

Principal Investigator:	**Dr LAURA ELO-UHLGREN**
Host Institution:	TURUN YLIOPISTO - FI

From longitudinal proteomics to dynamic individualized diagnostics

Longitudinal omics data hold great promise to improve biomarker detection and enable dynamic individualized predictions. Recent technological advances have made proteomics an increasingly attractive option but clinical longitudinal proteomic datasets are still rare and computational tools for their analysis underdeveloped. The objective of this proposal is to create a roadmap to detect clinically feasible protein markers using longitudinal data and effective computational tools. A biomedical focus is on early detection of Type 1 diabetes (T1D). Specific objectives are:

1) Novel biomarker detector using longitudinal data. DynaOmics introduces novel types of multi-level dynamic markers that are undetectable in conventional single-time cross-sectional studies (e.g. within-individual changes in abundance or associations), develops optimization methods for their robust and reproducible detection within and across individuals, and validates their utility in well-defined samples.

2) Individualized disease risk prediction dynamically. DynaOmics develops dynamic individualized predictive models using the multi-level longitudinal proteome features and novel statistical and machine learning methods that have previously not been used in this context, including joint models of longitudinal and time-to-event data, and one-class classification type techniques.

3) Dynamic prediction of T1D. DynaOmics builds a predictive model of dynamic T1D risk to assist early detection of the disease, which is crucial for developing future therapeutic and preventive strategies. T1D typically involves a relatively long symptom-free period before clinical diagnosis but current tools to predict early T1D risk have restricted power.

The objectives involve innovative and unconventional approaches and address major unmet challenges in the field, having high potential to open new avenues for diagnosis and treatment of complex diseases and fundamentally novel insights towards precision medicine.

Link to the ERC project webpage: https://elolab.utu.fi

Keywords of the ERC project: machine learning, computational biomedicine, longitudinal modelling, proteomics, type 1 diabetes

Keywords that characterize the scientific profile of the potential visiting researcher/s: machine learning, computational biomedicine, longitudinal modelling

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
694968	**PREMSOT**	**LS7** Diagnostic Tools, Therapies and Public Health

Principal Investigator:	**Dr VASILIS NTZIACHRISTOS**
Host Institution:	HELMHOLTZ ZENTRUM MUENCHEN DEUTSCHES FORSCHUNGSZENTRUM FUER GESUNDHEIT UND UMWELT GMBH - DE

Precision Multi-Spectral Optoacoustic Tomography for Discovery Diagnosis and Intervention

The 2008 ERC Advanced Grant multispectral optoacoustic tomography (MSOT) yielded a novel modality for post-genomic small animal optical imaging, >110 peer-reviewed publications and several major awards including the 2014 Germany's Innovation award. Since 2011 spin-off iThera Medical GmbH commercialized and placed MSOT systems in European, Asian and North American laboratories, making MSOT an international term. MSOT brought unprecedented optical imaging performance now enabling independent discovery and publications from researchers throughout the world.

Compared to other imaging modalities, MSOT uniquely images tissue oxygenation and other vascular and pathophysiology parameters in label-free and portable mode, using safe non-ionizing energy. Therefore, MSOT can impact real-time interventional guidance and longitudinal vascular diagnostics and enable a next level of discovery based on quantitative observations in humans, within the novel requirements of precision and personalized medicine. PREMSOT considers the next steps in the MSOT development and will ❶ design and develop label-free portable hybrid MSOT and ultrasound imaging (US) for human use, ❷ research novel theory and hardware to address remaining MSOT limitations and improve the sensitivity and quantification accuracy, a necessary step for improving MSOT precision, ❸ i) validate quantitative MSOT imaging of tissue oxygenation and hypoxia, (micro)-vascular morphology and function, ii) research label-free imaging of inflammation and metabolism and iii) relate MSOT contrast to tissue and disease pathophysiology metrics and ❹ introduce label-free MSOT/US to discovery and clinical care. MSOT contrast features will be investigated as biomarkers in vascular medicine and surgery and in exploratory measurements within neurology, ambulatory/bedside care or sepsis, addressing unmet discovery and clinical needs.

Link to the ERC project webpage: https://cordis.europa.eu/project/rcn/206906_de.html

Keywords of the ERC project: Optoacoustics, imaging, MSOT, label-free, non-invasive imaging

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:
725229	**EVICARE**	**LS7** Diagnostic Tools, Therapies and Public Health

Principal Investigator:	**Dr JOOST SLUIJTER**
Host Institution:	UNIVERSITAIR MEDISCH CENTRUM UTRECHT - NL

Extracellular Vesicle-Inspired CArdiac Repair

More than 3.5 million people are newly diagnosed with heart failure every year in Europe with a long-term prognosis of 50% mortality within 4 years. There is a major need for more innovative, regenerative therapies that have the potential to change the course of disease. My hypothesis is that we can recondition heart failure by stimulating cardiac repair with extracellular vesicles that are derived from progenitor cells. In my laboratory, extracellular released vesicles containing a cocktail of stimulating factors, are amongst the most potent vectors for cardiac repair.

To achieve a sustainable and long-term therapeutic effect of these vesicles and enhance cardiac function by stimulating myocardial repair, we will 1) improve local cardiac delivery of progenitor cell-derived extracellular vesicles, 2) understand the mechanism of action of extracellular vesicles, and 3) stimulate extracellular vesicles release and/or production by progenitor cells.

These questions form the rationale for the current proposal in which we will co-inject extracellular vesicles and slow-release biomaterials into the damaged myocardium. By subsequent genetic tracing, we will determine fate mapping of injected vesicles in vivo, and perform further mechanistic understanding in in vitro culture models of targeted and identified myocardial cell types. Moreover, we will upscale the vesicles production by progenitor cells further via bioreactor culturing and medium-throughput screening on factors that stimulate vesicles release.

The use of stem cell-derived extracellular vesicles to stimulate cardiac repair will potentially allow for an off-the shelf approach, including mechanistic understanding and future clinical use. Additionally, since these vesicles act as a natural carrier system outperforming current artificial drug delivery, we might understand and mimic their characteristics to enhance local (RNA-based) drug delivery systems for cardiovascular application.

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:
725840	**PAINTBOX**	**LS7** Diagnostic Tools, Therapies and Public Health

Principal Investigator:	**Dr CHARLOTTE LING**
Host Institution:	LUNDS UNIVERSITET - SE

Pancreatic islet dysfunction and type 2 diabetes – beyond the genome

The prevalence of type 2 diabetes (T2D) is rapidly increasing worldwide and despite great efforts to prevent and cure the disease, the increase persist. There is an urgent need to develop innovative and effective prevention and treatment strategies for T2D.

Recent genome-wide association studies were expected to uncover disease-causing mechanisms in common metabolic disorders. Surprisingly, the identified genetic variants only explain a small proportion of the estimated heritability of T2D. Novel studies, going beyond the genome, are therefore needed to identify key mechanisms causing T2D. These studies should focus on pancreatic islets, the tissue of primary pathogenetic importance for diabetes. Also, mechanisms that allow environmental factors to come into play are likely to be important. Epigenetics fulfill such criteria, and our previous work has pioneered epigenetic discoveries in T2D.

PAINTBOX is a multidisciplinary research program through which I will combine advanced sequencing technologies and novel epigenetic methods with mathematical models and clinical medicine to develop new prediction and treatment strategies for T2D. Innovative techniques and access to some of the world´s best patient cohorts permit me to address the role of epigenetics in development of T2D in new ways. The annotation of these discoveries will be done using genome-wide epigenomic and targeted gene-editing tools together with mathematics, whereas the translation of those findings will be achieved using powerful prospective cohorts for T2D and clinical studies.

PAINTBOX capitalizes on the largest existing human islet cohort and large prospective cohorts, and expertise that I have built-up over the past twenty years, but also exploits novel epi-genomic and gene-editing technologies that have not previously been used for T2D. I expect this novel interdisciplinary project to generate groundbreaking results that opens up new horizons for prediction, prevention and treatment of T2D.

Link to the ERC project webpage:

Keywords of the ERC project: epigenetics, type 2 diabetes, pancreatic islets, insulin secretion

Keywords that characterize the scientific profile of the potential visiting researcher/s: epigenetics, type 2 diabetes, pancreatic islets, insulin secretion, bioinformatics, multiomics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
758813	**MHINT**	**LS7** Diagnostic Tools, Therapies and Public Health

Principal Investigator:	**Dr REBECCA PEARSON**
Host Institution:	UNIVERSITY OF BRISTOL - UK

Genetic, behavioural and cognitive mechanisms underpinning the association between mother and offspring mental health problems: mental (M) health (H) intergenerational transmission (INT) - (MHINT)

Despite decades of research, and the introduction of parenting interventions, children of mentally ill mothers remain substantially more likely to have mental health problems themselves. I propose to shed new light on why mental health problems in a mother are passed on to her child, and help break this reinforcing cycle of mental health risk across generations. In order to harness the potential of modifying parenting for the prevention of child mental health risk, I will study parenting using more detailed, ecologically valid and genetically sensitive designs than have been done before.

Objectives:

1: To investigate the respective role of genetic and environmental (chiefly parenting) mechanisms in explaining associations between mother and child mental health. HOW: using a consortium of international cohorts with intergenerational genetic and phenotypic data (n>10,000) and, for the first time, modeling genetic risk which is and is not transmitted from mother to child to test alternative hypotheses.

2: To identify behavioural manifestation of maternal mental health, in observed mother-infant interaction, in an ecologically valid way. HOW: recording 300 mother- child dyads at home, using novel wearable cameras, in the next generation of a key cohort (ALSPAC-G2).

3: To identify cognitive underpinnings of maternal behaviour. HOW: including cognitive tasks (with eye tracking) as new measures in ALSPAC-G2, applying computational models to cognitive and (uniquely) real life data (measured in 2).

4: To establish whether modification of maternal parenting (highlighted in 1-3), changes child mental health. HOW: systematic review of parenting intervention trials and new synthesis methods to extract which intervention components reduce child mental health problems.

My study will provide critical new evidence regarding the nature of parenting interventions that have potential to improve child mental health and break intergenerational transmission of mental health problems.

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:
759585	**ToMeTuM**	**LS7** Diagnostic Tools, Therapies and Public Health

Principal Investigator:	**Dr VOJTECH ADAM**
Host Institution:	VYSOKE UCENI TECHNICKE V BRNE - CZ

Towards the Understanding a Metal-Tumour-Metabolism

A tumour cell uses both genetic and protein weapons in its development. Gaining a greater understanding of these lethal mechanisms is a key step towards developing novel and more effective treatments. Because the metal ion metabolism of a tumour cell is not fully understood, we will address the challenge of explaining the mechanisms of how a tumour cell copes both with essential metal ions and platinum based drugs. The metal-based mechanisms help a tumour to grow on one side and to protect itself against commonly used metal-based drugs. On the other side, the exact description of these mechanisms, which are being associated with multi-drug resistance occurrence and failure of a treatment, still remains unclear. We will reveal the mechanism of the as yet not understood biochemical and molecularly-biological relationships and correlations between metal ions and proteins in a tumour development revealing the way how to suppress the growth and development of a tumour and to markedly enhance the effectiveness of a treatment.
To achieve this goal, we will focus on metallothionein and its interactions with essential metals and metal-containing anticancer drugs (cisplatin, carboplatin, and oxaliplatin). Their actions will be monitored both in vitro and in vivo. For this purpose, we will optimize electrochemical, mass spectrometric and immune-based methods. Based on processing of data obtained, new carcinogenetic pathways will be sought on cell level and proved by genetic modifications of target genes. The discovered processes and the pathways found will then be tested on two animal experimental models mice bearing breast tumours (MCF-7 and 4T1) and MeLiM minipigs bearing melanomas.
The precise description of the tumour related pathways coping with metal ions based on metallothioneins will direct new highly effective treatment strategies. Moreover, the discovery of new carcinogenetic pathways will open a window for understanding of cancer formation and development.

Link to the ERC project webpage:

Keywords of the ERC project: metallothionein, cancer, treatment, resistance, bioanalytical chemistry, nanomaterials, advanced genome editing

Keywords that characterize the scientific profile of the potential visiting researcher/s: molecular biology, tumour diseases, prostate cancer, genome editing

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
639377	**DrugsInPregnancy**	**LS7** Diagnostic Tools, Therapies and Public Health

Principal Investigator:	**Dr HEDVIG NORDENG**
Host Institution:	UNIVERSITETET I OSLO - NO

Effects of Medication Use in Pregnancy on Infant Neurodevelopment

Currently, thousands of pregnant women in the EU and worldwide are being increasingly prescribed medications for which we do not have sufficient information on fetal safety. I hypothesize that our current understanding of safety pharmacology is oversimplified and that medication prescribed during pregnancy may play an unrecognized role in the development of neurodevelopmental disorders.
In this research proposal we have the unique opportunity to use a large population-based birth cohort including over 100 000 mother-child pairs and biological data to study how medications may act on the offspring. This offers novel and innovative pharmaceutical insight into the safety of medications.
By linking several nationwide registries (National Prescription Data Base, Norwegian Patient Registry, Medical Birth Registry) to a population-based birth cohort (n=108 000) we specifically aim to 1) estimate the effect of prenatal exposure to psychotropics and analgesics on neurodevelopment in young children using a range of methodological approaches to strengthen causal inference.
With these data made available, we will 2) determine whether fetal exposure to specific medications results in epigenetic events (i.e. changes in DNA methylation) in the child, and 3) determine whether such changes increase the risks of neurodevelopmental disorders in childhood.
The recent availability of large scale human data, possibility of register linkages and genome-wide mapping of DNA methylation at affordable costs makes this research proposal now possible. The size and richness of data including over hundred thousand pregnancies and existence of biological material makes this project unique. The final outcome will be fundamentally new knowledge about how medications affect the developing unborn child and will open up new horizons and opportunities for future research in a new field of "pharmaco-epigenetics" and enhance our understanding of origins of neurodevelopmental disorders.

Link to the ERC project webpage: www.mn.uio.no/farmasi/english/research/projects/drug-in-pregnancy/

Keywords of the ERC project: pharmacoepidemiology, medication safety, pregnancy, child neurodevelopment

Keywords that characterize the scientific profile of the potential visiting researcher/s: causal inference, pharmacoepidemiology, medication safety

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
677661	**ProFatMRI**	**LS7** Diagnostic Tools, Therapies and Public Health

Principal Investigator:	**Dr DIMITRIOS KARAMPINOS**
Host Institution:	KLINIKUM RECHTS DER ISAR DER TECHNISCHEN UNIVERSITAT MUNCHEN - DE

Magnetic resonance imaging platform for probing fat microstructure

Metabolic syndrome and osteoporosis are the two metabolic diseases with the highest and most rapidly growing prevalence, transforming them into a major global health and socioeconomic concern. Metabolic syndrome can be diagnosed with established biomarkers, but the selection of optimal prevention strategies for each individual patient is still problematic. Osteoporosis can be treated, but its current early diagnosis remains insufficient. The two diseases have been linked through the role of fat. Fat is central to their incidence and progression, and the probing of fat cellular properties can provide groundbreaking solutions for overcoming the existing challenges in the diseases early diagnosis and prevention.

In metabolic syndrome, there is evidence supporting a role of brown fat in preventing the disease. Brown fat has different microstructure than white fat. However, there is no established non-invasive biomarker to measure brown fat. In osteoporosis, there is evidence supporting a role of marrow fat, in combination with bone mineral density, for monitoring fracture risk. However, there is no non-invasive biomarker to measure marrow fat cellular changes in osteoporosis.

Magnetic resonance imaging (MRI) is the ideal modality for non-invasively measuring fat throughout the body. In order to differentiate brown from white fat and characterize the relationship between bone mineral and marrow fat cells, the employed MR methodology needs a technical breakthrough, shifting from the state-of-the-art water-centered paradigm to a fat-centered microstructural MRI paradigm. ProFatMRI describes an innovative research program that aims to develop and ex vivo validate diffusion and susceptibility MRI biomarkers of fat microstructure, and in vivo apply them at clinical MRI systems.

The resulting technologies will provide novel ways for selecting optimal individualized prevention strategies in metabolic syndrome and for achieving reliable risk fracture prediction in osteoporosis.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: Magnetic Resonance Imaging methods development and applications

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
677772	**RespMicroFlows**	**LS7** Diagnostic Tools, Therapies and Public Health

Principal Investigator:	**Dr JOSUE SZNITMAN**
Host Institution:	TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY - IL

Unravelling respiratory microflows in silico and in vitro: novel paths for targeted pulmonary delivery in infants and young children

Fundamental research on respiratory transport phenomena, quantifying momentum and mass transfer in the lung depths, is overwhelmingly focused on adults. Yet, children are not just miniature adults; their distinct lung structures and heterogeneous ventilation patterns set them aside from their parents. In RespMicroFlows, we will break this cycle and unravel the complex microflows characterizing alveolar airflows in the developing pulmonary acini. Our discoveries will foster ground-breaking transport strategies to tackle two urgent clinical needs that burden infants and young children. The first challenge relates to radically enhancing the delivery and deposition of therapeutics using inhalation aerosols; the second involves targeting liquid bolus installations in deep airways for surfactant replacement therapy.
By developing advanced in silico numerical simulations together with microfluidic in vitro platforms mimicking the pulmonary acinar environment, our efforts will not only deliver a gateway to reliably assess the outcomes of inhaling aerosols and predict deposition patterns in young populations, we will furthermore unravel the fundamentals of liquid bolus transport to achieve optimal surfactant delivery strategies in premature neonates. By recreating cellular alveolar environments that capture underlying physiological functions, our advanced acinus-on-chips will deliver both at true scale and in real time the first robust and reliable in vitro screening platforms of exogenous therapeutic materials in the context of inhaled aerosols and surfactant-laden installations. Combining advanced engineering-driven flow visualization solutions with strong foundations in transport phenomena, fluid dynamics and respiratory physiology, RespMicroFlows will pave the way to a new and unprecedented level in our understanding and quantitative mapping of respiratory flow phenomena and act as catalyst for novel targeted pulmonary drug delivery strategies in young children.

Link to the ERC project webpage: https://biofluids.technion.ac.il/erc/

Keywords of the ERC project: biomedical engineering, pulmonary therapy, drug delivery

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:
724872	**CellTrack**	**LS7** Diagnostic Tools, Therapies and Public Health

Principal Investigator:	**Dr BJÖRN HÖGBERG**
Host Institution:	KAROLINSKA INSTITUTET - SE

Cellular Position Tracking Using DNA Origami Barcodes

The research I propose here will provide an enabling technology; spatially resolved transcriptomics, to address important problems in cell- and developmental-biology, in particular: How are stem cells in the skin and gut proliferating without turning into cancers? How are differentiated cells related, in their transcriptome and spatial positions, to their progenitors?
To investigate these problems on a molecular level and open up paths to find completely new spatiotemporal interdependencies in complex biological systems, I propose to use our newly developed DNA-origami strategy (Benson et al, Nature, 523 p. 441 (2015)), combined with a combinatorial cloning technique, to build a new method for deep mRNA sequencing of tissue with single-cell resolution. These new types of origami are stable in physiological salt conditions and opens up their use in in-vivo applications.
In DNA-origami we can control the exact spatial position of all nucleotides. By folding the scaffold to display sequences for hybridization of fluorophores conjugated to DNA, we can create optical nano-barcodes. By using structures made out of DNA, the patterns of the optical barcodes will be readable both by imaging and by sequencing, thus enabling the creation of a mapping between cell locations in an organ and the mRNA expression of those cells.
We will use the method to perform spatially resolved transcriptomics in small organs: the mouse hair follicle, and small intestine crypt, and also perform the procedure for multiple samples collected at different time points. This will enable a high-dimensional data analysis that most likely will expose previously unknown dependencies that would provide completely new knowledge about how these biological systems work. By studying these systems, we will uncover much more information on how stem cells contribute to regeneration, the issue of de-differentiation that is a common theme in these organs and the effect this might have on the origin of cancer.

Link to the ERC project webpage: www.hogberglab.net

Keywords of the ERC project: DNA nanotechnology, transcriptomics, microscopy

Keywords that characterize the scientific profile of the potential visiting researcher/s: computer science, physics, biology

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
757398	**NANONC**	**LS7** Diagnostic Tools, Therapies and Public Health

Principal Investigator:	**Dr STEFAAN SOENEN**
Host Institution:	KATHOLIEKE UNIVERSITEIT LEUVEN - BE

Nanomaterials in Oncology: Exploiting the Intrinsic Cancer-Specific Toxicity of Nanoparticles.

In our current society, therapeutic strategies against cancer suffer from dose-limiting toxicity, lack of specificity and high morbidity. To overcome this, the use of nanomaterials (NMs) is rising, where several NM formulations are undergoing clinical trials or are used in clinics where the NMs are used as drug delivery vehicles or as mediators in physical anticancer methods (e.g. hyperthermia), where to date, the success rate is limited due to low tumor targeting efficacy, lack of specificity and frequent re-use of classical toxicity mechanisms.
To overcome these issues, this research program aims to exploit the intrinsic toxicity of certain types of metal-based, degradation-prone NMs (Fe-doped ZnO, Fe-doped CuO and Ag of different sizes and coatings) towards only cancer cells as a novel and generic anti-cancer tool with 1) improved efficacy against difficult to treat cancers such as multidrug-resistant cancer cells, 2) enhanced specificity and selectivity of the treatment by the intrinsic cancer cell-specific toxicity of NMs towards cancer cells. To overcome the issues related to selective delivery of the NMs, tumor-homing cells will be used that have been shown to efficiently home to primary tumors and their metastases. In practice, the NMs used show distinct degradation kinetics that primarily induce cancer-selective toxicity. To obtain efficient tumor targeting, suicide gene-expressing tumor-homing cells will be loaded with the NMs in their cytoplasm, hereby impeding premature NM degradation. The tumor homing efficacy of these cells will be monitored via optical imaging and once at the target site these cells will be chemically destroyed using the suicide gene strategy. This will release the NMs into the tumor site, where they can selectively destroy the cancer cells. This research program will be the first to explore the full potential of cancer-specific toxicity of NMs and the use of cytoplasmic loading of cells as biological carriers for efficient delivery.

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

Keywords of the ERC project: nanomedicine, oncology, optical imaging

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:
647787	**LocalAdaptation**	**LS8** Evolutionary, Population and Environmental Biology

Principal Investigator:	**Dr ANDREA MANICA**
Host Institution:	THE CHANCELLOR MASTERS AND SCHOLARS OF THE UNIVERSITY OF CAMBRIDGE - UK

Detecting Local Adaptation with Climate-Informed Spatial Genetic Models

Local adaptation, whereby individuals of a population exhibit higher fitness in their local environment compared to that experienced by other populations, has the potential to shape the distribution of genetic diversity and influence speciation. However, detecting and quantifying the extent of local adaptation is challenging, since neutral demographic processes can leave signatures which are hard to distinguish from those of local selection. In this project, I propose to quantify the extent of local adaptation in Anatomically Modern Humans by using climate-informed spatial genetic models (CISGeM) to reconstruct past population sizes, local movements, and range expansions, and thus provide a null model against which the signature of geographically-localised selection can be detected.

In CISGeM, demography is affected by local resource availability, which in turn is defined by paleoclimate and paleovegetation reconstructions. By using these additional lines of evidence, it is possible to generate accurate demographic reconstructions for any number of populations, as well as integrating information from both modern and ancient genomes. Such spatially-explicit reconstructions are key for defining the expected neutral patterns due to complex demography, and thus allow us to isolate the signals of selection from this noisy background with high fidelity. The availability of paleoclimate reconstructions also enables formally testing hypotheses about the drivers of selection, integrating the changes in the strength of selection through space and time.

While this project will be focused on Anatomically Modern Humans, the framework that I will develop will be applicable to the investigation of local adaptation from genomic data in any species. Such tools are very timely, given the ever-increasing availability of large genetic datasets thanks to the decreasing cost of genotyping and sequencing in both model and non-model organisms.

Link to the ERC project webpage:

Keywords of the ERC project: paleoclimate, human genetics

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:
648861	**EVOMESODERM**	**LS8** Evolutionary, Population and Environmental Biology

Principal Investigator:	**Dr ANDREAS HEJNOL**
Host Institution:	UNIVERSITETET I BERGEN - NO

The evolution of mesoderm and its differentiation into cell types and organ systems

Mesoderm, the embryonic germ layer between ectoderm and endoderm, gives rise to major organs within the circulatory and excretory systems and to stabilizing tissues (muscles, bones, connective tissue). Although mesoderm is a key-innovation in evolutionary history, its origin and further diversification into the different organs and cell types of a broad range of animals has not been elucidated. Our knowledge of mesoderm development is mainly based on work performed in prominent model systems including vertebrates (fish, frog and mouse) and invertebrates that are distantly-related and considered to be highly derived (Drosophila and C. elegans). The project proposed herein aims to study mesoderm development in a variety of highly informative animal taxa and trace its differentiation into cell types and organs, with the ultimate aim of reconstructing the history of mesoderm during animal evolution. Our approach combines advanced bioinformatics, live-imaging and molecular methods, and will be carried out in nine representative species belonging to under-investigated animal phyla. We will describe the morphological and molecular development of mesoderm in these species, and the differentiation of two important mesodermal cell types: nephridia and blood. Using this information we will be able to infer the embryology and mesodermal cell type composition of ancestors at six important nodes in the animal tree of life. We will also be able to comprehend when shifts in mesoderm development have occurred and how these shifts have remodeled the animal body plans. Further, our implementation of advanced methods in under-studied species will provide new model systems and a more comprehensive framework for further studies in evolutionary developmental biology as well as in other research fields.

Link to the ERC project webpage:

Keywords of the ERC project: mesoderm, developmental biology, genomics, evolution

Keywords that characterize the scientific profile of the potential visiting researcher/s: development, evolution, zoology, phylogeny

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
666971	**BIOSTASES**	**LS8** Evolutionary, Population and Environmental Biology

Principal Investigator:	**Dr MICHEL LOREAU**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FR

BIOdiversity, STAbility and sustainability in Spatial Ecological and social-ecological Systems

Biodiversity loss is one of the greatest environmental challenges of our time. There is mounting evidence that biodiversity increases the stability of ecosystem functions and services, suggesting that it may be critical to the sustainability of ecosystems and human societies in the face of environmental changes. Classical ecological theory, however, has focused on measures of stability that cannot explain and predict these stabilizing effects, especially in spatial systems.

The goal of BIOSTASES is to develop a coherent body of new theory on the stability of ecosystems and coupled social–ecological systems and its relationships with biodiversity at multiple spatial scales that can better inform empirical research. BIOSTASES will reach this goal through four complementary objectives. First, it will propose a mathematical framework focused on temporal variability as an empirically relevant measure of stability, and use this framework to build robust early warning signals for critical transitions. Second, it will use dynamical metacommunity models to explore a wide range of novel questions related to ecosystem stability and diversity–stability relationships across scales. Third, it will study the stability of complex meta-ecosystems to provide new perspectives on the stability of food webs and on synergies and trade-offs between multiple ecosystem services across space. Fourth, it will develop novel theory to study the long-term dynamics and sustainability of coupled social–ecological systems.

BIOSTASES proposes an ambitious innovative research programme that will provide new perspectives on the stability and sustainability of ecological and coupled social–ecological systems in the face of environmental changes. It will contribute to bridging the gaps between theoretical and empirical ecology and between ecology and social sciences, and to developing new approaches in biodiversity conservation, landscape management, and sustainable development.

Link to the ERC project webpage: http://www.cbtm-moulis.com/m-214-biostases.html

Keywords of the ERC project: Theoretical ecology, Biodiversity, Ecosystems, Human-nature interactions, Stability, Sustainability, Spatial ecology,

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:
677232	**ECOWORM**	**LS8** Evolutionary, Population and Environmental Biology

Principal Investigator:	**Dr NICO EISENHAUER**
Host Institution:	UNIVERSITAET LEIPZIG - DE

ECOSYSTEM RESPONSES TO EXOTIC EARTHWORM INVASION IN NORTHERN NORTH AMERICAN FORESTS

Earth is experiencing substantial biodiversity losses at the global scale, while both species gains and losses are occurring locally and regionally. Nonrandom changes in species distributions could profoundly influence ecosystem functions and services. However, few experimental tests have examined the influences of invasive ecosystem engineers, which can have disproportionally strong impacts on native ecosystems. Invasive earthworms are a prime example of ecosystem engineers that influence many ecosystems around the world. In particular, European earthworms invading northern North American forests may cause simultaneous species gains and losses with significant consequences for essential ecosystem processes like nutrient cycling and crucial services like carbon sequestration. Using a synthetic combination of field observations, field experiments, lab experiments, and meta-analyses, the proposed work will be the first systematic examination of earthworm effects on relationships between plant communities, soil food webs, and ecosystem processes. Further, effects of a changing climate on the spread and consequences of earthworm invasion will be investigated. Meta-analyses will be used to test if earthworms cause invasion waves, invasion meltdowns, habitat homogenization, and ecosystem state shifts. Global data will be synthesized to test if the relative magnitude of effects differ from place to place depending on the functional dissimilarity between native soil fauna and exotic earthworms. Moving from local to global scale, the present proposal examines the influence of earthworm invasions on biodiversity–ecosystem functioning relationships from an aboveground–belowground perspective. This approach is highly innovative as it utilizes exotic earthworms as an exciting model system that links invasion biology with trait-based community ecology, global change research, and ecosystem ecology, pioneering a new generation of biodiversity–ecosystem function research.

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:
693030	**BARRIERS**	**LS8** Evolutionary, Population and Environmental Biology

Principal Investigator:	**Dr ROGER BUTLIN**
Host Institution:	THE UNIVERSITY OF SHEFFIELD - UK

The evolution of barriers to gene exchange

Speciation is a central process in evolution that involves the origin of barriers to gene flow between populations. Species are typically isolated by several barriers and assembly of multiple barriers separating the same populations seems to be critical to the evolution of strong reproductive isolation. Barriers resulting from direct selection can become coincident through a process of coupling while reinforcement can add barrier traits that are not under direct selection. In the presence of gene flow, these processes are opposed by recombination. While recent research using the latest sequencing technologies has provided much increased knowledge of patterns of differentiation and the genetic basis of local adaptation, it has so far added little to understanding of the coupling and reinforcement processes.

In this project, I will focus on the accumulation of barriers to gene exchange and the processes underlying increasing reproductive isolation. I will use the power of natural contact zones, combined with novel manipulative experiments, to separate the processes that underlie patterns of differentiation and introgression. The Littorina saxatilis model system allows me to do this with both local replication and a contrast between distinct spatial contexts on a larger geographic scale. I will use modelling to determine how processes interact and to investigate the conditions most likely to promote coupling and reinforcement. Overall, the project will provide major new insights into the speciation process, particularly revealing the requirements for progress towards complete reproductive isolation.

Link to the ERC project webpage:

Keywords of the ERC project: speciation

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

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
694368	**Gradual_Change**	**LS8** Evolutionary, Population and Environmental Biology

Principal Investigator:	**Dr MATTHIAS RILLIG**
Host Institution:	FREIE UNIVERSITAET BERLIN - DE

Gradual and abrupt environmental change: connecting physiology, evolution and community composition

A major goal in ecology is to predict how environmental changes, including drivers of global change, affect communities and ecosystem functioning, with society demanding answers to these pressing questions. A key limitation of virtually all experimental approaches addressing such questions is that treatments are delivered abruptly, while many changes occurring in nature are gradual. Here I propose to comprehensively study consequences of environmental change when delivered abruptly vs. gradually. In order to understand and model effects of gradual vs. abrupt changes, we need to simultaneously consider physiological effects (e.g. acclimation), evolutionary changes (e.g. adaptation) and changes in community composition and functioning. Even though changes at these levels likely interact, there is no study in which physiology, evolutionary changes and community shifts have been studied in response to a changing environmental factor. This research program thus enters unchartered territory of empirical environmental research in proposing work at this nexus of physiology, environmental change and community composition/ function. I focus on soil fungi, key players in terrestrial ecosystems, testing a range of gradually vs. abruptly changing environmental factors, in a range of soils, in the field and in microcosms. We connect differential responses to species traits, apply modeling and employ data syntheses across all biomes and organisms to achieve high external validity. We carry out a set of core experiments that will afford unprecedented insight into the nature of change in a community context in response to warming, focusing on soil fungi. In these we follow evolutionary change (phenotype and genotype), test physiological shifts by re-isolation of fungi and monitor community changes. This work will have transformative character in providing not only new mechanistic insights into effects of environmental change, but will also represent a step change in fungal ecology.

Link to the ERC project webpage:

Keywords of the ERC project: ecology; soil; fungi; global change; evolution

Keywords that characterize the scientific profile of the potential visiting researcher/s: ecology; soil; fungi; global change; evolution

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
714916	**LEAF-FALL**	**LS8** Evolutionary, Population and Environmental Biology

Principal Investigator:	**Dr MATTEO CAMPIOLI**
Host Institution:	UNIVERSITEIT ANTWERPEN - BE

What makes leaves fall in autumn? A new process description for the timing of leaf senescence in temperate and boreal trees

Leaf phenology is a key component in the functioning of temperate and boreal deciduous forests. The environmental cues for bud-burst in spring are well known, but little is known about the cues controlling the timing of leaf fall in autumn. Leaf fall is the last stage of leaf senescence, a process which allows trees to recover leaf nutrients. We urgently need to understand the controls timing leaf senescence to improve our projections of forest growth and climate change. I propose a new general paradigm of the onset of leaf senescence, hypothesizing that leaf senescence is triggered by the cessation of tree growth in autumn. I expect that: (i) in the absence of growth-limiting environmental conditions, tree growth cessation directly controls leaf-senescence onset; and (ii) in the presence of growth-limiting conditions, photoperiod controls leaf-senescence onset – this prevents trees from starting to senesce too early. I will test these hypotheses with a combination of: (i) manipulative experiments on young trees - these will disentangle the impact of photoperiod from that of other factors affecting tree growth cessation, namely: temperature, drought and soil nutrient availability; (ii) monitoring leaf senescence and growth in mature forest stands; (iii) comparing the leaf senescence dynamics of four major tree species (Fagus sylvatica, Quercus robur, Betula pendula and Populus tremula) in four European locations spanning from 40º to 70º N; and (iv) integrating the new paradigm into a model of forest ecosystem dynamics and testing it for the major forested areas of Europe. The aim is to solve the conundrum of the timing of leaf senescence in temperate and boreal deciduous trees, provide a new interpretation of the relationship between leaf senescence, tree growth and environment, and deliver a modelling tool able to predict leaf senescence and tree growth, for projections of forest biomass production and climate change.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: post-doc (particularly with interest in modelling and meta-analyses)

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
725848	**CORALASSIST**	**LS8** Evolutionary, Population and Environmental Biology

Principal Investigator:	**Dr JAMES GUEST**
Host Institution:	UNIVERSITY OF NEWCASTLE UPON TYNE - UK

Assisting Coral Reef Survival in the Face of Climate Change

CORALASSIST spans the disciplines of evolutionary biology, restoration ecology and proteomics and examines the role assisted gene flow (AGF) can play in sustaining biodiversity and ecosystem services in the face of climate change. AGF involves the deliberate movement of individuals or gametes within their natural range to facilitate adaptation to environmental change. Corals reefs provide an excellent model for testing AGF as a conservation tool because reef building corals are foundation species and are highly vulnerable to thermal stress. Selective breeding and translocation of thermotolerant individuals may lead to reductions in recipient population fitness due to resource trade-offs with other fitness traits, such as growth and fecundity. The overall aim of CORALASSIST is to establish the feasibility of implementing AGF in coral reef ecosystems using a combination of selective breeding, proteomics and innovative translocation techniques. CORALASSIST will address four primary questions: 1) Are there resource trade-offs between increased thermotolerance and other fitness traits in corals? 2) Which physiological and proteomic traits correlate with increased individual thermotolerance in corals? 3) Are phenotypic traits for thermotolerance heritable? 4) Can AGF and selective breeding lead to persistent shifts in thermotolerance in recipient populations? Phenotypic traits will be measured in permanently tagged individuals within selected coral populations to examine the relationships between thermotolerance and key fitness attributes. For the first time, state of the art proteomic approaches will be used to elucidate the physiological basis for increased levels of thermotolerance in corals. Innovative translocation methods will be used in tandem with selective breeding techniques to carry out the first long term assessment of heritability of thermotolerance and to test the feasibility of large scale AGF to assist conservation of coral reef ecosystems.

Link to the ERC project webpage: https://www.coralassistlab.org/

Keywords of the ERC project: coral reefs, climate change, ecological restoration, assisted gene flow, proteomics

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:
742312	**MATURATION**	**LS8** Evolutionary, Population and Environmental Biology

Principal Investigator:	**Dr CRAIG PRIMMER**
Host Institution:	HELSINGIN YLIOPISTO - FI

Age at maturity in Atlantic salmon: molecular and ecological dissection of an adaptive trait

Life history is the nexus of biology, because various biological questions ultimately revolve around the causes and consequences of variation in reproduction and survival, i.e. fitness. Traditionally, a major tool in life-history research has been quantitative genetics because it provides an important statistical link between phenotype and genotype. However, the mechanisms by which evolution occurs may remain unclear unless such traditional approaches are combined with molecular investigations. Another complicating factor is that the fitness of male vs female life histories do not always align, and hence life history traits may be shaped by sexual conflict. This is why life-history approaches focusing on both quantifying the conflict and understanding its resolution at the genetic level are needed.

As in many species, age at maturity in Atlantic salmon is tightly linked with size at maturity and thus represents a classic evolutionary trade-off: later maturing individuals spend more time at sea before returning to freshwater to spawn and have higher reproductive success due to their larger size but also have a higher risk of dying prior to first reproduction. Our recent cover paper in Nature reported a large-effect gene explaining 40% of the variation in this key life history trait. Remarkably, the locus exhibits sex-dependent dominance and this resolves a potential intra-locus sexual conflict in the species. The relatively simple genetic architecture of this trait combined with the features of Atlantic salmon as a model system offer an ideal opportunity to better understand the molecular mechanisms and ecological drivers underlying a locally adapted life history trait.

In MATURATION I will i) characterize age at maturity candidate gene functions and allelic effects on phenotypes ii) elucidate fitness effects of these phenotypes and GxE interactions iii) develop a mechanistic model for the sex-dependent dominance and validate intra-locus sexual conflict resolution

---

Link to the ERC project webpage: http://www.helsinki.fi/evolution-conservation-and-genomics

Keywords of the ERC project: evolutionary genomics, ecological genetics, population genetics, functional genomics, sexual conflict, Atlantic salmon

Keywords that characterize the scientific profile of the potential visiting researcher/s: population genomics, functional genomics, sexual conflict, sexual selection

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
757688	**HIV ECLIPSE**	**LS8** Evolutionary, Population and Environmental Biology

Principal Investigator:	**Dr KATHERINE ATKINS**
Host Institution:	LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE - UK

HIV-1 acquisition and the future of prevention strategies: deciphering the eclipse phase through modelling and phylogenetics

The HIV eclipse phase typically refers to the time between a virus entering a sexually exposed person and detection of viral RNA in their plasma. Of the four phases of HIV-1 infection (eclipse, acute, chronic and AIDS), the eclipse phase is currently the only window of opportunity for viral clearance. Systemic infection is currently irreversible after the onset of the acute phase. Preventing systemic HIV infection after exposure, therefore, requires understanding and targeting the eclipse phase. Information on this phase, however, is partial and indirect, with fundamental gaps in our knowledge of its role in limiting transmission, in determining the efficacy of infection control strategies, and in governing later infection.

Mathematical modelling, when combined with statistical inference, is a useful tool for hypothesis testing and prediction using incomplete information. To date, however, there are no mathematical models that are particularly suitable because current models do not account for two important characteristics of eclipse phase infection. First, none of these models reconcile the very small per-exposure HIV-1 acquisition probability with the high estimate of the basic reproductive number, R0, during acute phase infection. Second, models of acute phase plasma viral load obscure early local dynamics of HIV when the virus forms local, heterogeneous clusters of infection in the genital mucosa before entering the lymphatic and blood systems.

My research programme will develop novel models of HIV that are calibrated to diverse data sources to ascertain whether eclipse phase dynamics determine the acquisition of HIV and later infection dynamics. I will use phylogenetic analysis of HIV samples to quantify the role of the transmitting partner in determining viral inoculum dose size, eclipse phase dynamics and HIV acquisition. This research will generate testable predictions for exposed populations and aim to propose novel methods for infection prevention.

Link to the ERC project webpage:

Keywords of the ERC project: HIV Phylogenetics; HIV Eclipse Phase; Transmission Pairs; Mathematical modelling; Whole Genome Sequencing

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:
758508	**MuBoEx**	**LS8** Evolutionary, Population and Environmental Biology

Principal Investigator:	**Dr STEPHEN MONTGOMERY**
Host Institution:	THE CHANCELLOR MASTERS AND SCHOLARS OF THE UNIVERSITY OF CAMBRIDGE - UK

Mushroom Body Expansion in Heliconius butterflies

The brain plays a central role in the production of adaptive behaviour. It must extract and integrate the most relevant sensory cues from the environment, and combine this information with memories of past experience to trigger appropriate behavioural responses. To fully understand the origins of behavioural novelty we need a detailed understanding of how behavioural differences are generated, both across evolutionary time and during development. This requires the integration of behavioural and neuroanatomical variation, and their genomic and developmental bases.

Mushroom bodies (MBs) are the most enigmatic structures in the insect brain. They have 'higher order' functions, integrating sensory information and storing memories of past experience. MBs share a conserved ground plan, but their size and structure varies extensively across species. MB morphology is determined by the number of MB neurons, and the nature and extent of connections they make with other brain regions. As such, they provide a model for asking fundamental questions about how selection, development and functional constraints shape brain evolution.

This project will establish a new study system in evolutionary neuroscience, Heliconius butterflies. MB volume in Heliconius is among the highest across insects, 3-4 times larger than typical for Lepidoptera, including closely related genera. The proposal represents a synthesis of four key objectives that will provide a cohesive understanding of MB expansion in Heliconius, encompassing both proximate and ultimate causes. Specifically, I will ask: i) How does MB expansion enhance behavioural function? ii) How do volumetric changes relate to differences in neuron number, density and connectivity? iii) What developmental mechanisms control region specific changes in neural proliferation? And iv) what is the genetic basis of MB expansion? Addressing these questions will provide profound advances in our understanding of brain evolution.

Link to the ERC project webpage: www.shmontgomery.co.uk

Keywords of the ERC project: mushroom body, brain evolution

Keywords that characterize the scientific profile of the potential visiting researcher/s: neurobiology, comparative anatomy

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
789037	**EPICLINES**	**LS8** Evolutionary, Population and Environmental Biology

Principal Investigator:	**Dr MAGNUS NORDBORG**
Host Institution:	GREGOR-MENDEL-INSTITUT FÜR MOLEKULARE PFLANZENBIOLOGIE GMBH - AT

Elucidating the causes and consequences of the global pattern of epigenetic variation in Arabidopsis thaliana

Epigenetics continues to fascinate, especially the notion that it blurs the line between “nature and nurture” and could make Lamarckian adaptation via the inheritance of acquired characteristics possible. That this is in principle possible is clear: in the model plant Arabidopsis thaliana (Thale cress), experimentally induced DNA methylation variation can be inherited and affect important traits. The question is whether this is important in nature. Recent studies of A. thaliana have revealed a pattern of correlation between levels of methylation and climate variables that strongly suggests that methylation is important in adaptation. However, somewhat paradoxically, the experiments also showed that much of the variation for this epigenetic trait appears to have a genetic rather than an epigenetic basis. This suggest that epigenetics may indeed be important for adaptation, but as part of a genetic mechanism that is currently not understood. The goal of this project is to determine whether the global pattern of methylation has a genetic or an epigenetic basis, and to use this information to elucidate the ultimate basis for the global pattern of variation: natural selection.

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:
682580	**BEAL**	**LS8** Evolutionary, Population and Environmental Biology

Principal Investigator:	**Dr PIERRE CARDOL**
Host Institution:	UNIVERSITE DE LIEGE - BE

Bioenergetics in microalgae : regulation modes of mitochondrial respiration, photosynthesis, and fermentative pathways, and their interactions in secondary algae

During the course of eukaryote evolution, photosynthesis was propagated from primary eukaryotic algae to non-photosynthetic organisms through multiple secondary endosymbiotic events. Collectively referred to as "secondary algae", these photosynthetic organisms account for only 1-2% of the total global biomass, but produce a large part (~30-50%) of the global annual fixation of carbon on Earth.
ATP is the universal chemical energy carrier in living cells. In photosynthetic eukaryotes, it is produced by two major cellular processes: photosynthesis and respiration taking place in chloroplasts and mitochondria, respectively. Both processes support the production of biomass and govern gas (O2 and CO2) exchanges. On the other hand, anaerobic fermentative enzymes have also been identified in several primary and secondary algae. The regulation modes and interactions of respiration, photosynthesis and fermentation are fairly well understood in primary green algae. Conversely, the complex evolutionary history of secondary algae implies a great variety of original regulatory mechanisms that have been barely investigated to date.
Over the last years my laboratory has developed and optimized a range of multidisciplinary approaches that now allow us, within the frame of the BEAL (BioEnergetics in microALgae) project, to (i) characterize and compare the photosynthetic regulation modes by biophysical approaches, (ii) use genetic and biochemical approaches to gain fundamental knowledge on aerobic respiration and anaerobic fermentative pathways, and (iii) investigate and compare interconnections between respiration, photosynthesis, and fermentation in organisms resulting from distinct evolutionary scenarios. On a long term, these developments will be instrumental to unravel bioenergetics constraints on growth in microalgae, a required knowledge to exploit the microalgal diversity in a biotechnological perspective, and to understand the complexity of the marine phytoplankton.

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:
754290	**MECH-EVO-INSECT**	**LS8** Evolutionary, Population and Environmental Biology

Principal Investigator:	**Dr ALEXANDER BLANKE**
Host Institution:	UNIVERSITAET ZU KOELN - DE

The mechanical evolution from biting-chewing to piercing-sucking in insects

Insects are extremely efficient feeders that impact on the world's ecosystems and our agriculture with their feeding capabilities. Insects evolved diverse mouthpart types during ~400 million years of evolution which allowed them to conquer many food recourses. How this feeding system evolved, in particular the transition from one mouthpart type to the other, is unclear. My idea represents the first extensive assessment of insect head mechanics applying latest semi-automatic workflows and engineering approaches to unravel the factors driving insect mouthpart evolution and performance.

Specifically, I will study the mechanical evolution from early biting-chewing to piercing-sucking mouthparts and head types, considering recent as well as fossil species.

In contrast to earlier studies, I aim to quantify mechanical evolution for the whole head which has never been attempted before for insects. This will be done using engineering software to simulate insect feeding, followed by 3D shape analysis and finally evolutionary modelling using algorithms based on likelihood models of evolutionary processes. The project is therefore positioned at the interconnection between experimental biology, engineering and biological simulation.

The results will impact our understanding of insect evolution, with the project identifying which mechanical factors made insects such extraordinarily successful feeders, and why their mouthparts evolved into so many different types. To achieve an integrative understanding, my idea will furthermore take into account ecological, evolutionary and life history factors. Understanding the mechanical head evolution has never been tried before in a systematic way at this scale. However, my project idea also delivers results for industry: Since modern engineering methods are used, the results can be readily exported to the industry for the design of lighter robot arms with better lifting capabilities, thus advancing robotic techniques.

Link to the ERC project webpage: http://www.zoologie.uni-koeln.de/blanke.html?&L=1

Keywords of the ERC project: insect, biomechanics, finite element, multibody dynamics, evolution, comparative morphology

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:
772284	**IceCommunities**	**LS8** Evolutionary, Population and Environmental Biology

Principal Investigator:	**Dr GENTILE FRANCESCO FICETOLA**
Host Institution:	UNIVERSITA DEGLI STUDI DI MILANO - IT

Reconstructing community dynamics and ecosystem functioning after glacial retreat

Glaciers show a pattern of retreat at the global scale. Increasing areas are exposed and colonized by multiple organisms, but lack of global studies hampers a complete understanding of the future of recently deglaciated terrains. What will be the fate of these areas? How do animals, plants and microorganisms colonize them? How do they interact to perform successful colonization? Which are the climatic, geological and biogeographical processes determining colonization patterns? How does ecosystem functioning evolves through time? Until now, the complete reconstruction of soil communities was hampered by the complexity of identification of organisms, thus analyses at broad geographical and taxonomic scale have been so far impossible. IceCommunities will combine innovative methods and a global approach to boost our understanding of the evolution of ecosystems in recently deglaciated areas. I will investigate chronosequences ranging from recently deglaciated terrains to late successional stages of soil pedogenesis. Through environmental DNA metabarcoding I will identify species from multiple taxonomic groups (bacteria, fungi, protists, soil invertebrates, plants), to obtain a complete reconstruction of biotic communities along glacier forelands over multiple mountain areas across the globe. This will allow measuring the rate of colonization at an unprecedented detail. Information on assemblages will be combined with analyses of soil, landscape and climate to identify the drivers of community changes. I will also identify the impact of eco-geographical factors (climate, regional pool of potential colonizers) on colonization. Analysis of functional traits will allow reconstructing how functional diversity emerges during community formation, and how it scales to the functioning of food webs. IceCommunities will help to predict the future development of these increasingly important ecosystems, providing a supported rationale for the appropriate management of these areas

Link to the ERC project webpage:

Keywords of the ERC project: environmental DNA, climate change, glacier, community composition

Keywords that characterize the scientific profile of the potential visiting researcher/s: bioinformatics, commuity analysis, simulations, ecology

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
788380	**LEAP-EXTREME**	**LS8** Evolutionary, Population and Environmental Biology

Principal Investigator:	**Dr UTE KRAEMER**
Host Institution:	RUHR-UNIVERSITAET BOCHUM - DE

Local Edaphic Adaptation in Plants through Leveraging an Extremophile Model

The discontinuous mosaic of soil compositions on the Earth's changeable surface intermittently requires the adaptation of plants as crucial mediators for ecosystems with the inorganic lithosphere harbouring all nutrient, but also toxic minerals. Only few gene variants have been implicated in local soil adaptation. There is a general lack of information about their relation with soil composition in the field, the manner in which such adaptations function and evolve, and why they arise in some taxa but never in others. To answer these questions, we will take advantage of the repeated evolution and the unusually large phenotypic ranges for multiple edaphic traits in Arabidopsis halleri. This species has undergone uniquely divergent natural selection for increased hyperaccumulation in leaves of the toxic metals zinc and cadmium as well as metal hypertolerance on ordinary soils, and for enhanced hypertolerance involving attenuated metal hyperaccumulation on heavy metal-contaminated soils.

Capitalizing on the most comprehensive collection ever established of a wild extremophile, and with a pioneering approach recording critical field data for each genotype, we will conduct large-scale genome resequencing and identify multi-trait multi-gene associations, complemented by genetic linkage mapping based on crosses. Local edaphic adaptation causal variants will be placed into the context of metal homeostasis network architecture and plasticity using transcriptomics, and we will comparatively evaluate mutation rates in A. halleri under ecologically relevant edaphic conditions.

Implementing state-of-the-art genome-enabled and novel phenotyping methodologies in this wild and biologically complex species will require continuous pioneering developments. Our work will deliver novel fundamental insights into local adaptation in plants and identify large-effect gene variants with potential for applications in environmental restoration, biotechnology and crop breeding.

Link to the ERC project webpage: https://www.ruhr-uni-bochum.de/mgpp/Seiten_en/index_e.html

Keywords of the ERC project: local adaptation, microevolution, soil mineral composition, leaf ionome, mutation rates, functional molecular networks, transcriptional networks, metal hyperaccumulation, heavy metal tolerance, extremophile, evolutionary ecology, moleular ecology

Keywords that characterize the scientific profile of the potential visiting researcher/s: bioinformatics, quantitative genetics, GWAS, computational genomics, sequence data analysis, genome re-sequencing, RNA-Seq, eQTL, molecular biology, phenotyping, population genomics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
678461	**AcetyLys**	**LS9** Applied life Sciences and Non-Medical Biotechnology

Principal Investigator:	**Dr EYAL ARBELY**
Host Institution:	BEN-GURION UNIVERSITY OF THE NEGEV - IL

Unravelling the role of lysine acetylation in the regulation of glycolysis in cancer cells through the development of synthetic biology-based tools

Synthetic biology is an emerging discipline that offers powerful tools to control and manipulate fundamental processes in living matter. We propose to develop and apply such tools to modify the genetic code of cultured mammalian cells and bacteria with the aim to study the role of lysine acetylation in the regulation of metabolism and in cancer development. Thousands of lysine acetylation sites were recently discovered on non-histone proteins, suggesting that acetylation is a widespread and evolutionarily conserved post translational modification, similar in scope to phosphorylation and ubiquitination. Specifically, it has been found that most of the enzymes of metabolic processes—including glycolysis—are acetylated, implying that acetylation is key regulator of cellular metabolism in general and in glycolysis in particular. The regulation of metabolic pathways is of particular importance to cancer research, as misregulation of metabolic pathways, especially upregulation of glycolysis, is common to most transformed cells and is now considered a new hallmark of cancer. These data raise an immediate question: what is the role of acetylation in the regulation of glycolysis and in the metabolic reprogramming of cancer cells? While current methods rely on mutational analyses, we will genetically encode the incorporation of acetylated lysine and directly measure the functional role of each acetylation site in cancerous and non-cancerous cell lines. Using this methodology, we will study the structural and functional implications of all the acetylation sites in glycolytic enzymes. We will also decipher the mechanism by which acetylation is regulated by deacetylases and answer a long standing question – how 18 deacetylases recognise their substrates among thousands of acetylated proteins? The developed methodologies can be applied to a wide range of protein families known to be acetylated, thereby making this study relevant to diverse research fields.

Link to the ERC project webpage:

Keywords of the ERC project: Genetic code expansion, synthetic biology, metabolism, lysine acetylation

Keywords that characterize the scientific profile of the potential visiting researcher/s: Cell biologist, biochemist, molecular biologist, tissue culture

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
680040	**EVOLOR**	**LS9** Applied life Sciences and Non-Medical Biotechnology

Principal Investigator:	**Dr ENIKO KUBINYI**
Host Institution:	EOTVOS LORAND TUDOMANYEGYETEM - HU

Cognitive Ageing in Dogs

The aim of this project is to understand the causal factors contributing to the cognitive decline during senescence and to develop sensitive and standardized behaviour tests for early detection in order to increase the welfare of affected species. With the rapidly ageing population of Europe, related research is a priority in the European Union.

We will focus both on characterising the ageing phenotype and the underlying biological processes in dogs as a well-established natural animal model. We develop a reliable and valid test battery applying innovative multidisciplinary methods (e.g. eye-tracking, motion path analysis, identification of behaviour using inertial sensors, EEG, fMRI, candidate gene, and epigenetics) in both longitudinal and cross-sectional studies. We expect to reveal specific environmental risk factors which hasten ageing and also protective factors which may postpone it. We aim to provide objective criteria (behavioural, physiological and genetic biomarkers) to assess and predict the ageing trajectory for specific individual dogs. This would help veterinarians to recognise the symptoms early, and initiate necessary counter actions.

This approach establishes the framework for answering the broad question that how we can extend the healthy life of ageing dogs which indirectly also contributes to the welfare of the owner and decreases veterinary expenses. The detailed description of the ageing phenotype may also facilitate the use of dogs as a natural model for human senescence, including the development and application of pharmaceutical interventions.

We expect that our approach offers the scientific foundation to delay the onset of cognitive ageing in dog populations by 1-2 years, and also increase the proportion of dogs that enjoy healthy ageing.

Link to the ERC project webpage: https://familydogproject.elte.hu/senior-family-dog-project/

Keywords of the ERC project: dog behaviour, cognitive ageing, brain bank

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:
683210	**EPIFISH**	**LS9** Applied life Sciences and Non-Medical Biotechnology

Principal Investigator:	**Dr JORGE FERNANDES**
Host Institution:	NORD UNIVERSITET - NO

INNOVATIVE EPIGENETIC MARKERS FOR FISH DOMESTICATION

Aquaculture is the fastest growing food production sector in the world, since there is an increasing demand for fish protein to feed a growing global population, which cannot be met by fisheries. In order to ensure the sustainability of this sector it is critical to domesticate and selectively improve the major commercial fish species. To date, the genetic markers used in selective breeding of fish account only for a fraction of the observed phenotypic variation. EPIFISH is a scientifically innovative and timely project that will address fish domestication and selection from a new perspective using a multidisciplinary approach. The rapid pace of substantial phenotypic changes during adaptation to new environmental conditions in fish undergoing domestication raises the original hypothesis that epigenetic mechanisms are involved in this process. Thus, the overarching aim of EPIFISH is to ascertain the importance of epigenetics in fish domestication using the Nile tilapia (Oreochromis niloticus) as model species. Specific objectives are i) to determine how selection affects the miRNA transcriptome and the epigenetic landscape during domestication, ii) to perform a functional characterization of miRNA variants and epigenetic alleles associated with growth, and iii) to validate them as potential epigenetic markers for future selective breeding programmes. The identification of epigenetic markers will be a ground-breaking element of EPIFISH with major impact on aquaculture biotechnology, since they will enable the development and application of epigenomic selection as a new feature in future selective breeding programmes. Moreover, the project outcomes will provide novel mechanistic insights into the role of epigenetics in fish domestication, which will surely open new horizons for future frontier research in epigenetics, namely transgenerational inheritance and nutritional epigenetics.

Link to the ERC project webpage:

Keywords of the ERC project: Epigenetics; Fish Domestication; Aquaculture

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:
695078	**noMAGIC**	**LS9** Applied life Sciences and Non-Medical Biotechnology

Principal Investigator:	**Dr ANNA MORONI**
Host Institution:	UNIVERSITA DEGLI STUDI DI MILANO - IT

Noninvasive Manipulation of Gating in Ion Channels

noMAGIC has the visionary goal of engineering genetically encoded ion channels, which can be remotely controlled (gated) by stimuli that penetrate deep into human tissue without negative side effects. The control over ion channel activity by deep penetrating stimuli will revolutionize research in neurobiology and physiology as it paves the way for remote and genuine non-invasive control of cell activity in vivo. Synthetic channels, which can be gated by magnetic fields (MF), near infrared (NIR) radiation or ultrasound (US) will be engineered in the frame of noMAGIC by three complementary work packages (WP1-3). Design and engineering of the channels will be performed in WP1 by reiterated steps of rational and irrational design, high throughput screening and in vitro and in vivo functional testing. We have identified two sensor modules for MF and NIR radiation, respectively, which will be functionally connected to a channel pore for a remote control of gating. For the US-gated channel we will engineer a channel pore that is maximally responding to local changes in the lipid environment induced by US. Design and engineering of channels will be complemented by a computational approach (WP2), which analyses, from elastic network models, the mechanical connections in the channel pore and which extracts information on the forces, which are required to gate a channel by the three stimuli. The outcome of WP2 will provide general design rules for synthetic channels with implications much beyond the present project. WP3 also contributes to the engineering effort in WP1 by a spectrum of avant-garde spectroscopic methods, which resolve structural changes of the channel proteins under the influence of remote stimuli. These structural insights will greatly advance our understanding of structure/function correlates in composite ion channels and it will inspire the design and engineering of channels, which respond to remote stimuli.

Link to the ERC project webpage: https://nomagicproject.eu/

Keywords of the ERC project: ion channel, protein engineering, optogenetics

Keywords that characterize the scientific profile of the potential visiting researcher/s: patch clamp, electrophysiology, synthetic biology, ion channel, protein engineering

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
695669	**PicoCB**	**LS9** Applied life Sciences and Non-Medical Biotechnology

Principal Investigator:	**Dr FLORIAN HOLLFELDER**
Host Institution:	THE CHANCELLOR MASTERS AND SCHOLARS OF THE UNIVERSITY OF CAMBRIDGE - UK

Exploring the Chemical Biology of Sequence Space via Picoliter Droplets

Directed evolution of functional proteins has arguably emerged as an approach to protein engineering that can complement or better design-led approaches to protein function. However, as a random process, enormous numbers of variants have to be screened and selected to have a chance to identify successful catalysts. This process is costly and cumbersome: Industrial screening facilities require investment of tens to hundred millions of dollars. My group has implemented key steps towards conducting quantitative biological experiments in a much cheaper format. Screening of individual library members in monodisperse oil-in-water compartments ('microdroplets') that are generated at kHz frequencies in microfluidic devices has been shown to be possible. The droplet compartment constitutes a link between a given phenotype and its encoding genotype, by capturing reaction product, and thus providing a unique system to screen for catalysis.In this way quantitative fitness landscapes for interconversion of members of enzyme superfamilies along the lines of catalytic promiscuity, understanding the factors governing specificity and the mechanistic interpretation of the observed evolutionary pathways can be made. We now apply this screening system of unprecedented capacity for directed evolution and metagenomic screening of enzymes in in vivo and in vitro formats. We plan to apply this system to do experiments that would not be possible with conventional, lower throughput approaches: (i) screening of metagenomic libraries for rare and promiscuous activities that characterise environmental gene collections for their reactivity and potential for applied biocatalysis; (ii) developing a fundamental understanding of and strategic guidelines for enzyme evolution based on fitness landscapes that record data on multiple, promiscuous activities in response to Indel mutations; and (iii) evolution of gene networks to build up signalling networks in vitro.

Link to the ERC project webpage: https://www.bioc.cam.ac.uk/hollfelder

Keywords of the ERC project: Directed evolution, protein engineering, enzyme mechanism, synthetic biology

Keywords that characterize the scientific profile of the potential visiting researcher/s: Directed evolution, protein engineering, enzyme mechanism, synthetic biology, antibody, display technologies

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
755617	**SENTIFLEX**	**LS9** Applied life Sciences and Non-Medical Biotechnology

Principal Investigator:	**Dr JOCHEM VERRELST**
Host Institution:	UNIVERSITAT DE VALENCIA - ES

Fluorescence-based photosynthesis estimates for vegetation productivity monitoring from space

Global food security will remain a worldwide concern for the next 50 years and beyond. Agricultural production undergoes an increasing pressure by global anthropogenic changes, including rising population, increased protein demands and climatic extremes. Because of the immediate and dynamic nature of these changes, productivity monitoring measures are urgently needed to ensure both the stability and continued increase of the global food supply. Europe has expressed ambitions to keep its fingers on the pulse of its agricultural lands. In response to that, this proposal - named SENTIFLEX - is dedicated to developing a European vegetation productivity monitoring facility based on the synergy of Sentinel-3 (S3) with FLEX satellite fluorescence data. ESA's 8th Earth Explorer FLEX is the first mission specifically designed to globally measure Sun-Induced chlorophyll Fluorescence (SIF) emission from terrestrial vegetation. These two European Earth observation missions offer immense possibilities to increase our knowledge of the basic functioning of the Earth's vegetation, i.e., the photosynthetic activity of plants resulting in carbon fixation. Two complementary approaches are envisioned to realize quantification of photosynthesis through satellite SIF and S3. First, the work seeks to advance the science in establishing and consolidating relationships between canopy-leaving SIF and unbiased estimates of photosynthesis of the plants, thereby disentangling the role of dynamic vegetative and atmospheric variables. Second, consolidated relationships between SIF and photosynthesis will be used to build a FLEX-S3 data processing assimilation scheme through process-based vegetation models that will deliver spatiotemporally highly resolved information on Europe's vegetation productivity. To streamline all these datasets into a prototype vegetation productivity monitoring facility, new data processing concepts will be introduced such as the emulation of radiative transfer models.

Link to the ERC project webpage: http://ipl.uv.es/sentiflex/

Keywords of the ERC project: FLEX, Sentinel, Earth Observation, fluorescence, vegetation productivity

Keywords that characterize the scientific profile of the potential visiting researcher/s: remote sensing scientist, Matlab, machine learning, radiative transfer modelling, fluorescence

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
757833	**FORMICA**	**LS9** Applied life Sciences and Non-Medical Biotechnology

Principal Investigator:	**Dr PIETER DE FRENNE**
Host Institution:	UNIVERSITEIT GENT - BE

Microclimatic buffering of plant responses to macroclimate warming in temperate forests

Recent global warming is acting across ecosystems and threatening biodiversity. Yet, due to slow responses, many biological communities are lagging behind warming of the macroclimate (the climate of a large geographic region). The buffering of microclimates near the ground measured in localized areas, arising from terrain features such as vegetation and topography, can explain why many species are lagging behind macroclimate warming. However, almost all studies ignore the effects of microclimatic buffering and key uncertainties still exist about this mechanism. Microclimates are particularly evident in forests, where understorey habitats are buffered by overstorey trees. In temperate forests, the understorey contains the vast majority of plant diversity and plays an essential role in driving ecosystem processes.

The overall goal of FORMICA (FORest MICroclimate Assessment) is to quantify and understand the role of microclimatic buffering in modulating forest understorey plant responses to macroclimate warming. We will perform the best assessment to date of the effects of microclimates on plants by applying microtemperature loggers, experimental heating, fluorescent tubes and a large-scale transplant experiment in temperate forests across Europe. For the first time, plant data from the individual to ecosystem level will be related to microclimate along wide temperature gradients and forest management regimes. The empirical results will then be integrated in cutting-edge demographic distribution models to forecast plant diversity in temperate forests as macroclimate warms.

FORMICA will provide the first integrative study on microclimatic buffering of macroclimate warming in forests. Interdisciplinary concepts and methods will be applied, including from climatology, forestry and ecology. FORMICA will reshape our current understanding of the impacts of climate change on forests and help land managers and policy makers to develop urgently needed adaptation strategies.

Link to the ERC project webpage: www.fornalab.ugent.be

Keywords of the ERC project: climate change, forests, microclimate, plants, biodiversity

Keywords that characterize the scientific profile of the potential visiting researcher/s: climate change, forests, microclimate, plants, biodiversity

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
787115	**MaCChines**	**LS9** Applied life Sciences and Non-Medical Biotechnology

Principal Investigator:	**Dr ROMAN JERALA**
Host Institution:	KEMIJSKI INSTITUT - SI

Molecular machines based on coiled-coil protein origami

Proteins are the most versatile and complex smart nanomaterials, forming molecular machines and performing numerous functions from structure building, recognition, catalysis to locomotion. Nature however explored only a tiny fraction of possible protein sequences and structures. Design of proteins with new, in nature unseen shapes and features, offers high rewards for medicine, technology and science. In 2013 my group pioneered the design of a new type of modular coiled-coil protein origami (CCPO) folds. This type of de novo designed proteins are defined by the sequence of coiled-coil (CC) dimer-forming modules that are concatenated by flexible linkers into a single polypeptide chain that self-assembles into a polyhedral cage based on pairwise CC interactions. This is in contrast to naturally evolved proteins where their fold is defined by a compact hydrophobic core. We recently demonstrated the robustness of this strategy by the largest de novo designed single chain protein, construction of tetrahedral, pyramid, trigonal prism and bipyramid cages that self-assemble in vivo.

This proposal builds on unique advantages of CCPOs and represents a new frontier of this branch of protein design science. I propose to introduce functional domains into selected positions of CCPO cages, implement new types of building modules that will enable regulated CCPO assembly and disassembly, test new strategies of caging and release of cargo molecules for targeted delivery, design knotted and crosslinked protein cages and introduce toehold displacement for the regulated structural rearrangement of CCPOs required for designed molecular machines, which will be demonstrated on protein nanotweezers. Technology for the positional combinatorial library-based single pot assembly of CCPO genes will provide high throughput of CCPO variants. Project will result in new methodology, understanding of potentials of CCPOs for designed molecular machines and in demonstration of different applications.

Link to the ERC project webpage:

Keywords of the ERC project: protein origami, designed protein cages, molecular machines, synthetic biology, structural biology

Keywords that characterize the scientific profile of the potential visiting researcher/s: synthetic biology, structural biology, molecular biology

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
639305	**SPECTRUM**	**PE1** Mathematics

Principal Investigator:	**Dr ALEXANDER SODIN**
Host Institution:	QUEEN MARY UNIVERSITY OF LONDON - UK

Spectral theory of random operators

The theme of this proposal is the study of random operators associated with some geometric structure, and the influence of the geometry on the spectral properties of the operator. Such operators appear in problems from theoretical physics, and lead to new and interesting mathematical structures.
One circle of questions is related to random operators, which describe the motion of a quantum particle in a disordered medium, such as random band matrices. The behaviour of the particle is influenced by the underlying geometry, as quantified by the (non-rigorous) Thouless criterion for localisation in terms of the mixing time of the classical random walk; in the context of random band matrices, the predictions of the Thouless criterion are supported by additional (non-rigorous) arguments. These predictions have so far not been rigorously justified; an exception is my own result, validating it at the spectral edges. One of our goals is to develop new methods, which would be applicable in the bulk of the spectrum, for random band matrices and other operators with geometric structure.
Another circle of questions is given by random processes taking values in large random matrices. The spectral properties of the random matrix at every point of the underlying space are described by the random matrix theory; but how does the spectrum evolve along the underlying space? The richness of this question is apparent from the one-dimensional case of Dyson Brownian motion. We intend to study the local eigenvalue statistics of general matrix-valued random processes with multi-dimensional underlying space; to give a complete description of the random processes which appear in the limit, first for the spectral edges and then for the bulk of the spectrum, and to explore the appearance of these processes in a variety of basic questions of mathematical physics.

Link to the ERC project webpage:

Keywords of the ERC project: spectral theory, random operators

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:
647133	**IChaos**	**PE1** Mathematics

Principal Investigator:	**Dr ALEXANDER BUFETOV**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FR

Intermediate Chaos

The transition from order to chaos has been a central theme of investigation in dynamical systems in the last two decades. Structures that exhibit a mix of deterministic and chaotic properties, for example, quasi-crystals, naturally arise in problems of geometry and mathematical physics. Despite intense study, key questions about these structures remain wide open.

The proposed research is an investigation of intermediate chaos in ergodic theory of dynamical systems. Specific examples include systems of geometric origin such as interval exchange maps, translation and Hamiltonian flows on surfaces of higher genus, symbolic substitution systems important in the study of quasi-crystals as well as dynamical systems arising in asymptotic combinatorics and mathematical physics such as determinantal and Pfaffian point processes. Specific tasks include computation of the Hausdorff dimension for the spectral measure of interval exchange maps (problem posed by Ya. Sinai), limit theorems for Hamiltonian flows on surfaces of higher genus (question of A. Katok), development of entropy theory and functional limit theorems for determinantal point processes and a description of the ergodic decomposition for infinite orthogonally-invariant measures on the space of infinite real matrices (the real case of the problem, posed in 2000 by A. Borodin and G. Olshanski, of harmonic analysis on the infinite-dimensional analogue of the Grassmann manifold). The project consolidates the proposer's past work, in particular, his limit theorems for translation flows (Annals of Math. 2014), his proof of the 1985 Vershik-Kerov entropy conjecture (GAFA 2012) and his solution of the complex case of the Borodin-Olshanski problem (preprint 2013). The proposer is currently PI of project ANR-11-IDEX-0001-02 (1.11.2013--30.10.2015; budget 360000 euro) under the Programme "Investissements d'avenir" of the Government of the French Republic.

Link to the ERC project webpage: https://www.i2m.univ-amu.fr/Home-ERC-IChaos?lang=fr

Keywords of the ERC project: ergodic theory, point processes

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:
648509	**LaDIST**	**PE1** Mathematics

Principal Investigator:	**Dr DANIEL KRAL**
Host Institution:	Masarykova univerzita - CZ

Large Discrete Structures

The proposed project seeks to introduce novel methods to analyze and approximate large graphs and other discrete structures and to apply the developed methods to solve specific open problems. A need for such methods comes from computer science where the sizes of input structures are often enormous. Specifically, the project will advance the recently emerged theory of combinatorial limits by developing new insights in the structure of limit objects and by proposing a robust theory bridging the sparse and dense cases. The analytic methods from the theory of combinatorial limits will be used to analyze possible asymptotic behavior of large graphs and they will be applied in conjunction with structural arguments to provide solutions to specific problems in extremal combinatorics. The obtained insights will also be combined with methods from discrete optimization and logic to provide new algorithmic frameworks.

Link to the ERC project webpage: https://www.fi.muni.cz/research/ladist/

Keywords of the ERC project: Combinatorics, graph theory

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:
694126	**DYCON**	**PE1** Mathematics

Principal Investigator:	**Dr ENRIQUE ZUAZUA**
Host Institution:	FUNDACION DEUSTO - ES

Dynamic Control and Numerics of Partial Differential Equations

This project aims at making a breakthrough contribution in the broad area of Control of Partial Differential Equations (PDE) and their numerical approximation methods by addressing key unsolved issues appearing systematically in real-life applications.
To this end, we pursue three objectives: 1) to contribute with new key theoretical methods and results, 2) to develop the corresponding numerical tools, and 3) to build up new computational software, the DYCON-COMP computational platform, thereby bridging the gap to applications.
The field of PDEs, together with numerical approximation and simulation methods and control theory, have evolved significantly in the last decades in a cross-fertilization process, to address the challenging demands of industrial and cross-disciplinary applications such as, for instance, the management of natural resources, meteorology, aeronautics, oil industry, biomedicine, human and animal collective behaviour, etc. Despite these efforts, some of the key issues still remain unsolved, either because of a lack of analytical understanding, of the absence of efficient numerical solvers, or of a combination of both.
This project identifies and focuses on six key topics that play a central role in most of the processes arising in applications, but which are still poorly understood: control of parameter dependent problems; long time horizon control; control under constraints; inverse design of time-irreversible models; memory models and hybrid PDE/ODE models, and finite versus infinite-dimensional dynamical systems.
These topics cannot be handled by superposing the state of the art in the various disciplines, due to the unexpected interactive phenomena that may emerge, for instance, in the fine numerical approximation of control problems. The coordinated and focused effort that we aim at developing is timely and much needed in order to solve these issues and bridge the gap from modelling to control, computer simulations and applications.

Link to the ERC project webpage: https://cmc.deusto.eus/dycon/

Keywords of the ERC project: Partial Differential Equations, Control Theory, Numerical Analysis, Scientific Computing, Applications

Keywords that characterize the scientific profile of the potential visiting researcher/s: Partial Differential Equations, Control Theory, Numerical Analysis, Scientific Computing, Software Development

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
770924	**IPTheoryUnified**	**PE1** Mathematics

Principal Investigator:	**Dr MIKKO SALO**
Host Institution:	JYVASKYLAN YLIOPISTO - FI

Inverse boundary problems: toward a unified theory

This proposal is concerned with the mathematical theory of inverse problems. This is a vibrant research field at the intersection of pure and applied mathematics, drawing techniques from PDE, geometry, and harmonic analysis as well as generating new research questions inspired by applications. Prominent questions include the Calderón problem related to electrical imaging, the Gel'fand problem related to seismic imaging, and geometric inverse problems such as inversion of the geodesic X-ray transform.

Recently, exciting new connections between these different topics have begun to emerge in the work of the PI and others, such as

- the explicit appearance of the geodesic X-ray transform in the Calderón problem
- an unexpected connection between the Calderón and Gel'fand problems involving control theory
- pseudo-linearization as a potential unifying principle for reducing nonlinear problems to linear ones
- the introduction of microlocal normal forms in inverse problems for PDE

These examples strongly suggest that there is a larger picture behind various different inverse problems, which remains to be fully revealed.

This project will explore the possibility of a unified theory for several inverse boundary problems. Particular objectives include:

1. The use of normal forms and pseudo-linearization as a unified point of view, including reductions to questions in integral geometry and control theory
2. The solution of integral geometry problems, including the analysis of convex foliations, invertibility of ray transforms, and a systematic Carleman estimate approach to uniqueness results
3. A theory of inverse problems for nonlocal models based on control theory arguments

Such a unified theory could have remarkable consequences even in other fields of mathematics, including controllability methods in transport theory, a solution of the boundary rigidity problem in geometry, or a general pseudo-linearization approach for solving nonlinear operator equations.

Link to the ERC project webpage:

Keywords of the ERC project: Mathematical theory of inverse problems, partial differential equations, differential 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:
771507	**StabCondEn**	**PE1** Mathematics

Principal Investigator:	**Dr PAOLO STELLARI**
Host Institution:	UNIVERSITA DEGLI STUDI DI MILANO - IT

Stability Conditions, Moduli Spaces and Enhancements

I will introduce new techniques to address two big open questions in the theory of derived/triangulated categories and their many applications in algebraic geometry.
The first one concerns the theory of Bridgeland stability conditions, which provides a notion of stability for complexes in the derived category. The problem of showing that the space parametrizing stability conditions is non-empty is one of the most difficult and challenging ones. Once we know that such stability conditions exist, it remains to prove that the corresponding moduli spaces of stable objects have an interesting geometry (e.g. they are projective varieties). This is a deep and intricate problem.
On the more foundational side, the most successful approach to avoid the many problematic aspects of the theory of triangulated categories consisted in considering higher categorical enhancements of triangulated categories. On the one side, a big open question concerns the uniqueness and canonicity of these enhancements. On the other side, this approach does not give a solution to the problem of describing all exact functors, leaving this as a completely open question. We need a completely new and comprehensive approach to these fundamental questions.
I intend to address these two sets of problems in the following innovative long-term projects:
1. Develop a theory of stability conditions for semiorthogonal decompositions and its applications to moduli problems. The main applications concern cubic fourfolds, Calabi-Yau threefolds and Calabi-Yau categories.
2. Apply these new results to the study of moduli spaces of rational normal curves on cubic fourfolds and their deep relations to hyperkaehler geometry.
3. Investigate the uniqueness of dg enhancements for the category of perfect complexes and, most prominently, of admissible subcategories of derived categories.
4. Develop a new theory for an effective description of exact functors in order to prove some related conjectures.

Link to the ERC project webpage: https://sites.google.com/view/stabconden

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:
786854	**G-Statistics**	**PE1** Mathematics

Principal Investigator:	**Dr XAVIER PENNEC**
Host Institution:	INSTITUT NATIONAL DE RECHERCHE ENINFORMATIQUE ET AUTOMATIQUE - FR

Foundations of Geometric Statistics and Their Application in the Life Sciences

Invariance under gauge transformation groups provides the natural structure explaining the laws of physics. In life sciences, new mathematical tools are needed to estimate approximate invariance and establish general but approximate laws. Rephrasing Poincaré: a geometry cannot be more true than another, it may just be more convenient, and statisticians must find the most convenient one for their data. At the crossing of geometry and statistics, G-Statistics aims at establishing the mathematical foundations of geometric statistics and to exemplify their impact on selected applications in the life sciences.
So far, mainly Riemannian manifolds and negatively curved metric spaces have been studied. Other geometric structures like quotient spaces, stratified spaces or affine connection spaces naturally arise in applications. G-Statistics will explore ways to unify statistical estimation theories, explaining how the statistical estimations diverges from the Euclidean case in the presence of curvature, singularities, stratification. Beyond classical manifolds, particular emphasis will be put on flags of subspaces in manifolds as they appear to be natural mathematical object to encode hierarchically embedded approximation spaces.
In order to establish geometric statistics as an effective discipline, G-Statistics will propose new mathematical structures and theorems to characterize their properties. It will also implement novel generic algorithms and illustrate the impact of some of their efficient specializations on selected applications in life sciences. Surveying the manifolds of anatomical shapes and forecasting their evolution from databases of medical images is a key problem in computational anatomy requiring dimension reduction in non-linear spaces and Lie groups. By inventing radically new principled estimations methods, we aim at illustrating the power of the methodology and strengthening the "unreasonable effectiveness of mathematics" for life sciences.

Link to the ERC project webpage: https://team.inria.fr/epione/fr/research/erc-g-statistics/

Keywords of the ERC project: Geometry, statistics, non-linear spaces

Keywords that characterize the scientific profile of the potential visiting researcher/s: Differential geometry, statistical estimation, manifold with boundaries, stratified spaces

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
713998	**GeoMeG**	**PE1** Mathematics

Principal Investigator:	**Dr ENRICO LE DONNE**
Host Institution:	JYVASKYLAN YLIOPISTO - FI

Geometry of Metric groups

What are the best trajectories to park a truck with several trailers? How fast can a lattice grow? These questions are some of the ones studied in this project because both the infinitesimal structure of controlling a truck and the asymptotic geometry of a (nilpotent) lattice are examples of metric groups: Lie groups with homogeneous distances.
The PI plans to study geometric properties of metric groups and implications to control systems and nilpotent groups. In particular, the plan is to exploit the relation between the regularity of distinguished curves, sets and maps in subRiemannian groups, volume asymptotics in nilpotent groups and embedding results. SubRiemannian spaces and in particular Carnot groups, appear in various areas of Mathematics, such as Control Theory, Harmonic and Complex Analysis, subelliptic PDE's and Geometric Group Theory. The results in the project will provide more links. The general goal is to develop an adapted Geometric Measure Theory.
The PI developed a net of high level international collaborations and obtained several results via a combination of analysis on metric spaces (differentiation of Lipschitz maps, tangents of measures and Gromov-Hausdorff limits) and the theory of locally compact groups (Lie group techniques and the solutions of the Hilbert 5th problem). The PI solved a number of open problems in the field as the analogue of Myers-Steenrod Theorem on the smoothness of isometries, of Nash Isometric Embedding and the non-minimality of curves with corners. Some of the next aims are to establish an analogue of the De Giorgi's rectifiability result for finite-perimeter sets and prove the smoothness of geodesics, a 30-year-old open problem.
The PI received his first degree at SNS Pisa (advisor: M.Abate) and his PhD from Yale (advisor: B.Kleiner). Before getting a permanent position only 3 years after graduation, he was at ETH, Orsay and MSRI. He received the prestigious position of research fellow of the Academy of Finland.

Link to the ERC project webpage: http://research.jyu.fi/geomeg/

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:
768679	**DerSympApp**	**PE1** Mathematics

Principal Investigator:	**Dr DAMIEN CALAQUE**
Host Institution:	UNIVERSITE DE MONTPELLIER - FR

Derived Symplectic Geometry and Applications

We propose a program that aims at providing new developments and new applications of shifted symplectic and Poisson structures. It is formulated in the language and framework of derived algebraic geometry after Toën–Vezzosi and Lurie.
On the foundational side, we will introduce the new notion of shifted symplectic groupoids and prove that they provide an alternative approach to shifted Poisson structures (as they were defined by the PI together with Tony Pantev, Bertrand Toën, Michel Vaquié and Gabriele Vezzosi). Along the way, we shall be able to prove several conjectures that have recently been formulated by the PI and other people.
Applications are related to mathematical physics. For instance:
- we will provide an interpretation of the Batalin–Vilkovisky formalism in terms of derived symplectic reduction.
- we will show that the semi-classical topological field theories with values in derived Lagrangian correspondences that were previously introduced by the PI are actually fully extended topological field theories in the sense of Baez–Dolan and Lurie.
- we will explain how one may use this formalism to rigorously construct a 2D topological field theory that has been discovered by Moore and Tachikawa.
Quantization problems will also be discussed at the end of the proposal.
This project proposal lies at the crossroads of algebraic geometry, mathematical physics (in its algebraic and geometric aspects) and higher algebra.

Link to the ERC project webpage: https://damienespadon.wixsite.com/dersympapp

Keywords of the ERC project: mathematics, derived geometry, homotopy theory, QFT, higher stuctures

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:
770880	**COMANFLO**	**PE1** Mathematics

Principal Investigator:	**Dr SIDDHARTHA MISHRA**
Host Institution:	EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH - CH

Computation and analysis of statistical solutions of fluid flow

Entropy (admissible) weak solutions are widely considered to be the standard solution framework for hyperbolic systems of conservation laws and incompressible Euler equations. However, the lack of global existence results in several space dimensions, the recent demonstration of non-uniqueness of these solutions and computations showing the lack of convergence of state of the art numerical methods to them, have reinforced the need to seek alternative solution paradigms.
Although one can show that numerical approximations of these nonlinear PDEs converge to measure-valued solutions i.e Young measures, these solutions are not unique and we need to constrain them further. Statistical solutions i.e, time-parametrized probability measures on spaces of integrable functions, are a promising framework in this regard as they can be characterized as a measure-valued solution that also contains information about all possible multi-point spatial correlations. So far, well-posedness of statistical solutions has been shown only in the case of scalar conservation laws.
The main aim of the proposed project is to analyze statistical solutions of systems of conservation laws and incompressible Euler equations and to design efficient numerical approximations for them. We aim to prove global existence of statistical solutions in several space dimensions, by showing convergence of these numerical approximations, and to identify suitable additional admissibility criteria for statistical solutions that can ensure uniqueness. We will use these numerical methods to compute statistical quantities of interest and relate them to existing theories (and observations) for unstable and turbulent fluid flows. Successful completion of this project aims to establish statistical solutions as the appropriate solution paradigm for inviscid fluid flows, even for deterministic initial data, and will pave the way for applications to astrophysics, climate science and uncertainty quantification.

Link to the ERC project webpage:

Keywords of the ERC project: Fluids, Statistical solutions, Turbulence, Numerical methods, Monte Carlo, Machine 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:
670462	**COMTESSA**	**PE10** Earth System Science

Principal Investigator:	**Dr ANDREAS STOHL**
Host Institution:	NORSK INSTITUTT FOR LUFTFORSKNING STIFTELSE - NO

Camera Observation and Modelling of 4D Tracer Dispersion in the Atmosphere

COMTESSA will push back the limits of our understanding of turbulence and plume dispersion in the atmosphere by bringing together full four-dimensional (space and time) observations of a (nearly) passive tracer (sulfur dioxide, SO2), with advanced data analysis and turbulence and dispersion modelling.
Observations will be made with six cameras sensitive to ultraviolet (UV) radiation and three cameras sensitive to infrared (IR) radiation. The UV cameras will be built specifically for this project where high sensitivity and fast sampling is important. The accuracy of UV and IR retrievals will be improved by using a state-of-the art-3D radiative transfer model.
Controlled puff and plume releases of SO2 will be made from a tower, which will be observed by all cameras, yielding multiple 2D images of SO2 integrated along the line of sight. The simultaneous observations will allow - for the first time - a tomographic reconstruction of the 3D tracer concentration distribution at high space (< 1 m) and time (>10 Hz) resolution. An optical flow code will be used to determine the eddy-resolved velocity vector field of the plume. Special turbulent phenomena (e.g. plume rise) will be studied using existing SO2 sources (e.g. smelters, power plants, volcanic fumaroles).
Analysis of the novel campaign observations will deepen our understanding of turbulence and tracer dispersion in the atmosphere. For instance, for the first time we will be able to extensively measure the concentration probability density function (PDF) in a plume not only near the ground but also at high-er altitudes; quantify relative and absolute dispersion; estimate the value of the Richardson-Obukhov constant, etc. We will also use the data to evaluate state-of-the-art LES and Lagrangian dispersion models and revise their underlying parameterizations.
COMTESSA's vision is that the project results will lead to large improvements of tracer transport in all atmospheric models.

Link to the ERC project webpage: https://comtessa-turbulence.net/

Keywords of the ERC project: SO2 camera, dispersion, turbulence, air pollution

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:
670874	**RotaNut**	**PE10** Earth System Science

Principal Investigator:	**Dr VERONIQUE DEHANT**
Host Institution:	KONINKLIJKE STERRENWACHT VAN BELGIE - BE

Rotation and Nutation of a wobbly Earth

The rotation of the Earth has long been used as a measure of time, and the stars as reference points to determine travellers' whereabouts on the globe. Today, precise timescales are provided using atomic clocks and precise positioning is determined using geodetic techniques such as GPS grounded on two reference frames: the terrestrial frame, fixed relative to the Earth and rotating synchronously with the planet, and the celestial frame, which is immobile in space, where the artificial satellites such as those of GPS are moving. The relationship between these frames is complicated by the fact that the rotation and orientation of the Earth is subject to irregularities induced by global mass redistributions with time and external forcing such as the gravitational pull of the Sun and the Moon. With the advance of observation precision, the causes of Earth orientation changes are progressively being identified by geodesists and geophysicists. The term 'precession' describes the long-term trend of the orientation of the axis of spin, while 'nutation' is the name given to shorter-term periodic variations, which are the prime focus of the present project. The rotation axis of the Earth is moving in space at the level of 1.5km/year due to precession and has periodic variations at the level of 600 meters as seen from space in a plane tangent to the pole. The present observations allow scientists to measure these at the sub-centimetre level enabling them to identify further physics of the Earth's interior to be taken into account in the Earth orientation models such as the coupling mechanisms at the boundary between the liquid core and the viscoelastic mantle, as well as many other factors (sometimes not yet definitely identified). The proposed research will address many of these and will result in the development of improved global orientation of the Earth with an unprecedented accuracy - at the sub-centimetre level.

Link to the ERC project webpage: https://rotanut.oma.be/

Keywords of the ERC project: Earth observations from space/remote sensing; Physics of earth's interior, seismology, volcanology

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:
677756	**FORECASToneMONTH**	**PE10** Earth System Science

Principal Investigator:	**Dr CHAIM GARFINKEL**
Host Institution:	THE HEBREW UNIVERSITY OF JERUSALEM - IL

Forecasting Surface Weather and Climate at One-Month Leads through Stratosphere-Troposphere Coupling

Anomalies in surface temperatures, winds, and precipitation can significantly alter energy supply and demand, cause flooding, and cripple transportation networks. Better management of these impacts can be achieved by extending the duration of reliable predictions of the atmospheric circulation.
Polar stratospheric variability can impact surface weather for well over a month, and this proposed research presents a novel approach towards understanding the fundamentals of how this coupling occurs. Specifically, we are interested in: 1) how predictable are anomalies in the stratospheric circulation? 2) why do only some stratospheric events modify surface weather? and 3) what is the mechanism whereby stratospheric anomalies reach the surface? While this last question may appear academic, several studies indicate that stratosphere-troposphere coupling drives the midlatitude tropospheric response to climate change; therefore, a clearer understanding of the mechanisms will aid in the interpretation of the upcoming changes in the surface climate.
I propose a multi-pronged effort aimed at addressing these questions and improving monthly forecasting. First, carefully designed modelling experiments using a novel modelling framework will be used to clarify how, and under what conditions, stratospheric variability couples to tropospheric variability. Second, novel linkages between variability external to the stratospheric polar vortex and the stratospheric polar vortex will be pursued, thus improving our ability to forecast polar vortex variability itself. To these ends, my group will develop 1) an analytic model for Rossby wave propagation on the sphere, and 2) a simplified general circulation model, which captures the essential processes underlying stratosphere-troposphere coupling. By combining output from the new models, observational data, and output from comprehensive climate models, the connections between the stratosphere and surface climate will be elucidated.

Link to the ERC project webpage:

Keywords of the ERC project: stratosphere-troposphere coupling

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:
678106	**INTERTRAP**	**PE10** Earth System Science

Principal Investigator:	**Dr ALIDA IULIA GABOR**
Host Institution:	UNIVERSITATEA BABES BOLYAI - RO

Integrated absolute dating approach for terrestrial records of past climate using trapped charge methods

The practice of tuning different climate proxies prevents the observation of regional response times of terrestrial archives to global changes. Thus, it is imperative to develop correlation protocols based on absolute chronologies. Loess-palaeosol deposits are continental archives of Quaternary paleoclimates and loess is generally considered an ideal material for the application of luminescence dating. The agreement obtained for 10-20 ka ages using different techniques has given us confidence in using the state of the art measurement protocols for young deposits, as confirmed by comparison with independent age control. INTERTRAP proposes detailed investigations of loess samples from three continents collected in close proximity to the transition to the recent soil, with the purpose of obtaining a temporal quantification of the ending of the Late Tardiglacial and the beginning of the Holocene. However, a series of recent luminescence investigations carried out on quartz of different grain sizes extracted from Romanian and Serbian loess yielded severe age discrepancies for ages >~40 ka. While the cause of this observation is hitherto not fully explained, our ongoing studies on Chinese loess prove that it is a general effect, potentially affecting deposits worldwide, and raising doubts on previous chronologies. Methodological studies within INTERTRAP will develop an integrated approach using optically stimulated luminescence, thermoluminescence and electron spin resonance investigations. This part of the study aims at unravelling the mechanism responsible for the observed discrepancies and developing innovative trapped charge dating measurement protocols based on quartz that will yield reliable ages for and beyond the last interglacial glacial cycle.

Link to the ERC project webpage:

Keywords of the ERC project: luminescence dating; electron spin resonance; quartz; loess

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:
679103	**METHID**	**PE10** Earth System Science

Principal Investigator:	**Dr HEATHER GRAVEN**
Host Institution:	IMPERIAL COLLEGE OF SCIENCE TECHNOLOGY AND MEDICINE - UK

Observation and Modelling of Radiocarbon in Atmospheric Methane for Methane Source Identification

Observation and Modelling of Radiocarbon in Atmospheric Methane for Methane Source Identification
Greenhouse gas emissions are the primary cause of global climate change, and methane (CH4) is the second most important contributor after carbon dioxide (CO2). Major sources of methane are both natural (wetlands) and anthropogenic (agriculture, landfills and fossil fuels). Current efforts to assess the anthropogenic CH4 influence on climate change and the effectiveness of mitigation policies for CH4 are limited by large uncertainties in estimates of total methane emissions and their attribution to various sources by accounting-based techniques. This project will pioneer and apply innovative techniques for atmospheric observation and modelling of radiocarbon in CH4 that will enable unique quantification of fossil fuel vs. biogenic CH4 sources at regional and global scales, thereby improving the estimation and attribution of CH4 emissions of different types. The proposed work will significantly advance the frontier of current research on atmospheric methane and the characterization of anthropogenic sources on policy-relevant scales, and it has the potential to influence climate policy and industrial practices over the next 10-20 years.

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:
681818	**IMPACT**	**PE10** Earth System Science

Principal Investigator:	**Dr RAZVAN CARACAS**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FR

The giant impact and the Earth and Moon formation

Very little is understood of the physics governing the Giant Impact and the subsequent formation of the Moon. According to this model an impactor hit the proto-Earth; the resulting energy was enough to melt and partially vaporize the two bodies generating a large protolunar disk, from which the Earth-Moon couple formed. Hydrodynamic simulations of the impact and the subsequent evolution of the protolunar disk are currently based on models of equations of state and phase diagrams that are unconstrained by experiments or calculations. Estimates of the positions of critical points, when available at all, vary by one order of magnitude in both temperature and density. Here we propose to compute the thermodynamics of the major rock-forming minerals and rock aggregates, and use it to study the formation and evolution of the protolunar disk. For this we employ a unique combination of atomistic state-of-the-art ab initio simulations. We use large-scale density-functional theory (DFT) molecular dynamics to study bulk fluids, coupled with Green functions (GW) and time-dependent DFT techniques to analyze atomic clusters and molecular species. We compute the vaporization curves, position the supercritical points, and characterize the sub-critical and supercritical regimes. We construct equations of state of the rocks at the conditions of the giant impact that are beyond current experimental capabilities. We employ a multiscale approach to bridge the gap between atomic, geological sample, and planetary scales via thermodynamics; we simulate the thermal profile through the disk, the ratio between liquid and vapor, and the speciation. From speciation we predict elemental and isotopic partitioning during condensation. Plausible impact scenarios, features of the impactor and of the proto-Earth will be constrained with a feedback loop, until convergence between predictions of final Earth-Moon compositions and observations is reached.

Link to the ERC project webpage: https://moonimpact.eu/

Keywords of the ERC project: molecular dynamics, ab initio, fluids, melts, supercritical, warm dense matter

Keywords that characterize the scientific profile of the potential visiting researcher/s: density-functional theory, melts, equilibrium, thermodynamics, high-temperature, shock, impact

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
682707	**ECOHERB**	**PE10** Earth System Science

Principal Investigator:	**Dr DANIEL METCALFE**
Host Institution:	LUNDS UNIVERSITET - SE

Drivers and impacts of invertebrate herbivores across forest ecosystems globally.

Forests slow global climate change by absorbing atmospheric carbon dioxide but this ecosystem service is limited by soil nutrients. Herbivores potentially alter soil nutrients in a range of ways, but these have mostly only been recorded for large mammals. By comparison, the impacts of the abundant invertebrates in forests have largely been ignored and are not included in current models used to generate the climate predictions so vital for designing governmental policies

The proposed project will use a pioneering new interdisciplinary approach to provide the most complete picture yet available of the rates, underlying drivers and ultimate impacts of key nutrient inputs from invertebrate herbivores across forest ecosystems worldwide. Specifically, we will:

(1) Establish a network of herbivory monitoring stations across all major forest types, and across key environmental gradients (temperature, rainfall, ecosystem development).

(2) Perform laboratory experiments to examine the effects of herbivore excreta on soil processes under different temperature and moisture conditions.

(3) Integrate this information into a cutting-edge ecosystem model, to generate more accurate predictions of forest carbon sequestration under future climate change.

The network established will form the foundation for a unique long-term global monitoring effort which we intend to continue long after the current funding time scale. This work represents a powerful blend of several disciplines harnessing an array of cutting edge tools to provide fundamentally novel insights into an area of direct and urgent importance for the society.

Link to the ERC project webpage: https://www.nateko.lu.se/dan-metcalfe

Keywords of the ERC project: herbivory, terrestrial biogeochemistry, forest ecology, soil microbiology

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:
715386	**TOPIOS**	**PE10** Earth System Science

Principal Investigator:	**Dr ERIK VAN SEBILLE**
Host Institution:	UNIVERSITEIT UTRECHT - NL

Tracking Of Plastic In Our Seas

The amount of plastic in our ocean is exponentially growing, with recent estimates of more than 5 million metric tonnes of plastic reaching the ocean each year. This plastic infiltrates the ocean food chain and thus poses a major threat to marine life. However, understanding of plastic movement and its budget in the ocean is inadequate to fully establish its environmental impact, prompting the EU and G7 to recently make marine litter a top science priority.

It is now recognised that the amount of plastic entering our ocean is several orders of magnitude larger than the estimates of floating plastic on the surface of the ocean. More than 99% of plastic within our ocean is therefore 'missing'.

This project will make breakthroughs towards closing the plastic budget by creating a novel comprehensive modelling framework that tracks plastic movement through the ocean. Building on well-established previous work to follow generic water parcels through hydrodynamic ocean models, this project will modify these 'virtual' parcels to represent pieces of plastic by, for the first time, simulating fragmentation, sinking, beaching, wave-mixing and ingestion by biota.

The new parameterisations that underpin this modelling will be based on field data and new coastal flume wave tank lab experiments. The simulated plastic particles will be tracked within state-of-the-art hydrodynamic ocean models, in order to compute maps of pathways and transports around our oceans and on coastlines and in biota. This numerical modelling will be used to evaluate a broad suite of scenarios and test hypotheses, including where the risk to marine biota is greatest.

The results from this project will inform policymakers and the public on which countries, for example, are responsible for which part of the plastic problem, crucial for mitigation and legal frameworks. It will also inform engineers on where and how to best invest resources in mitigating the problem of plastic in our ocean.

Link to the ERC project webpage: topios.org

Keywords of the ERC project: marine plastic litter; ocean circulation

Keywords that characterize the scientific profile of the potential visiting researcher/s: marine plastic litter; modelling

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
725955	**GEOSTICK**	**PE10** Earth System Science

Principal Investigator:	**Dr DANIEL PARSONS**
Host Institution:	UNIVERSITY OF HULL - UK

Morphodynamic Stickiness: the influence of physical and biological cohesion in sedimentary systems

Our coasts, estuaries, & low-land river environments are some of the most sensitive systems to sea-level rise & environmental change. In order to manage these systems, & adapt to future changes, we desperately need to be able to predict how they will alter under various scenarios. However, our models for these environments are not yet robust enough to predict, with confidence, very far into the future. Moreover, we also need to improve how we use our understanding of modern environments in reconstructing paleo-environments, where significant assumptions have been made in the way in which relationships derived from the modern have been applied to ancient rocks.

One of the main reasons our models, & geological interpretations, of these environments, are not yet good enough is because these models have formulations that are based on assumptions that these systems are composed of only non-cohesive sands. However, mud is the most common sediment on Earth & many of these systems are actually dominated by biologically-active muds & complex sediment mixtures. We need to therefore find ways to incorporate the effect of sticky mud & sticky biological components into our predictions. Recent work my colleagues & I have published show just how important such abiotic-biotic interactions can be: inclusion of only relatively small (<0.1% by mass) quantities of biological material into sediment mixtures can reduce alluvial bedform size by an order of magnitude.

However, this is just a start & there is much to do in order to advance our fundamental understanding & develop robust models that predict the combined effects of abiotic & biotic processes on morphological evolution of these environments under changing drivers & conditions. GEOSTICK will deliver this advance allowing us to test how sensitive these environments are, assess if there are tipping points in their resilience & examine evidence for the evolution of life in the ancient sediments of early Earth and Mars.

Link to the ERC project webpage: https://cordis.europa.eu/project/rcn/210032_en.html

Keywords of the ERC project: Morphodynamics, Sediment, Flooding, Tidal, River, Coast, Cohesive, Microbial, Zoo-geomorphology,

Keywords that characterize the scientific profile of the potential visiting researcher/s: Modeller; Experimentalist; DNA; Geologist; Geographer; Environmental Engineer

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
741120	**COMPASS**	**PE10** Earth System Science

Principal Investigator:	**Dr KAREN HEYWOOD**
Host Institution:	UNIVERSITY OF EAST ANGLIA - UK

COMPASS: Climate-relevant Ocean Measurements and Processes on the Antarctic continental Shelf and Slope

Processes on the Antarctic continental shelf and slope are crucially important for determining the rate of future sea level rise, setting the properties and volume of dense bottom water exported globally, and regulating the carbon cycle. Yet our ability to model and predict these processes over future decades remains rudimentary. This deficiency in understanding originates in a lack of observations in this inaccessible region. The COMPASS project seeks to rectify that by exploiting new technology - autonomous marine vehicles called gliders - to observe, quantify and elucidate processes on the continental shelf and slope of Antarctica that are important for climate.

The COMPASS objective is to make a step-change in our quantitative understanding of:

(i) the ocean front that marks the boundary between the Antarctic continental shelf and the open ocean, and its associated current system;

(ii) the interaction between ocean, atmosphere and sea-ice on the Antarctic continental shelf; and

(iii) the exchange of heat, salt and freshwater with the cavities beneath ice shelves.

These goals will be met by a series of targeted ocean glider campaigns around Antarctica, spanning different flow regimes, including areas where warm water is able to access the continental shelf and influence ice shelves, areas where the continental shelf is cold and fresh, and areas where the continental shelf hosts cold, salty, dense water that eventually spills into the abyss. A unique circumpolar assessment of ocean properties and dynamics, including instabilities and mixing, will be undertaken. COMPASS will develop new technology to deploy a profiling glider into inaccessible environments such as Antarctic polynyas (regions of open water surrounded by sea-ice). As well as scientific breakthroughs that will feed into future climate assessments, improving projections of future sea level rise and global temperatures, COMPASS will deliver enhanced design for future ocean observing systems.

Link to the ERC project webpage: http://compass-erc.eu

Keywords of the ERC project: ocean; observations; Antarctic; autonomous vehicles

Keywords that characterize the scientific profile of the potential visiting researcher/s: ocean observations; oceanographer; polar scientist

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 - NO

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://uib.no/en/persons/Hans.Christian.Steen-Larsen

Keywords of the ERC project: Ice Cores, Stable Water Isotopes, Hydrological Cycle, Snow

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:
771012	**TUVOLU**	**PE10** Earth System Science

Principal Investigator:	**Dr RIIKKA RINNAN**
Host Institution:	KOBENHAVNS UNIVERSITET - DK

Tundra biogenic volatile emissions in the 21st century

Biogenic volatile organic compounds (BVOCs) influence atmospheric oxidation causing climate feedback thought to be especially significant in remote areas with low anthropogenic emissions, such as the Arctic. Still, we do not understand the dynamics and impact of climatic and biotic BVOC emission drivers in arctic and alpine tundra, which are highly temperature-sensitive BVOC sources.

TUVOLU will redefine tundra BVOC emission estimates to account for rapid and dramatic climate warming accompanied by effects of vegetation change, permafrost thaw, insect outbreaks and herbivory using multidisciplinary, established and novel methodology.

We will quantify the relationships between leaf and canopy temperatures and BVOC emissions to improve BVOC emission model predictions of emission rates in low-statured tundra vegetation, which efficiently heats up. We will experimentally determine the contribution of induced BVOC emissions from insect herbivory in the warming Arctic by field manipulation experiments addressing basal herbivory and insect outbreaks and by stable isotope labelling to identify sources of the induced emission. Complementary laboratory assessment will determine if permafrost thaw leads to significant BVOC emissions from thawing processes and newly available soil processes, or if released BVOCs are largely taken up by soil microbes. We will also use a global network of existing climate warming experiments in alpine tundra to assess how the BVOC emissions from tundra vegetation world-wide respond to climate change.

Measurement data will help develop and parameterize BVOC emission models to produce holistic enhanced predictions for global tundra emissions. Finally, modelling will be used to estimate emission impact on tropospheric ozone concentrations and secondary organic aerosol levels, producing the first assessment of arctic BVOC-mediated feedback on regional air quality and climate.

Link to the ERC project webpage:

Keywords of the ERC project: ecosystem-atmosphere exchange, arctic, climate change ecology, tundra vegetation, permafrost thaw, biogenic emission

Keywords that characterize the scientific profile of the potential visiting researcher/s: chemical ecology, biogeochemical cycles, microbial ecology, polar biology, ecosystem modelling

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
682602	**BIGSEA**	**PE10** Earth System Science

Principal Investigator:	**Dr ERIC GALBRAITH**
Host Institution:	UNIVERSITAT AUTONOMA DE BARCELONA - ES

Biogeochemical and ecosystem interactions with socio-economic activity in the global ocean

The global marine ecosystem is being deeply altered by human activity. On the one hand, rising concentrations of atmospheric greenhouse gases are changing the physical and chemical state of the ocean, exerting pressure from the bottom up. Meanwhile, the global fishery has provided large economic benefits, but in so doing has restructured ecosystems by removing most of the large animal biomass, a major top-down change. Although there has been a tremendous amount of research into isolated aspects of these impacts, the development of a holistic understanding of the full interactions between physics, chemistry, ecology and economic activity might appear impossible, given the myriad complexities. This proposal lays out a strategy to assemble a team of trans-disciplinary expertise, that will develop a unified, data-constrained, grid-based modeling framework to represent the most important interactions of the global human-ocean system. Building this framework requires solving a series of fundamental problems that currently hinder the development of the full model. If these problems can be solved, the resulting model will reveal novel emergent properties and open the doors to a range of previously unexplored questions of high impact across a range of disciplines. Key questions include the ways in which animals interact with oxygen minimum zones with implications for fisheries, the impacts fish harvesting may have on nutrient recycling, spatio-temporal interactions between managed and unmanaged fisheries, and fundamental questions about the relationships between fish price, fishing cost, and multiple markets in a changing world. Just as the first coupled ocean-atmosphere models revealed a wealth of new behaviours, the coupled human-ocean model proposed here has the potential to launch multiple new fields of enquiry. It is hoped that the novel approach will contribute to a paradigm shift that treats human activity as one component within the framework of the Earth System.

Link to the ERC project webpage: https://earthsystemdynamics.org/research/bigsea/

Keywords of the ERC project: Human-Earth coupling; numerical modeling; fisheries; ecosystems; well-being

Keywords that characterize the scientific profile of the potential visiting researcher/s: Complex systems theory; theoretical ecology; human well-being; neuroscience; biogeochemistry

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
755865	**ISOBOREAL**	**PE10** Earth System Science

Principal Investigator:	**Dr KATJA RINNE-GARMSTON**
Host Institution:	LUONNONVARAKESKUS - FI

Towards Understanding the Impact of Climate Change on Eurasian Boreal Forests: a Novel Stable Isotope Approach

The vast boreal forests play a critical role in the carbon cycle. As a consequence of increasing temperature and atmospheric CO2, forest growth and subsequently carbon sequestration may be strongly affected. It is thus crucial to understand and predict the consequences of climate change on these ecosystems. Stable isotope analysis of tree rings represents a versatile archive where the effects of environmental changes are recorded. The main goal of the project is to obtain a better understanding of δ13C and δ18O in tree rings that can be used to infer the response of forests to climate change. The goal is achieved by a detailed analysis of the incorporation and fractionation of isotopes in trees using four novel methods: (1) We will measure compound-specific δ13C and δ18O of leaf sugars and (2) combine these with intra-annual δ13C and δ18O analysis of tree rings. The approaches are enabled by methodological developments made by me and ISOBOREAL collaborators (Rinne et al. 2012, Lehmann et al. 2016, Loader et al. in prep.). Our aim is to determine δ13C and δ18O dynamics of individual sugars in response to climatic and physiological factors, and to define how these signals are altered before being stored in tree rings. The improved mechanistic understanding will be applied on tree ring isotope chronologies to infer the response of the studied forests to climate change. (3) The fact that δ18O in tree rings is a mixture of source and leaf water signals is a major problem for its application on climate studies. To solve this we aim to separate the two signals using position-specific δ18O analysis on tree ring cellulose for the first time, which we will achieve by developing novel methods. (4) We will for the first time link the climate signal both in leaf sugars and annual rings with measured ecosystem exchange of greenhouse gases CO2 and H2O using eddy-covariance techniques.

Link to the ERC project webpage: https://www.researchgate.net/project/ERC-funded-project-Towards-Understanding-the-Impact-of-Climate-Change-on-Eurasian-Boreal-Forests-a-Novel-Stable-Isotope-Approach

Keywords of the ERC project: Boreal forest, tree rings, compound-specific, CSIA, stable isotopes, carbon cycle, water cycle, sugars, starch

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:
637352	**GQCOP**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr GERARDO ADESSO**
Host Institution:	THE UNIVERSITY OF NOTTINGHAM - UK

Genuine Quantumness in Cooperative Phenomena

The proposed research programme addresses issues of fundamental and technological importance in quantum information science and its interplay with complexity. The main aim of this project is to provide a new paradigmatic foundation for the characterisation of quantumness in cooperative phenomena and to develop novel platforms for its practical utilisation in quantum technology applications.
To reach its main goal, this programme will target five specific objectives:
O1. Constructing a quantitative theory of quantumness in composite systems;
O2. Benchmarking genuine quantumness in information and communication protocols;
O3. Devising practical solutions for quantum-enhanced metrology in noisy conditions;
O4. Developing quantum thermal engineering for refrigerators and heat engines;
O5. Establishing a cybernetics framework for regulative phenomena in the quantum domain.
This project is deeply driven by the scientific curiosity to explore the ultimate range of applicability of quantum mechanics. Along the route to satisfying such curiosity, this project will fulfill a crucial two-fold mission. On the fundamental side, it will lead to a radically new level of understanding of quantumness, in its various manifestations, and the functional role it plays for natural and artificial complex systems traditionally confined to a classical domain of investigation. On the practical side, it will deliver novel concrete recipes for communication, sensing and cooling technologies in realistic conditions, rigorously assessing in which ways and to which extent these can be enhanced by engineering and harnessing quantumness.
Along with a skillful team which this grant will allow to assemble, benefitting from the vivid research environment at Nottingham, and mainly thanks to his creativity, broad mathematical and physical preparation and relevant inter-disciplinary expertise, the applicant is in a unique position to accomplish this timely and ambitious mission.

Link to the ERC project webpage: https://cordis.europa.eu/project/rcn/193486_en.html

Keywords of the ERC project: quantum information, quantum resources, quantum-classical transition

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:
647981	**3DSPIN**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr ALESSANDRO BACCHETTA**
Host Institution:	UNIVERSITA DEGLI STUDI DI PAVIA - IT

3-Dimensional Maps of the Spinning Nucleon

How does the inside of the proton look like? What generates its spin? 3DSPIN will deliver essential information to answer these questions at the frontier of subnuclear physics.
At present, we have detailed maps of the distribution of quarks and gluons in the nucleon in 1D (as a function of their momentum in a single direction). We also know that quark spins account for only about 1/3 of the spin of the nucleon.
3DSPIN will lead the way into a new stage of nucleon mapping, explore the distribution of quarks in full 3D momentum space and obtain unprecedented information on orbital angular momentum.
Goals
1. extract from experimental data the 3D distribution of quarks (in momentum space), as described by Transverse-Momentum Distributions (TMDs);
2. obtain from TMDs information on quark Orbital Angular Momentum (OAM).
Methodology
3DSPIN will implement state-of-the-art fitting procedures to analyze relevant experimental data and extract quark TMDs, similarly to global fits of standard parton distribution functions. Information about quark angular momentum will be obtained through assumptions based on theoretical considerations. The next five years represent an ideal time window to accomplish our goals, thanks to the wealth of expected data from deep-inelastic scattering experiments (COMPASS, Jefferson Lab), hadronic colliders (Fermilab, BNL, LHC), and electron-positron colliders (BELLE, BABAR). The PI has a strong reputation in this field. The group will operate in partnership with the Italian National Institute of Nuclear Physics and in close interaction with leading experts and experimental collaborations worldwide.
Impact
Mapping the 3D structure of chemical compounds has revolutionized chemistry. Similarly, mapping the 3D structure of the nucleon will have a deep impact on our understanding of the fundamental constituents of matter. We will open new perspectives on the dynamics of quarks and gluons and sharpen our view of high-energy processes involving nucleons.

Link to the ERC project webpage: http://www.hadronicphysics.it/3dspin

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:
648575	**LIVIN**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr URIEL LEVY**
Host Institution:	THE HEBREW UNIVERSITY OF JERUSALEM - IL

Light-Vapour Interactions at the Nanoscale

The goal of this research is to develop a chip scale toolkit for exploring light-vapour interactions at the nanoscale. The integration of hot vapour cells with nanophotonics technology will be used for enhancing the interaction of light with vapours and for constructing miniaturized devices. Our main objectives are: I-developing an advanced and versatile platform which allows for the construction of miniaturized devices bringing together photonics/plasmonics and atomic vapours. II-exploring the science of light-vapour interactions at the nanoscale. III–exploiting the benefits and the uniqueness of our approach for mitigating challenging applications.

Two major platforms will be studied in great details. One is based on combining vapour cells with nanoscale dielectric waveguides and resonators, while the other consists of nanoscale plasmonic structures integrated with hot vapour cells. Using these platforms, plethora of physical effects will be studied and important applications will be demonstrated. Few examples include the study of atomic transitions near surfaces, weak and strong coupling between photonic and atomic resonant systems, slow and fast light effects, nonlinear optics, frequency standards and magnetometry. The proposed approach provides unique features, e.g. high optical densities, low power consumption, well-controlled coupling and small device footprint together with true chip scale integration. For example, owing to the enhanced light-vapour interaction and the small volume of the optical mode, it allows to explore few photons-few atoms interactions, with the ultimate goal of demonstrating effects in the single photon level regime.

Given the uniqueness of our approach, the successful implementation of the proposed research should provide an outstanding playground for conducting basic and applied research in the fields of nanophotonics, plasmonics and atomic physics, and will serve as a landmark for constructing novel miniaturized quantum devices.

Link to the ERC project webpage:

Keywords of the ERC project: Chip scale light vapor interactions, nanophotonics, atomic physics, hot vapors, optoelectronic 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:
648615	**VIBRA**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr DARIO POLLI**
Host Institution:	POLITECNICO DI MILANO - IT

Very fast Imaging by Broadband coherent RAman

The VIBRA project aims at developing an innovative microscope for real-time non-invasive imaging of cells and tissues, which promises to have a revolutionary impact on several fields of biology and medicine. Chemically specific vibrational signatures of molecules enable their direct structural characterization. Reliable and quantitative endogenous bio-markers can be established, e.g., to follow cell differentiation and to identify crucial properties of tissues (malignant vs benign phenotype of a tumour). In this way neoplasms can be located and their borders with normal tissue traced for surgery.
Spontaneous Raman spectroscopy demonstrated this capability, but it is intrinsically too slow for imaging. Coherent Raman microscopy, on the other hand, can reach extremely high speed (up to the video rate) but at the expense of poor chemical selectivity, being limited to a single vibrational frequency.
The ground-breaking goal of VIBRA is to combine the most detailed molecular information over the entire vibrational spectrum with the highest acquisition speed. The PI will develop a complete coherent Raman microscope for near-video-rate broadband vibrational imaging. This high risk/high gain goal will be achieved by the combination of four key developments: improved pulsed laser source; optimized non-linear interaction, enhancing the signal; increase in acquisition speed, thanks to innovative spectrometers; parallel on-board data processing.
In the final application phase, the VIBRA project will validate the performances of the novel vibrational imaging system studying two important bio-medical problems: cancerous cell differentiation and detection of neuronal tumours. This will pave the way towards future “virtual histopathology”: intraoperative non-invasive evaluation of cancerous tissue. My vision is to allow researchers and doctors without a specific knowledge in lasers and optics to routinely visualize functional properties of cells and tissues in vivo.

Link to the ERC project webpage: www.vibra.polimi.it

Keywords of the ERC project: Raman microscopy, ultrafast 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:
648680	**DARKHORIZONS**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr MALCOLM FAIRBAIRN**
Host Institution:	KING'S COLLEGE LONDON - UK

Dark Matter and the Early Universe in the LHC Era

The discovery of a Higgs like particle in its first science run shows that we are truly in the LHC era and when collisions resume we will learn more about the physics of the TeV scale.

There are two main areas at the interface of particle physics and cosmology that the LHC will shed light on - If dark matter is a thermal relic then we naturally expect new particle physics close to this TeV energy range. The LHC will also help us learn about the nature of the electroweak sector and its behaviour during the early Universe.

In this proposal we present a body of work which will combine information from the LHC with dark matter experiments and astronomical observations to understand both the nature of dark matter and the role of the Higgs sector in the first moments after the big bang.

We will investigate dark matter by developing a new categorisation of interactions between the dark sector and the standard model. This will enable us to perform detailed collider and direct detection phenomenology in a more comprehensive way than current approaches while avoiding the problems which occur when those methods breakdown. Different schemes for mitigating against the upcoming problem of the neutrino floor in direct detection experiments will also be investigated.

Many of the keys to understanding the particle nature of dark matter lie in astrophysics, and we will develop new techniques to understand the distribution of dark matter in the Universe, its behaviour and density in distant galaxies and its velocity dispersion in the Solar system, critical to predict event rates in detectors.

We will use LHC and CMB data to answer important questions - Can the electroweak phase transition be first order? What is the role of the Higgs field during inflation? Can we use the electroweak sector to infer information about physics at high energy scale or the nature of inflation?

The interdisciplinary experience of the PI will ensure the ambitious project is a success.

Link to the ERC project webpage:

Keywords of the ERC project: Dark Matter, Cosmology, Neutrinos, Astroparticle 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:
669288	**SM-GRAV**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr ELIAS KIRITSIS**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FR

Gravity, Holography and The Standard Model

The main thrust of this proposal is to investigate implications of a recent correspondence (string theory (ST) vs. gauge theory) to the physics beyond the Standard Model (SM) and its coupling to gravity. Instead of relying on the string picture of the unification of all interactions with gravity, I propose to look at its dual version: 4d quantum field
theories (QFT). The different perspective is expected to provide 3 distinct results:
(a) A QFT view of the SM embedding in string theory
(b) Novel phenomena and properties that are hard to see in the string theory picture.
(c) A "dual" view that would be valid in non-stringy regimes.
The key idea is that gravity, as observed in nature, is emergent: it is the avatar of a (hidden) large-N (near) CFT that is interacting with the SM at high energy (the Planck scale). Such an approach provides an appealing UV completion to the SM+gravity: a UV complete four-dimensional QFT. There are, however, many questions that need to be
addressed in order for this setup to be a viable physical theory:
1. Why is the gravitational force four-dimensional (instead of higher-dimensional as suggested by standard holography)?
2. Why does the coupling of the gravitational force to the SM satisfy the equivalence principle to such a high accuracy?
3. What are other universal interactions with the SM model implied in this picture? What are their phenomenological consequences?
4. How can one construct, precise and controllable models for this setup?
5. How is Cosmology emerging in this picture? How do the important problems associated with it get resolved?
SM-GRAV will address all of the above questions using the tools of QFT, of string theory and the AdS-CFT correspondence. The outcome of the proposed research is expected to be a concrete and quantitative model/scenario for the emergence and coupling of the "gravitational sector fields" to the SM model and the novel phenomenological implications for particle physics and cosmology.

Link to the ERC project webpage: http://hep.physics.uoc.gr/erc/index.php

Keywords of the ERC project: Gravity, emergent garvity, beyond SM physics, holography, dark energy, emergent axions

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:
681208	**SIRPOL**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr HANS PETER BÜCHLER**
Host Institution:	UNIVERSITAET STUTTGART - DE

Strongly interacting Rydberg slow light polaritons

A fundamental property of optical photons is their extremely weak interactions, which can be ignored for all practical purposes and applications. This phenomena forms the basis for our understanding of light and is at the heart for the rich variety of tools available to manipulate and control optical beams. On the other hand, a controlled and strong interaction between individual photons would be ideal to generate non-classical states of light, prepare correlated quantum states of photons, and harvest quantum mechanics as a new resource for future technology. Rydberg slow light polaritons have recently emerged as a promising candidate towards this goal, and first experiments have demonstrated a strong interaction between individual photons. The aim of this project is to develop and advance the research field of Rydberg slow light polaritons with the ultimate goal to generate strongly interacting quantum many-body states with photons. The theoretical analysis is based on a microscopic description of the Rydberg polaritons in an atomic ensemble, and combines well established tools from condensed matter physics for solving quantum many-body systems, as well as the inclusion of dissipation in this non-equilibrium problem. The goals of the present project addresses questions on the optimal generation of non-classical states of light such as deterministic single photon sources and Schrödinger cat states of photons, as well as assess their potential for application in quantum information and quantum technology. In addition, we will shed light on the role of dissipation in this quantum many-body system, and analyze potential problems and fundamental limitations of Rydberg polaritons, as well as address questions on equilibration and non-equilibrium dynamics. A special focus will be on the generation of quantum many-body states of photons with topological properties, and explore novel applications of photonic states with topological properties.

Link to the ERC project webpage:

Keywords of the ERC project: Rydberg polaritons, Strongly correlated many-body states of light, topological states of 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:
683107	**TempoQ**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr OTFRIED GUEHNE**
Host Institution:	UNIVERSITAET SIEGEN - DE

Temporal Quantum Correlations

Correlations are central for our modern view on the foundations of quantum theory and applications like quantum information processing. So far, research concentrated on correlations between two or more particles. Indeed, for this situation it is well established that spatial quantum correlations are a useful resource for tasks like quantum cryptography and quantum metrology. There are, however, other types of correlations in quantum mechanics, which arise if a sequence of measurements on a single quantum system is made. These temporal quantum correlations have recently attracted attention, because they are central for the understanding of some differences between the quantum and the classical world. Moreover, due to experimental progress their observation has become feasible with trapped ions, polarized photons, or other quantum optical systems.

This project aims at a full understanding and characterization of temporal quantum correlations. For that, we will derive criteria and measures for temporal quantum correlations and investigate their connection to information theory. Then, we will elucidate to which extent temporal correlations can be used to prove that a system is quantum and not classical. Finally, we consider implementations of temporal quantum correlations using continuous variable systems like nanomechanical oscillators and applications in quantum information processing.

Link to the ERC project webpage: http://www.physik.uni-siegen.de/tqo

Keywords of the ERC project: Quantum Information Theory, Foundations of Quantum Mechanics

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:
695088	**InPairs**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr LUIS SILVA**
Host Institution:	INSTITUTO SUPERIOR TECNICO - PT

In Silico Pair Plasmas: from ultra intense lasers to relativistic astrophysics in the laboratory

How do extreme electromagnetic fields modify the dynamics of matter? Will quantum electrodynamics effects be important at the focus of an ultra intense laser? How are the magnetospheres of compact stellar remnants formed, and can we capture the physics of these environments in the laboratory? These are all longstanding questions with an overarching connection to extreme plasma physics.
Electron-positron pair plasmas are pervasive in all these scenarios. Highly nonlinear phenomena such as QED processes, magnetogenesis, radiation, field dynamics in complex geometries, and particle acceleration, are all linked with the collective dynamics of pair plasmas through mechanisms that remain poorly understood.
Building on our state-of-the-art models, on the availability of enormous computational power, and on our recent transformative discoveries on ab initio modelling of plasmas under extreme conditions, the time is ripe to answer these questions in silico. InPairs aims to understand the multidimensional dynamics of electron-positron plasmas under extreme laboratory and astrophysical fields, to determine the signatures of the radiative processes on pair plasmas, and to identify the physics of the magnetospheres of compact stellar remnants, focusing on the electrodynamics of pulsars, that can be mimicked in laboratory experiments using ultra high intensity lasers and charged particle beams.
This proposal relies on massively parallel simulations to bridge the gap, for the first time, between the pair plasma creation mechanisms, the collective multidimensional microphysics, and their global dynamics in complex geometries associated with laboratory and astrophysical systems. Emphasis will be given to detectable signatures e.g. radiation and accelerated particles, with the ultimate goal of solving some of the central questions in extreme plasma physics, thus opening new connections between computational studies, laboratory experiments, and relativistic plasma astrophysics.

Link to the ERC project webpage: http://epp.tecnico.ulisboa.pt/

Keywords of the ERC project: Extreme plasma physics, massively parallel simulations, relativistic astrophysics, intense laser-plasma interactions, laboratory astrophysics

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:
714118	**TRAPLAB**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr GUY RON**
Host Institution:	THE HEBREW UNIVERSITY OF JERUSALEM - IL

Lab Based Searches for Beyond Standard Model Physics Using Traps

In this project I will measure a critical constant (beta-nu correlation) of the standard model to a precision of at least 0.1%, an order of magnitude improvement over the state of the art. The project will provide a platform for beyond standard-model (BSM) explorations, based on modern atom/ion trapping and a new accelerator facility.

High precision measurements of beta decay correlations in trapped radioactive atoms and ions are one of the most precise tools with which to search for BSM physics. The recently published US National Science Advisory Council 2015 Long Range Plan states: ``Measurements of the decays of neutrons and nuclei provide the most precise and sensitive characterization of the charge-changing weak force of quarks and are a very sensitive probe of yet undiscovered new forces. In fact, weak decay measurements with an accuracy of 0.1% or better provide a unique probe of new physics at the TeV energy scale``. Ne and He isotopes are particularly attractive due to calculable SM values, high sensitivity to several manifestations of BSM physics, ease of production, and lifetimes in the useful range for such experiments.

This program combines a Magneto-Optical Trap (MOT) and an Electrostatic Ion Beam Trap (EIBT) to perform a high-precision, competitive, measurement of correlations in the decay of such nuclei. The MOT program focuses on the neon isotopes, where existing measurements are of insufficient quality, and have unique sensitivities to aspects of BSM physics. The EIBT program focuses on measurements using 6He (where a comparison with existing measurements is of great import) and the aforementioned neon isotopes, allowing a direct comparison between the two systems within the same facility (a unique worldwide capability). The combination of these methods will allow an extraction of the beta-nu coefficient to the 0.1% level, making this proposal a forerunner in the field, which will provide a leap-step in the current set of world data.

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:
714626	**BinGraSp**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr SEBASTIANO BERNUZZI**
Host Institution:	FRIEDRICH-SCHILLER-UNIVERSITAT JENA - DE

Modeling the Gravitational Spectrum of Neutron Star Binaries

The most energetic electromagnetic phenomena in the Universe are believed to be powered by the collision of two neutron stars, the smallest and densest stars on which surface gravity is about 2 billion times stronger than gravity on Earth. However, a definitive identification of neutron star mergers as central engines for short-gamma-ray bursts and kilonovae transients is possible only by direct gravitational-wave observations. The latter provide us with unique information on neutron stars' masses, radii, and spins, including the possibility to set the strongest observational constraints on the unknown equation-of-state of matter at supranuclear densities.

Neutron stars binary mergers are among the main targets for ground-based gravitational-wave interferometers like Advanced LIGO and Virgo, which start operations this year. The astrophysical data analysis of the signals emitted by these sources requires the availability of accurate waveform models, which are missing to date. Hence, the theoretical understanding of the gravitational spectrum is a necessary and urgent step for the development of a gravitational-based astrophysics in the next years.

This project aims at developing, for the first time, a precise theoretical model for the complete gravitational spectrum of neutron star binaries, including the merger and postmerger stages of the coalescence process. Building on the PI's unique expertise and track record, the proposed research exploits synergy between analytical and numerical methods in General Relativity. Results from state of the art nonlinear 3D numerical relativity simulations will be combined with the most advanced analytical framework for the relativistic two-body problem. The model developed here will be used in the first gravitational-wave observations and will dramatically impact multimessenger astrophysics.

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:
716651	**NEDM**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr GUILLAUME PIGNOL**
Host Institution:	UNIVERSITE GRENOBLE ALPES - FR

The Neutron Electric Dipole Moment: pushing the precision to understand the matter-antimatter asymmetry

The existence of a permanent electric dipole moment (EDM) of the neutron, or any subatomic particle, would have far reaching implications connecting particle physics with cosmology. Time reversal invariance and CP symmetry would be violated. A new fundamental interaction producing the EDM, that is, deforming the charge distribution inside the neutron, could also have generated the matter-antimatter asymmetry in the early Universe. After 60 years of evolution, techniques to measure the neutron EDM are now so evolved that experiments are sensitive to microphysics associated with an energy scale beyond that accessible at the LHC. This situation offers a high likelihood of discovery for the next generation of experiments. In the same time, any improvement in precision is technically challenging. The control of the magnetic field must surpass that of the state of the art of atomic magnetometers. The n2EDM project aims at improving the precision by an order of magnitude or more. Systematic effects need to be controlled at an unprecedented level. In particular, the use of a mercury co-magnetometer based on the precession of 199Hg spins induces a set of subtle false effects due to the relativistic motional field.

I propose to initiate a comprehensive program to master these systematic effects beyond the current research program. In particular, the proposed project includes a precise determination of the 199Hg magnetic moment with a precision of 0.1 ppm. To this end, I will attempt a novel approach: combining mercury and 4He magnetometry in the same cell. As a by-product, this will also produce an improved determination of the neutron magnetic moment, a quantity of interest for metrology. The cross-check I propose will prove that all disturbances on the neutron or mercury spins are mastered at the sub-ppm level, a decisive step in the quest for the neutron EDM.

Link to the ERC project webpage: http://lpsc.in2p3.fr/index.php/en/groupes-de-physique/des-particules-aux-noyaux/ucn/nedm

Keywords of the ERC project: neutron magnetometry

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:
724704	**HIGCC**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr ALEXANDER SCHMIDT**
Host Institution:	RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN - DE

Search for Higgs bosons decaying to charm quarks

In the standard model of particle physics (SM), the Higgs boson explains the existence of mass of the elementary particles. However, the model suffers from severe weaknesses: radiative corrections drive the theoretical mass of the Higgs boson to extremely high, unnatural values, while the observed mass is rather low (the famous hierarchy problem). Unknown mechanisms of physics beyond the standard model (BSM) must exist to avoid this unnatural situation. Such BSM mechanisms modify the predicted properties and decay patterns of the Higgs boson. The experimental collaborations at the LHC are measuring these decay patterns as precisely as possible.

The decay of the Higgs boson into bottom quarks is dominant with a predicted decay fraction of 57%. Neither this nor the subdominant decay into charm quarks of 2.9% have ever been observed. The small decay fraction into charm quarks makes it susceptible to BSM modifications, if they exist. A measurement of this charm decay fraction would either unravel new physics that has been sought for more than 60 years, or constrain BSM scenarios to enhance the understanding of the fundamental theory of matter.

However, the decay of the Higgs boson into charm quarks has been considered to be experimentally inaccessible at the LHC, because of the difficulties to distinguish charm quarks from other quarks. In this proposal I will show how to overcome these experimental obstacles with new methods for the detection of charm quarks in the CMS detector. The new methods will be based on decay vertex reconstruction algorithms that make use of modern pattern recognition concepts. In combination with new techniques for data analysis and interpretation, this will facilitate the first observation of the Higgs to charm decay, and the measurement of its branching fraction, if it is anomalously enhanced through BSM contributions. With this strategy the first indication for physics beyond the standard model may be found.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: Higgs boson, CMS Experiment, CERN Large Hadron Collider

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
724707	**PINQS**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr WOLFRAM PERNICE**
Host Institution:	WESTFAELISCHE WILHELMS-UNIVERSITAET MUENSTER - DE

Photonic integrated quantum transceivers

Quantum processors are envisioned to conquer ultimate challenges in information processing and to enable simulations of complex physical processes that are intractable with classical computers. Among the various experimental approaches to implement such devices, scalable technologies are particularly promising because they allow for the realization of large numbers of quantum components in circuit form. For upscaling towards functional applications distributed systems will be needed to overcome stringent limitations in quantum control, provided that high-bandwidth quantum links can be established between the individual nodes. For this purpose the use of single photons is especially attractive due to compatibility with existing fibre-optical infrastructure. However, their use in replicable, integrated optical circuits remains largely unexplored for non-classical applications.

In this project nanophotonic circuits, heterogeneously integrated with superconducting nanostructures and carbon nanotubes, will be used to realize scalable quantum photonic chips that overcome major barriers in linear quantum optics and quantum communication. By relying on electro-optomechanical and electro-optical interactions, reconfigurable single photon transceivers will be devised that can act as broadband and high bandwidth nodes in future quantum optical networks. A hybrid integration approach will allow for the realization of fully functional quantum photonic modules which are interconnected with optical fiber links. By implementing quantum wavelength division multiplexing, the communication rates between individual transceiver nodes will be boosted by orders of magnitude, thus allowing for high-speed and remote quantum information processing and quantum simulation. Further exploiting recent advances in three-dimensional distributed nanophotonics will lead to a paradigm shift in nanoscale quantum optics, providing a key step towards optical quantum computing and the quantum internet.

Link to the ERC project webpage: https://www.uni-muenster.de/Physik.PI/Pernice/

Keywords of the ERC project: Quantum Photonics, Sinlge photon detection

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:
756966	**CounterLIGHT**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr PASCAL DEL HAYE**
Host Institution:	NPL MANAGEMENT LIMITED - UK

Interaction and Symmetry Breaking of Counterpropagating Light

Light is generally expected to travel through media independent of its direction. Exceptions can be achieved through polarization changes induced by magnetic fields (known as the Faraday effect) together with polarization-sensitive birefringent materials. However, light can also be influenced by the presence of a counterpropagating light wave. We have recently shown that this leads to the surprising consequence that light sent into tiny glass rings (microresonators) can only propagate in one direction, clockwise or counterclockwise, but not in both directions simultaneously. When sending exactly the same state of light (same power and polarization) into a microresonator, the interaction induces a spontaneous symmetry breaking in the propagation of light. In this proposal we plan to investigate the fundamental physics and a variety of ground-breaking applications of this effect. In one proposed application, this effect will be used for optical nonreciprocity and the realization of optical diodes in integrated photonic circuits that do not rely on magnetic fields (an important key element in integrated photonics). In another proposed experiment we plan to use the spontaneous symmetry breaking to demonstrate microresonator-based optical gyroscopes that have the potential to beat state-of-the-art sensors in both size and sensitivity. Additional research projects include experiments with all-optical logic gates, photonic memories, and near field sensors based on counterpropagating light states. Finally, we plan to demonstrate a microresonator-based system for the generation of dual-optical frequency combs that can be used for real-time precision spectroscopy in future lab-on-a-chip applications. On the fundamental physics side, our experiments investigate the interaction of counterpropagating light in a "box" with periodic boundary conditions. The fundamental nature of this system has the potential to impact other fields of science far beyond optical physics.

Link to the ERC project webpage: www.microphotonics.net

Keywords of the ERC project: Photonics, Optics, Microresonator, Laser, Nonlinear Optics, Frequency Comb

Keywords that characterize the scientific profile of the potential visiting researcher/s: Photonics, Optics, Microresonator, Laser, Nonlinear Optics, Frequency Comb

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
757646	**NewPhysLat**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr ANTONIN PORTELLI**
Host Institution:	THE UNIVERSITY OF EDINBURGH - UK

Search for new physics through lattice simulations

Despite its monumental success, we have reason to think that the Standard Model of particle physics is an effective description of a more fundamental theory. In order to maximise the chances of success of experiments to pinpoint the breakdown of this theory, it is crucial to provide precise, ab-initio theoretical predictions to compare it with. One of the main challenges in producing these predictions is to reliably take account of the non-perturbative, confining phase of the strong interaction. So far, the most efficient way to achieve that is to use numerical lattice simulations. In this proposal, I focus on theoretical quantities involved in the search for new physics and propose an ambitious lattice simulation programme to determine them precisely. Firstly, I propose to predict rare kaon decays amplitudes. These decays are extremely rare in the Standard Model and are expected to be sensitive to new physics. Secondly, I propose to determine how to include isospin breaking effects in the calculation of the anomalous magnetic moment of the muon and meson leptonic and semi-leptonic decay rates. Including these effects is a highly non-trivial task which is necessary to push the theoretical precision of these observables beyond the percent level in order to provide a higher constraint on the Standard Model. Thirdly, I propose to explore holographic cosmology, an ambitious and innovative alternative to ΛCDM, the "standard model" of cosmology. Finally, all these projects will directly contribute to the development of Grid, the emerging world-leading software solution for lattice simulations. All these projects are strongly pushing the boundaries of the application of lattice simulations and the results will be confronted with experimental measurements within the next five years. This proposal focuses on supporting world-leading particle physics experiments and I will deliver high-impact results which have the potential to uncover new physics beyond the Standard Model.

Link to the ERC project webpage:

Keywords of the ERC project: particle physics, cosmology, lattice simulations, lattice field theory, lattice QCD, theoretical 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:
758759	**HHQM**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr BLAISE GOUTÉRAUX**
Host Institution:	ECOLE POLYTECHNIQUE - FR

Hydrodynamics, holography and strongly-coupled quantum matter

The dynamics of weakly-coupled quantum matter can be solved by techniques deriving from perturbative quantum field theory. Conventional metals are described by long-lived quasiparticles (Fermi liquids). No such methods are available for strongly-coupled quantum matter where quasiparticles are short-lived, like the Quark-Gluon-Plasma, high Tc superconductors (HTCs) or graphene near the charge neutrality point.

In HTCs, it has been argued the interaction timescale is the fastest scale in the system, which warrants a hydrodynamic description. In a recent series of remarkable theoretical and experimental developments, hyrodynamics signatures have been discovered in several strongly-coupled quantum systems such as graphene, delafossites and HTCs. Further theoretical progress is impeded by the lack of symmetry: momentum is only approximately conserved, which complicates the use of hydrodynamics as an effective low-energy theory; and the strange metallic phenomenology of HTCs, believed to originate from a quantum critical point, is not captured by conventional scaling arguments. New ideas are required to move beyond the current state of the art.

Gauge/Gravity duality is a radically new approach which links a relativistic strongly-coupled quantum field theory to a classical theory of gravity. The hydrodynamic regime of the QGP has been very successfully described by these methods, which predict a shear viscosity very close to experimental values.

Our focus in this proposal is to use holography to consistently model hydrodynamics with momentum relaxation and study its interplay with unconventional quantum criticality. This is crucial for a better understanding of the phenomenology in strongly-coupled quantum matter. As many systems are not relativistic, we will also consider hydrodynamics in non-relativistic holographic theories, thus enhancing our understanding of holographic dualities beyond the original Anti de Sitter/Conformal Field Theory correspondence.

Link to the ERC project webpage: https://www.cpht.polytechnique.fr/?q=en/node/324

Keywords of the ERC project: Gauge/Gravity duality; Hydrodynamics; Strongly-coupled quantum matter; Transport

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:
758794	**Q-ROOT**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr PIERRE VERLOT**
Host Institution:	THE UNIVERSITY OF NOTTINGHAM - UK

Quantum optomechanics at ROOm Temperature

5 years ago, the field of optomechanics has entered the quantum regime. By doing so, this domain which investigates the reciprocal interactions between light and mechanical motion has overcome the long-standing paradox of Quantum Mechanical effects at the macroscopic scale. Such outstanding achievement relies on the so-called "cavity nano-optomechanical" technology, which combines strongly reduced dimensions with ultra-high optical confinement, enabling very large optomechanical coupling rates at the nanoscale.
In a more fundamental perspective, decreasing the size of optomechanical systems has enabled minimizing the detrimental effects of decoherence, resulting in a quasi-instantaneous collapse of quantum coherence at a macroscopic scale. At present, optomechanical systems seem to have reached their limits at cryogenic temperatures and remain overly sensitive to decoherence at room temperature to display any quantum behaviour.
The project Q-ROOT proposes a novel cavity optomechanical approach showing such unprecedentedly large coupling rates that it will operate in the quantum regime at room temperature for the first time. Our concept relies on tethering a low-loss nano-optical scatterer at the edge of the lightest possible mechanical device that is a carbon nanotube resonator. This system is expected to outperform the state-of-the-art (including atom–based systems) by orders of magnitude, even at room temperature. Amongst objectives, Q-ROOT notably plans to demonstrate ground-state cooling, strong ponderomotive squeezing, the standard quantum limit, quantum non-demolition of mechanical Fock states, and optomechanical photon blockade at room temperature. Besides very fundamental impact, the unique sensing abilities of the system developed in Q-ROOT will be further utilized in order to perform quantum limited sensing applications at room temperature, paving a generalized use of optomechanics for quantum sensing and information technology at room temperature.

Link to the ERC project webpage:

Keywords of the ERC project: Cavity optomechanics; nano-optomechanics; quantum optomechanics; NEMS

Keywords that characterize the scientific profile of the potential visiting researcher/s: ultra-sensitive measurement; micro-nanophotonics; cavity optomechanics; NEMS

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
771417	**RYD-QNLO**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr SEBASTIAN HOFFERBERTH**
Host Institution:	SYDDANSK UNIVERSITET - DK

Quantum nonlinear optics through Rydberg interaction

Optical photons, for all practical purposes, do not interact. This fundamental property of light forms the basis of modern optics and enables a multitude of technical applications in our every-day life, such as all-optical communication and microscopy. On the other hand, an engineered interaction between individual photons would allow the creation and control of light photon by photon, providing fundamental insights into the quantum nature of light and allowing us to harness non-classical states of light as resource for future technology. Mapping the strong interaction between Rydberg atoms onto individual photons has emerged as a highly promising approach towards this ambitious goal. In this project, we will advance and significantly broaden the research field of Rydberg quantum optics to develop new tools for realizing strongly correlated quantum many-body states of photons. Building on our successful work over recent years, we will greatly expand our control over Rydberg slow-light polaritons to implement mesoscopic systems of strongly interacting photons in an ultracold ytterbium gas. In parallel, we will explore a new approach to strong light-matter coupling, utilizing Rydberg superatoms made out of thousands of individual atoms, strongly coupled to a propagating light mode. This free-space QED system enables strong coupling between single photons and single artificial atoms in the optical domain without any confining structures for the light. Finally, we will experimentally realize a novel quantum hybrid system exploiting the strong electric coupling between single Rydberg atoms and piezo-electric micro-mechanical oscillators. Building on this unique coupling scheme, we will explore Rydberg-mediated cooling of a mechanical system and dissipative preparation of non-classical phonon states. The three complementary parts ultimately unite into a powerful Rydberg quantum optics toolbox which will provide unprecedented control over single photons and single phonons.

Link to the ERC project webpage: nqo.sdu.dk

Keywords of the ERC project: Quantum optics, Rydberg atoms, ultracold atoms

Keywords that characterize the scientific profile of the potential visiting researcher/s: experimental physics, cold atoms, optics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
788781	**IAXOplus**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr IGOR GARCIA IRASTORZA**
Host Institution:	UNIVERSIDAD DE ZARAGOZA - ES

Towards the detection of the axion with the International Axion Observatory

The nature of the Dark Universe is an outstanding question in modern science, and is connected with our understanding of the reality at the most fundamental level. Despite the enormous success of the Standard Model (SM) of particle physics, a number of shortcomings of the theory and the fact that it does not account for the Dark Matter and Energy, prompt theorists to propose possible hypothetical extensions.

Some of these extensions predict the existence of very-light and very-weakly-coupled axions (or axion-like particles, ALPs). Recent theoretical and phenomenological work is sharpening the physics case of these particles. They are now considered as very motivated portals for physics beyond the SM, and in particular as very plausible Dark Matter candidates. In addition, some intriguing astrophysical observations might be interpreted as hints for their existence.

The International Axion Observatory IAXO is one of the most ambitious proposals to find the axion. Its baseline configuration relies on the search for solar axions, but could also host relic axion detectors. IAXO will go well beyond current experiments' sensitivity and will probe a large fraction of the -still unexplored- parameter space of the axion and ALPs. The scope of the present proposal encompasses the realization of a first complete intermediate experimental stage, BabyIAXO, including prototypes of the IAXO magnet and detection systems. It will already provide relevant physics outcome in the time-frame of the current grant, while preparing the ground for, and extending the physics reach of, the full IAXO. In particular, BabyIAXO will already be able to test a number of axion and ALP models that are invoked by the aforementioned astrophysical hints and therefore already at this stage there is potential for discovery. The detection of a new fundamental pseudoscalar -potentially solving the DM problem- would lead to a breakthrough in Particle Physics, Cosmology and Astrophysics.

Link to the ERC project webpage: http://iaxo.web.cern.ch/; http://gifna.unizar.es/cast/

Keywords of the ERC project: axions; dark matter; time projection chamber; Micromegas; low background techniques

Keywords that characterize the scientific profile of the potential visiting researcher/s: particle detectors; dark matter or axion phenomenology; low background techniques; instrumentation

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
682474	**SOLID**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr ANTONIN VACHERET**
Host Institution:	IMPERIAL COLLEGE OF SCIENCE TECHNOLOGY AND MEDICINE - UK

Search for a new form of matter: the sterile neutrino

The goal of this proposal is to search for an entirely new kind of matter. This type of matter called a sterile neutrino doesn't interact with known particles and can only manifest itself through quantum mixing with the three neutrinos of the standard model, the prevailing theory of particle physics. The known neutrinos are by far the most abundant massive particles in the Universe. More than 70 years after the postulation of the existence of the neutrino, its nature and fundamental properties remain, paradoxically, poorly known. The discovery of the quantum mixing of neutrinos: neutrino oscillations, was a major surprise as it implied that neutrinos have mass which they do not have in the standard model. In this context the existence of a sterile neutrino is a natural extension but the discovery of this new state of matter would a profound challenge for the theory to explain. Several new anomalous experimental results have appeared which could be accounted for by the presence of a light sterile neutrino but each result taken separately is not statistically significant. New oscillation patterns in the neutrino energy spectrum would be a clear signature of the new state but are difficult to measure due to experimental and background limitations. We propose the most sensitive search to date for this oscillation signature using two key assets:
The SCK•CEN BR2 reactor which offers a unique low background environment combined with a novel detector technology invented by the PI capable of discriminating signal and background with greater sensitivity that any previous technique. We present an experimental program that includes the construction of a detector module and its precise calibration, the programming of a new type of electronic trigger and implementation of state of the art reconstruction techniques and analysis. The results that this proposal will deliver are far reaching both in science and in the development of a new technology for detecting anti-neutrinos.

Link to the ERC project webpage: http://solid-experiment.org

Keywords of the ERC project: reactor antineutrino, sterile neutrino, LiFZnS, scintillation, neutron capture

Keywords that characterize the scientific profile of the potential visiting researcher/s: neutrino oscillation fit, reactor antineutrino flux measurement, Geant4, neural networks

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
694896	**NuBSM**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr MIKHAIL SHAPOSHNIKOV**
Host Institution:	ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE - CH

From Fermi to Planck : a bottom up approach

The Standard Model of particle physics is a hugely successful theory that has been tested in experiments at ever increasing energies, culminating in the recent discovery of the Higgs boson. Nevertheless, some major riddles cannot be addressed by the Standard Model, such as neutrino oscillations, the existence of Dark Matter, the absence of antimatter in the Universe. New fundamental principles, interactions and unknown yet particles are required to address these questions. Much of the research done during the last three decades on physics 'beyond the Standard Model' (BSM) has been driven by attempts to find a 'natural' solution of the hierarchy problem: why the Planck and the electroweak scales are so different. The most popular approaches to this problem predict new particles with the masses right above the electroweak scale.

This project explores an alternative idea that the absence of new particles with masses between the electroweak and Planck scales, supplemented by extra symmetries (such as scale invariance) may itself explain why the mass of the Higgs boson is much smaller than the Planck mass. This calls for a solution of the BSM problems by extremely feebly interacting particles with masses below the electroweak scale. Along the same lines we also explore the possibility that cosmological inflation does not require a new field, but is driven by the Higgs field of the Standard Model.

The proposed model offers solutions for BSM puzzles and is among a few ones that can be tested with existing experimental technologies and are valid even if no evidence for new physics is found at the LHC.

Constructing such a theory requires consolidated efforts in domains of high-energy theory, particle physics phenomenology, physics of the early Universe, cosmology and astrophysics as well as analyses of the available data from previous experiments and from cosmology. We will make predictions and establish the sensitivity goals for future high intensity experiments.

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:
726276	**PUMA**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr ALEXANDRE OBERTELLI**
Host Institution:	TECHNISCHE UNIVERSITAT DARMSTADT - DE

antiProton Unstable Matter Annihilation

One of the most fascinating quantum phenomena in nuclear physics is the occurrence of neutron halos and neutron skins in very neutron rich atomic nuclei. Thick neutron skins and halos, not yet evidenced in medium mass nuclei, would be unique low-density neutron matter accessible in the laboratory. Nuclear shell structure is also known to change with the number of protons and neutrons. The nuclear structure of very heavy nuclei at and above Z=100 is barely known, and the existence of new long-lived heavy isotopes is still an open question. The above fundamental phenomena related to the unbalance of neutron and protons in unstable nuclei are essential to understand the complex nature of nuclei and related astrophysical processes.
We propose a new physics program to determine the neutron over proton densities at the nuclear surface for the most exotic nuclei that can be produced today, to evidence and to characterize neutron halos and skins in medium and heavy mass regions. PUMA will also allow the spectroscopy of single-particle states in heavy-nuclei above Z=100 will offer a new insight into the unknown shell structure at the top of the nuclear landscape. To address these questions, PUMA explores a new way to study radioactive nuclei produced at very low kinetic energy: the interaction of antiprotons with unstable nuclei.
PUMA is based on a new apparatus: a transportable magnetic trap to store antiprotons and maximize their interaction with slow rare isotopes in order to trigger annihilations and measure the following radiations. The PUMA methodology is based on two steps. (i) The storage of antiprotons will be performed at the new AD/ELENA facility of CERN in collaboration with the GBAR collaboration. (ii) The PUMA physics program is to take place at CERN/ISOLDE and, on a later stage beyond the ERC grant period, at the new SPIRAL2 facility in Europe. PUMA will open new horizons for nuclear structure research.

Link to the ERC project webpage:

Keywords of the ERC project: antimatter, nuclear physics, Penning trap, ultra-high vacuum

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:
740006	**NNNPDF**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr STEFANO FORTE**
Host Institution:	UNIVERSITA DEGLI STUDI DI MILANO - IT

Proton strucure for discovery at the Large Hadron Collider

The objective of this project is to revolutionize the way the structure of the proton is accessed, determined, and used in the computation of physical processes at hadron colliders such as the Large Hadron Collider (LHC) of CERN. At a hadron accelerator, predictions require a precise, detailed, and accurate description and understanding of the structure of the colliding protons, as encoded in parton distributions (PDFs) - the distributions of quarks and gluons. At the LHC, PDFs are at present the major source of uncertainty, and in the near future they will be the main hurdle for discovery. The vision of this project is to remove this hurdle by attacking the problem using recent results from artificial intelligence (AI). I will lead a research team of two staff scientists, four postdocs and three PhD students, who will apply to PDF determination the recent methods of deep reinforcement learning and Q-learning, which will be coupled with deep residual networks to achieve a fully parameter- and bias-free understanding of proton structure. I will bring into high-energy physics a methodology so far used for object recognition in self-driving cars and automatic game playing, leading both to new physics, and new computational techniques. The application of these techniques to PDFs will enable me to reach two secondary goals. The first is theoretical: the full use for PDF determination of recent high perturbative order (next-to-next-to leading order or NNLO) computations, which will be integrated by means of a new approximation method which relies on combining known exact results with all-order information in various kinematic limits to extend the scope of the former to a more detailed ("more exclusive") description of the final state.The second is phenomenological: the integration in PDF determination of the Monte-Carlo event generators which are used to turn field theoretical prediction into a realistic description which may be directly compared to experimental data.

Link to the ERC project webpage: http://n3pdf.mi.infn.it/

Keywords of the ERC project: LHC QCD parton distributions machine 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:
786306	**PREMOL**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr STEPHAN SCHILLER**
Host Institution:	HEINRICH-HEINE-UNIVERSITAET DUESSELDORF - DE

At the crossroad of molecular physics, quantum optics and spectroscopy: ultra-high-precision molecular spectroscopy for fundamental physics

Molecules have an enormous potential in the field of frequency metrology-based fundamental physics, yet have so far not played an important role, due to difficult experimental challenges. The goal of this project is to overcome these difficulties by developing new techniques, thus opening a new chapter in precision molecular spectroscopy. Furthermore, it will have far-reaching impact in fundamental physics:
(1) A 500-fold improved limit to the existence of a “fifth force” with range on the 0.1 nm scale.
(2) An independently determined set of the fundamental constants me/mp, me/md, and the Rydberg constant R∞. Their uncertainties will be reduced compared to CODATA2014 by up to a factor of 23 for me/mp, 4 for me/md, and 2 for R∞;
(3) A test of the current muonic atom discrepancies of proton and deuteron charge radii rp and rd at the 30% and 50% level, respectively;
(4) Achieve a precision 1×10-16 in molecular ion spectroscopy, thus exploring the feasibility of using, in the future, molecular ions for testing the time-dependence of me/mp and mp/md.
Molecular hydrogen ions (MHIs) are the systems in principle suitable for providing these results: indeed, the required ab initio theory has made outstanding advances, reaching the 8×10-12 inaccuracy level. To date, experimental results are orders of magnitude less precise.
In order to achieve an accuracy surpassing the theoretical one, this project shall develop new quantum optical techniques, including:
- Doppler-free spectroscopy, rotational and ro-vibrational;
- preparation of a single molecular ion in a single internal quantum state;
- resolution and control of systematic shifts at levels from 1×10-12 to 1×10-16;
- novel spectroscopy laser systems.
These techniques will be of general applicability in the field of molecular ion spectroscopy.
The proposed work is based on the wide experience of the PI in precision measurements and will make a strong and overdue contribution to spectroscopy and fundamental physics.

Link to the ERC project webpage:

Keywords of the ERC project: cold molecules, precision spectroscopy, quantum electrodynamics, fundamental constants, Rydberg constant, electron mass, proton mass, 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:
677513	**BioMNP**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr GIULIA ROSSI**
Host Institution:	UNIVERSITA DEGLI STUDI DI GENOVA - IT

Understanding the interaction between metal nanoparticles and biological membranes

The BioMNP objective is the molecular-level understanding of the interactions between surface functionalized metal nanoparticles and biological membranes, by means of cutting-edge computational techniques and new molecular models.

Metal nanoparticles (NP) play more and more important roles in pharmaceutical and medical technology as diagnostic or therapeutic devices. Metal NPs can nowadays be engineered in a multitude of shapes, sizes and compositions, and they can be decorated with an almost infinite variety of functionalities. Despite such technological advances, there is still poor understanding of the molecular processes that drive the interactions of metal NPs with cells. Cell membranes are the first barrier encountered by NPs entering living organisms. The understanding and control of the interaction of nanoparticles with biological membranes is therefore of paramount importance to understand the molecular basis of the NP biological effects.

BioMNP will go beyond the state of the art by rationalizing the complex interplay of NP size, composition, functionalization and aggregation state during the interaction with model biomembranes. Membranes, in turn, will be modelled at an increasing level of complexity in terms of lipid composition and phase. BioMNP will rely on cutting-edge simulation techniques and facilities, and develop new coarse-grained models grounded on finer-level atomistic simulations, to study the NP-membrane interactions on an extremely large range of length and time scales.

BioMNP will benefit from important and complementary experimental collaborations, will propose interpretations of the available experimental data and make predictions to guide the design of functional, non-toxic metal nanoparticles for biomedical applications. BioMNP aims at answering fundamental questions at the crossroads of physics, biology and chemistry. Its results will have an impact on nanomedicine, toxicology, nanotechnology and material sciences.

Link to the ERC project webpage: https://www.difi.unige.it/it/dipartimento/persone/rossi-giulia

Keywords of the ERC project: biophysics; molecular dynamics; metal nanoparticles; lipid membranes; protein corona;

Keywords that characterize the scientific profile of the potential visiting researcher/s: computational physicist, biophysicist

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
677532	**MicMactin**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr MARTIN LENZ**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FR

Dissecting active matter: Microscopic origins of macroscopic actomyosin activity

Biological motion and forces originate from mechanically active proteins operating at the nanometer scale. These individual active elements interact through the surrounding cellular medium, collectively generating structures spanning tens of micrometers whose mechanical properties are perfectly tuned to their fundamentally out-of-equilibrium biological function. While both individual proteins and the resulting cellular behaviors are well characterized, understanding the relationship between these two scales remains a major challenge in both physics and cell biology.

We will bridge this gap through multiscale models of the emergence of active material properties in the experimentally well-characterized actin cytoskeleton. We will thus investigate unexplored, strongly interacting nonequilibrium regimes. We will develop a complete framework for cytoskeletal activity by separately studying all three fundamental processes driving it out of equilibrium: actin filament assembly and disassembly, force exertion by branched actin networks, and the action of molecular motors. We will then recombine these approaches into a unified understanding of complex cell motility processes.

To tackle the cytoskeleton's disordered geometry and many-body interactions, we will design new nonequilibrium self consistent methods in statistical mechanics and elasticity theory. Our findings will be validated through simulations and close experimental collaborations.

Our work will break new ground in both biology and physics. In the context of biology, it will establish a new framework to understand how the cell controls its achitecture and mechanics through biochemical regulation. On the physics side, it will set up new paradigms for the emergence of original out-of-equilibrium collective behaviors in an experimentally well-characterized system, addressing the foundations of existing macroscopic "active matter" approaches.

Link to the ERC project webpage: https://erc.europa.eu/projects-figures/erc-funded-projects/results?search_api_views_fulltext=micmactin

Keywords of the ERC project: Active soft matter; Cytoskeleton

Keywords that characterize the scientific profile of the potential visiting researcher/s: Theoretical biophysics; Statistical Physics; Soft matter

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
714870	**MMUSCLES**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr JOHANNES FEIST**
Host Institution:	UNIVERSIDAD AUTONOMA DE MADRID - ES

Modification of Molecular structure Under Strong Coupling to confined Light modES

Understanding and controlling the properties of matter is one of the overarching goals of modern science. A powerful way to achieve is this by using light, usually in the form of intense laser beams. However, modern advances in nanophotonics allow us to confine light modes so strongly that their effect on matter is felt even when no external fields are present. In this regime of "strong coupling" or "vacuum Rabi splitting", the fundamental excitations of the coupled system are hybrid light-matter states which combine the properties of both constituents, so-called polaritons. Little attention has been paid to the fact that strong coupling can also affect internal structure, such as nuclear motion in molecules. First experimental indications for this effect have been found, but current theory cannot explain or predict such changes. We will thus develop theoretical methods that can treat the modification of molecular structure under strong coupling to confined light modes. This will require advances in the microscopic description of the molecules under strong coupling by explicitly including their rovibrational degrees of freedom, as well as techniques to incorporate the influence of these modes in the macroscopic setting of collective strong coupling. In order to achieve this, we will adapt well-known techniques from quantum chemistry and combine them with the concepts of polariton physics. We will investigate what level of control can be gained through this approach, and whether confined light modes could act as a "photonic catalyst" to control molecular dynamics without requiring an active ingredient. This could present a novel tool to control photochemical reactions that are of paramount importance in the biological mechanisms of vision and photosynthesis, and hold great interest for use in memories, photoswitching devices, light-driven actuators, or solar energy storage. Consequently, this work could have wide-ranging impact on many different fields of science.

Link to the ERC project webpage: https://mmuscles.eu

Keywords of the ERC project: Polaritonic chemistry; strong light-matter coupling; nanophotonics

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:
724103	**MODMAT**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr PHILIPP WERNER**
Host Institution:	UNIVERSITE DE FRIBOURG - CH

Nonequilibrium dynamical mean-field theory: From models to materials

Pump-probe techniques are a powerful experimental tool for the study of strongly correlated electron systems. The strategy is to drive a material out of its equilibrium state by a laser pulse, and to measure the subsequent dynamics on the intrinsic timescale of the electron, spin and lattice degrees of freedom. This allows to disentangle competing low-energy processes along the time axis and to gain new insights into correlation phenomena. Pump-probe experiments have also shown that external stimulation can induce novel transient states, which raises the exciting prospect of nonequilibrium control of material properties.

The ab-initio simulation of correlated materials is challenging, and the prediction of a material's behavior under nonequilibrium conditions is an even more ambitious task. In the equilibrium context, a significant recent advance is the implementation of dynamical mean field theory (DMFT) schemes capable of treating dynamically screened interactions. These techniques have enabled the combination of the GW ab-initio method and DMFT in realistic contexts. Another recent development is the nonequilibrium extension of DMFT, which has been established as a flexible tool for the simulation of time-dependent phenomena in correlated lattice systems.
The goal of this research project is to combine these two recently developed computational techniques into a GW and nonequilibrium DMFT based ab-initio framework capable of delivering quantitative and material-specific predictions of the nonequilibrium properties of correlated compounds. The new formalism will be used to study photoinduced phasetransitions, unconventional superconductors with driven phonons, and strongly correlated devices such as Mott insulating solar cells.

Link to the ERC project webpage:

Keywords of the ERC project: nonequilibrium dynamics, strongly correlated electron systems, dynamical mean field theory

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:
724813	**SmartCells**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr PASCAL HERSEN**
Host Institution:	UNIVERSITE PARIS DIDEROT - PARIS 7 - FR

Smart Lab-On-Chips for the Real -Time Control of Cells

Cells are complex, autonomous genetic machines with rich information processing capabilities. Synthetic Biology builds on these properties to design novel, synthetic genetic programs in cells with the aim of benefiting humans. Yet, safety and efficiency issues require creation of synthetic circuits that are reliable over a large range of operating conditions and stable to all sorts of perturbations. This is a tremendous challenge for synthetic biologists, as the robustness of any circuit is limited by their high dependence on the cellular host machinery and the fundamental stochastic nature of gene expression. Taking inspiration from physics and engineering we have imagined a computer-based feedback loop that can remotely, in real-time, control the state of a synthetic genetic program running in cells. Here, we will combine microfluidics, optogenetics, structured illumination, inference methods and control algorithm into such a real time control device of gene expression for yeast cells. We will then study how cells can be controlled at different scales and with increasing levels of complexity from a simple circuit to a simple multicellular ecosystem. Specifically, we aim at:
(1) Understanding the potential and limits of such a control method. We will ask to what extent robust control can be achieved at the single cell level over a broad range of operating conditions.
(2) Taking control of complex circuits. In particular, we will take control of key genes of the large regulatory network in charge of yeast adaptation to osmotic stress and dissect their roles in setting the mechano-biology properties of yeast.
(3) Taking control of multicellular systems. We will control the collective dynamics of a population of cells via single cell control at selected locations.
This framework will establish solid scientific and technological foundations of a novel research area combining physics, engineering and synthetic biology to take control of living 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
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
725920	**2DQP**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr BRIAN GERARDOT**
Host Institution:	HERIOT-WATT UNIVERSITY - UK

Two-dimensional quantum photonics

Quantum optics, the study of how discrete packets of light (photons) and matter interact, has led to the development of remarkable new technologies which exploit the bizarre properties of quantum mechanics. These quantum technologies are primed to revolutionize the fields of communication, information processing, and metrology in the coming years. Similar to contemporary technologies, the future quantum machinery will likely consist of a semiconductor platform to create and process the quantum information. However, to date the demanding requirements on a quantum photonic platform have yet to be satisfied with conventional bulk (three-dimensional) semiconductors.

To surmount these well-known obstacles, a new paradigm in quantum photonics is required. Initiated by the recent discovery of single photon emitters in atomically flat (two-dimensional) semiconducting materials, 2DQP aims to be at the nucleus of a new approach by realizing quantum optics with ultra-stable (coherent) quantum states integrated into devices with electronic and photonic functionality. We will characterize, identify, engineer, and coherently manipulate localized quantum states in this two-dimensional quantum photonic platform. A vital component of 2DQP's vision is to go beyond the fundamental science and achieve the ideal solid-state single photon device yielding perfect extraction - 100% efficiency - of on-demand indistinguishable single photons. Finally, we will exploit this ideal device to implement the critical building block for a photonic quantum computer.

Link to the ERC project webpage:

Keywords of the ERC project: single photon; quantum dot; two-dimensional semiconductor; graphene

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:
757553	**ODDSUPER**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr ANNICA BLACK-SCHAFFER**
Host Institution:	UPPSALA UNIVERSITET - SE

New mechanisms and materials for odd-frequency superconductivity

Odd-frequency superconductivity is a very unique superconducting state that is odd in time or, equivalently, frequency, which is opposite to the ordinary behavior of superconductivity. It has been realized to be the absolute key to understand the surprising physics of superconductor-ferromagnet (SF) structures and has also enabled the whole emerging field of superconducting spintronics. This project will discover and explore entirely new mechanisms and materials for odd-frequency superconductivity, to both generate a much deeper understanding of superconductivity and open for entirely new functionalities. Importantly, it will generalize and apply my initial discoveries of two new odd-frequency mechanisms, present in bulk multiband superconductors and in hybrid structures between topological insulators and conventional superconductors, respectively. In both cases odd-frequency superconductivity is generated without any need for ferromagnets or interfaces, completely different from the situation in SF structures. The result will be a significant expansion of the concept and importance of odd-frequency superconductivity to a very wide class of materials, ranging from multiband, bilayer, and nanoscale superconductors to topological superconductors. The project will also establish the connection between topology and odd-frequency pairing, which needs to be addressed in order to understand topological superconductors, as well as incorporate new materials and functionality into traditional SF structures. To achieve these goals the project will develop a novel methodological framework for large-scale and fully quantum mechanical studies with atomic level resolution, solving self-consistently for the superconducting state and incorporating quantum transport calculations.

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:
757725	**ETOPEX**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr JELENA KLINOVAJA**
Host Institution:	UNIVERSITAT BASEL - CH

Engineering Topological Phases and Excitations in Nanostructures with Interactions

The main goal of this theory project is to propose engineered topological phases emerging only in strongly interacting systems and to identify the most feasible systems for experimental implementation. First, we will focus on setups hosting topological states localized at domain walls in one-dimensional channels such as parafermions, which are a new class of non-Abelian anyons and most promising candidates for topological quantum computing schemes. Second, in the framework of weakly coupled wires and planes, we will develop schemes for novel fractional topological phases in two- and three-dimensional interacting systems. To achieve these two goals, my team will identify necessary ingredients such as strong electron-electron interactions, helical magnetic order, or crossed Andreev proximity-induced superconductivity and address each of them separately. Later, we combine them to lead us to the desired topological phases and states. On our way to the main goal, as test cases, we will also study non-interacting analogies of the proposed effects such as Majorana fermions and integer topological insulators and pay close attention to the rapid experimental progress to come up with the most feasible proposals. We will study transport properties, scanning tunneling and atomic force microscopy. Especially for systems driven out of equilibrium, we will develop a Floquet-Luttinger liquid technique. We will explore the stability of engineered topological phases, error rates of topological qubits based on them, and computation schemes allowing for a set of universal qubit gates. We will strive to find a reasonable balance between topological stability and experimental
feasibility of setups. Our main theoretical tools are Luttinger liquid techniques (bosonization and renormalization group), Green functions, Floquet formalism, and numerical simulations in non-interacting test models.

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:
758403	**ODYSSEY**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr JOHN GOOLD**
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 - IE

Open dynamics of interacting and disordered quantum systems

This research proposal focuses on the open quantum system dynamics of disordered and interacting many-body systems coupled to external baths. The dynamics of systems which contain both disorder and interactions are currently under intense theoretical investigation in condensed matter physics due to the discovery of a new phase of matter known as many-body localization. With the experimental realization of such systems in mind, this proposal addresses an essential issue which is to understand how coupling to external degrees of freedom influences dynamics. These systems are intrinsically complex and lie beyond the unitary closed system paradigm, so the research proposed here contains interdisciplinary methodology beyond the mainstream in condensed matter physics ranging from quantum information to quantum optics. The project has three principal objectives each of which would represent a major contribution to the field:

O1. To describe the dynamics of a interacting, disordered many-body systems when coupled to external baths.

O2. To perform a full characterization of spin and energy transport in their non-equilibrium steady state.

O3. To explore the system capabilities as steady state thermal machine from a systematic microscopic perspective.

This will be the first comprehensive study of the open system phenomenology of disordered interacting many-body

systems. It will also allow for the systematic study of energy and spin transport and the exploration of the potential of these systems as steady state thermal machines. In order to successfully carry out the work proposed here, the applicant will build a world class team at Trinity College Dublin. Due to his track record and interdisciplinary background in many-body physics, quantum information and statistical mechanics combined with his personal drive and ambition the applicant is in a formidable position to successfully undertake this task with the platform provided by this ERC Starting Grant.

Link to the ERC project webpage:

Keywords of the ERC project: quantum thermodynamics, quantum transport, disordered systems, thermal machines

Keywords that characterize the scientific profile of the potential visiting researcher/s: quantum information, quantum transport, quantum thermodynamics, many-body physics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
788185	**E-DESIGN**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr PETER LILJEROTH**
Host Institution:	AALTO KORKEAKOULUSAATIO SR - FI

Artificial designer materials

Constructing designer materials where the atomic geometry, interactions, magnetism and other relevant parameters can be precisely controlled is becoming reality. I will reach this aim by positioning every atom with the tip of a scanning probe microscope, or by using molecular self-assembly to reach the desired structures. I will realize and engineer several novel quantum materials hosting exotic electronic phases: 2D topological insulators in metal-organic frameworks (MOF) and 2D topological superconductors in hybrid molecule-superconductor structures. These classes of materials have not yet been experimentally realized but could enable novel spintronic and quantum computing devices. In addition, we will realize a tuneable platform for quantum simulation in solid-state artificial lattices, which could open a whole new area in this field.
I will employ a broad experimental approach to reach the above targets by utilizing molecular self-assembly and scanning probe microscopy -based atom/molecule manipulation. The systems are characterized using low-temperature atomic force microscopy (AFM) and scanning tunneling microscopy (STM). My group is one of the leading groups in these topics globally. We have initial results on the topics discussed in this proposal and are thus in a unique position to make ground-breaking contributions in realizing designer quantum materials.
The artificial designer materials we study are characterized by the engineered electronic response with atomically precise geometries, lattice symmetries and controlled interactions. Such ingredients can result in ultimately controllable materials that have large, robust and quick responses to small stimuli with applications in nanoelectronics, flexible electronics, high-selectivity and high-sensitivity sensors, and optoelectronic components. Longer term, the biggest impact is expected through a profound change in the way we view materials and what can be achieved through designer materials approach.

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:
637815	**QUEST**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr BENJAMIN SACÉPÉ**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FR

QUantum Hall Edge State Tunnelling spectroscopy

The quantum nature of an electronic fluid is ubiquitous in many solid-state systems subjected to correlations or confinement. This is particularly true for two-dimensional electron gases (2DEGs) in which fascinating quantum states of matter, such as the integer and fractional quantum Hall (QH) states, arise under strong magnetic fields. The understanding of QH systems relies on the existence of one-dimensional (1D) conducting channels that propagate unidirectionally along the edges of the system, following the confining potential. Due to the buried nature of 2DEG commonly built in semiconducting heterostructures, the considerable real space structure of this 1D electronic fluid and its energy spectrum remain largely unexplored.
This project consists in exploring at the local scale the intimate link between the spatial structure of QH edge states, coherent transport and the coupling with superconductivity at interfaces. We will use graphene as a surface-accessible 2DEG to perform a pioneering local investigation of normal and superconducting transport through QH edge states. A new and unique hybrid Atomic Force Microscope and Scanning Tunneling Microscope (STM) operating in the extreme conditions required for this physics, i.e. below 0.1 kelvin and up to 14 teslas, will be developed and will allow unprecedented access to the edge of a graphene flake where QH edge states propagate.
Overall, the original combination of magnetotransport measurements with scanning tunnelling spectroscopy will solve fundamental questions on the considerable real-space structure of integer and fractional QH edge states impinged by either normal or superconducting electrodes. Our world-unique approach, which will provide the first STM imaging and spectroscopy of QH edge channels, promises to open a new field of investigation of the local scale physics of the QH effect.

Link to the ERC project webpage: http://sacepe-quest.neel.cnrs.fr/

Keywords of the ERC project: Graphene quantum Hall effect; Scanning tunneling spectroscopy of Landau levels; superconducting proximity effect

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:
646807	**EXMAG**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr JAN KUNES**
Host Institution:	TECHNISCHE UNIVERSITAET WIEN - AT

Excitonic Magnetism in Strongly Correlated Materials

Spontaneous symmetry breaking leading to states of matter with long-range order is one of the central topics in condensed matter physics. Common types of order, such as ferro- and anti-ferromagnetic, are characterized by spin or charge densities modulated on inter-atomic scale, therefore well studied thanks to various scattering experiments. Order parameters that are not of this type are much more difficult to detect, giving rise to names such as hidden order or electronic nematicity. Their impact on transport or thermodynamic properties may, nevertheless, be substantial. In the EXMAG project we will investigate excitonic condensation in systems with strongly correlated electrons as a new mechanism leading to unconventional ordered states. The objective of the project is to characterize the physical properties of various excitonic phases and to find their realization in real materials. We will focus on intermediate coupling strength and doped systems where the interaction between the excitonic order and the charge carriers is expected to lead to new physics. In particular, we want to explore the potential of the excitonic order to induce instabilities, e.g. magnetic or superconducting, that are not present in the normal phase. We will also address the possibility of topologically non-trivial quasi-particle band-structures in the excitonic phase. Our main tool will be numerical simulations based on the dynamical mean-field theory and ab initio band-structure methods. We will pursue two main lines of research: investigation of simple models allowing access to many physical observables and studies of real materials capturing the chemical complexities at the cost of more severe approximations. Ultimately, we want to understand in detail the properties of the excitonic magnets and their potential functionalities,and to identify the main control parameters and promising 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:
648589	**SUPER-2D**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr ALEXANDER GRUENEIS**
Host Institution:	UNIVERSITAET ZU KOELN - DE

Many-body physics and superconductivity in 2D materials

The goal of this project is to prepare and functionalize layered materials and then to characterize them in-situ using a novel combination of electrical transport, photoelectron and optical spectroscopy. This approach provides a solution to the intense research efforts in trying to engineer, probe and unravel many-body physics and the superconducting coupling mechanism in layered solids. The materials under investigation are based on the families of graphene, dichalcogenides and iron based superconductors. Chemical functionalization using dopants and strain allows for an unprecedented control over their physical properties. The proposed material systems provide a new arena to explore diverse condensed matter phenomena such as electron correlation, electron-phonon coupling and superconductivity. The groundbreaking aspects of this proposal are as follows: (1) development of a unique setup where electrical transport, angle-resolved photoemission (ARPES) and optical spectroscopy is measured in-situ on the same sample, (2) large-area deterministic layer-by-layer growth by chemical vapour deposition (CVD) and molecular beam epitaxy, (3) the effects of mechanical strain and hence large pseudomagnetic fields on the electronic band structure will be investigated using ARPES, (4) the effects of alkali metal doping on the superconducting transition temperature and the spectral function will be investigated using transport, ARPES and optical spectroscopies shining light onto the superconducting pairing mechanisms in different classes of materials. The proposal's feasibility is firmly grounded on the pioneering work of the PI's group on superconducting coupling in functionalized graphene and the in-situ ARPES measurements of a CVD grown graphene/BN heterostructure.

Link to the ERC project webpage: http://www.ph2.uni-koeln.de/684.html

Keywords of the ERC project: graphene, 2D materials, ARPES, Raman, transport, MoS2

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:
669598	**SynDiv**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr CEES DEKKER**
Host Institution:	TECHNISCHE UNIVERSITEIT DELFT - NL

A nanophysics approach to synthetic cell division

Imagine building a living cell from basic components, a vesicle filled with biomolecules that can sustain itself and reproduce into similar offspring. Can this be done?
This proposal addresses the most tantalizing aspect: synthetic cell division. We aim to build liposomes (lipid vesicles enclosing an aqueous solution with proteins and DNA) that can spontaneously divide through a contractile protein ring at the vesicle perimeter. To realize this, we employ an experimental biophysics approach that addresses both the actual division and the prerequisite spatial control, with:
1. Cells in nanofabricated shapes. We will study cell-division proteins and DNA in live E.coli bacteria that are molded into user-defined arbitrary shapes and sizes. Clarifying the effects of cell shape will elucidate the guiding principles for the spatiotemporal organization of the cell-division machinery.
2. Proteins and DNA in nanofabricated chambers. We will use a bottom up approach to study the basic divisome components in vitro exploiting the full control provided by nanochambers. This will resolve the spatial organization of the fascinating patterns of Min proteins and chromatin that dictate the localization of the division ring.
3. Liposomes on chip. We will develop a chip-based technology to generate liposomes for exploring synthetic cell division. We will use both microfluidic constrictions and a biomimetic approach (encapsulation of divisome proteins such as FtsZ) to induce autonomous liposome splitting, thus enabling a simplified but tightly controlled form of synthetic cell division.
To our knowledge, this nanofabrication-based approach to synthetic division is unique. We expect to be able to make important contributions to understanding cell division, and anticipate that on a 5-year scale we indeed can master synthetic division. We believe that our mix of nanophysics and synthetic biology is bound to yield deep insight into the biophysical underpinnings of cellular reproduction.

Link to the ERC project webpage: https://ceesdekkerlab.nl

Keywords of the ERC project: single molecule biophysics nanobiology nano pores synthetic cells cell division

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:
714193	**QUESTDO**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr PHIL KING**
Host Institution:	THE UNIVERSITY COURT OF THE UNIVERSITY OF ST ANDREWS - UK

Quantum electronic states in delafossite oxides

One of the most active challenges of modern solid state physics and chemistry is harnessing the unique and varied physical properties of transition-metal oxides. From improved electrodes for solar cells to loss-less transmission of power, these compounds hold the potential to transform our daily lives. Subtle collective quantum states underpin their diverse properties. These complicate their physical understanding but render them extremely sensitive to their local crystalline environment, offering enormous potential to tune their functional behaviour. To date, the vast majority of work has focussed on transition-metal oxides based around cubic "perovskite" building blocks. In contrast, exploiting the layered traingular network of the delafossite structure, the QUESTDO project aims to establish delafossite oxides as a completely novel class of interacting electron system with properties and potential not known in more established systems.

Its scope bridges three of the most important current themes in condensed matter, investigating and controlling the delicate interplay of (i) frustrated triangular and honeycomb lattice geometries, (ii) interacting electrons, and (iii) effects of strong spin-orbit interactions. It brings together advanced spectroscopic measurement with precise materials fabrication. Through these studies, QUESTDO promises critical new insight on the quantum many-body problem in solids, and will advance our understanding and demonstrate atomic-scale control of the physical properties of delafossites. Ultimately, it seeks to establish new design methodologies for the targeted creation of emergent and topological phases in this little-studied family of transition-metal oxides, paving the route for their further study and ultimate application.

Link to the ERC project webpage: http://www.cdqm.uk/questdo

Keywords of the ERC project: Electronic structure, condensed matter physics, oxides, delfaossites

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:
724881	**3D-BioMat**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr VIRGINIE CHAMARD**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FR

Deciphering biomineralization mechanisms through 3D explorations of mesoscale crystalline structure in calcareous biomaterials

The fundamental 3D-BioMat project aims at providing a biomineralization model to explain the formation of microscopic calcareous single-crystals produced by living organisms. Although these crystals present a wide variety of shapes, associated to various organic materials, the observation of a nanoscale granular structure common to almost all calcareous crystallizing organisms, associated to an extended crystalline coherence, underlies a generic biomineralization and assembly process. A key to building realistic scenarios of biomineralization is to reveal the crystalline architecture, at the mesoscale, (i. e., over a few granules), which none of the existing nano-characterization tools is able to provide.

3D-BioMat is based on the recognized PI's expertise in the field of synchrotron coherent x-ray diffraction microscopy. It will extend the PI's disruptive pioneering microscopy formalism, towards an innovative high-throughput approach able at giving access to the 3D mesoscale image of the crystalline properties (crystal-line coherence, crystal plane tilts and strains) with the required flexibility, nanoscale resolution, and non-invasiveness.

This achievement will be used to timely reveal the generics of the mesoscale crystalline structure through the pioneering explorations of a vast variety of crystalline biominerals produced by the famous Pinctada margaritifera oyster shell, and thereby build a realistic biomineralization scenario.

The inferred biomineralization pathways, including both physico-chemical pathways and biological controls, will ultimately be validated by comparing the mesoscale structures produced by biomimetic samples with the biogenic ones. Beyond deciphering one of the most intriguing questions of material nanosciences, 3D-BioMat may contribute to new climate models, pave the way for new routes in material synthesis and supply answers to the pearl-culture calcification problems.

Link to the ERC project webpage:

Keywords of the ERC project: biomineralization, crystallography, synchrotron, coherent diffraction

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

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
741121	**MajoranaTopIn**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr YOICHI ANDO**
Host Institution:	UNIVERSITAET ZU KOELN - DE

Majorana Fermions in Topological Insulator Platforms

Majorana fermions were recently discovered in topological superconductors as exotic quasiparticles having the curious property of being their own antiparticles. They are not only interesting as novel relativistic quasiparticles, but are also useful for realizing fault-tolerant quantum computers. However, currently available platforms to materialize Majorana fermions are limited, and the existing platforms have respective drawbacks for actually building qubits for a scalable quantum computer. Also, various unusual properties are predicted for Majorana fermions, but few have been experimentally addressed. To make a leap in the Majorana-fermion research which is technically highly demanding, one needs to grow state-of-the-art materials and tightly combine them with mesoscopic device research. By performing such an integrated research efforts in the same laboratory, this project aims to explore new platforms for Majorana qubits and to establish new methodologies to address peculiar physics of Majorana fermions. As new platforms, we pursue (i) three-dimensional topological-insulator nanoribbons and (ii) ferromagnetic topological-insulator thin films, both of which will be proximity-coupled to an s-wave superconductor. Each of them allows for conceiving Majorana qubits based on different principles, which will be tested in this project. Also, by developing new methodologies, we will elucidate (i) non-Abelian statistics probed by interferometry and (ii) quantized/universal heat transport phenomena probed by thermal conductance. These works will be complemented by materials growth efforts involving molecular beam epitaxy and detailed characterizations of the local electronic states using scanning tunnelling spectroscopy. If successful, this project will not only contribute to the realization of scalable quantum computers, but also elucidate the non-Abelian statistics, which is a fundamentally new property of particles and is ground breaking in physics.

Link to the ERC project webpage:

Keywords of the ERC project: Majorana fermion, topological quantum computing, qubits, mesoscopic physics

Keywords that characterize the scientific profile of the potential visiting researcher/s: microwave technique, qubit operation, nano-fabrication, quantum dot

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
771503	**TopMechMat**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr SEBASTIAN HUBER**
Host Institution:	EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH - CH

Topological Mechanical Metamaterials

Mechanical metamaterials are man-made structures with tailored vibrational properties geared towards applications such as earth-quake protection, energy harvesting, or medical imaging. Recently, we promoted a new design principle for such materials: topological band-theory known from quantum condensed matter physics. To date, the use of topology in mechanical materials has been largely restricted to one or two dimensions, a central shortcoming for applications. The objective of TopMechMat is to address this challenge (i) by establishing a theoretical framework for topological mechanical metamaterials in three dimensions, (ii) by developing a novel algorithm enabling the sample design, and (iii) by experimentally validating the proposed materials.

The current approach to topological mechanical systems is based on lcoal symmetries unnatural to classical mechanics. Crystalline symmetries, on the other hand, are ubiquitous in metamaterials and are known to stabilize topological phases. Using group cohomology techniques we will establish a theoretical framework for topological phonons in three dimensions.

Translating a theoretical model into an actual sample requires extensive finite element simulations. However, the complexity of topological phonon models precludes the application of known design algorithms. We plan to use a neural network to address this challenge. This will allow us to exploit the power of genetic algorithms in executing the required large-scale parameter scans. The successful implementation of this design algorithm will present us with an exciting opportunity: Mechanical systems might enable the discovery of yet unobserved topological phases of matter.

We plan to build a three-axis scanning vibrometer to investigate additively manufactured metamaterial samples. This will allow us to validate our ideas and to provide proof-of-principle results emphasizing the feasibility of our designs for concrete 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:
635919	**SURFINK**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr DIMAS DE OTEYZA**
Host Institution:	FUNDACION DONOSTIA INTERNATIONAL PHYSICS CENTER - ES

Functional materials from on-surface linkage of molecular precursors

With the advent of self-assembly, increasingly high hopes are being placed on supramolecular materials as future active components of a variety of devices. The main challenge remains the design and assembly of supramolecular structures with emerging functionalities tailored according to our needs. In this respect, the extensive research over the last decades has led to impressive progress in the self-assembly of molecular structures. However, self-assembly typically relies on non-covalent interactions, which are relatively weak and limit the structure's stability and often even their functionality. Only recently the first covalently bonded organic networks were synthesized directly on substrate surfaces under ultra-high-vacuum, whose structure could be defined by appropriate design of the molecular precursors. The potential of this approach was immediately recognized and has attracted great attention. However, the field is still in its infancy, and the aim of this project is to lift this new concept to higher levels of sophistication reaching real functionality.
For optimum tunability of the material's properties, its structure must be controlled to the atomic level and allow great levels of complexity and perfection. Complexity can be reached e.g. with hybrid structures combining different types of precursors. In this project, this hardly explored approach will be applied to three families of materials of utmost timeliness and relevance: graphene nanoribbons, porous frameworks, and donor-acceptor networks. Along the pursuit of these objectives, side challenges that will be addressed are the extension of our currently available chemistry-on-surfaces toolbox by identification of new reactions, optimized reaction conditions, surfaces, and ultimately their combination strategies. A battery of tools, with special emphasis on scanning probe microscopies, will be used to visualize and characterize the reactions and physical-chemical properties of the resulting materials.

Link to the ERC project webpage: https://sumolab.wordpress.com/research/

Keywords of the ERC project: on-surface synthesis, surface chemistry, scanning probe microscopy and spectroscopy, graphene nanoribbons, covalent organic frameworks, organic donor-acceptor heterostructures,

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:
637831	**SURFLINK**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr SABINE MAIER**
Host Institution:	FRIEDRICH-ALEXANDER-UNIVERSITAET ERLANGEN NUERNBERG - DE

MOLECULAR CARPETS ON INSULATING SURFACES: RATIONAL DESIGN OF COVALENT NETWORKS

IInspired by the possibility to create artificial, three-dimensional covalent organic frameworks, the overall aim of this project is to construct novel two-dimensional (2D), covalently-linked, organic networks in a bottom-up approach on insulating surfaces. 2D materials have unique properties suitable for many scientific and technological applications including nano-electronic devices and sensors. On-surface synthesis of covalent structures is mainly limited to metal surfaces, as controlled growth procedures of molecules on insulators are often hindered by the weak, unspecific interaction with the substrate. We will establish suitable concepts for the covalent linking of molecules on insulators by balancing the molecule-molecule and molecule-surface interactions. That will greatly advance the atomic-scale understanding of molecular structures on insulators. Specially designed molecular building blocks doped with heteroatoms will be used to create functional 2D networks with tunable electronic properties and nanometer-sized pores. Novel concepts will be developed to achieve high quality structures with long-range order; one of the great challenges in all covalent-linked structures.

The SURFLINK project uses a surface science approach in ultra-high vacuum to understand the fundamental mechanisms and properties of covalently-linked networks at the atomic level. The covalent networks will be studied by high-resolution scanning probe microscopy and spectroscopy at the atomic-scale. We will determine the electronic properties of the novel nano-porous networks that can be tailored by their geometry. The functionalized pores included in the network will be studied with respect to their size and their prospects to adsorb guest molecules. The rational design of the networks proposed in the SURFLINK project has great potential for materials research and will ultimately result in the development of new materials with adjustable electronic properties.

Link to the ERC project webpage:

Keywords of the ERC project: molecules on surfaces, scanning probes, self-assembly, on-surface synthesis, surface 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:
648974	**P-MEM-NMR**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr GUIDO PINTACUDA**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FR

Structure of paramagnetic integral membrane metalloproteins by MAS-NMR

Integral membrane metalloproteins are involved in the transport and homeostasis of metal ions, as well as in key redox reactions that have a tremendous impact on many fields within life sciences, environment, energy, and industry.
Most of our understanding of fine details of biochemical processes derives from atomic or molecular structures obtained by diffraction methods on single crystal samples. However, in the case of integral membrane systems, single crystals large enough for X-ray diffraction cannot be easily obtained, and the problem of structure elucidation is largely unsolved.
We have recently pioneered a breakthrough approach using Magic-Angle Spinning Nuclear Magnetic Resonance (MAS-NMR) for the atomic-level characterization of paramagnetic materials and complex biological macromolecules. The proposed project aims to leverage these new advances through a series of new concepts i) to improve the resolution and sensitivity of MAS-NMR from nuclei surrounding a paramagnetic metal ion, such as e.g. cobalt, nickel and iron, and ii) to extend its applicability to large integral membrane proteins in lipid membrane environments. With these methods, we will enable the determination of structure-activity relationships in integral membrane metalloenzymes and transporters, by combining the calculation of global structure and dynamics with measurement of the electronic features of metal ions.
These goals require a leap forward with respect to today's protocols, and we propose to achieve this through a combination of innovative NMR experiments and isotopic labeling, faster MAS rates and high magnetic fields. As outlined here, the approaches go well beyond the frontier of current research. The project will yield a broadly applicable method for the structural characterization of essential cellular processes and thereby will provide a powerful tool to solve challenges at the forefront of molecular and chemical sciences today.

Link to the ERC project webpage: http://perso.ens-lyon.fr/guido.pintacuda

Keywords of the ERC project: NMR; magic-angle spinning; metal ions; paramagnetism; membrane proteins

Keywords that characterize the scientific profile of the potential visiting researcher/s: structural biology; spectroscopy; quantum chemistry; coordination chemistry

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
677511	**ComplexSwimmers**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr GIOVANNI VOLPE**
Host Institution:	GOETEBORGS UNIVERSITET - SE

Biocompatible and Interactive Artificial Micro- and Nanoswimmers and Their Applications

Microswimmers, i.e., biological and artificial microscopic objects capable of self-propulsion, have been attracting a growing interest from the biological and physical communities. From the fundamental side, their study can shed light on the far-from-equilibrium physics underlying the adaptive and collective behavior of biological entities such as chemotactic bacteria and eukaryotic cells. From the more applied side, they provide tantalizing options to perform tasks not easily achievable with other available techniques, such as the targeted localization, pick-up and delivery of microscopic and nanoscopic cargoes, e.g., in drug delivery, bioremediation and chemical sensing.

However, there are still several open challenges that need to be tackled in order to achieve the full scientific and technological potential of microswimmers in real-life settings. The main challenges are: (1) to identify a biocompatible propulstion mechanism and energy supply capable of lasting for the whole particle life-cycle; (2) to understand their behavior in complex and crowded environments; (3) to learn how to engineer emergent behaviors; and (4) to scale down their dimensions towards the nanoscale.

This project aims at tackling these challenges by developing biocompatible microswimmers capable of elaborate behaviors, by engineering their performance when interacting with other particles and with a complex environment, and by developing working nanoswimmers.

To achieve these goals, we have laid out a roadmap that will lead us to push the frontiers of the current understanding of active matter both at the mesoscopic and at the nanoscopic scale, and will permit us to develop some technologically disruptive techniques, namely, targeted delivery of cargoes within complex environments, which is of interest for drug delivery and bioremediation, and efficient sorting of chiral nanoparticles, which is of interest for biomedical and pharmaceutical applications.

Link to the ERC project webpage: http://softmatterlab.org

Keywords of the ERC project: microswimmers, active matter, optical tweezers, Brownian motion, artificial intelligence, deep learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: microswimmers, active matter, optical tweezers, Brownian motion, artificial intelligence, deep learning

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
681285	**TAME-Plasmons**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr STEFANO CORNI**
Host Institution:	UNIVERSITA DEGLI STUDI DI PADOVA - IT

a Theoretical chemistry Approach to tiME-resolved molecular Plasmonics

Ultrafast spectroscopy is a powerful tool able to disclose the atomistic real-time motion picture of the basic chemical events behind technology and Life, such as catalytic reactions or photosynthetic light harvesting. Nowadays, by cleverly harnessing the interaction of the studied molecules with plasmons (collective electron excitations supported, e.g., by metal nanoparticles) it is becoming possible to focus these investigations on specific nanoscopic regions, such as a portion of a catalytic surface or of a photosynthetic membrane. This coupling can also produce new quantum effects such as molecule-plasmon hybrid excitations. On the other hand, it makes the real-time molecular evolution and its perturbation by light more complex, and thus calls for new theoretical treatments. The available ones are unable to tackle this complexity, because they consist of phenomenological models focused on field enhancements or on generic features of the various plasmon-molecule coupling regimes. The goal of TAME-Plasmons is to develop a theoretical chemistry approach to directly simulate the real time evolution of molecules interacting with plasmons and light. Our approach lifts the current theoretical limitations by coupling a real-time quantum chemical description of the molecules with a time-dependent electromagnetic description of plasmons, rooted in our previous work on steady-state molecular plasmonics. We will implement this approach in an open-source software, accessible also to non-specialists. We will address current open issues such as the controversial nature of plasmon-aided frequency up-conversion by noble gases and the interpretation of sub-molecularly resolved photoemission induced by scanning tunneling microscopy. We will also anticipate questions that may arise along with progress in the field, for example how to engineer energy transfer paths in photosynthetic light harvesting proteins by exploiting the coupling to plasmons.

Link to the ERC project webpage: www.tame-plasmons.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:
695197	**DYNAMOX**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr MAJED CHERGUI**
Host Institution:	ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE - CH

Charge carrier dynamics in metal oxides

Transition metal (TM) oxides (TiO2, ZnO, NiO) are large gap insulators that have emerged as highly attractive materials over the past two decades for applications in photocatalysis, solar energy conversion, etc., all of which rely on the generation of charge carriers, their evolution and their eventual trapping at defects or a self-trapped excitons. Despite the huge interest for such materials, the very nature of the elementary electronic excitations (Frenkel, Wannier or charge transfer exciton) is still not established, nor is the way these excitations evolve after being created: excitonic polaron or charged polaron. Finally, the electron and hole recombine is also not clearly established because of issue of defects and trapping.
In order to tackle these issues, here we implement novel experimental tools that would provide us with hitherto inaccessible information about the charge carrier dynamics in TM oxides. Of importance is the ability to detect both the electrons and the holes. Some of these tools have been developed in the PI's group: i) Ultrafast X-ray absorption spectroscopy (XAS) will provide information about the final metal d-orbitals and about the structural changes around it; ii) Ultrafast X-ray emission (XES) will provide information about hole states. While these two approaches are ideal element-selective ones, the localization of the electron at metal atoms represents a small proportion of the electron population. Therefore, ultrafast Angle-resolved photoemission spectroscopy (ARPES) will be used to map out the band structure changes in the system and the evolution of the conduction band electrons. Ultrafast 2-dimensional (2D) UV (<400nm) transient absorption spectroscopy allows the mapping of the time evolution of both the valence and the conduction bands by its ability to pump and probe above the band gap. Last, Fourier Transform visible 2D spectroscopy will allow the probing of gap state dynamics at high time resolution.

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:
714519	**HP4all**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr SAMI JANNIN**
Host Institution:	UNIVERSITE LYON 1 CLAUDE BERNARD - FR

Persistent and Transportable Hyperpolarization for Magnetic Resonance

Magnetic resonance imaging (MRI) and nuclear magnetic resonance (NMR) and are two well-established powerful and versatile tools that are extensively used in many fields of research, in clinics and in industry.
Despite considerable efforts involving highly sophisticated instrumentation, these techniques suffer from low sensitivity, which keeps many of today's most interesting problems in modern analytical sciences below the limits of MR detection.
Hyperpolarization (HP) in principle provides a solution to this limitation. We have recently pioneered breakthrough approaches using dissolution dynamic nuclear polarization (d-DNP) for preparing nuclear spins in highly aligned states, and therefore boosting sensitivity in several proof-of-concept reports on model systems. The proposed project aims to leverage these new advances through a series of new concepts i) to generate the highest possible hyperpolarization that can be transported in a persistent state, and ii) to demonstrate their use in magnetic resonance experiments with > 10'000 fold sensitivity enhancements, with the potential of revolutionizing the fields of MRI and NMR.
By physically separating the source of polarization from the substrate at a microscopic level, we will achieve polarized samples with lifetimes of days that can be stored and transported over long distances to MRI centers, hospitals and NMR laboratories. Notable applications in the fields of drug discovery, metabolomics and real-time metabolic imaging in living animals will be demonstrated.
These goals require a leap forward with respect to today's protocols, and we propose to achieve this through a combination of innovative sample formulations, new NMR methodology and advanced instrumentation.
This project will yield to a broadly applicable method revolutionizing analytical chemistry, drug discovery and medical diagnostics, and thereby will provide a powerful tool to solve challenges at the forefront of molecular and chemical sciences today.

Link to the ERC project webpage: http://hmrlab.eu

Keywords of the ERC project: NMR, EPR, DNP, hyperpolarization

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

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
715502	**EvoluTEM**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr SARAH HAIGH**
Host Institution:	THE UNIVERSITY OF MANCHESTER - UK

Illuminating Atomic Scale Processes in Liquids and Gases

EvoluTEM: Illuminating Atomic Scale Processes in Liquids and Gases
Objective 1: To build new capability in atomic resolution environmental imaging and analysis.
Objective 2: To apply this platform to synthesise new photonic nanomaterials with enhanced performance.
The vision is to design, construct, and make available the next generation of multifunctional in situ specimen holders for the scanning /transmission electron microscope (S/TEM). This new experimental resource will enable ground-breaking characterisation of complex nanoscale reactions under realistic and relevant environmental conditions using a lab-on-a-chip configuration. By providing a platform with unparalleled atomic scale imaging and simultaneous elemental analysis capabilities, as well as flexible in situ (temperature, pressure, and illumination) environments, this effort will provide an experimental module for a wide range of breakthrough in situ nanomaterials experiments. Motivating this work is the goal of being able to fully characterize the synthesis of novel photonic 2D materials, optoelectronic nanoparticles, and photoactive organic-inorganic perovskites. This research could lead to a new level of mechanistic understanding, providing knowledge to realize routes for the production of new nanostructures, with properties that can be optimally tailored for photonic applications (photovoltaics, light emission or optoelectronics). This ambitious research program is only possible because of the principal investigators outstanding electron microscopy expertise, coupled with the world leading nanofabrication capabilities and in situ imaging facilities at the University of Manchester. The project has been structured into five work packages (WPs) with each having well-defined milestones and deliverables.

Link to the ERC project webpage: https://www.research.manchester.ac.uk/portal/en/researchers/sarah-haigh.html

Keywords of the ERC project: TEM in situ

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:
716792	**SOFT-PHOTOCONVERSION**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr MICHEAL SCANLON**
Host Institution:	UNIVERSITY OF LIMERICK - IE

Solar Energy Conversion without Solid State Architectures: Pushing the Boundaries of Photoconversion Efficiencies at Self-healing Photosensitiser Functionalised Soft Interfaces

Innovations in solar energy conversion are required to meet humanity's growing energy demand, while reducing reliance on fossil fuels. All solar energy conversion devices harvest light and then separate photoproducts, minimising recombination. Normally charge separation takes place at the surface of nanostructured electrodes, often covered with photosensitiser molecules such as in dye-sensitised solar cells; DSSCs. However, the use solid state architectures made from inorganic materials leads to high processing costs, occasionally the use of toxic materials and an inability to generate a large and significant source of energy due to manufacturing limitations. An alternative is to effect charge separation at electrically polarised soft (immiscible water-oil) interfaces capable of driving charge transfer reactions and easily "dye-sensitised". Photoproducts can be separated on either side of the soft interface based on their hydrophobicity or hydrophilicity, minimising recombination. SOFT-PHOTOCONVERSION will explore if photoconversion efficiencies at soft interfaces can be improved to become competitive with current photoelectrochemical systems, such as DSSCs. To achieve this goal innovative soft interface functionalisation strategies will be designed. To implement these strategies an integrated platform technology consisting of (photo)electrochemical, spectroscopic, microscopic and surface tension measurement techniques will be developed. This multi-disciplinary approach will allow precise monitoring of morphological changes in photoactive films that enhance activity in terms of optimal kinetics of photoinduced charge transfer. An unprecedented level of electrochemical control over photosensitiser assembly at soft interfaces will be attained, generating photoactive films with unique photophysical properties. Fundamental insights gained may potentially facilitate the emergence of new class of solar conversion devices non-reliant on solid state architectures.

Link to the ERC project webpage: https://cordis.europa.eu/project/rcn/209132_en.html

Keywords of the ERC project: solar energy conversion, liquid-liquid interfaces, porphyrin, photochemistry, electrochemistry

Keywords that characterize the scientific profile of the potential visiting researcher/s: Electrochemist, spectro-electrochemist, photochemist, chemist

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
741860	**CLUNATRA**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr IB CHORKENDORFF**
Host Institution:	DANMARKS TEKNISKE UNIVERSITET - DK

Discovering new Catalysts in the Cluster-Nanoparticle Transition Regime

The purpose of this proposal is to establish new fundamental insight of the reactivity and thereby the catalytic activity of oxides, nitrides, phosphides and sulfides (O-, N-, P-, S- ides) in the Cluster-Nanoparticle transition regime. We will use this insight to develop new catalysts through an interactive loop involving DFT simulations, synthesis, characterization and activity testing. The overarching objective is to make new catalysts that are efficient for production of solar fuels and chemicals to facilitate the implementation of sustainable energy, e.g. electrochemical hydrogen production and reduction of CO2 and N2 through both electrochemical and thermally activated processes.

Recent research has identified why there is a lack of significant progress in developing new more active catalysts. Chemical scaling-relations exist among the intermediates, making it difficult to find a reaction pathway, which provides a flat potential energy landscape - a necessity for making the reaction proceed without large losses. My hypothesis is that going away from the conventional size regime, > 2 nm, one may break such chemical scaling-relations. Non-scalable behavior means that adding an atom results in a completely different reactivity. This drastic change could be even further enhanced if the added atom is a different element than the recipient particle, providing new freedom to control the reaction pathway. The methodology will be based on setting up a specifically optimized instrument for synthesizing such mass-selected clusters/nanoparticles. Thus far, researchers have barely explored this size regime. Only a limited amount of studies has been devoted to inorganic entities of oxides and sulfides; nitrides and phosphides are completely unexplored. We will employ atomic level simulations, synthesis, characterization, and subsequently test for specific reactions. This interdisciplinary loop will result in new breakthroughs in the area of catalyst material discovery.

Link to the ERC project webpage: http://www.fysik.dtu.dk/english/Research/surfcat/

Keywords of the ERC project: Catalysis, Energy conversion, Electro-Catalysis, Surface Physics, Mass-selected nanoparticles

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:
742422	**HBEAM**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr ALEC WODTKE**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DE

Probing chemical dynamics at surfaces with ultrafast atom pulses

Ultra-short light pulses have become invaluable in time-resolved studies in chemistry and physics. But many important processes are initiated by collisions. While lasers have revolutionized experiments using light pulses, experimentally proven concepts for producing ultra-short pulses of neutral matter are still in their infancy. Hence, our ability to control when a collision occurs is still extremely limited. Recently, we have reported bunch-compression photolysis, the first demonstrated method for producing ultra-short pulses of neutral matter. Here, photolysis of jet-cooled hydrogen iodide is carried out with femto-second laser pulses whose frequency bandwidth has been spatially ordered. Thus, fast H-atom photoproducts overtake slow ones, producing an ultra-short pulse.The central objective of this project is to develop bunch-compression photolysis as a tool for ultrafast timing experiments involving collisions of ultrashort pulses of H-atoms at synchronously photo-excited solid surfaces. Bunch-compression photolysis allows collisions at a surface to be synchronized with photoexcitation on the ps time scale, opening up new ways to study the dynamics of collisions at selectively photo-excited surfaces that have not yet relaxed. Studies on collision dynamics involving excitons produced in 2D semiconductors is one exciting direction for this work. Experiments on synchronized H atom collisions with vibrationally excited surfaces prepared by infrared photoexcitation is another - this enables kinetics experiments with surface site-specificity as well as the direct observation of reaction intermediates. The work and ideas presented here show how to overcome the most challenging barrier to a new class of time-resolved dynamics experiments, opening new frontiers in the study of surface chemistry, where we will begin to understand how selected degrees of freedom of the solid influence collision dynamics and reaction rates.

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:
766555	**ELECNANO**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr DAVID ECIJA FERNANDEZ**
Host Institution:	FUNDACION IMDEA NANOCIENCIA - ES

Electrically Tunable Functional Lanthanide Nanoarchitectures on Surfaces

Lanthanide metals are ubiquitous nowadays, finding use in luminescent materials, optical amplifiers and waveguides, lasers, photovoltaics, rechargeable batteries, catalysts, alloys, magnets, bio-probes, and therapeutic agents. In addition, they bear potential for high temperature superconductivity, magnetic refrigeration, molecular magnetic storage, spintronics and quantum information.
Surprisingly, the study of lanthanide physico-chemical properties on surfaces is at its infancy, particularly at the nanoscale. To address this extraordinary scientific opportunity, I will research the foundations and prospects of lanthanide elements to design functional nanoarchitectures on surfaces and I will study their inherent physico-chemical phenomena in distinct coordination environments, targeting novel approaches for sensing, nanomagnetism and electroluminescence. Importantly, our studies will encompass both metal substrates and decoupling surfaces including ultra-thin film insulators and graphene. Nurturing from these studies and in parallel, we will focus on graphene voltage back-gated supports, thus surpassing the seminal knowledge on electrically-inert substrates and enhancing the scope of our research to address the overarching objective of the proposal, i.e., the design of electrically tunable functional lanthanide nanomaterials.
The culmination of ELECNANO project will provide strategies for:
1.-Design of functional nanomaterials on high-technological supports.
2.-Development of advanced coordination chemistry on surfaces.
3.-Rationale of the physico-chemical properties of lanthanide-coordination environments.
4.-Engineering of lanthanide nanoarchitectures for ultimate sensing, nanomagnetism and electroluminescence.
5.-In-situ atomistic views of electrically tunable materials and unprecedented fundamental studies of charge-molecule/metal physics on devices.

Link to the ERC project webpage:

Keywords of the ERC project: SCANNING PROBE MICROSCOPY, SURFACE SCIENCE, ON-SURFACE CHEMISTRY, METAL-ORGANICS, DEVICES

Keywords that characterize the scientific profile of the potential visiting researcher/s: SCANNING PROBE MICROSCOPY, SURFACE SCIENCE, DEVICES

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
648433	**ICONICAL**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr FERDINAND GROZEMA**
Host Institution:	TECHNISCHE UNIVERSITEIT DELFT - NL

In control of exciton and charge dynamics in molecular crystals

The aim of the work proposed here is to achieve control over charge and excited state dynamics in organic crystalline materials and in this way to come to solid state materials with explicit built-in functionality. The charge and excited state dynamics do not only depend on the properties of individual molecules but are to a large extent determined by the interactions between multiple molecules. By careful engineering of the properties of individual molecules and of the way they aggregate in the solid crystalline state it is in principle possible to design materials that exhibit a specific functionality. Examples of this are materials that are optimized to give high charge carrier mobilities and high exciton diffusion coefficients. It is also possible to design more complex functionality. An example of this is singlet exciton fission, a process by which one singlet excited state transforms into a combination of two triplet states. This spin-allowed process can in principle increase the efficiency of organic solar cells by a factor 1.5. A second example is upconversion of low energy photons into higher energy photons. This is possible by combining two low-energy triplet excited states into a single singlet excited state by triplet-triplet annihilation. Finally, it is possible gain control over charge separation on the interface of two different materials to increase the charge separation efficiency in photovoltaic cells.
In this work, we will explore ways to achieve control of charge and exciton dynamics in a combined effort including organic synthesis, computational chemistry and time-resolved spectroscopy and conductivity experiments. This research represents a major step forward in the understanding of the relation between molecular and solid state structure and the electronic properties of organic crystalline materials. This is of considerable fundamental interest but also has direct implications for the utilization of these materials in electronic devices.

Link to the ERC project webpage:

Keywords of the ERC project: Singlet fission, upconversion, organic solar cells, hybrid perovskites, ultrafast 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:
694097	**QSpec-NewMat**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr ANGEL RUBIO**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DE

Quantum Spectroscopy: exploring new states of matter out of equilibrium

This project addresses the development of novel theoretical and computational tools that utilize the quantum nature of light to understand and control quantum phenomena in complex systems in and out of equilibrium. Some examples of these processes include exciton-exciton interaction, quantum coherence, assisted energy and charge transport, photochemistry, and new states of matter.
The present project aims to build up the basic theoretical and computational machinery to allow quantum computations of the electronic and ionic dynamics of atomic, molecular or extended systems coupled to quantised electromagnetic fields and thereby set the stage for a new era in the first-principle computational modelling of light-matter interactions. To achieve this goal, we will combine the principles of time-dependent density functional theory (TDDFT) and quantum electrodynamics (QED) into a new quantum electrodynamical-DFT approach named as “QEDFT”.
Insight, design and control define the scientific rationale of the project, which will focus on the discovery of the general principles that describe and control systems far from equilibrium and orchestrate the behavior of many electrons and atoms to create new phenomena/states of matter. Besides developing and implementing the new theory of QEDFT, we will investigate atoms and molecules with quantum optical fields; whether and how selected laser pulses drive molecules and solids into new states of matter that have no equilibrium counterpart. What happens when it enters these coherent states? The objective is to identify the spectroscopic fingerprint of those new states. Which states arise in the strong light-matter coupling regime? e.g. hybridized states such as photon bound states, exciton/plasmon-polariton states, so far still undiscovered states. The long-term goal is to deliver an all-out theoretical and computational toolbox for QED-TDDFT applicable to complex molecular systems (like presently approachable by DFT and by TDDFT).

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:
716142	**GreenOnWaterCat**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr THOMAS KÜHNE**
Host Institution:	UNIVERSITAET PADERBORN - DE

Unravelling the Nature of Green Organic "On-Water" Catalysis via Novel Quantum Chemical Methods

The target of the research program, GreenOnWaterCat, is to revolutionize the understanding of green "on-water" catalysis and to unravel its microscopic origin. To enable these goals to be reached, several novel theoretical methods will be developed and implemented that will enable for unprecedented large-scale quantum molecular dynamics simulations, where both the electronic and nuclear Schrödinger equations are solved simultaneously. In addition, these methods will also allow the efficient computation of various state-of-the-art vibrational spectroscopies "on-the-fly", at essentially no additional computational cost. Furthermore, new analysis techniques permit to assign the spectra and explain their correlation with the atomic structure in order to gain invaluable insights and eventually grasp the relationships between the dynamics and structure of "on-water" catalysis and vibrational spectroscopies. Since the latter offers a convenient connection to experiment, the unique results are of utmost value in order to explain the experimental findings. In consequence, new synthetic processes based on the "on-water" phenomenon will be proposed and investigated. The expected results will be most helpful so that water will soon become not only a viable, but also very attractive solvent in the design of novel synthetic processes and to make it even more useful for industrial applications.

Beside the development and implementation of novel computational methods, which will be made publicly available, the additional outcomes expected are as follows:

- To conclusively explain the underlying mechanism of the "on-water" rate phenomenon for the first time
- To elucidate the experimental measurements and characterize the corresponding atomic structure
- To propose novel synthetic processes which exploit the "on-water" concept, such as catalysis at the organic/metal oxide interface
- To investigate the possibility of "on-water" catalysis using two water-insoluble solid reactants

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:
716265	**TSuNAMI**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr JANA KALBACOVA VEJPRAVOVA**
Host Institution:	UNIVERZITA KARLOVA - CZ

Trans-Spin NanoArchitectures: from birth to functionalities in magnetic field

Control over electrons in molecules and periodic solids can be reached via manipulation of their internal quantum degrees of freedom. The most prominent and exploited case is the electronic spin accommodated in standalone spin units composed of 1 – 10^5 of spins. A challenging alternative to the spin is the binary quantum degree of freedom, termed pseudospin existing e.g. in two-dimensional semiconductors. The aim of the proposed research is to build prototypes of trans-spin nano-architectures composed of at least two divergent spin entities, the TSuNAMIes. The spin entities of interest correspond to single atomic spin embedded in spin crossover complexes (SCO), molecular spin of molecular magnets (SMM), superspins of single-domain magnetic nanoparticles (SuperS) and pseudospins in two-dimensional transition metal dichalcogenides (PseudoS). Ultimate goal of the project is to identify a profit from trans-spin cooperation between the different spin entities coexisting in a single TSuNAMI. Influence of external static and alternating magnetic fields on the elementary spin state, unit cell magnetic structure, long-range magnetic order, mesoscopic spin order, spin relaxations and pseudospin state mirrored in essential fingerprints of the spin units and their ensembles will be explored using macroscopic and microscopic in situ and ex situ probes, including Raman and Mössbauer spectroscopies in magnetic field. Within the proposed high-risk/high-gain trans-spin strategy, we thus expect: 1. Enhancement of magnetic anisotropy in SMM-SuperS with enormous impact on cancer therapy using magnetic fluid hyperthermia, 2. Control over SCO via coupling to giant classical spin giving rise to miniature 'on-particle' sensors, 3. Mutual visualization of electronic states in SCO-PseudoS pushing frontiers of nowadays pseudospintronics, and 4. Control over electronic states with nanometer resolution in SuperS-PseudoS giving rise to novel functionalization strategies of graphene successor.

Link to the ERC project webpage:

Keywords of the ERC project: spin, magnetism, 2D materials, low temperature physics

Keywords that characterize the scientific profile of the potential visiting researcher/s: condensed matter physics, Raman spectroscopy, diffraction methods

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
716539	**HybridSolarFuels**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr CSABA JANAKY**
Host Institution:	SZEGEDI TUDOMANYEGYETEM - HU

Efficient Photoelectrochemical Transformation of CO2 to Useful Fuels on Nanostructured Hybrid Electrodes

Given that CO2 is a greenhouse gas, using the energy of sunlight to convert CO2 to transportation fuels (such as methanol) represents a value-added approach to the simultaneous generation of alternative fuels and environmental remediation of carbon emissions. Photoelectrochemistry has been proven to be a useful avenue for solar water splitting. CO2 reduction, however, is multi-electron in nature (e.g., 6 e- to methanol) with considerable kinetic barriers to electron transfer. It therefore requires the use of carefully designed electrode surfaces to accelerate e- transfer rates to levels that make practical sense. In addition, novel flow-cell configurations have to be designed to overcome mass transport limitations of this reaction.
We are going to design and assemble nanostructured hybrid materials to be simultaneously applied as both adsorber and cathode-material to photoelectrochemically convert CO2 to valuable liquid fuels. The three main goals of this project are to (i) gain fundamental understanding of morphological-, size-, and surface functional group effects on the photoelectrochemical (PEC) behavior at the nanoscale (ii) design and synthesize new functional hybrid materials for PEC CO2 reduction, (iii) develop flow-reactors for PEC CO2 reduction. Rationally designed hybrid nanostructures of large surface area p-type semiconductors (e.g., SiC, CuMO2, or CuPbI3) and N-containing conducting polymers (e.g., polyaniline-based custom designed polymers) will be responsible for: (i) higher photocurrents due to facile charge transfer and better light absorption (ii) higher selectivity towards the formation of liquid fuels due to the adsorption of CO2 on the photocathode (iii) better stability of the photocathode. The challenges are great, but the possible rewards are enormous: performing CO2 adsorption and reduction on the same system may lead to PEC cells which can be deployed directly at the source point of CO2, which would go well beyond the state-of-the-art.

Link to the ERC project webpage:

Keywords of the ERC project: electrochemistry, photoelectrochemistry, solar fuels, carbon dioxide, perovskite

Keywords that characterize the scientific profile of the potential visiting researcher/s: Chemical engineering, flow chemistry, ion exchange membranes

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
716641	**AQUARAMAN**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr ALEIX GARCIA GUELL**
Host Institution:	ECOLE POLYTECHNIQUE - FR

Pipet Based Scanning Probe Microscopy Tip-Enhanced Raman Spectroscopy: A Novel Approach for TERS in Liquids

Tip-enhanced Raman spectroscopy (TERS) is often described as the most powerful tool for optical characterization of surfaces and their proximities. It combines the intrinsic spatial resolution of scanning probe techniques (AFM or STM) with the chemical information content of vibrational Raman spectroscopy. Capable to reveal surface heterogeneity at the nanoscale, TERS is currently playing a fundamental role in the understanding of interfacial physicochemical processes in key areas of science and technology such as chemistry, biology and material science.

Unfortunately, the undeniable potential of TERS as a label-free tool for nanoscale chemical and structural characterization is, nowadays, limited to air and vacuum environments, with it failing to operate in a reliable and systematic manner in liquid. The reasons are more technical than fundamental, as what is hindering the application of TERS in water is, among other issues, the low stability of the probes and their consistency. Fields of science and technology where the presence of water/electrolyte is unavoidable, such as biology and electrochemistry, remain unexplored with this powerful technique.

We propose a revolutionary approach for TERS in liquids founded on the employment of pipet-based scanning probe microscopy techniques (pb-SPM) as an alternative to AFM and STM. The use of recent but well established pb-SPM brings the opportunity to develop unprecedented pipet-based TERS probes (beyond the classic and limited metallized solid probes from AFM and STM), together with the implementation of ingenious and innovative measures to enhance tip stability, sensitivity and reliability, unattainable with the current techniques.

We will be in possession of a unique nano-spectroscopy platform capable of experiments in liquids, to follow dynamic processes in-situ, addressing fundamental questions and bringing insight into interfacial phenomena spanning from materials science, physics, chemistry and biology.

Link to the ERC project webpage:

Keywords of the ERC project: Raman spectroscopy SPM TERS electrochemistry biology

Keywords that characterize the scientific profile of the potential visiting researcher/s: AFM high-speed TERS Raman Spectroscopy

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
637394	**SILION**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr SHIGEYOSHI INOUE**
Host Institution:	TECHNISCHE UNIVERSITAET MUENCHEN - DE

Design, Synthesis, Characterization and Catalytic Application of Silyliumylidene Ions

This ERC-StG 2014 proposal, SILION, outlines a strategy for the one-pot synthesis, characterization, and reactivity investigation of a positively charged, electron-deficient, highly Lewis acidic, cationic silicon(II) species, denoted “silyliumylidene ions”. Silyliumylidene ion has only four valence electrons, consisting of a lone pair of electrons and two vacant orbitals on the central silicon atom. It will be expected to bear the best combined character of both silylenes as silicon analogue of carbene and silylium ions as silicon analogue of carbenium ions. The program described herein is also aimed at the development of silyliumylidene ion as novel catalysts based on main group elements.

The proposed silyliumylidene ions should fulfil the following criteria:

a) compounds can be synthesized by a facile one-pot reaction of the corresponding dichlorosilane with two equivalents of N-heterocyclic carbenes,

b) silyliumylidene ions will potentially possess three reactive sites including (i) a lone pair at the silicon center, (ii) p-orbital at the silicon center, and (iii) N-heterocyclic carbenes,

c) thanks to their strong sigma-donor as well as pi-acceptor ability, the highly reactive silyliumylidene ions are expected to serve as innovative reagents for activation of organic small molecules, excellent catalysts, and strikingly versatile coordination ligands toward transition metals.

The target of this proposal is the introduction of facile accessible silyliumylidene ions, which are combined the best properties of silylene and silylium ions, and development of its reactivity and catalytic activity. The synthesis of silyliumylidene ions is straightforward and should allow the investigation of electronic and steric properties of the substituents and N-heterocyclic carbenes. It is anticipated that novel silyliumylidene ions can be used for a promising new building block for low-valent organosilicon compounds and high-performance catalysts.

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:
637624	**ThermoTex**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr CHRISTIAN MÜLLER**
Host Institution:	CHALMERS TEKNISKA HOEGSKOLA AB - SE

Woven and 3D-Printed Thermoelectric Textiles

Imagine a world, in which countless embedded microelectronic components continuously monitor our health and allow us to seamlessly interact with our digital environment. One particularly promising platform for the realisation of this concept is based on wearable electronic textiles. In order for this technology to become truly pervasive, a myriad of devices will have to operate autonomously over an extended period of time without the need for additional maintenance, repair or battery replacement. The goal of this research programme is to realise textile-based thermoelectric generators that without additional cost can power built-in electronics by harvesting one of the most ubiquitous energy sources available to us: our body heat.
Current thermoelectric technologies rely on toxic inorganic materials that are both expensive to produce and fragile by design, which renders them unsuitable especially for wearable applications. Instead, in this programme we will use polymer semiconductors and nanocomposites. Initially, we will focus on the preparation of materials with a thermoelectric performance significantly beyond the state-of-the-art. Then, we will exploit the ease of shaping polymers into light-weight and flexible articles such as fibres, yarns and fabrics. We will explore both, traditional weaving methods as well as emerging 3D-printing techniques, in order to realise low-cost thermoelectric textiles.
Finally, within the scope of this programme we will demonstrate the ability of prototype thermoelectric textiles to harvest a small fraction of the wearer's body heat under realistic conditions. We will achieve this through integration into clothing to power off-the-shelf sensors for health care and security applications. Eventually, it can be anticipated that the here interrogated thermoelectric design paradigms will be of significant benefit to the European textile and health care sector as well as society in general.

Link to the ERC project webpage:

Keywords of the ERC project: thermoelectrics, conducting polymer, molecular doping, textile, fiber, yarn, bulk processing

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:
647301	**DECRESIM**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr ALEJANDRO GAITA**
Host Institution:	UNIVERSITAT DE VALENCIA - ES

A Chemical Approach to Molecular Spin Qubits: Decoherence and Organisation of Rare Earth Single Ion Magnets

Coordination Chemistry and Molecular Magnetism are in an ideal position for the rational design of Single-Molecule Magnets which can be used as molecular spin qubits, the irreducible components of any quantum technology. Indeed, a major advantage of molecular spin qubits over other candidates stems from the power of Chemistry for a tailored and inexpensive synthesis of systems for their experimental study. In particular, the so-called Lanthanoid-based Single-Ion Magnets, which are currently the hottest topic in Molecular Magnetism, have the potential to be chemically designed, tuning both their single-molecule properties and their crystalline environment. This will allow the independent study of the different quantum processes that cause the loss of quantum information, collectively known as decoherence. The study of quantum decoherence processes in the solid state is necessary both to lay the foundations for next-generation quantum technologies and to answer some fundamental questions.

The goals of this project are:

#1 To unravel the mechanistic details of decoherence in molecular spin qubits based on mononuclear lanthanoid complexes. This study will stablish criteria for the rational design of single spin qubits.

#2 To extend this study to the coupling between two or more spin qubits. This will allow us to explore the use of polynuclear lanthanoid complexes to achieve quantum gates or simple algorithms.

#3 To extrapolate to infinite systems formed by the complex organization of spin qubits. This exploratory goal will permit us to move beyond zero-dimensional systems, thus facilitating the advance towards complex quantum functions.

Link to the ERC project webpage: https://www.uv.es/gaita/decresim.html

Keywords of the ERC project: lanthanide, molecular spin qubits, open quantum systems, molecular vibrations, decoherence, quantum coherence

Keywords that characterize the scientific profile of the potential visiting researcher/s: EPR, pulsed EPR, molecular vibrations, phonons, singlet fission

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
647550	**UNBICAT**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr JOSE ALEMAN**
Host Institution:	UNIVERSIDAD AUTONOMA DE MADRID - ES

Unconventional Bifunctional Catalysts

The development of sustainable chemical processes is one of the most important features in modern chemistry. It has become a key research area worldwide providing solutions to important societal demands by optimizing the use of natural resources and minimizing waste and environmental impact. Among the relevant methods for achieving this goal, catalysis represents a key and central approach. Both Organocatalysis and Metal Catalysis have emerged as solutions to the problems in this context. In this field, the progress of a novel bifunctional organocatalyst that could increase the number of different activations, and therefore the synthesis of valuable enantio-enriched molecules, would be highly desirable. Especially important, but still unknown, are the bifunctional-catalysts based on a Neutral Coordinate Organocatalyst and Photo-Organocatalysts. This proposal aims to develop two new unconventional approaches for the synthesis of bifunctional organocatalysts.

The first one is based on the development of new Bifunctional Neutral Coordinate Organocatalyst and their application to the synthesis of biologically relevant compounds. I propose to use these bifunctional catalysts to promote the dual activation of silyl reagents and suitable electrophiles. This approach constitutes an unconventional way to synthesize asymmetric molecules and has no precedent in the literature.

The second section of this proposal explores the photo-activation-bifunctional organocatalyst. I propose the design and application of new metal-free Bifunctional Photo-Organocatalysts which are able to chemically and photo-activate the substrate simultaneously in an asymmetric manner.

This project has the potential to change the general view of asymmetric Neutral Coordinate Organocatalyst and Photo-catalysis as we know it today. These unconventional bifunctional would be incorporated into the privileged catalyst library for its applications in new asymmetric transformations.

Link to the ERC project webpage: www.uam.es/jose.aleman

Keywords of the ERC project: bifunctional catalysis, photocatalysis, organocatalysis

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:
677786	**DYNAP**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr JAVIER MONTENEGRO**
Host Institution:	UNIVERSIDAD DE SANTIAGO DE COMPOSTELA - ES

Dynamic Penetrating Peptide Adaptamers

The aim of this proposal is to identify, at the molecular level, the minimal topological and structural motifs that govern the membrane translocation of short peptides. A covalent reversible bond strategy will be developed for the synthesis of self-adaptive penetrating peptides (adaptamers) for targeted delivery.

It is known that the recently developed therapeutic technologies (i.e. gene therapy, chemotherapy, hyperthermia, etc.) cannot reach their expected potential due to limitations in the current delivery strategies, which hinder the efficient targeting of the appropriate tissues, cells and organelles. Despite the enormous therapeutic potential of short penetrating peptides, these molecules suffer from drawbacks such as toxicity, instability to protease digestion and lack of specificity.

Dynamic covalent chemistry has significant synthetic advantages. In the proposed research, peptide scaffolds with clickable reversible groups (e.g. hydrazide) will be conjugated with collections of aldehydes to afford self-adaptive biomimetic transporters, whose secondary structure and penetrating properties will be systematically characterized by biophysical, cell-biology and pattern recognition techniques.

The versatility of dynamic supramolecular “peptide adaptamers” with precisely positioned protein ligands will be explored for multivalent specific recognition, protein transport, cell targeting of drugs and probes and membrane epitoping.

Additionally, we propose to synthesise dynamic and environmentally sensitive fluorescent probes for biocompatible membrane labelling and uptake signalling.

The resulting discoveries of this research will allow the formulation of novel transfecting reagents for gene therapy, selective platforms for drug-delivery and the development of dynamic fluorescent membrane probes. The potential results of this proposal will shake the fields of drug-delivery and non-viral gene transfection and will resolve the limitations of the current approaches.

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

Keywords of the ERC project: penetrating peptides, chemical biology, supramolecular chemistry, organic chemistry

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:
678565	**STEM**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr JUAN JOSÉ VILATELA**
Host Institution:	FUNDACION IMDEA MATERIALES - ES

Structural energy harvesting composite materials

The purpose of this project is the development of new multifunctional structural composite materials that combine high-performance mechanical properties and the possibility to harvest energy. The multifunctional composites are based on a continuous macroscopic fibre made up of highly aligned carbon nanotubes that has bulk mechanical, electrical and thermal properties already superior to carbon fibre and the mesoporosity and chemical resistance of an activated carbon; which will be combined with nanostructured semiconductors that can transfer charge/energy when subjected to external stimuli (piezoelectric, photovoltaic) and integrated in a polymer matrix to form composite ply structures. Such composites will be fabricated from bottom to top, resulting in a 3-component hierarchical structure. Load, charge and energy transfer processes at the nanocarbon/inorganic interface, for example, will be carefully controlled through tailoring the structure and optoelectronic properties of the two components during their synthesis, and by exploiting the role of the fibre surface to template the growth of inorganic semiconductors and form an electronic junction. The project comprises a detailed multiscale study of materials synthesis and properties, including in-situ spectroscopy, electron microscopy and synchrotron XRD during mechanical testing, junction characterisation (emission/absorption spectroscopy, impedance) and photocurrent measurements. The uniqueness of the proposal lies in exploiting advanced optoelectronic processes in macroscopic strong composites on a composite ply length-scale, in the quest for a new generation of light-weight multifunctional structural materials.

Link to the ERC project webpage: http://www.materials.imdea.org/groups/mng/

Keywords of the ERC project: energy harvesting, carbon nanotube fiber, composite

Keywords that characterize the scientific profile of the potential visiting researcher/s: energy harvesting, x-ray, synthesis, carbon nanotube

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
716315	**AlCat**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr MICHAEL COWLEY**
Host Institution:	THE UNIVERSITY OF EDINBURGH - UK

Bond activation and catalysis with low-valent aluminium

This project will develop the principles required to enable bond-modifying redox catalysis based on aluminium by preparing and studying new Al(I) compounds capable of reversible oxidative addition.
Catalytic processes are involved in the synthesis of 75 % of all industrially produced chemicals, but most catalysts involved are based on precious metals such as rhodium, palladium or platinum. These metals are expensive and their supply limited and unstable; there is a significant need to develop the chemistry of non-precious metals as alternatives. On toxicity and abundance alone, aluminium is an attractive candidate. Furthermore, recent work, including in our group, has demonstrated that Al(I) compounds can perform a key step in catalytic cycles - the oxidative addition of E-H bonds.
In order to realise the significant potential of Al(I) for transition-metal style catalysis we urgently need to:
- establish the principles governing oxidative addition and reductive elimination reactivity in aluminium systems.
- know how the reactivity of Al(I) compounds can be controlled by varying properties of ligand frameworks.
- understand the onward reactivity of oxidative addition products of Al(I) to enable applications in catalysis.
In this project we will:
- Study mechanisms of oxidative addition and reductive elimination of a range of synthetically relevant bonds at Al(I) centres, establishing the principles governing this fundamental reactivity.
- Develop new ligand frameworks to support of Al(I) centres and evaluate the effect of the ligand on oxidative addition/reductive elimination at Al centres.
- Investigate methods for Al-mediated functionalisation of organic compounds by exploring the reactivity of E-H oxidative addition products with unsaturated organic compounds.

Link to the ERC project webpage:

Keywords of the ERC project: main group chemistry, synthetic chemistry, inorganic chemistry, organometallic chemistry, catalysis, aluminium

Keywords that characterize the scientific profile of the potential visiting researcher/s: professor, postdoc, PhD student

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
717026	**SHINING**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr FENG GAO**
Host Institution:	LINKOPINGS UNIVERSITET - SE

Stable and High-Efficiency Perovskite Light-Emitting Diodes

Light-emitting diodes (LEDs), which emit light by a solid-state process called electroluminescence, are considered as the most promising energy-efficient technology for future lighting and display. It has been demonstrated that optimal use of LEDs could significantly reduce the world's electricity use for lighting from 20% to 4%. However, current LED technologies typically rely on expensive high-vacuum manufacturing processes, hampering their widespread applications. Therefore, it is highly desirable to develop low-cost LEDs based on solution-processed semiconductors.

A superstar in the family of solution-processed semiconductors is metal halide perovskites, which have shown great success in photovoltaic applications during the past few years. The same perovskites can also been applied in LEDs. Despite being at an early stage of development with associated challenges, metal halide perovskites provide great promise as a new generation of materials for low-cost LEDs.

This project aims to develop high-efficiency and stable perovskite LEDs based on solution-processed perovskites. Two different classes of low-dimensional perovskites will be investigated independently. These new perovskites materials will then be coupled with novel interface engineering to fabricate perovskite LEDs with the performance beyond the state of the art. At the core of the research is the synthesis of new perovskite nanostructures, combined with advanced spectroscopic characterization and device development. This project combines recent advances in perovskite optoelectronics and low-dimensional materials to create a new paradigm for perovskite LEDs. This research will also lead to the development of new perovskites materials which will serve future advances in photovoltaics, transistors, lasers, etc.

Link to the ERC project webpage:

Keywords of the ERC project: perovskites; optoelectronics; photophysics; LEDs

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:
742401	**NANOCHEM**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr MARTIN SCHRODER**
Host Institution:	THE UNIVERSITY OF MANCHESTER - UK

Nanopores for New Molecular Nitrogen Chemistry

We will study the adsorption, binding, transport and reactivity of N-containing substrates within the nanopores of functionalized and doped metal-organic framework (MOF) materials. A range of important target molecules (e.g., NH3, N2H4, N2O, NO, NO2 and N2O4) will be studied in this project, which aims to re-define the molecular chemistry for these energetic N-compounds in confined space, and to develop selective catalytic reduction (SCR) of NOx in the presence of NH3, urea and hydrocarbons. The PI has extensive experience in the field of coordination chemistry and hybrid materials, and seeks to change research direction to develop new gas phase catalysts and to gain fundamental understanding of molecular interactions, properties and function of specific energy, environmentally-related substrates within MOFs. Research objectives include the:

• Design and synthesis of new porous MOFs with emphasis on the decoration of their pore environment and improvement of their structural stability and function;

• Characterisation of host and substrate-loaded materials by state-of-the-art in situ structural, dynamic and spectroscopic methods for the construction of structure-function relationships, supported by computational analysis and modelling;

• Adsorption, binding, release and separation of NH3, N2H4, N2O, NO, NO2 and N2O4 via both static and dynamic experiments;

• Tests of degradation and selective catalytic reduction (SCR) of captured NOx molecules with NH3, urea and hydrocarbons under mild conditions using nanoporous MOFs as host catalysts;

• Assembly of a MOF-based (i) catalytic deNOx reactor and (ii) NH3 storage system for potential portable applications.

This project will deliver new functional materials as high capacity portable NH3 stores, efficient capture medium for NOx, and new catalysts for reduction and mitigation of NOx to deliver significant impacts to academia, industry and society of direct relevance to clean energy and sustainable environment.

Link to the ERC project webpage:

Keywords of the ERC project: MOFs, materials, coordination chemistry

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:
756277	**ATMEN**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr TOMA SUSI**
Host Institution:	UNIVERSITAT WIEN - AT

Atomic precision materials engineering

Despite more than fifty years of scientific progress since Richard Feynman's 1959 vision for nanotechnology, there is only one way to manipulate individual atoms in materials: scanning tunneling microscopy. Since the late 1980s, its atomically sharp tip has been used to move atoms over clean metal surfaces held at cryogenic temperatures. Scanning transmission electron microscopy, on the other hand, has been able to resolve atoms only more recently by focusing the electron beam with sub-atomic precision. This is especially useful in the two-dimensional form of hexagonally bonded carbon called graphene, which has superb electronic and mechanical properties. Several ways to further engineer those have been proposed, including by doping the structure with substitutional heteroatoms such as boron, nitrogen, phosphorus and silicon. My recent discovery that the scattering of the energetic imaging electrons can cause a silicon impurity to move through the graphene lattice has revealed a potential for atomically precise manipulation using the Ångström-sized electron probe. To develop this into a practical technique, improvements in the description of beam-induced displacements, advances in heteroatom implantation, and a concerted effort towards the automation of manipulations are required. My project tackles these in a multidisciplinary effort combining innovative computational techniques with pioneering experiments in an instrument where a low-energy ion implantation chamber is directly connected to an advanced electron microscope. To demonstrate the power of the method, I will prototype an atomic memory with an unprecedented memory density, and create heteroatom quantum corrals optimized for their plasmonic properties. The capability for atom-scale engineering of covalent materials opens a new vista for nanotechnology, pushing back the boundaries of the possible and allowing a plethora of materials science questions to be studied at the ultimate level of control.

Link to the ERC project webpage: http://mostlyphysics.net/erc/

Keywords of the ERC project: electron microscopy, atom manipulation, nanotechnology, graphene

Keywords that characterize the scientific profile of the potential visiting researcher/s: electron microscopy, machine learning, first principles modeling

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
759552	**SEC**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr ANDREW LAWRENCE**
Host Institution:	THE UNIVERSITY OF EDINBURGH - UK

Stereoretentive-Enantioconvergent Catalysis: A New Concept in Asymmetric Synthesis

This project will experimentally establish a new concept in asymmetric synthesis: stereoretentive-enantioconvergent catalysis. This will represent a completely new method for accessing enantiopure materials starting from racemic substrates and will therefore impact all areas of synthetic chemistry. The ability to synthesise chiral molecules in enantiopure form is vitally important, most recognisably for the pharmaceutical industry. This is because the molecules of life are chiral (e.g., D-sugars and L-amino acids) and enantiomers often interact very differently with living organisms. Classically, asymmetric synthesis utilising racemic substrates is limited to achieving a maximum yield of 50% (e.g., kinetic resolutions). Enantioconvergent catalysis avoids this limitation with both enantiomers of the starting material being converted into a single enantioenriched product, thanks to complex stereoablative or stereomutative de-racemisation processes. This project will establish a conceptually new stereoretentive-dimerisation approach that results in both enantiomers of the starting material being incorporated into the product with no de-racemisation required. This new concept will prove highly valuable for the synthesis of small enantiopure building blocks, which will be of high value in many areas of synthesis, and also for more complex late-stage transformations in complex molecule synthesis. Several approaches will be pursued to demonstrate proof-of-principle, and applications in the synthesis of complex natural and unnatural products will then be used to demonstrate the potential of stereoretentive-enantioconvergent catalysis in target-orientated synthesis.

Link to the ERC project webpage: https://cordis.europa.eu/project/rcn/212330_en.html

Keywords of the ERC project: Organic Chemistry, Asymmetric Synthesis, Enantioconvergent Reactions

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:
759577	**EnBioN**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr CIRO CHIAPPINI**
Host Institution:	KING'S COLLEGE LONDON - UK

Engineering the Biointerface of Nanowires to Direct Stem Cell Differentiation

ENBION will engineer a platform to direct the differentiation of stem cells by developing principles for the rational design of the biointerface of nanowires.
It is increasingly evident that efficient tissue regeneration can only ensue from combining the regenerative potential of stem cells with regulatory stimuli from gene therapy and niche engineering. Yet, despite significant advances towards integrating these technologies, the necessary degree of control over cell fate remains elusive.
Vertical arrays of high aspect ratio nanostructures (nanowires) are rapidly emerging as promising tools to direct cell fate. Thanks to their unique biointerface, nanowires enable gene delivery, intracellular sensing, and direct stimulation of signalling pathways, achieving dynamic manipulation of cells and their environment.
This broad manipulation potential highlights the importance and timeliness of engineering nanowires for regenerative medicine. However, developing a nanowire platform to direct stem cell fate requires design principles based on the largely unknown biological processes governing their interaction with cells. Enabling localized, vector-free gene therapy through efficient transfection relies on understanding the still debated mechanisms by which nanowires induce membrane permeability. Directing cell reprogramming requires understanding the largely unexplored mechanosensory processes and the resulting epigenetic effects arising from the direct interaction of nanowires with multiple organelles within the cell. Engineering the cell microenvironment requires yet undeveloped strategies to localize signalling and transfection with a resolution comparable to the lengthscale of cells.
ENBION will develop this critical knowledge and integrate it into guidelines for dynamic manipulation of cells. Beyond the nanowire platform, the principles highlighted by this unique interface can guide the development of nanomaterials with improved control over cellular processes.

Link to the ERC project webpage: http://chiappinilab.com

Keywords of the ERC project: nanomedicine, tissue engineering, nanotechnology, drug delivery, biosensing, nanoneedles, porous silicon, stem cells

Keywords that characterize the scientific profile of the potential visiting researcher/s: material science, bioengineering, biomedical engineering, biology, cell, stem cells, nanotechnology

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
772462	**ProLiCell**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr JULIEN GAUTROT**
Host Institution:	QUEEN MARY UNIVERSITY OF LONDON - UK

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/
https://cordis.europa.eu/project/rcn/214708_en.html

Keywords of the ERC project: Biomaterials, nanomaterials, self-assembly, biointerfaces, cell adhesion, stem cell phenotype, bioreactor

Keywords that characterize the scientific profile of the potential visiting researcher/s: Materials chemistry, nanoscale mechanics, self-assembly, recombinant proteins, stem cell biology

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
788231	**ProgrES**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr SABINE FLITSCH**
Host Institution:	THE UNIVERSITY OF MANCHESTER - UK

Programmable Enzymatic Synthesis of Bioactive Compounds

Enzymes are now established as highly selective biocatalysts in organic synthesis with the range of catalysts and reactions rapidly increasing through access to large protein databases and high-throughput molecular biology tools for biocatalyst engineering. The diversity of biocatalytic reactions is now at a stage where they can be linked in (chemo)-enzymatic reaction cascades, where two or more chemical and/or enzymatic reactions can be catalysed simultaneously generating de novo biosynthetic pathways for chemical synthesis not found in Nature. These reaction cascades have demonstrated important prior art, however they have been mostly limited to few steps and lack the complexity provided by the natural pharmacopeia. ProgrES aims to achieve a step-change by introducing unprecedented structural complexity into de novo pathways and by moving away from manual to automated, high-throughput cascade design and implementation. The proposal is to use a transdisciplinary approach that addresses three important bottlenecks: i. Identification of enzymatic reactions that allow early functionalisation and late stage diversification of the cascade toolkit to increase structural complexity, building on C-H activation mediated by monooxygenases, which are well established in our research group. ii. As diversity of targets increases, high resolution structural analysis of pathway intermediates and products becomes a bottleneck, which is addressed by high-throughput label free mass spectrometry based analytical tools that will match the demands on timescale and numbers. iii. In parallel, we will establish bioinformatics tools adapted from both chemical synthesis and biosynthesis, to allow programmable enzymatic synthesis for cascade design. As proof-of-concept and test bed for the ProgrES platform we aim to generate a library of diverse synthetic imino sugars. This proposal will lead to a major breakthrough in creating a diverse range of scaffolds of therapeutic interest.

Link to the ERC project webpage:

Keywords of the ERC project: biocatalysis enzyme cascades

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

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
647969	**ENERCAPSULE**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr DMITRY SHCHUKIN**
Host Institution:	THE UNIVERSITY OF LIVERPOOL - UK

Nanoencapsulation for Energy Storage and Controlled Release

The main vision of the project ENERCAPSULE is the development of nanoencapsulation technologies based on switchable nanoscale barriers for novel generation of controlled energy storage and delivery systems. These systems will be based on the "smart" nanocontainers (size below 200 nm) loaded with the energy-enriched active components: materials for thermal energy (both latent and based on chemical reactions) storage and substances for bioenergy (ATP or its components) storage for synthetic biology platforms. First novelty of the proposed project is the protection of the nanoscaled energy-enriched materials against environment during storage and controlled release of the encapsulated energy on demand only using both inherent properties of nanocontainer shell or biomimetic nanovalves introduced as shell components. Another main objective of the project is to study the structure and surface-to-volume properties of the energy enriched materials dispersed and encapsulated on nanoscale. The questions of stability of energy nanomaterials, influence of the nanocontainer shell on their energy capacity, homogeneity and operation lifetime will be investigated. Polymer organic nanocapsules with hollow interior and mesoporous carbon nanoparticles are chosen in the project as main types of the nanocontainer scaffolds for energy-enriched materials due to their high loading capacity and potential to design their shells to attain them controlled permeability properties. At the end of the project, developed novel energy storage and delivery systems will be combined within one network having several mechanisms for release and uptake of energy, which can be activated depending on type and intensity of the external impact (demand). The potential applications of such multienergy storage systems will be tested by industrial companies supporting the project.

Link to the ERC project webpage:

Keywords of the ERC project: energy storage, energy capsules, encapsulation of active materials, nanocapsule

Keywords that characterize the scientific profile of the potential visiting researcher/s: energy storage, nanochemistry, materials chemistry, sonochemistry

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
679124	**NANOCOMP**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr MARIA DEL CARMEN GIMENEZ LOPEZ**
Host Institution:	UNIVERSIDAD DE SANTIAGO DE COMPOSTELA - ES

Complex Dynamics of Clusters in High-Aspect Ratio Hollow Nanostructures:
A Nanoscale Platform for High-Performance Computing

Practical aspects and understanding of frontier-computing concepts such as memcomputing (a brain-inspired computational paradigm), quantum computing and spintronics are hindered because of the lack of suitable nanostructured materials. The NANOCOMP project aims to develop a technology for the integration of redox and magnetic nano-switches within the confined space of high-aspect ratio hollow carbon nanostructures, yielding a totally new class of hybrid metal-carbon nanomaterials with different dimensionality as model systems enabling the realisation of these computing schemes. This research will also pave the way for developing new energy-storage concepts. The main objectives are: 1) To develop protocols for successful transport and encapsulation of intact nano-switches within tubular carbon nanostructures (TCN); 2) To understand and control the effects of the confined nano-switches on the carbon nanocontainer (and vice versa); 3) To unravel and develop new methodologies for exploiting the functional properties of the confined nano-switches; 4) To fabricate nanodevices, novel 2D ordered arrays and highly-porous 3D networks for a variety of applications ranging from quantum processors to flexible spintronic devices and supercapacitors. For the first time, the interiors of TCN will be exploited for a) memory capacitors that can store energy in addition to information, b) tackling the problem of scalability of single-molecule magnets (qubits) into electronic circuits and c) exploiting the synergy between electron transport and nanomagnetism (solving spin injection in spintronics). This project will open up a new broad horizon for nanomaterials science and its applications, as the proposed approach can be extended not only to different types of carbon nanostructures (fibers & tubes) and nano-switches (with optical properties), but also to other hollow inorganic tubular nanostructures with different chemical composition and properties (TiO2, BN and WS2, among others).

Link to the ERC project webpage: https://www.usc.es/ciqus/en/grupos/FunNanoMat

Keywords of the ERC project: hybrid carbon nanostructures, molecular magnetism, energy-related applications

Keywords that characterize the scientific profile of the potential visiting researcher/s: molecular magnetism, electrochemistry, nanoparticles, clusters

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
694610	**SUPRABIOTICS**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr ANDREAS HERRMANN**
Host Institution:	DWI LEIBNIZ-INSTITUT FUR INTERAKTIVE MATERIALIEN EV - DE

Supramolecular Protective Groups Enabling Antibiotics and Bioimaging

The pharmaceutical sector has a huge demand for new active compounds including natural products to fill the drug pipelines and to stop the global decline in novel approved active pharmaceutical ingredients. Therefore, developing new tools to fabricate complex molecular structures in a fast and reliable way is paramount. This holds especially true for the field of antibiotics. Multidrug resistant (MDR) pathogens evolve at a terrifying rate and confer resistance to all presently available antibacterial treatments and therefore WHO has identified MDR bacteria as major threat to human health.

In this ERC Advanced Grant, I propose a radically new approach to fabricate very complex molecules with minimal synthetic effort. The technology is based on nucleic acid binders (aptamers), which are evolved in a selection protocol and block several functional groups within a target molecule while allowing other functionalities not in contact with the aptamer to be selectively modified in a single reaction step. Here, we aim to establish this groundbreaking aptameric protective group (APG) method as a novel tool that gives access to compounds that would otherwise be too difficult to obtain by multistep synthesis. Toward this end, the specific objectives are:

- To develop reagents and reactions that are compatible with aptamer-mediated reactions
- To control the site of chemical modification within complex molecules by APGs
- To establish APGs as a general paradigm in natural product derivatization to modify several kinds of substrates
- To achieve site selective modification of proteins by aptamers
- To synthesize novel antibiotics that kill MDR bacteria
- To fabricate “image-and-activate” antibiotics by the APG technology
- To employ the aptamer-target complexes for live-cell imaging of RNA

The outcomes will enable future advances in drug discovery and drug design, bioimaging technologies, and the site-specific modification of therapeutic proteins.

Link to the ERC project webpage:

Keywords of the ERC project: antibiotics, nucleic acids, natural products, aptamers, bioimaging

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:
714122	**chem-fs-MOF**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr CARLOS MARTI-GASTALDO**
Host Institution:	UNIVERSITAT DE VALENCIA - ES

Chemical Engineering of Functional Stable Metal-Organic Frameworks: Porous Crystals and Thin Film Devices

Metal-Organic-Frameworks (MOFs) offer appealing advantages over classical solids from combination of high surface areas with the crystallinity of inorganic materials and the synthetic versatility (unlimited combination of metals and linkers for fine tuning of properties) and processability of organic materials. Provided chemical stability, I expect combination of porosity with manipulable electrical and optical properties to open a new world of possibilities, with MOFs playing an emerging role in fields of key environmental value like photovoltaics, photocatalysis or electrocatalysis. The conventional insulating character of MOFs and their poor chemical stability (only a minimum fraction are hydrolytically stable) are arguably the two key limitations hindering further development in this context.

With chem-fs-MOF I expect to deliver:

1. New synthetic routes specifically designed for producing new, hydrolytically stable Fe(III) and Ti(IV)-MOFs (new synthetic platforms for new materials).
2. More advanced crystalline materials to feature tunable function by chemical manipulation of MOF's optical/electrical properties and pore activity (function-led chemical engineering).
3. High-quality ultrathin films, reliant on the transfer of single-layers, alongside establishing the techniques required for evaluating their electric properties (key to device integration). Recent works on graphene and layered dichalcogenides anticipate the benefits of nanostructuration for more efficient optoelectronic devices. Notwithstanding great potential, this possibility remains still unexplored for MOFs.

Overall, I seek to exploit MOFs' unparalleled chemical/structural flexibility to produce advanced crystalline materials that combine hydrolytical stability and tunable performance to be used in environmentally relevant applications like visible light photocatalysis. This is an emerging research front that holds great potential for influencing future R&D in Chemistry and Materials Science.

Link to the ERC project webpage: http://www.icmol.es/funimat/

Keywords of the ERC project: Metal-Organic Frameworks, charge transport, photocatalysis, reticular chemistry, chemical stability

Keywords that characterize the scientific profile of the potential visiting researcher/s: Metal-Organic Frameworks, coordination chemistry, catalysis, thin-films, electrocatalysis

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
714968	**VISIRday**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr MARKUS RETSCH**
Host Institution:	UNIVERSITAET BAYREUTH - DE

VISible to far-IR optical tuning: passive DAYtime cooling by hierarchical structures and hybrid materials

Efficient daytime cooling without the need for a heat engine is an essential technology to lower our overall energy consumption. Nature offers a chance to off-load heat directly into the cold outer space via the so-called "sky window": a spectral range from 8 – 13 µm, where our atmosphere is transparent. Concomitantly, solar radiance influx needs to be minimized by scattering and reflection, which would counteract the radiatively removed energy. VISIRday aims to provide ground-breaking new materials and concepts to emit thermal energy directly into this transparent sky window. A radically holistic approach is necessary to understand and design the optical properties of nano- and mesostructured materials over the entire spectral range (300 nm – 20 µm), with the mid-IR sky window being fully emissive, and all other spectral wavelengths being fully reflective. I will therefore combine top-down direct write lithography with intricate bottom-up colloidal self-assembly to device hierarchically structured systems fully addressing these stringent optical properties. A new material class – surface phonon polariton supporting nano- and mesoparticles – with adjustable absorption properties in the mid-IR range, will take a leading role as novel colloidal building block. In combination with polymers and metallic nanostructures my team will demonstrate hybrid structures with finely adjusted and even externally tuneable optical properties. Simulations based on finite element modelling to conceive optimum design rules will complement the experimental work. Inspired by examples from nature, namely white beetles and the Saharan silver ant, I will push the fundamental insights towards novel technologies such as radiative daytime cooling paints and fibres. I am convinced that this project provides the urgently needed materials and concepts to add radiative daytime cooling to the existing mix of green energy technologies.

Link to the ERC project webpage: http://www.retsch.uni-bayreuth.de/en/research/06_erc/index.html

Keywords of the ERC project: material science, surface phonon polariton, photonics, passive cooling, hierarchical structuring

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

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
715060	**CALCEAM**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr MARC-ETIENNE MORET**
Host Institution:	UNIVERSITEIT UTRECHT - NL

Cooperative Acceptor Ligands for Catalysis with Earth-Abundant Metals

Homogeneous catalysis is of prime importance for the selective synthesis of high added value chemicals. Many of the currently available catalysts rely on noble metals (Ru, Os, Rh, Ir, Pd, Pt), which suffer from a high toxicity and environmental impact in addition to their high cost, calling for the development of new systems based on first-row transition metals (Mn, Fe, Co, Ni, Cu). The historical paradigm for catalyst design, i.e. one or more donor ligands giving electron density to stabilize a metal center and tune its reactivity, is currently being challenged by the development of acceptor ligands that mostly withdraw electron density from the metal center upon binding. In the last decade, such ligands – mostly based on boron and heavier main-group elements – have evolved from a structural curiosity to a powerful tool in designing new reactive units for homogeneous catalysis.

I will develop a novel class of ligands that use C=E (E=O, S, NR) multiple bonds anchored in close proximity to the metal by phosphine tethers. The electrophilic C=E multiple bond is designed to act as an acceptor moiety that adapts its binding mode to the electronic structure of reactive intermediates with the unique additional possibility of involving the lone pairs on heteroelement E in cooperative reactivity. Building on preliminary results showing that a C=O bond can function as a hemilabile ligand in a catalytic cycle, I will undertake a systematic, experimental and theoretical investigation of the structure and reactivity of M–C–E three membered rings formed by side-on coordination of C=E bonds to a first-row metal. Their ability to facilitate multi-electron transformations (oxidative addition, atom/group transfer reactions) will be investigated. In particular, hemilability of the C=E bond is expected to facilitate challenging C–C bond forming reactions mediated by Fe and Ni. This approach will demonstrate a new conceptual tool for the design of efficient base-metal catalysts.

Link to the ERC project webpage:

Keywords of the ERC project: Organometallic Chemistry, homogeneous catalysis

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:
756575	**CoopCat**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr JESUS CAMPOS MANZANO**
Host Institution:	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS - ES

Cooperative Catalysis: Using Interdisciplinary Chemical Systems to Develop New Cooperative Catalysts

Catalysis, a multidisciplinary science at the heart of many industrial processes, is crucial to deliver future growth and minimize anthropogenic environmental impact, thus being critical to our quality of life. Thus, the development and fundamental understanding of innovative new catalyst systems has clear, direct and long-term benefits to the chemical manufacturing sector and to the broader knowledge-based economy.

In this ERC project I will develop novel innovative cooperative catalysts using interdisciplinary chemical systems based on main group elements, transition metals and molecular clusters to achieve better efficiency and improve chemical scope and sustainability of key chemical transformations.

This will be achieved through 3 complementary and original strategies based on catalytic cooperation: (i) Transition-Metal Frustrated Lewis Pairs (TM-FLPs); (ii) hybrid systems combining low-valent heavier main group elements with transition metals (Hybrid TM/MGs); and (iii) intercluster compounds (ICCs) as versatile heterogeneized materials for Green Catalysis.

These systems, of high synthetic feasibility, combine fundamental concepts from independent areas, e.g. FLPs and low-valent heavier main group elements with transition metal chemistry, and homogeneous with heterogeneous catalysis. The overall approach will be pivotal in discovering novel reactions that rely on the activation of otherwise unreactive substrates. The experience and knowledge gained from (i)-(iii) will be used to inform the design of a second generation of ICC materials in which at least one of the nanoscale bricks is based on polymetallic TM-FLPs or Hybrid TM/MG systems.

Delivering ground-breaking new fundamental science, this pioneering project will lay the foundation for future broad ranging benefits to a number of EU priority areas dependant on innovations in catalysis: innovative and sustainable future energy systems, solar technologies, sustainable chemistry, manufacturing, and healthcare.

Link to the ERC project webpage: http://jcamposgroup.iiq.us-csic.es/

Keywords of the ERC project: cooperative catalysis, organometallic chemistry, Frustrated Lewis Pairs, Main Group Chemistry, Green catalysis

Keywords that characterize the scientific profile of the potential visiting researcher/s: highly enthusiastic and motivated candidates

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
758345	**DISCOVER**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr DAVID SCANLON**
Host Institution:	UNIVERSITY COLLEGE LONDON - UK

Design of Mixed Anion Inorganic Semiconductors for Energy Conversion

Multi-component systems offer the chemical and structural flexibility necessary to meet the needs of next-generation energy conversion. The vast majority of work in the field has focused on mixed-metal compounds. DISCOVER will computationally explore mixed-anion compounds. These are complex systems that provide significant technical challenges for atomistic and electronic structure modelling. Currently, structure-property relationships are poorly developed and there is a distinct lack of understanding of order-disorder transitions. Crucially, no systematic approach has been established for designing new combinations which can be tailored to match the criteria for technological applications.

This project aims to utilize advanced computational techniques to: (i) understand trends in existing mixed anion systems, and (ii) to employ state of the art crystal structure prediction codes to investigate novel ternary and quaternary mixed-anion compositions. The structure-property information emanating from this analysis will allow us to develop design principles for mixed anion semiconductors, which we will use to predict prototype systems for energy conversion. Promising candidates will be experimentally tested through a collaborative network of experts in the field. This ambitious project will push the boundaries of computational materials design, through the use of both classical and electronic structure simulation techniques for bulk, surface and excited states calculations.

The principle outcome will be a novel understanding of how to controllably design mixed anion semiconductors for technological applications, which will drive this material class to the forefront of materials science, while establishing my group at the frontier of computational materials science.

Link to the ERC project webpage: https://cordis.europa.eu/project/rcn/212093_en.html

Keywords of the ERC project: Materials Discovery, Mixed Anion Semconductors, Density functional Theory

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

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
771443	**DYNAFLUORS**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr MARC VENDRELL ESCOBAR**
Host Institution:	THE UNIVERSITY OF EDINBURGH - UK

Dynamic Activatable Fluorophores

In DYNAFLUORS I will develop the first chemical toolbox for imaging in real time the activity of immune cells in tumours.

Although the management of cancer has improved over the years, the cure rates for patients with metastasis and advanced tumours remain low due to lack of appropriate therapies. Recent studies suggest that drugs empowering host immune cells (i.e. immunotherapies) are promising approaches for intractable tumours. However, there are no tools to visualise and understand how host immune cells stop cancer progression in vivo. This important unmet challenge drives the ambitious targets of this proposal.

Over the past 10 years, I have pioneered the development of chemical fluorophores that allow unparalleled analysis of biological systems. In this project, I will implement an innovative approach to unify cutting-edge methodologies in chemistry and biology and develop Dynamic Activatable Fluorophores (DYNAFLUORS) as a chemical toolbox with enhanced imaging capabilities over current technologies.

The cross-disciplinary and ambitious nature of this project will open multiple avenues for broad impact in many areas of chemistry as well as in basic biology, imaging and medicine. DYNAFLUORS will allow us to image, from the molecular level to human tissue, the activity of immune cells in tumours and the response to therapy in real time. This ground-breaking chemical platform will represent a step forward in the forefront of chemical imaging and will create new opportunities in the personalised management of cancer.

In the long term, DYNAFLUORS will become a transformative toolbox for monitoring disease in humans. The integration of functional fluorophores into imaging technologies to perform 'optical biopsies' in vivo and to create patient-specific drug-response assays has the potential to revolutionise the diagnosis, stratification and personalised treatment of disease.

Link to the ERC project webpage:

Keywords of the ERC project: imaging, fluorophores, sensors, immunology, chemical biology, probes

Keywords that characterize the scientific profile of the potential visiting researcher/s: proteins, peptides, chemical biology, fluorescence, optical imaging, therapy

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
772564	**Morpheus**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr NATHALIE KATSONIS**
Host Institution:	UNIVERSITEIT TWENTE - NL

Morphogenesis of photo-mechanized molecular materials

The sophistication reached by organic chemistry has enabled the design and synthesis of a wide range of dynamic molecules that display controlled shape changes with an ever-increasing refinement. However, amplifying these molecular-scale dynamics to support shape-transformation in a broad range of macroscopic functions remains a key challenge.

To address this challenge, I draw inspiration from living materials where molecular machines maintain out of equilibrium states by ingenious coupling with their anisotropic supramolecular environment, and ultimately promote the appearance of emergent properties on higher levels of organization.

The aim of Morpheus is to develop shape-shifting materials and shape-generating photochemical systems by amplifying the motion of molecular machines over increasing length scales, towards the emergence of cohesive shape transformation in artificial tissue-like materials.

We will (i) develop motorized materials by coupling light-driven molecular motors to liquid crystals and pre-program photoreaction-diffusion processes to achieve continuous motion; (ii) combine microfluidics with the anisotropic response of liquid crystal elastomers to create a library of shape-shifting bubbles and shells that undergo pre-programmed shape modification under irradiation with light; (iii) promote adhesion between units of mechanized matter, while preserving their original shape-shifting and shape-generating properties; and (iv) assemble tissue-like morphing materials from large cohesive networks of shape-shifting micro-spheres.

This project will lay the scientific foundation for a new and multidisciplinary approach towards shape-generating molecular materials. It will yield unprecedented examples of emergent dynamics, provide simple models to untangle the underpinnings of mechanical transduction in nature, and contribute to developing new paradigms for the design of active matter.

Link to the ERC project webpage: www.katsonis.eu

Keywords of the ERC project: molecular machines, liquid crystals, artificial molecular motors and switches, soft matter, supramolecular chemistry

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:
788144	**COMPLEXORDER**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr ANDREW GOODWIN**
Host Institution:	THE CHANCELLOR, MASTERS AND SCHOLARS OF THE UNIVERSITY OF OXFORD - UK

The Complexity Revolution: Exploiting Unconventional Order in Next-Generation Materials Design

The fundamental objective of the research described in this proposal is to lay the foundations for understanding how structural complexity can give rise to materials properties inaccessible to structurally-simple states. The long-term vision is a paradigm shift in the way we as chemists design materials—the "Complexity Revolution"—where we move to thinking beyond the unit cell and harness unconventional order to generate emergent states with entirely novel behaviour. The key methodologies of the project are (i) exploitation of the rich structural information accessible using 3D-PDF / diffuse scattering techniques, (ii) exploration of the phase behaviour of unconventional ordered states using computational methods, and (iii) experimental/computational studies of a broad range of materials in which complexity arises from a large variety of different phenemona. In this way, the project will establish how we might controllably introduce complexity into materials by varying chemical composition and synthesis, how we might then characterise these complex states, and how we might exploit this complexity when designing next-generation materials with unprecedented electronic, catalytic, photonic, information storage, dielectric, topological, and magnetic properties.

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:
637277	**FLEXILOG**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr STEVEN SCHOCKAERT**
Host Institution:	CARDIFF UNIVERSITY - UK

Formal lexically informed logics for searching the web

Semantic search engines use structured knowledge to improve traditional web search, e.g. by directly answering questions from users. Current approaches to semantic search rely on the unrealistic assumption that all true facts about a given domain are explicitly stated in their knowledge base or on the web. To reach their full potential, semantic search engines need the ability to reason about known facts. However, existing logics cannot adequately deal with the imperfect nature of knowledge from the web. One problem is that relevant information tends to be distributed over several heterogeneous knowledge bases that are inconsistent with each other. Moreover, domain theories are seldom complete, which means that a form of so-called plausible reasoning is needed. Finally, as relevant logical theories do not exist for many domains, reasoning may need to rely on imperfect probabilistic theories that have been learned from the web.
To overcome these challenges, FLEXILOG will introduce a family of logics for robust reasoning with messy real-world knowledge, based on vector-space representations of natural language terms (i.e. of lexical knowledge). In particular, we will use lexical knowledge to estimate the plausibility of logical models, using conceptual simplicity as a proxy for plausibility (i.e. Occam's razor). This will enable us to implement various forms of commonsense reasoning, equipping classical logic with the ability to draw plausible conclusions based on regularities that are observed in a knowledge base. We will then generalise our approach to probabilistic logics, and show how we can use the resulting lexically informed probabilistic logics to learn accurate and comprehensive domain theories from the web. This project will enable a robust data-driven approach to logic-based semantic search, and more generally lead to fundamental progress in a variety of knowledge-intensive applications for which logical inference has traditionally been too brittle.

Link to the ERC project webpage: http://www.cs.cf.ac.uk/flexilog/

Keywords of the ERC project: vector space embeddings, commonsense reasoning, knowledge representation, natural language processing

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:
637422	**EVERYSOUND**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr TUOMAS VIRTANEN**
Host Institution:	TTY-SAATIO - FI

Computational Analysis of Everyday Soundscapes

Sounds carry a large amount of information about our everyday environment and physical events that take place in it. For example, when a car is passing by, one can perceive the approximate size and speed of the car. Sound can easily and unobtrusively be captured e.g. by mobile phones and transmitted further – for example, tens of hours of audio is uploaded to the internet every minute e.g. in the form of YouTube videos. However, today's technology is not able to recognize individual sound sources in realistic soundscapes, where multiple sounds are present, often simultaneously, and distorted by the environment.
The ground-breaking objective of EVERYSOUND is to develop computational methods which will automatically provide high-level descriptions of environmental sounds in realistic everyday soundscapes such as street, park, home, etc. This requires developing several novel methods, including joint source separation and robust pattern classification algorithms to reliably recognize multiple overlapping sounds, and a hierarchical multilayer taxonomy to accurately categorize everyday sounds. The methods are based on the applicant's internationally recognized and awarded expertise on source separation and robust pattern recognition in speech and music processing, which will allow now tackling the new and challenging research area of everyday sound recognition. The results of EVERYSOUND will enable searching for multimedia based on its audio content, which is not possible with today's technology. It will allow mobile devices, robots, and intelligent monitoring systems to recognize activities in their environments using acoustic information. Producing automatically descriptions of vast quantities of audio will give new tools for geographical, social, cultural, and biological studies to analyze sounds related to human, animal, and natural activity in urban and rural areas, as well as multimedia in social networks.

Link to the ERC project webpage:

Keywords of the ERC project: acoustic pattern classification, sound event detection, environmental sound, everyday soundscapes

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:
638049	**SYNTECH**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr SHAHAR MAOZ**
Host Institution:	TEL AVIV UNIVERSITY - IL

Synthesis Technologies for Reactive Systems Software Engineers

The design and development of open reactive systems, which compute by reacting to ongoing stimuli from their environment, and include, for example, mobile applications running on smart phone devices, web-based applications, industrial robotic systems, embedded software running on chips inside cars and aircraft, etc., is a complex and challenging task. Despite advancement from low-level assembly languages to higher-level languages with powerful abstraction mechanisms, and the use of automated testing and formal verification, reactive systems software development is still a mostly manual and error-prone iterative activity of coding and debugging.

A fundamentally different alternative approach to reactive systems development is synthesis, the automatic creation of correct-by-construction software from its specification. Synthesis has the potential to transform the way open reactive systems software is developed, making the process more effective and productive, and making its results more reliable and usable. However, while important advancements have been recently made on the algorithmic aspects of synthesis, no work has yet taken advantage of these achievements to change software engineering practices from “program centric” to “specification centric”. No effective end-to-end means to use synthesis are available to engineers, and the potential revolutionary impact of synthesis on the engineering of reactive systems software is far from being fully explored.

The proposal targets four objectives: a new, rich specification language, tailored for synthesis and for use by software engineers; a set of new methods for specification centric development; tool implementations in ‘killer app’ application domains; and systematic evaluation with engineers.

The research aims to unleash and evaluate the potential of synthesis to revolutionize reactive systems software development and to open the way for new directions in software engineering research and practice.

Link to the ERC project webpage: http://smlab.cs.tau.ac.il/syntech/

Keywords of the ERC project: Software engineering, program synthesis, formal methods

Keywords that characterize the scientific profile of the potential visiting researcher/s: Software engineering, formal methods, modeling

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
639813	**CLC**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr BENNY APPLEBAUM**
Host Institution:	TEL AVIV UNIVERSITY - IL

Cryptography with Low Complexity

The efficiency of cryptographic constructions is a fundamental question. Theoretically, it is important to understand how much computational resources are needed to guarantee strong notions of security. Practically, highly efficient schemes are always desirable for real-world applications. More generally, the possibility of cryptography with low complexity has wide applications for problems in computational complexity, combinatorial optimization, and computational learning theory.

In this proposal we aim to understand what are the minimal computational resources needed to perform basic cryptographic tasks. In a nutshell, we suggest to focus on three main objectives. First, we would like to get better understanding of the cryptographic hardness of random local functions. Such functions can be computed by highly-efficient circuits and their cryptographic hardness provides a strong and clean formulation for the conjectured average-case hardness of constraint satisfaction problems - a fundamental subject which lies at the core of the theory of computer science. Our second objective is to harness our insights into the hardness of local functions to improve the efficiency of basic cryptographic building blocks such as pseudorandom functions. Finally, our third objective is to expand our theoretical understanding of garbled circuits, study their limitations, and improve their efficiency.

The suggested project can bridge across different regions of computer science such as random combinatorial structures, cryptography, and circuit complexity. It is expected to impact central problems in cryptography, while enriching the general landscape of theoretical computer science.

Link to the ERC project webpage:

Keywords of the ERC project: Cryptography, theoretical computer 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:
647544	**PAW**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr ANDERS MØLLER**
Host Institution:	AARHUS UNIVERSITET - DK

Automated Program Analysis for Advanced Web Applications

Web applications that execute in the user's web browser constitute a substantial part of modern software. JavaScript is the main programming language of the web, although alternatives are emerging, in particular, TypeScript and Dart. Despite the advances in design of languages and libraries, it is difficult to prevent errors when programming such web applications.

Although the basic principles of software verification have been known for decades and researchers have developed an abundance of techniques for formal reasoning about programs, modern software has lots of errors, as everyday users can testify.

The PAW project will create novel automated program analysis algorithms for preventing errors and improving performance of advanced web applications. The project hypothesis is that a scientific breakthrough is within reach, due to recent results by the PI and others in static and dynamic program analysis for JavaScript. The central idea is to combine static and dynamic analysis in new ways and approach the main challenges from two sides:

1) Web applications, especially libraries and frameworks, contain complex uses of dynamic language features that obstruct existing static analysis techniques. The PAW project will address this by integrating concrete execution into static analysis.

2) Web applications are driven by events, which makes it difficult to test all relevant scenarios. The PAW project will enhance the coverage for automated testing by incorporating abstract domains into test scripts and using symbolic execution.

In addition, the project will demonstrate to the research community that it is possible, in contrast to the current dominant practice, to make program analysis algorithms and infrastructure available in a form that embraces reusability.

Link to the ERC project webpage: http://casa.au.dk/

Keywords of the ERC project: program analysis

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:
679515	**COLORAMAP**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr NICOLAS GILLIS**
Host Institution:	UNIVERSITE DE MONS - BE

Constrained Low-Rank Matrix Approximations: Theoretical and Algorithmic Developments for Practitioners

Low-rank matrix approximation (LRA) techniques such as principal component analysis (PCA) are powerful tools for the representation and analysis of high dimensional data, and are used in a wide variety of areas such as machine learning, signal and image processing, data mining, and optimization. Without any constraints and using the least squares error, LRA can be solved via the singular value decomposition. However, in practice, this model is often not suitable mainly because (i) the data might be contaminated with outliers, missing data and non-Gaussian noise, and (ii) the low-rank factors of the decomposition might have to satisfy some specific constraints. Hence, in recent years, many variants of LRA have been introduced, using different constraints on the factors and using different objective functions to assess the quality of the approximation; e.g., sparse PCA, PCA with missing data, independent component analysis and nonnegative matrix factorization. Although these new constrained LRA models have become very popular and standard in some fields, there is still a significant gap between theory and practice. In this project, our goal is to reduce this gap by attacking the problem in an integrated way making connections between LRA variants, and by using four very different but complementary perspectives: (1) computational complexity issues, (2) provably correct algorithms, (3) heuristics for difficult instances, and (4) application-oriented aspects. This unified and multi-disciplinary approach will enable us to understand these problems better, to develop and analyze new and existing algorithms and to then use them for applications. Our ultimate goal is to provide practitioners with new tools and to allow them to decide which method to use in which situation and to know what to expect from it.

Link to the ERC project webpage: https://sites.google.com/site/nicolasgillis/projects/overview

Keywords of the ERC project: low-rank matrix approximations

Keywords that characterize the scientific profile of the potential visiting researcher/s: doctoral and postdoctoral researchers

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
713999	**Matryoshka**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr JASMIN CHRISTIAN BLANCHETTE**
Host Institution:	STICHTING VU - NL

Fast Interactive Verification through Strong Higher-Order Automation

Proof assistants are increasingly used to verify hardware and software and to formalize mathematics. However, despite the success stories, they remain very laborious to use. The situation has improved with the integration of first-order automatic theorem provers -- superposition provers and SMT (satisfiability modulo theories) solvers -- through middleware such as Sledgehammer for Isabelle, codeveloped by the PI; but this research has now reached the point of diminishing returns. Only so much can be done when viewing automatic provers as black boxes.

To make interactive verification more cost-effective, we propose to deliver very high levels of automation to users of proof assistants by fusing and extending two lines of research: automatic and interactive theorem proving. This is our grand challenge. Our starting point is that first-order automatic provers are the best tools available for performing most of the logical work. Our approach will be to enrich superposition and SMT with higher-order reasoning in a careful manner, to preserve their desirable properties. We will design proof rules and strategies, guided by representative benchmarks from interactive verification.

With higher-order superposition and higher-order SMT in place, we will develop highly automatic provers building on modern superposition provers and SMT solvers, following a novel stratified architecture. To reach end users, these new provers will be integrated in proof assistants, including Coq, Isabelle, and the TLA+ Proof System, and will be available as backends to more specialized verification tools. The users of proof assistants and similar tools stand to experience substantial productivity gains: In the past five years, the success rate of automatic provers on interactive proof obligations from a representative benchmark suite has risen from 47% to 77%; with this project, we aim at 90%--95% proof automation.

Link to the ERC project webpage: http://matryoshka.gforge.inria.fr

Keywords of the ERC project: higher-order logic, proof automation, automatic theorem provers, SMT solvers, proof assistants

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:
724464	**Mathador**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr ALEKSANDAR NANEVSKI**
Host Institution:	FUNDACION IMDEA SOFTWARE - ES

Type and Proof Structures for Concurrent Software Verification

Verification of concurrent software is a notoriously difficult subject, whose complexities stem from the inability of the existing verification methods to modularize, and thus divide-and-conquer, the verification problem.
Dependent types are a formal method well-known for its ability to modularize and scale complex mathematical proofs. But, when it comes to programming, dependent types are considered limited to the purely functional and terminating programming model.
The grand challenge of this project is to remove the limitation and scale dependent types to support implementation of stateful concurrent programs, and their correctness proofs, simultaneously. By applying the modularizing power of dependent types to both programs and proofs, the project will obtain novel and scalable foundations for the field of concurrent software verification.
Writing mechanized proofs of software, concurrent or otherwise, is generally considered infeasible. But if one chooses the right linguistic abstractions to express the proofs, we argue that it does not have to be so. This observation is supported by our encouraging preliminary results. The project will discover further novel linguistic abstraction that facilitate engineering of practically feasible formal proofs, and experimentally evaluate them by mechanically verifying extensive concurrent programs drawn from realistic applications, such as concurrent garbage collectors, OS kernels, and popular open-source concurrent libraries.
The project is high risk because it proposes novel foundations for concurrent software verification, whose development requires deep intertwining of logic and program semantics theory, with significant hands-on implementation and experimentation with formal proofs. But it is also high gain, as scaling concurrent software verification is the most significant open problem of present-day programming languages and semantics research.

Link to the ERC project webpage: aleks.nanevski@imdea.org

Keywords of the ERC project: Theoretical computer science, formal methods, and quantum computing. Software engineering, operating systems, computer languages. Software verification, Concurrency, Dependent type theory, Hoare logic

Keywords that characterize the scientific profile of the potential visiting researcher/s: Theoretical computer science, formal methods, and quantum computing. Software engineering, operating systems, computer languages. Software verification, Concurrency, Dependent type theory, Hoare logic

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
741097	**Load Slice Core**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr LIEVEN EECKHOUT**
Host Institution:	UNIVERSITEIT GENT - BE

Load Slice Core: A Power and Cost-Efficient Microarchitecture for the Future

The ideal processor building block is a power and cost-efficient core that can maximize the extraction of memory hierarchy parallelism, a combination that neither traditional in-order nor out-of-order cores provide. We propose the Load Slice Core microarchitecture, a restricted out-of-order engine aimed squarely at extracting memory hierarchy parallelism, which, according to preliminary results, delivers a nearly 8 times higher performance per Watt per euro compared to an out-of-order core.

The overarching objective of this project to fully determine the potential of the Load Slice Core as a key building block for a novel multi-core processor architecture needed in light of both current and future challenges in software and hardware, including variable thread-level parallelism, managed language workloads, the importance of sequential performance, and the quest for significantly improved power and cost efficiency.

We anticipate significant improvement in multi-core performance within the available power budget and cost by combining chip-level dynamism to cope with variable thread-level parallelism along with the inherent power- and cost-efficient Load Slice Core design. If we are able to demonstrate the true value and potential of the Load Slice Core to address future hardware and software challenges, this project will have a long-lasting impact on the microprocessor industry moving forward.

Link to the ERC project webpage: https://users.elis.ugent.be/~leeckhou/

Keywords of the ERC project: computer architecture

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

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
757360	**NoTape**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr SØREN HAUBERG**
Host Institution:	DANMARKS TEKNISKE UNIVERSITET - DK

Measuring with no tape

Society generates increasing amounts of data, which is both a resource and a challenge. The data reveal new insights that may potentially improve our livelihood, but their quantity renders such insights difficult to find. Machine learning techniques sift through the data looking for statistical patterns of interest to a given task. Due to an exponential growth in available data, these techniques enable us to automate difficult decisions, such as those needed for personalized medicine and self-driving cars.

NoTape note that machine learning techniques depend on a distance measure to determine which data points are similar and which are not. As this measure is difficult to choose, NoTape develop methods for estimating an optimal distance measure directly from data. Empirical evidence suggest that the optimal distance measure in one region of data space need not coincide with the optimal measure in another region, i.e.that the distance measure should locally adapt to the data. Local adaptability imply that the distance measure itself will be sensitive to noise in the data, and therefore should be described as a random variable. NoTape estimate distance measures as random Riemannian metrics and perform statistical data analysis accordingly. The notion of statistical computations with respect to an uncertain locally adaptive distance measure is uncharted territory, which need new algorithms for numerical integration and for solving differential equations.

As a guiding example, we estimate statistical models that reflect human perception. As perception processes are not fully understood, an optimal distance measure cannot be precisely estimated and the uncertainty of NoTape is needed.

The geometric nature of the developed methods ensure that attained models are interpretable by humans, which contrast current locally adaptive techniques. As society automate more decisions, interpretability is increasing important to ensure that the machine learning system can be trusted

Link to the ERC project webpage:

Keywords of the ERC project: machine learning; differential geometry; metric learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: machine learning; mathematics; geometry; topology; statistics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
757609	**CGinsideNP**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr WOLFGANG MULZER**
Host Institution:	FREIE UNIVERSITAET BERLIN - DE

Complexity Inside NP - A Computational Geometry Perspective

Traditional complexity theory focuses on the dichotomy between P and NP-hard problems. Lately, it has become increasingly clear that this misses a major part of the picture. Results by the PI and others offer glimpses on a fascinating structure hiding inside NP: new computational problems that seem to lie between polynomial and NP-hard have been identified; new conditional lower bounds for problems with large polynomial running times have been found; long-held beliefs on the difficulty of problems in P have been overturned. Computational geometry plays a major role in these developments, providing some of the main questions and concepts.
We propose to explore this fascinating landscape inside NP from the perspective of computational geometry, guided by three complementary questions:
(A) What can we say about the complexity of search problems derived from existence theorems in discrete geometry? These problems offer a new perspective on complexity classes previously studied in algorithmic game theory (PPAD, PLS, CLS). Preliminary work indicates that they have the potential to answer long-standing open questions on these classes.
(B) Can we provide meaningful conditional lower bounds on geometric problems for which we have only algorithms with large polynomial running time? Prompted by a question raised by the PI and collaborators, such lower bounds were developed for the Frechet distance. Are similar results possible for problems not related to distance measures? If so, this could dramatically extend the traditional theory based on 3SUM-hardness to a much more diverse and nuanced picture.
(C) Can we find subquadratic decision trees and faster algorithms for 3SUM-hard problems? After recent results by Pettie and Gronlund on 3SUM and by the PI and collaborators on the Frechet distance, we have the potential to gain new insights on this large class of well-studied problems and to improve long-standing complexity bounds for them.

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:
757983	**DLT**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr GUIDO MONTUFAR**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DE

Deep Learning Theory: Geometric Analysis of Capacity, Optimization, and Generalization for Improving Learning in Deep Neural Networks

Deep Learning is one of the most vibrant areas of contemporary machine learning and one of the most promising approaches to Artificial Intelligence. Deep Learning drives the latest systems for image, text, and audio processing, as well as an increasing number of new technologies. The goal of this project is to advance on key open problems in Deep Learning, specifically regarding the capacity, optimization, and regularization of these algorithms. The idea is to consolidate a theoretical basis that allows us to pin down the inner workings of the present success of Deep Learning and make it more widely applicable, in particular in situations with limited data and challenging problems in reinforcement learning. The approach is based on the geometry of neural networks and exploits innovative mathematics, drawing on information geometry and algebraic statistics. This is a quite timely and unique proposal which holds promise to vastly streamline the progress of Deep Learning into new frontiers.

Link to the ERC project webpage: https://www.mis.mpg.de/montufar/index.html

Keywords of the ERC project: Deep Learning, Neural networks, Optimization, Representational power, Generalization, Information geometry, Algebraic statistics

Keywords that characterize the scientific profile of the potential visiting researcher/s: Mathematics, Machine learning, Information geometry, Algebraic statistics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
759207	**P2PMODELS**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr SAMER HASSAN**
Host Institution:	UNIVERSIDAD COMPLUTENSE DE MADRID - ES

Decentralized Blockchain-based Organizations for Bootstrapping the Collaborative Economy

The Collaborative Economy (CE) is rapidly expanding through new forms of Internet labor and commerce, from Wikipedia to Kickstarter and Airbnb. However, it suffers from 3 main challenges: (1) Infrastructure: centralized surveillance that the central hubs of information exercise over their users, (2) Governance: disempowered communities which do not have any decision-making influence over the platform, and (3) Economy: concentration of profits in a few major players who do not proportionally redistribute them to the contributors. How can CE software platforms be implemented for solving these challenges? P2PMODELS explores a new way of building CE software platforms harnessing the blockchain, an emerging technology that enables autonomous agent-mediated organizations, in order to (1) provide a software framework to build decentralized infrastructure for Collaborative Economy organizations that do not depend on central authorities, (2) enable democratic-by-design models of governance for communities, by encoding rules directly into the software platform, and (3) enable fairer value distribution models, thus improving the economic sustainability of both CE contributors and organizations.

Together, these 3 objectives will bootstrap the emergence of a new generation of self-governed and more economically sustainable peer-to-peer CE communities. The interdisciplinary nature of P2PMODELS will open a new research field around agent-mediated organizations for collaborative communities and their self-enforcing rules for automatic governance and economic rewarding. Bringing this proposal to life requires a funding scheme compatible with a high-risk/high-gain vision to finance a fully dedicated and highly motivated research team with multidisciplinary skills.

Link to the ERC project webpage: http://p2pmodels.eu

Keywords of the ERC project: Blockchain, Commons, Governance, Communities, Decentralization

Keywords that characterize the scientific profile of the potential visiting researcher/s: Either Blockchain Researcher (decentralized technologies) or Social Researcher (commons, communities, peer production)

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
771779	**DeciGUT**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr SEBASTIAN RUDOLPH**
Host Institution:	TECHNISCHE UNIVERSITAET DRESDEN - DE

A Grand Unified Theory of Decidability in Logic-Based Knowledge Representation

Logic-based knowledge representation (KR) constitutes a vital area of IT. The field inspires and guides scientific and technological developments enabling intelligent management of large and complex knowledge resources. Elaborate languages for specifying knowledge (so-called ontology languages) and querying it have been defined and standardized. Algorithms for automated reasoning and intelligent querying over knowledge resources are being developed, implemented and practically deployed on a wide scale.
Thereby, decidability investigations play a pivotal role to characterize what reasoning or querying tasks are at all computationally solvable.
Past decades have seen a proliferation of new decidable formalisms for KR, dominated by two major paradigms: description logics and rule-based approaches, most notably existential rules. Recently, these research lines have started to converge and first progress has been made toward identifying commonalities among the various formalisms. Still, the underlying principles for establishing their decidability remain disparate, ranging from proof-theoretic notions to model-theoretic ones.
DeciGUT will accomplish a major breakthrough in the field by establishing a "Grand Unified Theory" of decidability. We will provide a novel, powerful model-theoretic criterion inspired by advanced graph-theoretic notions. We will prove that the criterion indeed ensures decidability and that it subsumes most of (if not all) currently known decidable formalisms in the KR field.
We will exploit our results toward the definition of novel decidable KR languages of unprecedented expressivity. We will ultimately extend our framework to encompass more advanced KR features beyond standard first order logic such as counting and non-monotonic aspects.
Our research will draw from and significantly impact the scientific fields of AI, Database Theory and Logic, but also give rise to drastically improved practical information management technology.

Link to the ERC project webpage:

Keywords of the ERC project: logic, automated reasoning, decidability, knowledge representation, model theory, database theory

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:
772346	**TUgbOAT**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr PIOTR SANKOWSKI**
Host Institution:	UNIWERSYTET WARSZAWSKI - PL

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: https://www.mimuw.edu.pl/~tugboat/

Keywords of the ERC project: algorithms

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:
787413	**Interfaces**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr SRIRAM SUBRAMANIAN**
Host Institution:	THE UNIVERSITY OF SUSSEX - UK

Manipulating Acoustic wavefronts using metamaterials for novel user interfaces

In this project we will leverage developments in acoustic meta-materials to build interactive systems that manipulate sound to create experiences with the same ease and fidelity as we are so accustomed to doing with light. This involves designing and evaluating new acoustic meta-materials AND building interactive systems that create novel interaction experiences that were hitherto impossible to achieve.

We will use acoustic metamaterials technology to build a Spatial Sound Modulator (SSM) that aims to be a software controlled device that transforms an input acoustic wave into a time-variable, user-defined acoustic field. SSM comprises of a surface made of electronically adjustable acoustic metamaterial bricks. Each brick in the surface can individually vary the phase of an incident acoustic field, to shape the complex output field.

Our objectives are:

1. Design, implement and evaluate dynamically reconfigurable metamaterial unit-cells and surfaces using transmissive modes of operation. We will explore narrow-band devices for air-borne operation at low ultrasonic frequencies (e.g. 40 kHz).
2. Design SSMs from a spatial distribution of metamaterial unit cells. Specifically, we will identify discretization strategies, digital control mechanisms and develop concepts that are efficient and reduce field reconstruction errors while at the same time constructing the SSM from a small set of reconfigurable metamaterial unit-cells.
3. Create multiple application-specific prototypes of the SUM and identify context specific design constraints and trade-offs.

Link to the ERC project webpage: http://interact-lab.com

Keywords of the ERC project: Metamaterials, human-computer interfaces, computational fabrication

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:
639554	**aSCEND**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr HOETECK WEE**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FR

Secure Computation on Encrypted Data

Recent trends in computing have prompted users and organizations to store an increasingly large amount of sensitive data at third party locations in the cloud outside of their direct control. Storing data remotely poses an acute security threat as these data are outside our control and could potentially be accessed by untrusted parties. Indeed, the reality of these threats have been borne out by the Snowden leaks and hundreds of data breaches each year. In order to protect our data, we will need to encrypt it.

Functional encryption is a novel paradigm for public-key encryption that enables both fine-grained access control and selective computation on encrypted data, as is necessary to protect big, complex data in the cloud. Functional encryption also enables searches on encrypted travel records and surveillance video as well as medical studies on encrypted medical records in a privacy-preserving manner; we can give out restricted secret keys that reveal only the outcome of specific searches and tests. These mechanisms allow us to maintain public safety without compromising on civil liberties, and to facilitate medical break-throughs without compromising on individual privacy.

The goals of the aSCEND project are (i) to design pairing and lattice-based functional encryption that are more efficient and ultimately viable in practice; and (ii) to obtain a richer understanding of expressive functional encryption schemes and to push the boundaries from encrypting data to encrypting software. My long-term vision is the ubiquitous use of functional encryption to secure our data and our computation, just as public-key encryption is widely used today to secure our communication. Realizing this vision requires new advances in the foundations of functional encryption, which is the target of this project.

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:
648785	**BODY-UI**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr KASPER HORNBÆK**
Host Institution:	KOBENHAVNS UNIVERSITET - DK

Using Embodied Cognition to Create the Next Generations of Body-based User Interfaces

Recent advances in user interfaces (UIs) allow users to interact with computers using only their body, so-called body-based UIs. Instead of moving a mouse or tapping a touch surface, people can use whole-body movements to navigate in games, gesture in mid-air to interact with large displays, or scratch their forearm to control a mobile phone. Body-based UIs are attractive because they free users from having to hold or touch a device and because they allow always-on, eyes-free interaction. Currently, however, research on body-based UIs proceeds in an ad hoc fashion and when body-based UIs are compared to device-based alternatives, they perform poorly. This is likely because little is known about the body as a user interface and because it is unclear whether theory and design principles from human-computer interaction (HCI) can be applied to body-based UIs. While body-based UIs may well be the next interaction paradigm for HCI, results so far are mixed.
This project aims at establishing the scientific foundation for the next generations of body-based UIs. The main novelty in my approach is to use results and methods from research on embodied cognition. Embodied cognition suggest that thinking (including reasoning, memory, and emotion) is shaped by our bodies, and conversely, that our bodies reflect thinking. We use embodied cognition to study how body-based UIs affect users, and to increase our understanding of similarities and differences to device-based input. From those studies we develop new body-based UIs, both for input (e.g., gestures in mid-air) and output (e.g., stimulating users' muscles to move their fingers), and evaluate users' experience of interacting through their bodies. We also show how models, evaluation criteria, and design principles in HCI need to be adapted for embodied cognition and body-based UIs. If successful, the project will show how to create body-based UIs that are usable and orders of magnitude better than current UIs.

Link to the ERC project webpage:

Keywords of the ERC project: human-computer interaction

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:
670077	**AMPLify**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr TOBY WALSH**
Host Institution:	TECHNISCHE UNIVERSITAT BERLIN - DE

Allocation Made PracticaL

Allocation Made PracticaL
The AMPLify project will lay the foundations of a new field, computational behavioural game theory that brings a computational perspective, computational implementation, and behavioural insights to game theory. These foundations will be laid by tackling a pressing problem facing society today: the efficient and fair allocation of resources and costs. Research in allocation has previously considered simple, abstract models like cake cutting. We propose to develop richer models that capture important new features like asynchronicity which occur in many markets being developed in our highly connected and online world. The mechanisms currently used to allocate resources and costs are limited to these simple, abstract models and also do not take into account how people actually behave in practice. We will therefore design new mechanisms for these richer allocation problems that exploit insights gained from behavioural game theory like loss aversion. We will also tackle the complexity of these rich models and mechanisms with computational tools. Finally, we will use computation to increase both the efficiency and fairness of allocations. As a result, we will be able to do more with fewer resources and greater fairness. Our initial case studies in resource and cost allocation demonstrate that we can improve efficiency greatly, offering one company alone savings of up to 10% (which is worth tens of millions of dollars every year). We predict even greater impact with the more sophisticated mechanisms to be developed during the course of this project.

Link to the ERC project webpage:

Keywords of the ERC project: artificial intelligence, resource allocation, social choice, game theory

Keywords that characterize the scientific profile of the potential visiting researcher/s: artificial intelligence, resource allocation, social choice, game theory

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
683253	**GraphInt**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr PHILIPPE CUDRE-MAUROUX**
Host Institution:	UNIVERSITE DE FRIBOURG - CH

Principles of Graph Data Integration

The present proposal tackles fundamental problems in data management, leveraging expressive, large-scale and heterogeneous graph structures in order to integrate both unstructured (e.g., text) and structured (e.g., relational) content. Integrating heterogeneous content has become a key hurdle in the deployment of Big Data applications, due to the meteoric rise of both machine and user-generated data storing information in a variety of formats. Traditional integration techniques cleaning up, fusing and then mapping heterogeneous data onto rigid abstractions fall short of accurately capturing the complexity and wild heterogeneity of today's information. Having closely followed the emergence of heterogeneous information sources online, I am convinced that only an interdisciplinary approach drawing both from classical data management and from large-scale Web information processing techniques can solve the formidable data integration challenges that they pose. The following project proposes an ambitious overhaul of information integration techniques embracing the scale and heterogeneity of today's data. I propose the use of expressive and heterogeneous graphs of entities to continuously and dynamically interrelate disparate pieces of content while capturing their idiosyncrasies. The following project focuses on three core issues related to large-scale and heterogeneous information graphs: i) the effective extraction of fined-grained information from unstructured sources and their proper integration into large-scale heterogeneous and probabilistic graphs, ii) the creation of novel physical storage structures and primitives to durably and efficiently manage the profusion of data considered by such graphs using clusters of commodity machines, and iii) the development of logical data abstraction mechanisms facilitating the effective and efficient resolution of complex analytic and data integration queries on top of the physical layer.

Link to the ERC project webpage: https://exascale.info/graphint-project/

Keywords of the ERC project: probabilistic inference; graph data; integration; entity-centric data management

Keywords that characterize the scientific profile of the potential visiting researcher/s: machine learning; data management

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
637935	**CONT-ACT**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr LUDOVIC RIGHETTI**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DE

Control of contact interactions for robots acting in the world

What are the algorithmic principles that would allow a robot to run through a rocky terrain, lift a couch while reaching for an object that rolled under it or manipulate a screwdriver while balancing on top of a ladder? Answering this seemingly naïve question resorts to understanding the fundamental principles for robot locomotion and manipulation, which is very challenging. However, it is a necessary step towards ubiquitous robots capable of helping humans in an uncountable number of tasks. The fundamental aspect of both locomotion and manipulation is that the dynamic interaction of the robot with its environment through the creation of physical contacts is at the heart of the tasks. The planning of such interactions in a general manner is an unsolved problem. Moreover, it is not clear how sensory information (e.g. tactile and force sensors) can be included to improve the robustness of robot behaviors. Most of the time, it is simply discarded. CONT-ACT has the ambition to develop a consistent theoretical framework for motion generation and control where contact interaction is at the core of the approach and an efficient use of sensory information drives the development of high performance, adaptive and robust planning and control methods. CONT-ACT develops an architecture based on real-time predictive controllers that fully exploit contact interactions. In addition, the structure of sensory information during contact interactions is experimentally analyzed to create sensor representations adapted for control. It is then possible to learn predictive models in sensor space that are used to create very reactive controllers. The robot constantly improves its performance as it learns better sensory models. It is a step towards a general theory for robot movement that can be used to control any robot with legs and arms for both manipulation and locomotion tasks and that allows robots to constantly improve their performances as they experience the world.

Link to the ERC project webpage:

Keywords of the ERC project: robotics; optimal control; reinforcement 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:
639109	**FLATLIGHT**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr PATRICE GENEVET**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FR

Functional 2D metamaterials at visible wavelengths

For the last 15 years, optics has undergone a remarkable evolution towards ever decreasing sizes, better integration in complex systems, and more compact devices readily available to mass markets. Whereas traditional optics is at the centimeter scale, newly developed techniques use nanoscale objects to control, guide, and focus light. From the capability to shape metallic and dielectric nanostructures has emerged the field of nanophotonics.

Advances in nanophotonics offer the possibility to control the material's optical properties to create artificial materials with electromagnetic properties not found in nature. Man-made 3D metamaterials have interesting fundamental aspects and present many advantages with respect to conventional devices. Unexpected effects have led to the development of interesting applications like high resolution lenses and cloaking devices.

Inspired by this new technology, we have developed new 2D metamaterials. Our flat metamaterials (metasurfaces) are much simpler to manufacture than their 3D counterparts. By depositing a set of nanostructures at an interface, we can immediately control the light properties; unlike refractive optical components, the wavefront is modified without propagation. As of today, these interfaces are created using metallic nanostructures and work in the infrared. In this ERC, we plan to extend the concept of optical metasurfaces in the visible which is the most important wavelength range for applications. By combining with optically active semiconductors such as InGaAlN, we will add optical gain and modulation capability to the system to create new, efficient optoelectronic devices. The response of the metasurfaces is tunable by changing the environment surrounding the nanostructures. We will use this property to create ultrathin reconfigurable flat devices. Metasurfaces will be integrated with AlN/GaN to modulate light at high frequencies and further exploited to control polariton gases in solid state metasystems.

Link to the ERC project webpage: https://2dphotonics.weebly.com/

Keywords of the ERC project: metasurfaces

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:
677854	**BEACON**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr DENIZ GUNDUZ**
Host Institution:	IMPERIAL COLLEGE OF SCIENCE TECHNOLOGY AND MEDICINE - UK

Hybrid Digital-Analog Networking under Extreme Energy and Latency Constraints

The objective of the BEACON project is to (re-)introduce analog communications into the design of modern wireless networks. We argue that the extreme energy and latency constraints imposed by the emerging Internet of Everything (IoE) paradigm can only be met within a hybrid digital-analog communications framework. Current network architectures separate source and channel coding, orthogonalize users, and employ long block-length digital source and channel codes, which are either suboptimal or not applicable under the aforementioned constraints. BEACON questions these well-established design principles, and proposes to replace them with a hybrid digital-analog communications framework, which will meet the required energy and latency constraints while simplifying the encoding and decoding processes. BEACON pushes the performance of the IoE to its theoretical limits by i) exploiting signal correlations that are abundant in IoE applications, given the foreseen density of deployed sensing devices, ii) taking into account the limited and stochastic nature of energy availability due to, for example, energy harvesting capabilities, iii) using feedback resources to improve the end-to-end signal distortion, and iv) deriving novel converse results to identify fundamental performance benchmarks.

The results of BEACON will not only shed light on the fundamental limits on the performance any coding scheme can achieve, but will also lead to the development of unconventional codes and communication protocols that can approach these limits, combining digital and analog communication techniques. The ultimate challenge for this project is to exploit the developed hybrid digital-analog networking theory for a complete overhaul of the physical layer design for emerging IoE applications, such as smart grids, tele-robotics and smart homes. For this purpose, a proof-of-concept implementation test-bed will also be built using software defined radios and sensor nodes.

Link to the ERC project webpage:

Keywords of the ERC project: wireless communications, machine learning, coding, compression, ultra-low latency

Keywords that characterize the scientific profile of the potential visiting researcher/s: Expertise in information theory and wireless communications, and/or in machine learning (particularly deep learning and reinforcement learning)

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
678919	**DEEPVISION**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr IVO VELLEKOOP**
Host Institution:	UNIVERSITEIT TWENTE - NL

Information-age microscopy for deep vision imaging of biological tissue

Modern biology could not exist without the optical microscope. Hundreds of years of research have seemingly developed microscopes to perfection, with one essential limitation: in turbid biological tissue, not even the most advanced microscope can penetrate deeper than a fraction of a millimetre. At larger depths light scattering prevents the formation of an image. DEEP VISION takes a radically new approach to microscopy in order to lift this final limitation.

Microscopes are based on the idea that light propagates along a straight line. In biological tissue, however, this picture is naive: light is scattered by every structure in the specimen. Since the amount of 'non-scattered' light decreases exponentially with depth, a significant improvement of the imaging depth is fundamentally impossible, unless scattered light itself is used for imaging.

In 2007, Allard Mosk and I pioneered the field of wavefront shaping. The game-changing message of wavefront shaping is that scattering is not a fundamental limitation for imaging: using a spatial light modulator, light can be focused even inside the most turbid materials, if 'only' the correct wavefront is known.

DEEP VISION aims to initiate a fundamental change in how we think about microscopy: to use scattered light rather than straight rays for imaging. The microscope of the future is no longer based on Newtonian optics. Instead, it combines new insights in scattering physics, wavefront shaping, and compressed sensing to extract all useful information from a specimen.

Whereas existing microscopes are ignorant to the nature of the specimen, DEEP VISION is inspired by information theory; imaging revolves around a model that integrates observations with statistical a-priori information about the tissue. This model is used to calculate the wavefronts for focusing deeper into the specimen. Simulations indicate that my approach will penetrate at least four times deeper than existing microscopes, without loss of resolution.

Link to the ERC project webpage:

Keywords of the ERC project: wavefront shaping, computational imaging

Keywords that characterize the scientific profile of the potential visiting researcher/s: wavefront shaping, computational imaging

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
679774	**HetScaleNet**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr IOANNIS LESTAS**
Host Institution:	THE CHANCELLOR MASTERS AND SCHOLARS OF THE UNIVERSITY OF CAMBRIDGE - UK

Analysis and control of large scale heterogeneous networks: scalability, robustness and fundamental limits

The proposed research will make a contribution towards the analysis and synthesis of large scale complex networks: fundamental theory will be developed and important applications will be addressed, by extending tools from control theory. Networks are present throughout the physical and biological world, but nowadays they also pervade our societies and everyday lives. Major challenges that will be addressed are:

I. The engineering of large scale heterogeneous networks that are guaranteed to be robust and scalable.

II. The reverse engineering of biological networks.

A distinctive feature of the networks we would like to engineer, which falls outside more traditional domains in systems and control, is that of scalability, i.e. the ability to guarantee robust stability for an arbitrary interconnection by conditions on only local interactions. The methodologies that will be developed will have a significant impact in various applications where scalability is important, such as data network protocols, group coordination problems and power distribution networks, as they can lead to network designs with guaranteed robustness, thus avoiding conservative schemes with poor performance. The proposed project will also make a contribution towards the reverse engineering of biological networks at the molecular level. Life in the cell is dictated by chance; noise is ubiquitous with its sources ranging from fluctuating environments to intrinsic fluctuations due to the random births and deaths of molecules. The fact that a substantial part of the noise is intrinsic provides a major challenge in control theoretic methodologies. How can feedback be used to suppress these fluctuations, what are the associated tradeoffs and limitations, and how does nature manage to handle these so efficiently? These are questions that will be addressed by developing tools for analyzing known configurations, but more importantly, by deriving fundamental limitations that hold for arbitrary feedback.

Link to the ERC project webpage:

Keywords of the ERC project: control theory, large scale networks, power networks, biological networks

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:
679820	**MYKI**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr CHRISTIAN CIPRIANI**
Host Institution:	SCUOLA SUPERIORE DI STUDI UNIVERSITARI E DI PERFEZIONAMENTO SANT'ANNA - IT

A Bidirectional MyoKinetic Implanted Interface for Natural Control of Artificial Limbs

MYKI aims at developing and clinically evaluating a dexterous hand prosthesis with tactile sensing which is naturally controlled and perceived by the amputee. This will be possible by overcoming the conventional approaches based on recording electrical signals from the peripheral nervous system (nerves or skeletal muscles) through the development of a radically new Human-Machine Interface (HMI) based on magnetic field principles, both able to decode voluntary motor commands and to convey sensory feedback to the individual. Core of this system is a multitude of magnets implanted in independent muscles and external magnetic readers/drivers (MRDs) able to (i) continuously localize the movements of the magnets and, at specific times, (ii) induce subtle movements in specific magnets. In fact, as a magnet is implanted it will travel with the muscle it is located in, and its localization will provide a direct measure of the contraction/elongation of that muscle, which is voluntarily controlled by the central nervous system. In this way it will be possible to decode the efferent signals sent by the brain by observing a by-product of the muscle fibres recruitment. On the other hand, a movement induced in the implanted magnet by the external MRD, could provide a perceivable stimulus, conveyed to the brain by means of the peripheral sensory receptors present in the muscle (e.g. muscle spindles or Golgi tendon organ) or in the neighbouring skin (tactile mechanoreceptors). In this way we aim to provide tactile and/or proprioceptive sensory information to the brain, thus restoring the physiological sensorimotor control loop. Remarkably, with passive magnetic tags (that do not require to be powered-on) and wearable readers/drivers, it will be possible to implement a wireless, bidirectional HMI with dramatically enhanced capabilities with respect to the state of the art interfaces, as illustrated in this proposal.

Link to the ERC project webpage: http://www.mykierc.eu/

Keywords of the ERC project: prosthetic limbs, motor control, sensory substitution

Keywords that characterize the scientific profile of the potential visiting researcher/s: neuroscience, neurophysiology, magnetic fields

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
694974	**POSTCELL**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr ANGEL LOZANO**
Host Institution:	UNIVERSIDAD POMPEU FABRA - ES

Post-Cellular Wireless Networks

POSTCELL aims at laying the foundation for future generations of wireless networks as they move past the reigning cell-centric paradigm and into the post-cellular era. This entails the definition of a new architecture for such networks and the characterization of the ensuing performance. For the future of wireless communications, the implications would be far-reaching.

The growth of wireless traffic is relentless, and it is actually gaining new momentum on account of fresh mechanisms: smartphones, cloud computing, and machine-to-machine communication. As a result, the volume of wireless traffic is poised to increase to truly staggering levels and, to face this challenge, wireless networks need to enter a new stage.

There is a fledging awareness that this challenge can only be fended off by a process of network massification, with two views about it. In the first view, densification is the only strategy through which dramatic improvements can be attained hereafter; this leads to a vision where base stations become tiny and exceedingly abundant. The second view, in turn, is built on the idea of dramatically scaling the number of colocated antennas per base station from the current handful to possibly hundreds. One of the seeds of POSTCELL is that, since neither form of massification can by itself resolve the challenge facing wireless systems, the two forms will have to end up coexisting.

Reconciling these two forms of massification and enabling a truly phenomenal scaling calls for an entirely new architecture where cells and physical base stations become things of the past, replaced by dynamically defined virtual base stations, powerful caches, and the possibility of device clustering, among other leaps forward. The signal processing needs to shift away from base stations, which become deconstructed, so as to gather at new places. POSTCELL seeks to drive this transformation and to gauge the performance of post-cellular wireless networks.

Link to the ERC project webpage: http://www.dtic.upf.edu/~alozano/

Keywords of the ERC project: Wireless, Wireless Communications, Wireless Networks

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:
715362	**SMART**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr TAL ELLENBOGEN**
Host Institution:	TEL AVIV UNIVERSITY - IL

Structured nonlinear Metamaterials for efficient generation and Active functional control of Radiation of THz light

The terahertz optical regime, covering the long wavelength end of the optical spectrum, has been for many years the least explored spectral regime. Recent interest in this regime has led to important emerging applications spanning many disciplines including medical, biological, materials sciences, communications, security, and basic sciences. However, advances in these emerging applications are held back by the lack of good and controllable terahertz light sources.

I propose to lead a potential breakthrough in this field by developing a new family of THz sources with unmatched functionality. The developed sources will be based on nano-engineered nonlinear heterostructured metamaterials, man-made materials with artificial optical properties. The proposal is based on very recent studies that show that metamaterials can be used to emit THz light with excellent efficiency, comparable to the best available nonlinear materials in nature. In addition it relies on our recent experimental demonstrations of functional nonlinear metamaterials that allow unprecedented control of nonlinear optical interactions. We will apply this recent knowledge to design novel active metamaterials that efficiently emit THz light at any desired frequency, shape and polarization, focus it directly from the emitter to a desired sample location and even actively steer and modify its radiation properties all-optically. In addition, we will enhance the THz generation efficiency from metamaterials by more than three orders of magnitude compared to the state of the art. We will also use our expertise to fabricate large scale and multi-layered THz light emitting metamaterials by leveraging novel nanolithography methods. Overall I expect that the outcome of this research will be in development of one of a kind family of THz light emitters that will lead to the, long sought for, leap in THz technology and will open the door to new applications and to new tools for advancing fundamental science.

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:
715770	**QD-NOMS**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr FEI DING**
Host Institution:	GOTTFRIED WILHELM LEIBNIZ UNIVERSITAET HANNOVER - DE

Elementary quantum dot networks enabled by on-chip nano-optomechanical systems

Is there any limit to the size of a quantum system? How large and how small can it be? Both questions are related to scalability, a most critical issue in quantum technologies. A scalable quantum network, which can be extended almost infinitely, is built by entangling individual quantum systems, e.g. atoms. It will provide thrilling opportunities across a range of intellectual and technical frontiers in quantum information science. Building such a network is however a great challenge, in both physics and engineering.
Often referred to as artificial atoms, semiconductor quantum dots (QDs) are among the most promising single and entangled photon sources to build a photonic quantum network. However there is a longstanding and yet unsolved challenge on scalability, since, unlike real atoms, every QD is different. By engineering individual QDs with an innovative nano-optomechanical system (NOMS), elementary QD networks will be built via scalable interactions of single or entangled photons, in a fashion similar to that of real atoms.

The scientific goals are to upscale QD networks with the first demonstrations of (1) indistinguishable entangled photons from different QDs, (2) deterministic entanglement swapping, purification and graph states with multiple QDs (3) deterministic Boson sampling with more than 4 QDs on chip.

The technological goals are (1) to downscale the footprint (<50 µm) of individual QD sources with full tunabilities, and to realize (2) arrays (>4×4) of tunable single and entangled photon sources, (3) waveguide integration on III-V/silicon chips, and (4) compact quantum LED demonstrators.

QD-NOMS will address the physical and technological challenges in building a solid-state QD-based quantum network. Its success does not only provide a novel toolkit to realize scalable QD systems for cutting-edge fundamental researches but also brings the semiconductor QD based platforms, after a decade of development, to the attention of practical applications.

Link to the ERC project webpage: https://cordis.europa.eu/project/rcn/207395_en.html

Keywords of the ERC project: quantum technologies

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:
725731	**FOGHORN**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr OSVALDO SIMEONE**
Host Institution:	KING'S COLLEGE LONDON - UK

FOG-aided wireless networks for communication, cacHing and cOmputing: theoRetical and algorithmic fouNdations

The FOGHORN project aims at developing the theoretical and algorithmic foundations of fog-aided wireless networks. This is an emerging class of wireless systems that leverages the synergy and complementarity of cloudification and edge processing, two key technologies in the evolution towards 5G systems and beyond. Fog-aided wireless networks can reap the benefits of centralization via cloud processing, in terms of capital and operating cost reductions, greening, and enhanced spectral efficiency, while, at the same time, being able to cater to low-latency applications, such as the "tactile" internet, by means of localized intelligence at the network edge.

The operation of fog-aided wireless networks poses novel fundamental research problems pertaining to the optimal management of the communication, caching and computing resources at the cloud and at the edge, as well as to the transmission on the fronthaul network connecting cloud and edge. The solution of these problems challenges the theoretical principles and engineering insights which have underpinned the design of existing networks. The initial research activity on the topic, of which the EU is at the forefront, focuses, by and large, on ad hoc solutions and technologies. In contrast, the goal of this project is to develop fundamental theoretical insights and algorithmic principles with the main aim of guiding engineering choices, unlocking new academic opportunities and disclosing new technologies. The theoretical framework is grounded in network information theory, which enables the distillation of design principles, along with signal processing, (non-convex) optimization, queuing and distributed computing to develop and analyse algorithmic solutions. FOGHORN builds on the PI's unique research experience on the information-theoretic and algorithmic analysis of wireless networks. If granted, this project will enable to start up his research group in an EU member state, transferring his know-how and experience.

Link to the ERC project webpage:

Keywords of the ERC project: information theory, wireless, machine 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:
740355	**STEMS**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr STEFAN WABNITZ**
Host Institution:	UNIVERSITA DEGLI STUDI DI BRESCIA - IT

Spatiotemporal multimode complex optical systems

The STEMS project is about exploiting the new concept that has been recently introduced by the PI and his co-workers, namely the self-control of the spatial coherence of optical beams in multimode nonlinear optical fibers. This concept will enable a breakthrough technology, capable of delivering high-energy optical pulses with high-average powers and much higher beam quality from fiber lasers than what is possible today. High-power fiber lasers are largely limited by transverse mode instabilities, and the loss of spatial coherence in delivery fibers. Optical fibers provide the backbone of today's internet communication networks, and enable compact, low cost light sources for a variety of industrial and biomedical applications. In most of these applications, single-mode fibers are used. Replacing single-mode fibers with multimode fibers leads to a dramatic growth of transmission capacity, and a substantial increase of average power and pulse energy from fiber lasers. However, because of spatial dispersion and resulting mode interference, multimode fibers suffer from an inherent randomization of the spatial transverse beam profile, leading to a loss of spatial coherence. My approach is to exploit the intensity dependent refractive index, or Kerr nonlinearity, of glass fibers to recover the spatial coherence of a multimode wave, and compensate for temporal modal dispersion.
First, I propose to develop methods to control fiber nonlinearity, to compensate for temporal and spatial dispersion, thus preventing information spreading in the temporal domain, and coherence loss in the spatial domain. Second, by adding rare-earth dopants to multimode fibers, I will demonstrate self-control of modal dispersion and beam quality in active multimode fibers. Third, via the spatio-temporal control of beam propagation, I will introduce a new fast saturable absorber mechanism for the mode-locking of high-power fiber lasers, analogous to Kerr-lens mode-locking with bulk crystals.

Link to the ERC project webpage: https://sites.google.com/view/erc-stems/home

Keywords of the ERC project: nonlinear optics; lasers; optical fibers; optical communications; optical amplifiers; complex systems

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:
742648	**AGNOSTIC**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr BJÖRN OTTERSTEN**
Host Institution:	UNIVERSITE DU LUXEMBOURG - LU

Actively Enhanced Cognition based Framework for Design of Complex Systems

Parameterized mathematical models have been central to the understanding and design of communication, networking, and radar systems. However, they often lack the ability to model intricate interactions innate in complex systems. On the other hand, data-driven approaches do not need explicit mathematical models for data generation and have a wider applicability at the cost of flexibility. These approaches need labelled data, representing all the facets of the system interaction with the environment. With the aforementioned systems becoming increasingly complex with intricate interactions and operating in dynamic environments, the number of system configurations can be rather large leading to paucity of labelled data. Thus there are emerging networks of systems of critical importance whose cognition is not effectively covered by traditional approaches. AGNOSTIC uses the process of exploration through system probing and exploitation of observed data in an iterative manner drawing upon traditional model-based approaches and data-driven discriminative learning to enhance functionality, performance, and robustness through the notion of active cognition. AGNOSTIC clearly departs from a passive assimilation of data and aims to formalize the exploitation/exploration framework in dynamic environments. The development of this framework in three applications areas is central to AGNOSTIC. The project aims to provide active cognition in radar to learn the environment and other active systems to ensure situational awareness and coexistence; to apply active probing in radio access networks to infer network behaviour towards spectrum sharing and self-configuration; and to learn and adapt to user demand for content distribution in caching networks, drastically improving network efficiency. Although these cognitive systems interact with the environment in very different ways, sufficient abstraction allows cross-fertilization of insights and approaches motivating their joint treatment.

Link to the ERC project webpage: https://sites.google.com/view/erc-agnostic

Keywords of the ERC project: wireless communications, MIMO radar, caching networks

Keywords that characterize the scientific profile of the potential visiting researcher/s: Solid publication record in top journals, long-term stay

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
757259	**Real-PIM-System**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr SHAHAR KVATINSKY**
Host Institution:	TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY - IL

Memristive In-Memory Processing System

Our project aims to develop a new computer architecture that enables true in-memory processing based on a unit that can both store and process data using the same cells. This unit, called a memristive memory processing unit (mMPU), will substantially reduce the necessity to move data in computing systems, solving the two main bottlenecks exist in current computing systems, i.e., speed ('memory wall') and energy efficiency ('power wall'). Emerging memory technologies, namely memristive devices, are the enablers of the mMPU. While memristors are naturally used as memory, these novel devices can also perform logical operations using a technique we have invented called Memristor Aided Logic (MAGIC). This combination is the basis of mMPU.
The goal of this research is to design a fully functional mMPU, and by that, to demonstrate a real computing system with significantly improved performance and energy efficiency. We have identified four main research tasks which must be completed to demonstrate a full system utilizing mMPU: mMPU design, system architecture and software, modeling and evaluation, and fabrication. Both memristive memory array and mMPU control will be designed and optimized for different technologies in the first objective. The second objective will deal with the different aspects of the system, including programming model, different mMPU modes of operation and their corresponding system implications, compiler and operating systems. For system evaluation, we will develop models and tools in the third objective in order to measure the performance, area and energy and to compare them to other state-of-the-art computing systems. Lastly, we will fabricate the different parts of the system to demonstrate the full system.
Encouraged from our preliminary experimental results, we expect to achieve 10X improvement in performance, and 100X improvement in energy efficiency as compared to state-of-the-art von Neumann systems when working with appropriate workloads.

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:
757444	**SONGBIRD**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr MARIA TENJE**
Host Institution:	UPPSALA UNIVERSITET - SE

SOphisticated 3D cell culture scaffolds for
Next Generation Barrier-on-chip In vitro moDels

The blood-brain barrier is a sophisticated biological barrier comprising several different cell types, structured in a well-defined order with the task to strictly control the passage of molecules - such as drugs against neurodegenerative diseases - from the blood into the brain. To reduce the ethical and economic costs of drug development, which in EU today uses
~10 million experimental animals every year, we must develop in vitro models of the blood-brain barrier with high in vivo correlation, as these are completely missing today.
SONGBIRD aims to achieve this with the scientific approach to
- Develop advanced microfabrication methods to handle biologically derived materials
- Structure the materials into heterogeneous 3D multi-layer suspended cell culture scaffolds
- Incorporate blood-brain barrier cells with precise control on location and order
- Integrated the 3D scaffolds into a microfluidic network as a miniaturised screening platform

The vision is to develop and validate versatile microfabrication methods to mechanically structure and physically handle soft biological materials to unlock the use of next generation animal-free barrier-on-chip models that can be used to speed up drug development, serve as screening platforms for nanotoxicology and help medical researchers to gain mechanistic insight in drug delivery. During SONGBIRD, I will focus on the blood-brain barrier due to its urgent relevance for drug development for the ageing population but the final processing tool-box will be suitable for realising in vitro models of any biological barrier in the future.
SONGBIRD is proposed to run for 60 months and will include researchers with expertise in microsystem engineering (PI), hydrogel synthesis and drug delivery. The expected output is a validated 3D barrier-on-chip model as well as a microfabrication toolbox for biological materials enabling transformation from 2D to 3D cell cultures in several other life science research areas.

Link to the ERC project webpage:

Keywords of the ERC project: organs-on-chip, microfabrication, microfluidics, blood-brain barrier

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:
757791	**FUN-NOTCH**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr ALEX ALVARADO**
Host Institution:	TECHNISCHE UNIVERSITEIT EINDHOVEN - NL

Fundamentals of the Nonlinear Optical Channel

Fibre optics are critical infrastructure for society because they carry nearly all the global Internet traffic. For a long time, optical fibre systems were thought to have infinite information-carrying capabilities. With current traffic demands growing by a factor between 10 and 100 every decade, however, this is no longer the case. In fact, it is currently unknown if the installed optical infrastructure will manage to cope with these demands in the future, or if we will face the so-called "capacity crunch".

To satisfy traffic demands, transceivers are being operated near the nonlinear regime of the fibres. In this regime, a power-dependent nonlinear phenomenon known as the Kerr effect becomes the key impairment that limits the information-carrying capability of optical fibres. The intrinsic nonlinear nature of these fibres makes the analysis very difficult and has led to a series of unanswered fundamental questions about data transmission in nonlinear optical fibres, and nonlinear media in general. For example, the maximum amount of information that optical fibres can carry in the highly nonlinear regime is still unknown, and the design of transceivers well-suited for this regime is also completely unexplored.

In this project, the PI will answer these fundamental questions by studying the simplest nontrivial building blocks underlying optical fibres, and will give a definitive answer to the capacity crunch question. The PI will use a systematic methodology that aims at embracing nonlinear effects, consider the continuous-time channel as the correct starting point for analysis, and redesign optical transceivers from scratch, lifting all linear assumptions. The proposed methodology is in sharp contrast with current research trends, which aim at mitigating nonlinearities, and consider discrete-time models in the linear regime. Due to the central role of information transmission in modern society, the results in this project will have broad societal impact.

Link to the ERC project webpage: https://www.sps.tue.nl/ictlab/project/funnotch/

Keywords of the ERC project: Fiber optical communications, information theory, communication theory, nonlinear effects, nonlinear Schroedinger equation, nolninear Fourier transform, optical networks, channel capacity, Shannon theory, forward error correcting codes.

Keywords that characterize the scientific profile of the potential visiting researcher/s: Fiber optical communications, information theory, communication theory, nonlinear effects, nonlinear Schroedinger equation, nolninear Fourier transform, optical networks, channel capacity, Shannon theory, forward error correcting codes.

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
773196	**CONSYN**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr HEINZ KOEPPL**
Host Institution:	TECHNISCHE UNIVERSITAT DARMSTADT - DE

Contextualizing biomolecular circuit models for synthetic biology

Synthetic biology is the bottom-up engineering of new molecular functionality inside a biological cell. Although it aims at a quantitative and compositional approach, most of today's implementations of synthetic circuits are based on inefficient trial-and-error runs. This approach to circuit design does not scale well with circuit complexity and is against the basic paradigm of synthetic biology. This unsatisfactory state of affairs is partly due to the lack of the right computational methodology that can support the quantitative characterization of circuits and their significant context dependency, i.e., their change in behavior upon interactions with the host machinery and with other circuit elements.

CONSYN will contribute computational methodology to overcome the trial-and-error approach and to ultimately turn synthetic circuit design into a rational bottom-up process that heavily relies on computational analysis before any actual biomolecular implementation is considered. In order to achieve this goal, we will work on the following agenda: (i) develop biophysical and statistical models of biomolecular contexts into which the synthetic circuit or synthetic part can be embedded in silico; (ii) devise new statistical inference methods that can deliver accurate characterization of circuits and their context dependency by making use of cutting-edge single-cell experimental data; (iii) derive new context-insensitive circuit designs through in silico sensitivity analysis and application of filtering theory; (iv) optimize protocols and measurement infrastructure using model-based experimental design yielding a better circuit and context characterization; (v) experimentally build synthetic circuits in vivo and in cell-free systems in order to validate and bring to life the above theoretical investigations. We are in the unique position to also address (v) in-house due to the experimental wetlab facilities in our group.

Link to the ERC project webpage: https://www.bcs.tu-darmstadt.de

Keywords of the ERC project: Computational biology, synthetic biology, statistical physics, machine learning, statistical inference

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:
648328	**QUANTUMMETALINK**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr NICOLAE PANOIU**
Host Institution:	UNIVERSITY COLLEGE LONDON - UK

Quantum Metamaterials: A Theoretical and Computational Approach Towards Seamlessly Integrated Hybrid Classical/Quantum Nano-structures

The overarching aim of this proposal is to initiate and advance an integrated theoretical and computational research programme in an emerging area of metamaterials research, namely Quantum Metamaterials. Thus, it is commonly believed that one of the most noteworthy developments witnessed in the last decade in physical sciences and engineering is the emergence of metamaterials. Unlike ordinary materials, which are assembled at the atomic level, metamaterials are composite materials built up from artificially engineered meta-atoms and meta-molecules. The fundamental idea in this area of research is that remarkable physical properties beyond those available in naturally occurring materials can be achieved by designing the meta-constituents of the metamaterial and structuring it at a scale comparable or smaller than the optical wavelength. In this context, a new paradigm in metamaterials research emerges when the building blocks of metamaterials are quantum resonators, e.g., quantum dots (QDs), QD molecules, graphene disks coupled to interacting QDs, and quantum nanowires, case in which the macroscopic properties of quantum metamaterials are determined by the quantum properties of their basic constituents. We have organised this research programme along three broad, synergistically integrated themes. The first will focus on the development of a general theory of the effective, macroscopic properties of quantum metamaterials. The key challenge is to build a theoretical framework in which the macroscopic properties of quantum metamaterials are derived directly from those of their quantum building blocks. The second theme will be geared towards developing a set of numerical methods and software tools for ab initio simulations of fundamental physical properties quantum metamaterials. The foundational work pertaining to the first two themes will enable us to pursue the main objective of the third theme, which is the exploration of new science and novel 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:
694829	**neuroXscales**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr ANDREAS HIERLEMANN**
Host Institution:	EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH - CH

Microtechnology and integrated microsystems to investigate neuronal networks across scales

To advance knowledge in electrophysiology and information processing of neuronal networks, we propose employing microtechnology and microelectronics to rigorously study neural networks in vitro across scales. Across scales pertains to the spatial domain - from details of subcellular components through single neurons to entire networks - and the temporal domain - from single action potentials to long-term developmental processes. Besides our CMOS-microelectronics-based high-density microelectrode arrays for recording and stimulation, the methodology will encompass patch-clamping directly on the microelectrode chips, high-resolution microscopy, genetic methods, large-scale data handling strategies, and dedicated data analysis and modeling algorithms. We will use mammalian cortical neuron cultures and brain slices.
We will potentially have access to every neuron and every action potential. We aim at studying - at the same time in the same preparation - details of specific neurons and subcellular components (somas, axons, synapses, dendrites) in their functional context and the characteristics of the corresponding networks (functional connectivity, emergent properties, plasticity). We will study alterations of components and networks over time and upon defined perturbations and mutual interdependence of network and component characteristics.
The high-spatio-temporal-resolution methodology will enable new fundamental neuroscientific insights through, e.g., facilitating investigation of axonal and axonal initial segment signaling characteristics, with the "axonal" side of neuronal activity being largely inaccessible to established methods. It will also enable the mapping of the overall synaptic input to a specific neuron, or the high-throughput monitoring of all action potentials in a network over extended time to see developmental effects or effects of disturbances. Potential applications include research in neural diseases and pharmacology.

Link to the ERC project webpage: https://www.bsse.ethz.ch/bel/research/erc-advanced-grants.html

Keywords of the ERC project: microelectrode arrays, neuronal networks, neurons, extracellular electrophysiology

Keywords that characterize the scientific profile of the potential visiting researcher/s: electrical engineering, neurobiology, machine learning and computer science

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
742299	**VIDEO HOLOGRAPHY**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr JAN GENOE**
Host Institution:	INTERUNIVERSITAIR MICRO-ELECTRONICA CENTRUM - BE

video-rate holographic projection by novel meta-materials

Today, despite many efforts by researchers world-wide, there are no holographic projectors that allow video-rate electronically controlled projection of complex holograms. Optically re-write-able holograms exist, but they are too slow; Acoustically-formed holograms can be switched fast but the image complexity is very limited. We identify the essential roadblock as one that we intend to clear by a breakthrough innovation coming from a combination of electronics, optics and material science.

We propose a radically novel way to make and control holograms, that will be based on the direct, analog, nanometer-resolution and nanosecond-speed control over the local refractive index of a slab waveguide core over several square centimetres. Holograms will be formed by leaky waves evanescent from the waveguide, and controlled by the refractive-index modulation profile in the core. That profile will be controlled and modulated by electrical fields applied with nano-precision through one of the cladding layers of the waveguide. To that end, a novel metamaterial is proposed for this cladding. Also novel driving schemes will be needed to control the new holographic projecting method.

With this combined radical innovation in architecture, materials and driving schemes, it is the goal of this project to fully prove the concept of video-rate electrically-controlled holographic projection. This will be the basis for many future innovations and applications, in domains such as augmented reality, automotive, optical metrology (LIDAR, microscopy, ...), mobile communication, education, safety, etc..., and result in a high economic and social impact.

Link to the ERC project webpage:

Keywords of the ERC project: Holography optical materials

Keywords that characterize the scientific profile of the potential visiting researcher/s: optical properties of materials, modeling of holograms

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
771687	**CORNEA**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr MING CAO**
Host Institution:	RIJKSUNIVERSITEIT GRONINGEN - NL

Controlling evolutionary dynamics of networked autonomous agents

Large-scale technological, biological, economic, and social complex systems act as complex networks of interacting autonomous agents. Large numbers of interacting agents making self-interested decisions can result in highly complex, sometimes surprising, and often suboptimal, collective behaviors. Empowered by recent breakthroughs in data-driven cognitive learning technologies, networked agents collectively give rise to evolutionary dynamics that cannot be easily modeled, analysed and/or controlled using current systems and control theory. Consequently, there is an urgent need to develop new theoretical foundations to tackle the emerging challenging control problems associated with evolutionary dynamics for networked autonomous agents.

The aim of this project is to develop a rigorous theory for the control of evolutionary dynamics so that interacting autonomous agents can be guided to solve group tasks through the pursuit of individual goals in an evolutionary dynamical process. The theory will then be tested, validated and improved against experimental results using robotic fish.

To achieve the aim, I will: (1) develop a general formulation for stochastic evolutionary dynamics with control inputs, enabling the study on controllability and stabilizability for evolutionary processes; (2) introduce stochastic control Lyapunov functions to design control laws; (3) construct new classes of conditional strategies that may propagate controlled actions effectively from focal agents in multiple time scales; and (4) validate experimentally on tasks with unknown difficulties that require a group of robotic fish to evolve and adapt.

The project will result in a major advance from the conventional usage of evolutionary game theory with the systematic design to actively control evolutionary outcomes. The combination of theory with experimentation and the multi-disciplinary nature of the approach will lead to new applications of autonomous robotic systems.

Link to the ERC project webpage:

Keywords of the ERC project: multi-agent systems, complex networks

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:
647067	**BIOLOCHANICS**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr STÉPHANE AVRIL**
Host Institution:	ASSOCIATION POUR LA RECHERCHE ET LE DEVELOPPEMENT DES METHODES ET PROCESSUS INDUSTRIELS - FR

Localization in biomechanics and mechanobiology of aneurysms: Towards personalized medicine

Rupture of Aortic Aneurysms (AA), which kills more than 30 000 persons every year in Europe and the USA, is a complex phenomenon that occurs when the wall stress exceeds the local strength of the aorta due to degraded properties of the tissue. The state of the art in AA biomechanics and mechanobiology reveals that major scientific challenges still have to be addressed to permit patient-specific computational predictions of AA rupture and enable localized repair of the structure with targeted pharmacologic treatment. A first challenge relates to ensuring an objective prediction of localized mechanisms preceding rupture. A second challenge relates to modelling the patient-specific evolutions of material properties leading to the localized mechanisms preceding rupture. Addressing these challenges is the aim of the BIOLOCHANICS proposal. We will take into account internal length-scales controlling localization mechanisms preceding AA rupture by implementing an enriched, also named nonlocal, continuum damage theory in the computational models of AA biomechanics and mechanobiology. We will also develop very advanced experiments, based on full-field optical measurements, aimed at characterizing localization mechanisms occurring in aortic tissues and at identifying local distributions of material properties at different stages of AA progression. A first in vivo application will be performed on genetic and pharmacological models of mice and rat AA at Yale University where the PI is a visiting professor. Eventually, a retrospective clinical study involving more than 100 patients at the Saint-Etienne University hospital will permit calibrating estimations of AA rupture risk thanks to our novel approaches and infuse them into future clinical practice. Through the achievements of BIOLOCHANICS, nonlocal mechanics will be possibly extended to other soft tissues for applications in orthopaedics, oncology, sport biomechanics, interventional surgery, human safety, cell biology, etc.

Link to the ERC project webpage: https://www.mines-stetienne.fr/en/research/projects/biolochanics/

Keywords of the ERC project: mechanobiology ; biomechanics ; aneurysm

Keywords that characterize the scientific profile of the potential visiting researcher/s: computational mechanics ; biomechanics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
666983	**MaGic**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr BEREND SMIT**
Host Institution:	ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE - CH

The Materials Genome in Action

It is now possible to make an enormous spectrum of different, novel nanoporous materials simply by changing the building blocks in the synthesis of Metal Organic Frameworks (MOF) or related materials. This unique chemical tunability allows us to tailor-make materials that are optimal for a given application. The promise of finding just the right material seems remote however: because of practical limitations we can only ever synthesize, characterize, and test a tiny fraction of all possible materials. To take full advantage of this development, therefore, we need to develop alternative techniques, collectively referred to as Materials Genomics, to rapidly screen large numbers of materials and obtain fundamental insights into the chemical nature of the ideal material for a given application. The PI will tackle the challenge and promise posed by this unprecedented chemical tunability through the development of a multi-scale computational approach, which aims to reliably predict the performance of novel materials before synthesis. We will develop methodologies to generate libraries of representative sets of synthesizable hypothetical materials and perform large-scale screening of these libraries. These studies should give us fundamental insights into the common molecular features of the top-performing materials. The methods developed will be combined into an open access infrastructure in which our hypothetical materials are publicly accessible for data mining and big-data analysis. The project is organized in three Work Packages, each centered around finding better materials for carbon capture: (1) screen materials for gas separations and develop the tools to predict the best materials for carbon capture; (2) gain insights into and develop a computational methodology for screening the mechanical properties of nanoporous materials; (3) achieve an understanding of the amine-CO2 chemistry in diamine-appended MOFs and use this to predict their performance.

Link to the ERC project webpage:

Keywords of the ERC project: materials genomics, mofs, molecular simulation, nanoporous materials

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:
669141	**VIRMETAL**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr JAVIER LLORCA**
Host Institution:	FUNDACION IMDEA MATERIALES - ES

Virtual Design, Virtual Processing and Virtual Testing of Metallic Materials

The project VIRMETAL is aimed at developing multiscale modeling strategies to carry out virtual design, virtual processing and virtual testing of advanced metallic alloys for engineering applications so new materials can be designed, tested and optimized before they are actually manufactured in the laboratory. The focus of the project is on materials engineering i.e. understanding how the structure of the materials develops during processing (virtual processing), the relationship between this structure and the properties (virtual testing) and how to select materials for a given application (virtual design).

Multiscale modeling will be tackled using a bottom-up, hierarchical, modeling approach. Modeling efforts will begin with ab initio simulations and bridging of the length and time scales will be accomplished through different multiscale strategies which will encompass the whole range of length and time scales required by virtual design, virtual processing and virtual testing. Nevertheless, not everything can or should be computed and critical experiments are an integral part of the research program for the calibration and validation of the multiscale strategies.

The research will be focused on two cast metallic alloys from the Al-Si-Mg and Mg-Al-Zn systems. The expected breakthrough is precisely to demonstrate that the structure and properties of two standard engineering alloys of considerable industrial interest can be obtained from first principles by bridging a cascade of modeling tools at the different length scales. Once this is proven, further research will lead to the continuous expansion of both the number and the capability of multiscale simulation tools, leading to widespread application of Computational Materials Engineering in academia and industry. This will foster the implementation of this new revolutionary technology in leading European industries from aerospace, automotive, rail transport, energy generation and engineering sectors.

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:
679086	**COMPASS**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr CAMILLA COLOMBO**
Host Institution:	POLITECNICO DI MILANO - IT

Control for Orbit Manoeuvring through Perturbations for Application to Space Systems

Space benefits mankind through the services it provides to Earth. Future space activities progress thanks to space transfer and are safeguarded by space situation awareness. Natural orbit perturbations are responsible for the trajectory divergence from the nominal two-body problem, increasing the requirements for orbit control; whereas, in space situation awareness, they influence the orbit evolution of space debris that could cause hazard to operational spacecraft and near Earth objects that may intersect the Earth. However, this project proposes to leverage the dynamics of natural orbit perturbations to significantly reduce current extreme high mission cost and create new opportunities for space exploration and exploitation.

The COMPASS project will bridge over the disciplines of orbital dynamics, dynamical systems theory, optimisation and space mission design by developing novel techniques for orbit manoeuvring by “surfing” through orbit perturbations. The use of semi-analytical techniques and tools of dynamical systems theory will lay the foundation for a new understanding of the dynamics of orbit perturbations. We will develop an optimiser that progressively explores the phase space and, though spacecraft parameters and propulsion manoeuvres, governs the effect of perturbations to reach the desired orbit. It is the ambition of COMPASS to radically change the current space mission design philosophy: from counteracting disturbances, to exploiting natural and artificial perturbations.

COMPASS will benefit from the extensive international network of the PI, including the ESA, NASA, JAXA, CNES, and the UK space agency. Indeed, the proposed idea of optimal navigation through orbit perturbations will address various major engineering challenges in space situation awareness, for application to space debris evolution and mitigation, missions to asteroids for their detection, exploration and deflection, and in space transfers, for perturbation-enhanced trajectory design.

Link to the ERC project webpage: www.compass.polimi.it

Keywords of the ERC project: Orbital Dynamics, Orbit Perturbation, Space Trajectory Design, Optimisation, Space Debris, Asteroids, Small Satellites

Keywords that characterize the scientific profile of the potential visiting researcher/s: Simulation, Applied Mathematics, Optimisation, Aerospace Engineering, Orbital Mechanics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
679891	**IntelGlazing**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr IOANNIS PAPAKONSTANTINOU**
Host Institution:	UNIVERSITY COLLEGE LONDON - UK

Intelligent functional glazing with self-cleaning properties to improve the energy efficiency of the built environment

The latest forecast by the International Energy Agency predicts that the CO2 emissions from the built environment will reach 15.2Gt in 2050, double their 2007 levels. Buildings consume 40% of the primary energy in developed countries with heating and cooling alone accounting for 63% of the energy spent indoors. These trends are on an ascending trajectory - e.g. the average energy demand for air-conditioning has been growing by ~17% per year in the EU. Counterbalancing actions are urgently required to reverse them.

The objective of this proposal is to develop intelligent window insulation technologies from sustainable materials. The developed technologies will adjust the amount of radiation escaping or entering a window depending upon the ambient environmental conditions and will be capable of delivering unprecedented reductions to the energy needed for regulating the temperature in commercial and residential buildings.

Recognising the distinct requirements between newly built and existing infrastructure, two parallel concepts will be developed: i) A new class of intelligent glazing for new window installations, and, ii) a flexible, intelligent, polymer film to retrofit existing window installations. Both solutions will be enhanced with unique self-cleaning properties, bringing about additional economic benefits through a substantial reduction in maintenance costs.

Overall, we aim to develop intelligent glazing technologies that combine: i) power savings of >250 W/m2 of glazing capable of delivering >25% of energy savings and efficiency improvements >50% compared with existing static solutions; ii) visible transparency of >60% to comply with the EU standards for windows ,and, iii) self-cleaning properties that introduce a cost balance.

A number of technological breakthroughs are required to satisfy such ambitious targets which are delivered in this project by the seamless integration of nanotechnology engineering, novel photonics and advanced material synthesis.

Link to the ERC project webpage: www.ee.ucl.ac.uk/pilab

Keywords of the ERC project: antireflective structures, vanadium dioxide, thermochromic materials, thermal metamaterials

Keywords that characterize the scientific profile of the potential visiting researcher/s: nanophotonics, nanofabrication, experiments optical set-ups, modelling of nanostructures, photonics, heat transport

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
681652	**UTOPES**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr LOTHAR WONDRACZEK**
Host Institution:	FRIEDRICH-SCHILLER-UNIVERSITAT JENA - DE

Unifying concepts in the topological design of non-crystalline materials

Glasses have traditionally been enabling materials to major societal challenges. Significant breakthroughs on many areas of technological progress have been very closely linked to the exploitation of glassy materials. It is strong consensus that this key role will persist in the emerging solutions to major global challenges in living, energy, health, transport and information processing, provided that the fundamental limitations of the presently available empirical or semi-empirical approaches to glass processing can be overcome.

In the coming decade, it is therefore a major task to take the step towards ab initio exploitation of disordered materials through highly-adapted processing strategies. This requires pioneering work and in-depth conceptual developments which combine compositional design, structural evolution and the thermo-kinetics of material deposition into holistic tools. Only those would significantly contribute to solving some of the most urgent materials needs for glass applications in functional devices, be it in the form of thin films, particles or bulk materials.

The present project challenges today's engineering concepts towards the conception of such tools. For that, melt deposition, isothermal deposition from liquid phases, and gas-phase deposition of non-crystalline materials will be treated - within the class of inorganic glasses - in a generalist approach, unified by the understanding that glass formation represents the only strict deviation from self-organization, and that, hence, the evolution of structural complexity in glassy materials can be tailored on any length-scale through adequate processing. Providing a topological scheme for the quantification and chemical tailoring of structural complexity, UTOPES will answer to the challenge of finding order in disorder, and will thus break the grounds for the third generation of glasses with properties beyond what is presently thought as the limits of physical engineering.

Link to the ERC project webpage: www.glas.uni-jena.de

Keywords of the ERC project: glass; materials; photonics; material science

Keywords that characterize the scientific profile of the potential visiting researcher/s: glass; solid state chemistry; material science; MOF; zeolite

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
682001	**BoneImplant**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr GUILLAUME HAIAT**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FR

Monitoring bone healing around endosseous implants: from multiscale modeling to the patient's bed

Implants are often employed in orthopaedic and dental surgeries. However, risks of failure, which are difficult to anticipate, are still experienced and may have dramatic consequences. Failures are due to degraded bone remodeling at the bone-implant interface, a multiscale phenomenon of an interdisciplinary nature which remains poorly understood. The objective of BoneImplant is to provide a better understanding of the multiscale and multitime mechanisms at work at the bone-implant interface. To do so, BoneImplant aims at studying the evolution of the biomechanical properties of bone tissue around an implant during the remodeling process. A methodology involving combined in vivo, in vitro and in silico approaches is proposed.
New modeling approaches will be developed in close synergy with the experiments. Molecular dynamic computations will be used to understand fluid flow in nanoscopic cavities, a phenomenon determining bone healing process. Generalized continuum theories will be necessary to model bone tissue due to the important strain field around implants. Isogeometric mortar formulation will allow to simulate the bone-implant interface in a stable and efficient manner.
In vivo experiments realized under standardized conditions will be realized on the basis of feasibility studies. A multimodality and multi-physical experimental approach will be carried out to assess the biomechanical properties of newly formed bone tissue as a function of the implant environment. The experimental approach aims at estimating the effective adhesion energy and the potentiality of quantitative ultrasound imaging to assess different biomechanical properties of the interface.
Results will be used to design effective loading clinical procedures of implants and to optimize implant conception, leading to the development of therapeutic and diagnostic techniques. The development of quantitative ultrasonic techniques to monitor implant stability has a potential for industrial transfer.

Link to the ERC project webpage:

Keywords of the ERC project: Biomechanics, bone, implant, interface, ultrasound, modeling

Keywords that characterize the scientific profile of the potential visiting researcher/s: Biomechanics, bone, implant, interface, ultrasound, modeling, dental or orthopedic surgeon

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
682444	**E-motion**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr LOUIS DE SMET**
Host Institution:	WAGENINGEN UNIVERSITY - NL

Electro-motion for the sustainable recovery of high-value nutrients from waste water

Current water treatment technologies are mainly aimed to improve the quality of water. High-value nutrients, like nitrate and phosphate ions, often remain present in waste streams. Electro-driven separation processes offer a sustainable way to recover these nutrients. Ion-selective polymer membranes are a strong candidate to achieve selectivity in such processes.

The aim of E-motion is to chemically modify porous electrodes with membranes to introduce selectivity in electro-driven separation processes. New, ultrathin ion-selective films will be designed, synthesized and characterized. The films will be made by successively adsorbing polycations and polyanions onto the electrodes. Selectivity will be introduced by the incorporation of ion-selective receptors. The adsorbed multilayer films will be studied in detail regarding their stability, selectivity and transport properties under varying experimental conditions of salinity, pH and applied electrical field, both under adsorption and desorption conditions.

The first main challenge is to optimize and to understand the film architecture in terms of 1) stability towards an electrical field, 2) ability to facilitate ion transport. Also the influence of ion charge and ion size on the transport dynamics will be addressed. The focus of E-motion is set on phosphate ions, which is rather complex due to their large size, pH-dependent speciation and the development of phosphate-selective materials. Theoretical modelling of the solubility equilibria and electrical double layers will be pursued to frame the details of the electrosorption of phosphate.

E-motion represents a major step forward in the selective recovery of nutrients from water in a cost-effective, chemical-free way at high removal efficiency. The proposed surface modification strategies and the increased understanding of ion transport and ionic interactions in membrane media offer also applications in the areas of batteries, fuel cells and solar fuel devices.

Link to the ERC project webpage:

Keywords of the ERC project: nutrient recovery, capacitive deionization, selectivitiy, functional materials, polymers, organic chemistry

Keywords that characterize the scientific profile of the potential visiting researcher/s: selective materials, electrochemistry, molecular recognition, surface/electrode chemistry, sensors

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
695070	**MILEPOST**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr MERCEDES MAROTO-VALER**
Host Institution:	HERIOT-WATT UNIVERSITY - UK

Microscale Processes Governing Global Sustainability

Reactive transport modelling is a key tool in understanding the extremely complex interplay of flow, transport and reactions occurring over various temporal and spatial scales in the subsurface. The most difficult challenge in reactive transport is the capture of scale dependence, and upscaling reactive transport will ultimately only be successful if there is a detailed understanding of fundamental mechanisms at the pore level and the supporting data are available. State-of-the-art tools (e.g. X-ray microtomography and on-chip porous media) are not sufficient to understand reactive flow, as they do not provide real-time mapping of propagation of fronts (e.g. temperature, pressure, concentration) that are critical to refine and validate simulations.

The ambition is to progress beyond the state of the art via additive manufacturing tools to print 3D replicas of porous cores that enable monitoring the properties within the pores. Our unique approach is to develop for the first time three-dimensional instrumented replicas of porous structures, so we can gain much needed dynamic data at the pore scale that can be incorporated into validated simulations coupling flow and reactive transport processes.

We combine expertise and integrating ground-breaking work in: (i) additive manufacturing to produce three dimensional replicas of porous structures; (ii) tools to embed sensors to determine in-vivo propagation of fronts (pressure, temperature, pH) within complex structures; and (iii) novel high-fidelity in-silico pore models coupling relative permeability functions and critical saturations with compositional changes and validated using virtual reality tools. The ERC MILEPOST project will transform our ability to analyse and predict the behaviour of a wide range of pore-scale processes governing the macroscopic behaviour of complex subsurface systems and open up new horizons for science in other areas, e.g porosity controlled in polymers and bioprinting.

Link to the ERC project webpage: https://cordis.europa.eu/project/rcn/203425_en.html

Keywords of the ERC project: Reactive transport, micromodels manufacturing, micro-fluidics, core flooding, pore scale modeling

Keywords that characterize the scientific profile of the potential visiting researcher/s: pore scale modeler, sensors, microfluidics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
714317	**DAMOC**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr JAVIER RAMON**
Host Institution:	FUNDACIO INSTITUT DE BIOENGINYERIA DE CATALUNYA - ES

Diabetes Approach by Multi-Organ-on-a-Chip

Insulin secretion and insulin action are critical for normal glucose homeostasis. Defects in both of these processes lead to type 2 diabetes (T2D). Unravelling the mechanisms that lead to T2D is fundamental in the search of new molecular drugs to prevent and control this disease. Organ-on-a-chip devices offer new approaches for T2D disease modelling and drug discovery by providing biologically relevant models of tissues and organs in vitro integrated with biosensors. As such, organ-on-a-chip devices have the potential to revolutionize the pharmaceutical industry by enabling reliable and high predictive in vitro testing of drug candidates. The capability to miniaturize biosensor systems and advanced tissue fabrication procedures have enabled researchers to create multiple tissues on a chip with a high degree of control over experimental variables for high-content screening applications. The goal of this project is the fabrication of a biomimetic multi organ-on-a-chip integrated device composed of skeletal muscle and pancreatic islets for studying metabolism glucose diseases and for drug screening applications. Engineered muscle tissues and pancreatic islets are integrated with the technology to detect the glucose consumption, contraction induced glucose metabolism, insulin secretion and protein biomarker secretion of cells. We aim to design a novel therapeutic tool to test drugs with a multi organ-on-a-chip device. Such finding would improve drug test approaches and would provide for new therapies to prevent the loss of beta cell mass associated with T2D and defects in the glucose uptake in skeletal muscle.

Link to the ERC project webpage:

Keywords of the ERC project: Organ on a chip, biosensors, tissue engineering, 3D bioprnting

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:
714605	**VADEMECOM**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr ALESSANDRO PARENTE**
Host Institution:	UNIVERSITE LIBRE DE BRUXELLES - BE

VAlidation driven DEvelopment of Modern and Efficient COMbustion technologies

Combustion science will play a major role in the future quest for sustainable, secure and environmentally friendly energy sources. Two thirds of the world energy supply rely on combustion of fossil and alternative fuels, and all scenarios forecast an increasing absolute energy supply through combustion, with an increasing share of renewables. Thus, combustion will remain the major actor in transportation and power generation as well as in manufacturing processes, like steel and glass.

Nevertheless, combustion science will need profound innovation to meet future energy challenges, such as energy efficiency and fuel flexibility, and ensure future generations with affordable and sustainable energy and healthy environment. In this context, MILD combustion represents a very attractive solution for its fuel flexibility and capability to deliver very high combustion efficiency with virtually zero pollutant emissions. Such a combustion regime is the result of a very strong interaction between turbulent mixing and chemical kinetics. The fundamental mechanism of this interaction is not fully understood, thus justifying the need for experimental and numerical investigations.

The overall objective of the present research proposal is to drive the development of modern and efficient combustion technologies, by means of experimental, theoretical, and numerical simulation approaches. New-generation simulation tools for MILD combustion will be developed, to reduce the dependence on sub-grid models and increase the fidelity of numerical simulations. High-fidelity experimental data will be collected on quasi-industrial systems, to disclose the nature of the interactions between fluid dynamics, chemistry and pollutant formation processes in MILD combustion. Experiment and numerical simulations will be tied together by Validation and Uncertainty Quantification techniques, to allow the ground-breaking application of the developed approaches and promote innovation in the energy sector.

Link to the ERC project webpage: http://burn-research.be/project/vademecom/

Keywords of the ERC project: Combustion; Computational Fluid Dynamics; Flameless combustion; MILD combustion; Oxyflameless
combustion; Oxy-MILD combustion; Turbulence/chemistry interactions; Validation.

Keywords that characterize the scientific profile of the potential visiting researcher/s: Chemical kinetics; Clean combustion; Computational Fluid Dynamics; Large Eddy Simulations; MILD combustion; Optimization; Uncertainty Quantification

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
714712	**NICEDROPS**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr MANISH TIWARI**
Host Institution:	UNIVERSITY COLLEGE LONDON - UK

Precise and smart nanoengineered surfaces: Impact resistance, icephobicity and dropwise condensation

Water freezing (icing) and condensation are ubiquitous in our life. Preventing undesirable icing on surfaces with minimal energy and chemical use, and improving the efficiency of condensation heat exchangers has broad societal value. Thus, I aim to use fundamental insights to offer energy-efficient solutions for undesirable ice formation and promoting dropwise condensation using novel and robust nanoengineered surfaces. My objectives are:

i) to realise thermodynamically guided metallic surfaces with precise (<10 nm) morphology and controlled superficial stiffness for energy-efficient icing prevention and sustaining dropwise flow condensation

ii) to rationally intercalate polymers and/or suspensions into surface nanotextures and exploit nanomechanics in order to enable robust and smart nanoengineered surfaces for high speed impact, abrasion and chemical resistance; stable icephobicity (delaying freezing); and sustained dropwise condensation.

iii) to develop new fundamental insights to: a) prevent icing due to high speed (~100 m/s) supercooled droplet/ice crystal impact; b) realise icephobicity down to -30 degrees Celsius; c) minimise ice-surface adhesion; and d) sustain dropwise condensation at high (50-100 m/s) vapour speeds.

The proposal emphasis on energy efficiency is aligned with the EU's 20/20/20 Strategic Energy Technology (SET) Plan. To exemplify their salient impact, the proposed smart nanoengineered surfaces offer a passive solution for airplane icing (and related accidents) and will delay evaporator icing on air source heat pumps and refrigerators, thereby helping to lower the energy use in buildings and cold storages. The latter are tied to the global food storage and distribution challenges. Similarly, sustained dropwise condensation will make condensers in process industry and steam power plants compact and efficient. Optimally, only ~1 micron of the surface depth will require treatment – this will minimize chemical use and promote sustainability.

Link to the ERC project webpage: https://mecheng.ucl.ac.uk/nano/

Keywords of the ERC project: Nanotechnology, anodization, block-copolymer lithography, nanomanufacturing, nanoengineering, icephobic surfaces, anti-icing, condensation, flow, phase change, multiphase, droplets, impact, microfluidics, nanofluidics, advanced materials, colloids, comple

Keywords that characterize the scientific profile of the potential visiting researcher/s: Nanotechnologist, Engineer, Chemist, Material Scientist, Physicist, Computational Scientist, CFD and LB Modeller, Theoretician, Applied Mathematician, Molecular Dynamics Modeller etc.

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
715027	**Uniting PV**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr BART VERMANG**
Host Institution:	INTERUNIVERSITAIR MICRO-ELECTRONICA CENTRUM - BE

Applying silicon solar cell technology to revolutionize the design of thin-film solar cells and enhance their efficiency, cost and stability

Thin film (TF) photovoltaics (PV) hold high potential for Building Integrated PV, an important market as European buildings require to be nearly zero-energy by 2020. Currently, Cu(In,Ga)(S,Se)2 (= CIGS(e)) TF solar cells have high efficiency, but also a simple one-dimensional cell design with stability and reliability concerns. Furthermore, its present research has been mainly focused on improving the absorber and buffer layers.
Scientifically, Uniting PV aims to study the practical boundaries of CIGS(e) TF solar cell efficiency. For that reason, its goal is to revolutionize the design of CIGS(e) solar cells through implementation of advanced three-dimensional silicon (Si) solar cell concepts. This novel design consists of (i) surface passivation layers and (ii) light management methods integrated into ultra-thin (UT) CIGS(e) solar cells: (i) Passivation layers will be studied to reduce charge carrier recombination at CIGS(e) surfaces. The aim is to create new understanding and thus scientific models. (ii) Light management methods will be studied to optimize optical confinement in UT CIGS(e) layers. The aim is to examine the interaction between light management and charge carrier recombination in UT CIGS(e), and to create scientific models. The main reasons to introduce these developments is to reduce charge carrier recombination at the CIGS(e) surfaces and in the CIGS(e) bulk, while maintaining optical confinement.
Technologically, the project targets to establish a solar cell with: (1) Increased cell efficiency, at least 23.0 % and up to 26.0 %; (2) improved stability and reliability, due to reduced CIGS(e) thickness and passivation layers hindering alkali metal movement; and (3) reduced cost, due to the use of less Ga and In, and industrially viable materials, methods and equipment. Hence, its outcome will be upscalable, valuable for other TF PV materials, and start a new wave of innovation in and collaboration between TF and Si PV research fields.

Link to the ERC project webpage: https://cordis.europa.eu/project/rcn/208289_en.html

Keywords of the ERC project: photovoltaics, solar cell, thin film, chalcogenide, new cell architectures, passivation, optical confinement, simplified absorber

Keywords that characterize the scientific profile of the potential visiting researcher/s: photovoltaics, solar cell, thin film, chalcogenide, new cell architectures, passivation, optical confinement, simplified absorber

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
725513	**SuperRepel**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr ROBIN RAS**
Host Institution:	AALTO KORKEAKOULUSAATIO SR - FI

Superslippery Liquid-Repellent Surfaces

I aim to progress substantially the understanding and applications of extremely non-wetting surfaces, tying together basic research and attractive technological advancements.
The first part focuses on robust synthesis methods for superslippery liquid-repellent (SS-LR) surfaces. I will use vapor deposition towards ultradense surfactant monolayers to reach extremely low surface energies, not only for planar surfaces but also for more challenging nanostructured substrates. Furthermore, using new types of ultrasensitive force measurement for droplets, I will investigate in depth the dissipation dynamics of mobile water droplets and adhesion of droplets to surfaces, to promote understanding on low-friction surfaces.
The second part aims at applying these SS-LR surfaces in droplet actuation with potential to outperform existing technologies. Additionally, the potential of SS-LR surfaces for anti-icing and for preventing bio-fouling will be investigated.
The research results will have a major impact on superhydrophobic research and will explore the fundamental physical limits of non-wetting.

Link to the ERC project webpage: http://physics.aalto.fi/smw

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:
725762	**LIGNINFIRST**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr ROBERTO RINALDI**
Host Institution:	IMPERIAL COLLEGE OF SCIENCE TECHNOLOGY AND MEDICINE - UK

The Lignin-First Approach for the Full Valorisation of Lignocellulosic Biomass

Early-stage Catalytic Conversion of Lignin (ECCL), or the 'Lignin-First' approach, constitutes an emerging multidisciplinary research field targeting the valorisation of lignin. ECCL involves the concurrent extraction and catalytic conversion of the lignin fragments released from plant biomass in a one-pot process. In this manner, ECCL benefits from the intrinsically high reactivity of the lignin oligomers, leading to further depolymerisation (via hydrogenolysis of ether linkages) and, most importantly, to the passivation of the intermediates (via hydrodeoxygenation of aldehyde and ketone groups), thus protecting the lignin fragments from recondensation. In short, this novel approach renders a high yield of mono-aromatic products (>60%) and highly delignified pulps, allowing for the full utilisation of lignocellulose. LIGNINFIRST objectives will be achieved by high-risk/high-gain research into: (1) understanding (and control over) the solvolytic release of lignin fragments; (2) advancing the molecular understanding of H-transfer reactions catalysed by sponge Ni catalysts to accelerate the discovery of catalytic methods for lignin valorisation, and; (3) reaction engineering of the interdependent processing steps for fractionation of the initial biomass feedstock (catalytic upstream biorefining) to the intended value-added products (catalytic downstream processing). The full impact of LIGNINFIRST will be realised by undertaking pioneering research at the border of Wood Chemistry, Catalysis and Reaction Engineering. The most significant anticipated outcome is a profound understanding of the synergy between deconstruction of lignin, occurring in the plant tissue throughout the 'cooking process', and ECCL. The new scientific insights that will emerge from the implementation of this proposal have the great potential for revolutionising the utilisation of lignin in biorefineries.

Link to the ERC project webpage: https://www.imperial.ac.uk/people/r.rinaldi-sobrinho

Keywords of the ERC project: lignin, catalysis, lignin-first, biorefining

Keywords that characterize the scientific profile of the potential visiting researcher/s: lignin, catalysis, lignin-first, biorefining

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
726360	**MOLEMAT**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr SHAHZADA AHMAD**
Host Institution:	FUNDACION BCMATERIALS - BASQUE CENTRE FOR MATERIALS, APPLICATIONS AND NANOSTRUCTURES - ES

Molecularly Engineered Materials and process for Perovskite solar cell technology

Societal pressure to develop inexpensive yet efficient solar energy conversion requires a new approach. Recently emerged organic-inorganic perovskites, offer to harvest light at cost effective price. Perovskites hold merits to the existing materials, however, a fundamental challenge for high performance devices is to optimize the crystals for maximize charge carrier generation and minimize recombination losses. Their widespread use is, however, limited by insufficient stability, scalability and reproducibility. We have recently developed new concepts to fabricate efficient and stable perovskite solar cells at lab scale that are potentially up-scalable to industrial production. MOLEMAT will accomplish this by, pioneering innovative methods and will demonstrate that molecularly engineered materials enable the tuning of the charge transport and interface. Our interdisciplinary approach, combining materials science, chemistry, device physics and engineering, will not only lead to improvements in the performance and stability of perovskite solar cell beyond 24% at lab scale, but will also provide deep insights in the functioning of solar cells. The success of MOLEMAT will rapidly advance the field by enabling reproducible and stable performance adding a significant value with respect to current state of the art. However, for making it marketable product, several developments are required and the MOLEMAT targets will provide relevant answers to three key limitations: encapsulation, stability and cost competitive materials. MOLEMAT envisages the development of 30×30 cm2 modules, with a power conversion efficiency of c.a 18% and a lifetime of 10+ years. MOLEMAT is divided into two parallel research directions, a fundamental research line, dealing with rational design of materials and to gain its understanding. Simultaneously an applied research line targets the development of module by the identification of scale up process to pave the way for its industrialization.

Link to the ERC project webpage:

Keywords of the ERC project: Solar cells, perovskite solar cells, organic semiconductors, electrochemistry, Materials Science, Energy, processing, photochemistry

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:
757923	**CAD4FACE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr SILVIA SCHIEVANO**
Host Institution:	UNIVERSITY COLLEGE LONDON - UK

Computational modelling for personalised treatment of congenital craniofacial abnormalities

Craniosynostosis is a group of congenital craniofacial abnormalities consisting in premature fusion (ossification) of one or more cranial sutures during infancy. This results in growth restriction perpendicular to the axis of the suture and promotes growth parallel to it, causing physical deformation of the cranial and facial skeleton, as well as distortion of the underling brain, with potential detrimental effects on its function: visual loss, sleep apnoea, feeding and breathing difficulties, and neurodevelopment delay. Conventional management of craniosynostosis involves craniofacial surgery delivered by excision of the prematurely fused sutures, multiple bone cuts and remodelling of the skull deformities, with the primary goal of improving patient function, while normalising their appearance. Cranial vault remodelling surgical procedures, aided by internal and external devices, have proven functionally and aesthetically effective in correcting skull deformities, but final results remain unpredictable and often suboptimal because of an incomplete understanding of the biomechanical interaction between the device and the skull.
The overall aim of this grant is to create a validated and robust computational framework that integrates patient information and device design to deliver personalised care in paediatric craniofacial surgery in order to improve clinical outcomes. A virtual model of the infant skull with craniosynostosis, including viscoelastic properties and mechano-biology regulation, will be developed to simulate device implantation and performance over time, and will be validated using clinical data from patient populations treated with current devices. Bespoke new devices will be designed allowing for pre-programmed 3D shapes to be delivered with continuous force during the implantation period. Patient specific skull models will be used to virtually test and optimise the personalised devices, and to tailor the surgical approach for each individual case.

Link to the ERC project webpage: https://cordis.europa.eu/project/rcn/214049_en.html

Keywords of the ERC project: skull, craniosynostosis, devices, nitinol, computational modelling, patient specific

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:
758056	**PURPOSE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr JOSE ANTONIO RODRÍGUEZ**
Host Institution:	UNIVERSIDAD CARLOS III DE MADRID - ES

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/projects/purpose-project

Keywords of the ERC project: Printed metals, Solid Mechanics, Constitutive modelling, Dynamic loading, Fragmentation,

Keywords that characterize the scientific profile of the potential visiting researcher/s: Constitutive modelling, Numerical simulations, Analytical methods

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
759212	**MemoMOFEnergy**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr MONIQUE VAN DER VEEN**
Host Institution:	TECHNISCHE UNIVERSITEIT DELFT - NL

Constructing polar rotors in metal-organic frameworks for memories and energy harvesting

I seek to develop new ferroelectrics based on metal-organic frameworks with dipolar rotors. Ferroelectrics are targeted to be used as physically flexible memories and mechanical energy harvesters for biocompatible sensors and implantable monitoring devices.
As ferroelectrics can store and switch their polarity, they can be used as memories. Via the piezoelectric effect, they can harvest mechanical vibrations. The materials most compatible with flexible substrates, are soft matter materials. However, these so far don't meet the requirements. Especially lacking is a combination of i) polarisation stability, ii) a sufficiently low energy barrier for polarisation switching and iii) fast switching. As energy harvesters, soft matter materials are hampered by low piezoelectric coefficients.
The main objective of this proposal is rational design of ferroelectrics by obtaining a fundamental understanding of the relation between structure and properties. I will achieve this by uniquely synthesizing polar rotors into 3D crystalline scaffolds that allow to alter the rotors' nano-environement. I will achieve this via polar ligands in metal-organic frameworks (MOFs). The variability of MOFs allows to tune the nature of the hindrance towards rotation of the polar rotors. The tuneable flexibility allows to regulate the energy harvesting efficiency. Moreover, MOFs have already shown potential as biocompatible materials that can be integrated on physically flexible substrates.
The research consists of i) synthesis of polar rotor MOFs with targeted variations, ii) reliable characterisation and computational modelling of the electronic properties, iii) nanoscopic insight in the switching dynamics. The approach allows to understand how ferro- and piezoelectricity are related to the materials' structure, and hence to develop materials with exceptional performance. My recent observation of the ferroelectric behaviour of a nitrofunctionalised MOF is the basis for this proposal.

Link to the ERC project webpage: https://www.tudelft.nl/cheme/vanderveengroup

Keywords of the ERC project: metal-organic frameworks, piezoelectricity, ferroelectricity, flexible electronics, hybrid materials

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:
759419	**MuDiLingo**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr STEFAN SANDFELD**
Host Institution:	TECHNISCHE UNIVERSITAET BERGAKADEMIE FREIBERG - DE

A Multiscale Dislocation Language for Data-Driven Materials Science

Crystalline defects in metals and semiconductors are responsible for a wide range of mechanical, optical and electronic properties. Controlling the evolution of dislocations, i.e. line-like defects and the carrier of plastic deformation, interacting both among themselves and with other microstructure elements allows tailoring material behaviors on the micro and nanoscale. This is essential for rational design approaches towards next generation materials with superior mechanical properties.

For nearly a century, materials scientists have been seeking to understand how dislocation systems evolve. In-situ microscopy now reveals complex dislocation networks in great detail. However, without a sufficiently versatile and general methodology for extracting, assembling and compressing dislocation-related information the analysis of such data often stays at the level of “looking at images” to identify mechanisms or structures. Simulations are increasingly capable of predicting the evolution of dislocations in full detail. Yet, direct comparison, automated analysis or even data transfer between small scale plasticity experiments and simulations is impossible, and a large amount of data cannot be reused.

The vision of MuDiLingo is to develop and establish for the first time a Unifying Multiscale Language of Dislocation Microstructures. Bearing analogy to audio data conversion into MP3, this description of dislocations uses statistical methods to determine data compression while preserving the relevant physics. It allows for a completely new type of high-throughput data mining and analysis, tailored to the specifics of dislocation systems. This revolutionary data-driven approach links models and experiments on different length scales thereby guaranteeing true interoperability of simulation and experiment. The application to technologically relevant materials will answer fundamental scientific questions and guide towards design of superior structural and functional materials.

Link to the ERC project webpage:

Keywords of the ERC project: dislocations; crystal plasticity; machine learning; pattern recognition; materials science; 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:
759630	**CO2LIFE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr PATRICIA LUIS**
Host Institution:	UNIVERSITE CATHOLIQUE DE LOUVAIN - BE

BIOMIMETIC FIXATION OF CO2 AS SOURCE OF SALTS AND GLUCOSE

The continued increase in the atmospheric concentration of CO2 due to anthropogenic emissions is leading to significant changes in climate, with the industry accounting for one-third of all the energy used globally and for almost 40% of worldwide CO2 emissions. Fast actions are required to decrease the concentration of this greenhouse gas in the atmosphere, value that has currently reaching 400 ppm. Among the technological possibilities that are on the table to reduce CO2 emissions, carbon capture and storage into geological deposits is one of the main strategies that is being applied. However, the final objective of this strategy is to remove CO2 without considering the enormous potential of this molecule as a source of carbon for the production of valuable compounds. Nature has developed an effective and equilibrated mechanism to concentrate CO2 and fixate the inorganic carbon into organic material (e.g., glucose) by means of enzymatic action. Mimicking Nature and take advantage of millions of years of evolution should be considered as a basic starting point in the development of smart and highly effective processes. In addition, the use of amino-acid salts for CO2 capture is envisaged as a potential approach to recover CO2 in the form of (bi)carbonates.
The project CO2LIFE presents the overall objective of developing a chemical process that converts carbon dioxide into valuable molecules using membrane technology. The strategy followed in this project is two-fold: i) CO2 membrane-based absorption-crystallization process on basis of using amino-acid salts, and ii) CO2 conversion into glucose or salts by using enzymes as catalysts supported on or retained by membranes. The final product, i.e. (bi)carbonates or glucose, has a large interest in the (bio)chemical industry, thus, new CO2 emissions are avoided and the carbon cycle is closed. This project will provide a technological solution at industrial scale for the removal and reutilization of CO2.

Link to the ERC project webpage:

Keywords of the ERC project: CO2 capture; membrane contactors; enzymes; aminoacids

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:
772261	**XFab**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr ALESSANDRO MOLLE**
Host Institution:	CONSIGLIO NAZIONALE DELLE RICERCHE - IT

Xene Fabrication for a Two-Dimensional Nanotechnology Platform

Xenes denote two-dimensional (2D) monoelemental (X) crystals beyond graphene with a honeycomb lattice. Unlike graphene, Xenes do not exist in Nature, but they become stable via epitaxy on substrates. So far experimental evidences of Xene epitaxy have been reported for X=Si, Ge, Sn, B, P, and Sb (named silicene, germanene, stanene, borophene, phosphorene, and antimonene, respectively). Xene single layers also serve as a background for the synthesis of new Xene-related materials (XRMs) such as Xene heterostructures and functionalized Xenes. Xenes can appear as metals, semimetals, semiconductors, and topological insulators thus allowing for a broad range of applications in nanotechnology. However only silicene has been integrated into transistors operating at room temperature albeit fast degradation. Nonetheless, a viable Xene-based nanotechnology is currently missing due to the lack of reliable standards for the Xene production and implementation. For this purpose, the proposal aims at developing viable schemes for high-quality crystal growth, environmental stabilization, and device integration of Xenes and XRMs frameworks. At first the effort will be focused on the high-quality synthesis of selected Xenes and XRMs by means of molecular beam epitaxy, and on their stabilization in encapsulated structures enabling subsequent processing into Xene-based device platforms. Validation of the Xene properties, quality, and performances will be carried out by means of advanced in situ and ex situ characterization of the atomic and electronic structure. Secondly, prototypical electronic device (e.g. field effect transistors or vertical diodes) incorporating stabilized Xene frameworks as active elements will be used to assess the Xene electrical behaviour and performances so as to establish a reliable Xene-based nanotechnology.

Link to the ERC project webpage: www.xfab.mdm.imm.cnr.it

Keywords of the ERC project: 2D materials, Xenes, silicene, stanene, phosphorene, nanoelectronics

Keywords that characterize the scientific profile of the potential visiting researcher/s: epitaxy, ARPES, STM, nanofabrication, device processing

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
670747	**FireBar-Concept**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr SERGE BOURBIGOT**
Host Institution:	UNIVERSITE DE LILLE - FR

MULTI-CONCEPTUAL DESIGN OF FIRE BARRIER: A SYSTEMIC APPROACH

The development of science and technology provides the availability of sophisticated products but concurrently, increases the use of combustible materials, in particular organic materials. Those materials are easily flammable and must be flame retarded to make them safer. In case of fire, people must be protected by materials confining and stopping fire. It is one of the goals of the FireBar-Concept project to design materials and assembly of materials exhibiting low flammability, protecting substrates and limiting fire spread.
The objective of FireBar-Concept is to make a fire barrier formed at the right time, at the right location and reacting accordingly against thermal constraint (fire scenario). This fire barrier can be developed in several ways according to the chemical nature of the material and/or of its formulation:
- Heat barrier formed by inherently flame retarded materials (e.g. mineral fibers, ceramic …) and exhibiting low thermal conductivity (note the assembly of those materials can also provide low thermal conductivity controlling porosity and its distribution)
- Evolution of reactive radicals poisoning the flame and forming a protective 'umbrella' avoiding the combustion of the material
- Additives promoting charring of the materials and forming an expanding carbonaceous protective coating or barrier (intumescence)
- Additives forming a physical barrier limiting mass transfer of the degradation products to the flame
The FireBar-Concept project is multidisciplinary and it requires expertise in material science, chemical engineering, chemistry, thermal science and physics. The approach is to make 5 actions linked together by transverse developments (3) according to this scheme: (i) fundamentals of fire barrier, (ii) multi-material and combination of concepts, (iii) modeling and numerical simulation, (iv) design and development of experimental protocols and (v) optimization of the systems.

Link to the ERC project webpage:

Keywords of the ERC project: Fire protection, flammabilty, fire barrier

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:
714080	**SCARCE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr EWAN MCADAM**
Host Institution:	CRANFIELD UNIVERSITY - UK

Sustainable Chemical Alternatives for Re-use in the Circular Economy

This proposal seeks to develop a novel non-invasive, real-time direct observation methodology to provide new knowledge on the mechanisms underpinning crystal growth and harvesting within membrane crystallisation reactor technology. Crystallisation represents one of the most important separation processes in the chemical industry and will play a critical role in the circular economy through enabling the recovery of resources from wastewater to yield an array of sustainable low cost chemicals for use in European industries. Existing crystallisation reactor designs suffer from imperfect mixing and inhomogeneous solvent removal which makes control of crystal quality and consistency problematic and can limit application of the final product.
Membrane crystallisation reactor technology is a disruptive innovation that combines process intensification with the capability to achieve significant control over the crystallisation process at a fraction of the scale thus ameliorating many of the problems associated with existing crystallisers. However, before this disruptive membrane based technology can be realised at full scale, there is a critical need to understand the role of shear forces in mediating the growth and harvesting of crystals at the solvent-membrane boundary which has to date received little attention. With no reliable and accurate description of the shear force behaviour within the boundary layer, there is considerable risk incurred in the scaling up of membrane crystallisation reactor design which could lead to inconsistent and inefficient performance. Development of the novel non-invasive, real-time direct observation methodology will enable direct measurement of these discrete forces. The arising new knowledge will be challenged at various process sizes to evolve the science underlying process scale-up of membrane crystallisers and in doing so will deliver internationally competitive research, placing the applicant at the forefront of his academic field.

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:
714591	**VirBAcous**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr EDWIN REYNDERS**
Host Institution:	KATHOLIEKE UNIVERSITEIT LEUVEN - BE

Virtual building acoustics: a robust and efficient analysis and optimization framework for noise transmission reduction

Achieving a sufficient sound insulation of buildings is a complex problem since multiple transmission paths are important, uncertainties can have a large effect, and acoustic performance requirements often conflict with structural and thermal requirements. Furthermore, accurate vibro-acoustic modelling across the entire building acoustics frequency range presently requires a huge computational effort. As a result, the acoustic development of building systems is usually based on general design rules, insufficiently accurate prediction models and many experimental prototype tests. Such development is costly and time consuming, and leads to suboptimal designs. This project therefore aims to develop an efficient yet sufficiently accurate prediction framework for the acoustic design of building systems which takes all uncertainties into account and which opens the way for design optimization. Four fundamental breakthroughs are required. First, a new approach to high-frequency subsystem modelling will overcome the limitations of the current statistical energy analysis paradigm and handle a high degree of geometric and material complexity. Second, a modelling framework for built-up systems will be developed, which incorporates different component model types and which switches between them as the frequency increases. The third development consists of quantifying the combined effect of all uncertain parameters on the overall sound insulation performance in a logically consistent and computationally efficient way. Finally, a robust optimization approach that spans the entire building acoustics frequency range and that accounts for all relevant non-acoustic performance criteria as well will be developed. Each development will be complemented by showcase applications in building acoustics, yet the fundamental nature of the developments make that they will have a profound impact in all disciplines where the study and/or control of mechanical wave propagation are important.

Link to the ERC project webpage: http://cordis.europa.eu/project/rcn/209704_en.html

Keywords of the ERC project: technical acoustics; structural vibration; numerical modeling

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:
715788	**WoCaFi**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr MICHAEL HUMMEL**
Host Institution:	AALTO KORKEAKOULUSAATIO SR - FI

Unlocking the Entire Wood Matrix for the Next Generation of Carbon Fibers

WoCaFi envisions a game-changing approach for the production of bio-based carbon fibers in which the drawbacks of traditional cellulose and lignin fibers are entirely bypassed by a new type of hybrid precursor fibers containing simultaneously all wood biopolymers cellulose, hemicellulose and lignin.
These unique fully wood-based multi-component filaments are accessible via a novel ionic liquid-based dry-jet wet spinning technique. The process provides the possibility to orientate lignin and hemicellulose embedded in a cellulose matrix. The special morphology of the resulting composite filaments is envisioned to increase the mechanical properties of thereof derived carbon fibers significantly, targeting 2000 MPa tensile strength and 200 GPa tensile modulus. These bio-based, low cost carbon fibers will reduce the dependency on non-renewable petroleum-based feedstocks and are highly suitable for lightweight applications in the automotive, sports and leisure sectors.
Most distinctively, our technique also enables us to spin wood almost in its native form. Thus, the pretreatment steps and intensity can be reduced drastically and pronounced synergistic effects between the bio-polymers are created. This will lead to higher carbon yields and a significantly enhanced graphitization. In very recent initial trials on a continuous single tow carbonization line we found indicators that the oxidation step, typically accounting for almost 50% of the carbonization heating energy costs, can be reduced or omitted completely depending on the lignin content of the precursor fiber.
This – in combination with activated wood as low cost raw material – would be the absolute game changer in developing low-cost, bio-based carbon fibers.
In this project the PI, who has developed the spinning technique and a strong background in organic chemistry and spinning physics, will lead a group of 2 PhD students and 1 Postdoc. The Postdoc will complement the team with enhanced spectroscopic knowledge.

Link to the ERC project webpage:

Keywords of the ERC project: carbon fiber, biopolymer, cellulose, lignin

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:
715832	**NANOPHOM**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr GABRIEL LOZANO**
Host Institution:	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS - ES

Nanophosphor-based photonic materials for next generation light-emitting devices

Energy-efficient and environmentally friendly light sources are an essential part of the global strategy to reduce the worldwide electricity consumption. Light-emitting diodes (LEDs) emerge as a key alternative to conventional lighting, due to their high power-conversion efficiency, long lifetime, fast switching, robustness, and compact size. Nonetheless, their implementation in the consumer electronic industry is hampered by the limited control over brightness, colour quality and directionality of LED emission that conventional optical elements relying on geometrical optics provide.

This project exploits new ways of controlling the emission characteristics of nanophosphors, surpassing the limits imposed by conventional optics, through the use of exciting nanophotonic concepts - an approach that has not been explored so far due to the strong multiple light-scattering that standard micrometre-sized phosphors present. The development of reliable and scalable nanophosphor-based photonic materials will allow ultimate spectral and angular control over the light emission properties, addressing the critical shortcomings of current LEDs. The new optical design of these devices will be based on multilayers, surface textures and nano-scatterers of controlled composition, size and shape, to attain large-area materials possessing photonic properties that will enable a precise management of the visible radiation. To prove and on-demand control over the colour appearance and the angular emission pattern of emitting devices, the project will culminate in an experimental demonstration of two paradigmatic cases: i) directional white-light emission within a narrow angular cone; ii) omnidirectional emission of monochromatic light.

Nanophom will significantly advance our comprehension of fundamental phenomena like the formation of photonic modes in complex optical media to which light can couple, as well as advancing the state of the art of high-efficiency solid-state lighting devices.

Link to the ERC project webpage: www.nanophom.eu

Keywords of the ERC project: optical materials, nanophotonics, color conversion, LEDs

Keywords that characterize the scientific profile of the potential visiting researcher/s: photonics, nanostructured materials, light-emitting materials

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
739964	**COPMAT**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr SAURO SUCCI**
Host Institution:	FONDAZIONE ISTITUTO ITALIANO DI TECNOLOGIA - IT

Full-scale COmputational design of Porous mesoscale MATerials

The last decades have witnessed major progress in our understanding of the basic physics of soft matter materials. At the same time, microfluidics has also undergone spectacular theoretical and experimental progress. The confluence of such major advances spawns unprecedented opportunities for the design and manufacturing of new soft mesoscale materials, with promising applications in tissue engineering, photonics, catalysis and many others. COPMAT is targeted at making the most this opportunity through the pursuit of a single general goal: the full-scale simulation at nanometric resolution of micro-reactors for the design and synthesis of new tunable porous materials. In particular, we shall focus on the microfluidic design of: multi-jel materials, trabecular porous media and soft mesoscale molecules. We shall also explore new designs concepts based on unexplored microscale phenomena, such as the interaction between plasticity and nano-rugosity. The complex interplay between the highly non-linear rheology of soft materials and the major experimental control parameters leads to an engineering design of formidable complexity, characterized by a strong sensitivity of the macroscale material properties on the details of nanoscale interfacial interactions. COPMAT will tackle this formidable multiscale challenge through the deployment of an entirely new family of multiscale techniques, centered upon highly innovative extensions of the Lattice Boltzmann method and its combinations with Immersed Boundary Method, Dissipative Particle Dynamics and Dissipative Voronoi Dynamics. The success of COPMAT will be gauged by its capability of inspiring and realizing the design of microfluidic devices for the synthesis of novel families of porous materials for bio-engineering applications. The new paradigm established by COPMAT for the computational design of soft materials is expected to extend well beyond the time-horizon of the project.

Link to the ERC project webpage: www.copmat.euro

Keywords of the ERC project: Computational physics, Multiscale Modeling, Soft matter, Lattice Boltzmann, Microfluidics

Keywords that characterize the scientific profile of the potential visiting researcher/s: Computational modeling, statistical physics, soft matter, microfluidics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
757848	**CoQuake**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr IOANNIS STEFANOU**
Host Institution:	ECOLE NATIONALE DES PONTS ET CHAUSSEES - FR

Controlling earthQuakes

According to the Centre for Research on the Epidemiology of Disasters (CRED), earthquakes are responsible for more than half of the total human losses due to natural disasters from 1994 to 2003. There is no doubt that earthquakes are lethal and costly. CoQuake proposes an alternative, ground-breaking approach for avoiding catastrophic earthquakes by inducing them at a lower energetic level. Earthquakes are a natural phenomenon that we cannot avoid, but –for the first time– in CoQuake I will show that it is possible to control them, hence reducing the seismic risk, fatalities and economic cost. CoQuake goes beyond the state-of-the-art by proposing an innovative methodology for investigating the effect and the controllability of various stimulating techniques that can reactivate seismic faults. It involves large-scale, accurate simulations of fault systems based on constitutive laws derived from micromechanical, grain-by-grain simulations under Thermo-Hydro-Chemo-Mechanical couplings (THMC), which are not calibrated on the basis of ad-hoc empirical and inaccurate constitutive laws. A pioneer experimental research programme and the design and construction of a new apparatus of metric scale, will demonstrate CoQuake's proof-of-principle and it will help to explore the transition from aseismic to seismic slip. CoQuake is an interdisciplinary project as it takes knowledge from various fields of engineering, computational mechanics, geomechanics, mathematics and geophysics. CoQuake opens a new field and new line of research in earthquake mechanics and engineering, with a direct impact on humanity and science.

Link to the ERC project webpage: http://www.coquake.eu/

Keywords of the ERC project: fault mechanics, earthquake control, instabilities, geomechanics, geophysics, engineering

Keywords that characterize the scientific profile of the potential visiting researcher/s: machine learning, numerical modeling, upscaling, experimental research and design, geophysics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
759603	**IMMOCAP**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr KRZYSZTOF FIC**
Host Institution:	POLITECHNIKA POZNANSKA - PL

'If immortality unveil…'– development of the novel types of energy storage systems with excellent long-term performance

The major goal of the project is to develop a novel type of an electrochemical capacitor with high specific power (up to 5 kW/kg) and energy (up to 20 Wh/kg) preserved along at least 50 000 cycles. Thus, completion of the project will result in remarkable enhancement of specific energy, power and life time of modern electrochemical capacitors. Advanced electrochemical testing (galvanostatic cycling with constant power loads, electrochemical impedance spectroscopy, accelerated aging and kinetic tests) will be accompanied by materials design and detailed characterization. Moreover, the project aims at the implementation of novel concepts of the electrolytes and designing of new operando technique for capacitor characterization. All these efforts aim at the development of sustainable and efficient energy conversion and storage system.

Link to the ERC project webpage:

Keywords of the ERC project: energy storage, electrochemical capacitors, interfacial phenomena, electrochemistry

Keywords that characterize the scientific profile of the potential visiting researcher/s: electrochemistry, energy storage, materials chemistry, physical chemistry

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
770870	**MOOiRE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr ALEXANDRU VLAD**
Host Institution:	UNIVERSITE CATHOLIQUE DE LOUVAIN - BE

Mix-in Organic-InOrganic Redox Events for High Energy Batteries

The ever-increasing demand for improved electrochemical energy storage technologies has fostered intense, worldwide and interdisciplinary research over the past decade. The field of positive electrode materials remains largely dominated by transition metal compounds in which only the redox of metal cations contributes to the energy storage. The development of new materials and technologies, wherein both anions and cations display reversible, multi-electron redox, is bound to strongly impact this field.
MOOiRE will achieve this goal through innovative approaches on Metal Organic Frameworks (MOFs) with mix-in many-electron reversible redox of both, metal cations and organic ligand anions. Building on our preliminary results MOOiRE will adopt an integrated approach. We will combine performance oriented MOF molecular design supported by advanced in-operando analytical inspection tools with novel electrode engineering approaches to overcome the limitations and enable efficient electrochemical charge storage. Through this highly interdisciplinary research, MOOiRE intends to leadership the science and technology of mix-in redox MOFs for next generation batteries, supercapacitors and their hybrids.
MOOiRE will also be a major systematic study of the fundamentals of MOF-based energy storage systems in view of a practical implementation. The overall impact will extend beyond the energy science community: the developed knowledge, tools and procedures will influence research and development related to porous composite materials, sorption, ion exchange and electrocatalysis. In the context of energy storage, this will be a disruptive development, enabling the use of MOFs electrodes, with superior levels of performance as compared to current technology, at affordable costs and based on novel protocols.

Link to the ERC project webpage:

Keywords of the ERC project: Chemistry Of Electroactive Coordination Compounds And Frameworks

Keywords that characterize the scientific profile of the potential visiting researcher/s: - MOFs and COFs
- organometallic chemistry: synthesis and characterisation
- synthesis of organic ligands and characterisation
- solid-state and molecular electrochemistry
- crystallography
- autonomous
- multidisciplinary project and team

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
679633	**EXO-ATMOS**	**PE9** Universe Sciences

Principal Investigator:	**Dr JEAN-MICHEL DESERT**
Host Institution:	UNIVERSITEIT VAN AMSTERDAM - NL

Exploring the Plurality of New Worlds: Their Origins, Climate and Habitability

Recent surveys have revealed an amazing, and yet unexplained, diversity of planets orbiting other stars. The key to understanding and exploiting this diversity is to study their atmospheres. This is because exoplanets' atmospheres are unique laboratories that hold the potential to transform our understanding of planet formation, physics, and habitability. This is a new opportunity to place the Solar System and the Earth's ecosystem in a broader context; one of the main goals of modern astrophysics.

The aim of this proposal is to leverage exoplanet detections, as well as observational capabilities and theoretical frameworks, to deepen and broaden our understanding of planetary physics. This project will transform the field of exoplanet atmospheres by contributing to three major advances. We will: i) push exoplanet characterization new frontiers by providing the largest in-depth study of atmospheres through the measurements of precise spectra, and the retrieval of their composition, in order to constrain their origins; ii) reveal for the first time global exo-climate through a novel method to probe atmospheric structure and dynamics; and iii) pioneer an innovative approach that uses robotic small telescopes to estimate the impact of stellar radiation on atmospheres, with a particular focus on their habitability. Theses objectives will be achieved via an ambitious portfolio of cutting-edge observations, combined with state-of-the-art modelling for their interpretation. Their accomplishment would be a major breakthrough, culminating in a comprehensive comparative exoplanetology, which in turn will open up new key discoveries in planetary formation and evolution. Our expertise will also enable predictions on conditions for habitability and direct the search atmospheric biosignatures with upcoming capabilities. The impact of our discoveries will go well beyond the scientific community since the quest of our origins is of interest to mankind.

Link to the ERC project webpage:

Keywords of the ERC project: Exoplanet atmospheres, exoplanets, stellar astrophysics

Keywords that characterize the scientific profile of the potential visiting researcher/s: Exoplanet atmospheres, exoplanets, stellar astrophysics, planetary sciences, modeling atmospheres, observational astronomy

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
682393	**AWESoMeStars**	**PE9** Universe Sciences

Principal Investigator:	**Dr SEAN MATT**
Host Institution:	THE UNIVERSITY OF EXETER - UK

Accretion, Winds, and Evolution of Spins and Magnetism of Stars

This project focuses on Sun-like stars, which possess convective envelopes and universally exhibit magnetic activity (in the mass range 0.1 to 1.3 MSun). The rotation of these stars influences their internal structure, energy and chemical transport, and magnetic field generation, as well as their external magnetic activity and environmental interactions. Due to the huge range of timescales, spatial scales, and physics involved, understanding how each of these processes relate to each other and to the long-term evolution remains an enormous challenge in astrophysics. To face this challenge, the AWESoMeStars project will develop a comprehensive, physical picture of the evolution of stellar rotation, magnetic activity, mass loss, and accretion.

In doing so, we will

(1) Discover how stars lose the vast majority of their angular momentum, which happens in the accretion phase

(2) Explain the observed rotation-activity relationship and saturation in terms of the evolution of magnetic properties & coronal physics

(3) Characterize coronal heating and mass loss across the full range of mass & age

(4) Explain the Skumanich (1972) relationship and distributions of spin rates observed in young clusters & old field stars

(5) Develop physics-based gyrochronology as a tool for using rotation rates to constrain stellar ages.

We will accomplish these goals using a fundamentally new and multi-faceted approach, which combines the power of multi-dimensional MHD simulations with long-timescale rotational-evolution models. Specifically, we will develop a next generation of MHD simulations of both star-disk interactions and stellar winds, to model stars over the full range of mass & age, and to characterize how magnetically active stars impact their environments. Simultaneously, we will create a new class of rotational-evolution models that include external torques derived from our simulations, compute the evolution of spin rates of entire star clusters, & compare with observations.

Link to the ERC project webpage: http://empslocal.ex.ac.uk/AWESoMeStars/

Keywords of the ERC project: Astrophysics, Sun-like stars, theory, MHD, rotational evolution, magnetic activity, accretion, star formation

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:
716155	**SACCRED**	**PE9** Universe Sciences

Principal Investigator:	**Dr ÁGNES KÓSPÁL**
Host Institution:	MAGYAR TUDOMANYOS AKADEMIA CSILLAGASZATI ES FOLDTUDOMANYI KUTATOKOZPONT - HU

Structured ACCREtion Disks: initial conditions for planet formation in the time domain

In this ERC Starting Grant, I propose an ambitious research program to target important challenges in predicting realistic initial conditions for the planet formation process. I will perform a large systematic study of the accretion-driven eruptions of newborn stars, and evaluate their influence on the structure, composition, and chemistry of the terrestrial planet forming zone in the circumstellar disk. The research will focus on three main questions:

- How does the mass accretion proceed in realistic, structured, non-axisymmetric disks?
- What physical mechanisms explain the accretion-driven eruptions?
- What is the effect of the eruptions on the disk?

My new research group will study young eruptive stars, pre-main sequence objects prone to episodes of extremely powerful accretion-driven outbursts, and combine new observations, state-of-the-art numerical modelling, and information from the literature. With a novel concept, we will first model the time-dependence of mass accretion in circumstellar disks, taking into account the latest observational results on inhomogeneous disk structure, and determine what fraction of young stellar objects is susceptible to high mass accretion peaks. Next, we will revise the paradigm of the eruptive phenomenon, compelled by recently discovered young eruptive stars whose outbursts are inconsistent with current outburst theories. Finally, we will determine the impact of accretion-driven eruptions on the disk, by considering the increased external irradiation, internal accretion heating, and stellar winds. With my experience and track record, I am in a position to comprehensively synthesize existing and newly acquired information to reach the proposed goals. The expected outcome of the ERC project is a conclusive demonstration of the ubiquity and profound impact of episodic accretion on disk structure, providing the initial physical conditions for disk evolution and planet formation models.

Link to the ERC project webpage: http://konkoly.hu/SACCRED/

Keywords of the ERC project: astrophysics, star formation, young stellar objects, accretion disks

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:
724326	**BOSS-WAVES**	**PE9** Universe Sciences

Principal Investigator:	**Dr TOM VAN DOORSSELAERE**
Host Institution:	KATHOLIEKE UNIVERSITEIT LEUVEN - BE

Back-reaction Of Solar plaSma to WAVES

The solar coronal heating problem is a long-standing astrophysical problem. The slow DC (reconnection) heating models are well developed in detailed 3D numerical simulations. The fast AC (wave) heating mechanisms have traditionally been neglected since there were no wave observations.
Since 2007, we know that the solar atmosphere is filled with transverse waves, but still we have no adequate models (except for my own 1D analytical models) for their dissipation and plasma heating by these waves. We urgently need to know the contribution of these waves to the coronal heating problem.
In BOSS-WAVES, I will innovate the AC wave heating models by utilising novel 3D numerical simulations of propagating transverse waves. From previous results in my team, I know that the inclusion of the back-reaction of the solar plasma is crucial in understanding the energy dissipation: the wave heating leads to chromospheric evaporation and plasma mixing (by the Kelvin-Helmholtz instability).
BOSS-WAVES will bring the AC heating models to the same level of state-of-the-art DC heating models.
The high-risk, high-gain goals are (1) to create a coronal loop heated by waves, starting from an "empty" corona, by evaporating chromospheric material, and (2) to pioneer models for whole active regions heated by transverse waves.

Link to the ERC project webpage: http://perswww.kuleuven.be/~u0041608/webs/index.php?loc=boss-waves

Keywords of the ERC project: Astrophysics, solar corona, MHD wave modelling

Keywords that characterize the scientific profile of the potential visiting researcher/s: plasma physics, astrophysics, MHD modelling

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
724560	**RADIOSTAR**	**PE9** Universe Sciences

Principal Investigator:	**Dr MARIA LUGARO**
Host Institution:	MAGYAR TUDOMANYOS AKADEMIA CSILLAGASZATI ES FOLDTUDOMANYI KUTATOKOZPONT - HU

Radioactivities from Stars to Solar Systems

RADIOSTAR will exploit radioactive nuclei produced by nuclear reactions inside stars and ejected by stellar winds and supernova explosions to fill the missing pieces of the puzzle of the origin of our Solar System: What were the circumstances of the birth of our Sun? Were they similar to those of the majority of other stars in our Galaxy, or were they special? Radioactive nuclei are the key to answer these questions because meteoritic analysis has proven that many of them were present at the time of the birth of the Sun. Their origin, however, has been so far elusive. RADIOSTAR steps beyond the state-of-the-art to answer these open questions by (i) combining the evolution of radioactive nuclei in the Galaxy and within molecular clouds and (ii) considering all the seventeen radionuclides of interest and all their stellar sources and analysing the effects of uncertainties in their stellar production. This will allow us to:

- Use the decay of radioactive nuclei produced by the chemical evolution of the Galaxy as a clock to measure the lifetime of the Sun's parent molecular cloud prior to the Sun's birth;
- Calculate the self-pollution of this molecular cloud from the ejecta of stars with lives shorter than such lifetime;
- Discover if such self-pollution can fully explain the abundances of radioactive nuclei present at the time of the birth of the Sun, or whether special conditions are required.

RADIOSTAR will also have a far-reaching impact on our understanding of exoplanetary systems because the heat produced by radioactivity affects the evolution of planetesimals, with implications for the amount of water on terrestrial planets in the habitable zone. RADIOSTAR will open a new window into research on the effect of radioactivity on the evolution of planetesimals outside our Solar System.

Link to the ERC project webpage: http://www.konkoly.hu/radiostar/

Keywords of the ERC project: nucleosynthesis radioactivity

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

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
772663	**MAGALOPS**	**PE9** Universe Sciences

Principal Investigator:	**Dr MARIJKE HAVERKORN**
Host Institution:	STICHTING KATHOLIEKE UNIVERSITEIT - NL

The MAgnetic field in the GALaxy, using Optical Polarization of Stars

What makes our Galaxy's ecosystem so fascinating is the complex interactions between its components: stars, gas, dust, magnetic fields, and cosmic rays. Of these components, the Galactic magnetic field (GMF) may well be the most enigmatic. Only partially observable through indirect means, its study relies heavily on modeling, almost exclusively using line-of-sight integrated radio-polarimetric data. Although much has been learned, many questions are still unanswered especially about the turbulent, small-scale field component and out-of-plane field.

The crucial innovations proposed here are large independent data sets with 3D (distance) information – which can only be provided by stars polarized due to differential absorption by interstellar dust, with known distances – and more advanced Bayesian statistics which allows including prior knowledge and enables quantitative model comparison.

I propose to use 2 new polarization surveys in the V (visual) band, resulting in polarimetry of millions of stars across the southern sky. With distance information provided by the GAIA satellite, this improves the current data situation by 3 orders of magnitude. We will test GMF models against all available data, employing a Bayesian inference software package which we are developing. In the process, we will produce the first 3D all-sky (out to absorption limits) dust distribution consistent with both UV/optical/near IR absorption and optical polarization.

This research will result in a next-generation GMF model that includes all observational GMF tracers and can use informative priors. It will allow mapping out interstellar magnetized turbulence in the Galaxy, instead of providing averaged parameters only, and understanding the interplay between the local GMF, gas and dust. Its legacy is a 1000x increased stellar polarization catalog, an all-sky 3D dust model, a bayesian sampler for GMF models, and a superior GMF model for use in cosmic ray modeling or foreground subtraction.

Link to the ERC project webpage: https://astro.ru.nl/~haverkorn/magalops/index.html

Keywords of the ERC project: Galactic magnetism, optical starlight polarization, Galactic magnetic field modeling, Milky Way dust

Keywords that characterize the scientific profile of the potential visiting researcher/s: Galactic magnetism, optical starlight polarization, Galactic magnetic field modeling, Galactic dust distribution

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
771310	**PI2FA**	**PE9** Universe Sciences

Principal Investigator:	**Dr ELENA KHOMENKO**
Host Institution:	INSTITUTO DE ASTROFISICA DE CANARIAS - ES

Partial Ionisation: Two-Fluid Approach

PI2FA proposal's overarching aim is to make a major breakthrough in our understanding of the magnetised solar chromosphere under a novel frame of a multi-fluid plasma theory. Future large-aperture solar telescopes, EST and DKIST, will have among their primary focus observations of chromospheric magnetic fields. The correct interpretation of solar data requires sophisticated theories. The solar atmosphere is made of strongly stratified, weakly ionised and not completely collisionally coupled plasma. In the previous PI's ERC SPIA project we opened a new research line and performed systematic investigations of non-ideal effects due to neutrals in the solar plasma. To build the complexity step by step, we advanced a single-fluid formalism, best valid for a strongly collisionally coupled case. Nevertheless, a multi-fluid treatment is essential for the weakly coupled chromosphere because the processes of the energy transport and conversion happen at nearly collisional scales. Now it is the right moment to take advantage and consolidate the experience gained in the SPIA project and to bring our research to a new level of challenge. The ambition of the PI2FA proposal is to create and apply tools for multi-dimensional modelling of the solar chromosphere under a precise two-fluid multi-species approach. In the recent few years it has been repeatedly demonstrated that processes related to non-ideal plasma behaviour due to neutrals may be the key to solve the problem of chromospheric heating and dynamics. PI2FA project will make progress in the following questions: determination of chromospheric heating mechanisms; understanding destabilization mechanisms of prominences related to neutrals, and creation of multi-dimensional two-fluid models of the solar chromosphere. These models will include altogether complex interactions down to smallest scales and allow direct comparison to observations, as a way to prepare our community for the coming large-aperture telescopes.

Link to the ERC project webpage:

Keywords of the ERC project: Sun, chromosphere, magnetohydrodynamics, numerical simulations

Keywords that characterize the scientific profile of the potential visiting researcher/s: Sun, chromosphere, magnetohydrodynamics, numerical simulations

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
788433	**FAIR**	**SH1** Individuals, Markets and Organisations

Principal Investigator:	**Dr BERTIL TUNGODDEN**
Host Institution:	NORGES HANDELSHOYSKOLE - NO

Fairness and the Moral Mind

The project provides a comprehensive and groundbreaking approach to the analysis of the moral mind and inequality acceptance. The first part of the project will provide a novel study of how the moral ideals of personal responsibility and individual freedom, which are fundamental values in most liberal societies, shape inequality acceptance. It will also provide the first experimental study of how people draw the moral circle, which is at the heart of the most pressing policy challenges facing the world today and strongly related to the question of global fairness. The second part will study how social institutions shape inequality acceptance and how it develops in childhood and adolescence, by providing two unique international studies of inequality acceptance in 60 countries across the world. These studies will provide novel insights on the distributive behavior of nationally representative samples of adults and children and on the cultural transmission of moral preferences in society. The project is rooted in behavioral and experimental economics, but will also draw on insights from other social sciences and philosophy. It will develop novel experimental paradigms to study the moral mind and the nature of inequality acceptance, including incentivized experiments on nationally representative populations, and combine structural and non-parametric empirical analysis with theory development. Taken together, the project represents a unique study of inequality acceptance in the social sciences that will address an important knowledge gap in the literature on inequality.

Link to the ERC project webpage:

Keywords of the ERC project: moral inequality personal responsibility individual freedom childhood behavorial economics

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:
648429	**TRANSPOP**	**SH2** Institutions, Values, Beliefs and Behaviour

Principal Investigator:	**Dr PETER STAMATOV**
Host Institution:	UNIVERSIDAD CARLOS III DE MADRID - ES

The Transformation of Popular Politics in Europe's Long Nineteenth Century

How did ordinary people acquire the capacity to mobilize and influence the political decision-making process? How did standard forms of popular collective action emerge and get institutionalized in European modernity? To address these questions, this project explores the transformation of European popular politics in the long nineteenth-century (c. 1789-1914), while also offering a systematic and empirically rigorous causal account of the processes that led to the emergence of the typical forms of social movement activities that dominate the current landscape of popular protest.

The project will seek to address two interconnected problems in current scholarship. First, it will enrich our knowledge of the scope and variety of popular politics in the period by focusing on cases (Hungary, Italy, the Netherlands, and Spain) that unlike the "core" cases of Great Britain and France have not been studied exhaustively. Second, it will transcend the limitations of existing treatments that have focused predominantly on class formation and state building as the ultimate determinants of popular politics in the period. Through careful archival research and innovative quantitative techniques, the participants will consider an interrelated set of questions on the proper causal relationship between political scale and political mobilization and on the varied cultural and organizational forms of social movement activity.

Link to the ERC project webpage: https://transpopproject.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:
716686	**ConflictNET**	**SH2** Institutions, Values, Beliefs and Behaviour

Principal Investigator:	**Dr NICOLE STREMLAU**
Host Institution:	THE CHANCELLOR, MASTERS AND SCHOLARS OF THE UNIVERSITY OF OXFORD - UK

The Politics and Practice of Social Media in Conflict

Over the next five years an unprecedented number of initiatives will coalesce, contributing to an extension of the reach of the Internet to the world's most remote regions. While previous efforts to expand Internet access have focused on urban areas, current initiatives are leveraging new technologies from drones to satellites to provide affordable access to the worlds poorest, many of whom are in Africa and live in regions where the state is weak and there is protracted violent conflict. Current debates have largely focused on technical issues of improving access, or assumed ways that technology will help 'liberate' populations or improve governance. This project focuses on a key puzzle that is often overlooked: How does increased access to social media affect the balance between peace-building efforts and attempts perpetuate violence in conflict-affected communities?

With a focus on Africa (and particularly on religious and political violence in Eastern Africa), this project will investigate the relationship between social media and conflict through three research questions at the macro, meso and micro level: how are social media altering the transnational dimensions of conflict and peacebuilding? How are public authorities reacting to, and appropriating, social media to either encourage violence or promote peace? And in what ways are social media changing the way people experience, participate in, or respond to violent conflict? It will examine these questions in the context of dangerous speech online; the exit and entry of individuals away from, and into, conflict; the tactics and strategies actors adopt to shape the Internet; and how governance actors are leveraging social media in conflict-affected communities.

Link to the ERC project webpage: http://pcmlp.socleg.ox.ac.uk/conflictnet/

Keywords of the ERC project: media, conflict, africa, social media, migration, hate speech, governance

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:
756672	**HumanTrafficking**	**SH2** Institutions, Values, Beliefs and Behaviour

Principal Investigator:	**Dr HILA SHAMIR**
Host Institution:	TEL AVIV UNIVERSITY - IL

Human Trafficking: A Labor Perspective

This project conducts a theoretical, methodological, and normative paradigm shift in the research and analysis of human trafficking, one of the most pressing moral and political challenges of our times. It moves away from the currently predominant approach to trafficking, which focuses on criminal law, border control, and human rights, towards a labor-based approach that targets the structure of labor markets that are prone to severely exploitative labor practices. This shift represents an essential development both in the research of migratory labor practices and in the process of designing more effective, and more just, anti-trafficking measures, that are context-sensitive as well as cognizant to global legal and economic trends. The project will include four main parts: 1) Theoretical: articulating and justifying the proposed shift on trafficking from individual rights and culpabilities to structural labor market realities. 2) Case-studies: conducting a multidisciplinary study of a series of innovative case studies, in which the labor context emerges as a significant factor in the trafficking nexus – bilateral agreements on migration, national regulations of labor standards and recruiters, unionization, and voluntary corporate codes of conduct. The case studies analysis employs the labor paradigm in elucidating the structural conditions that underlie trafficking, reveal a thus-far mostly unrecognized and under-theorized set of anti-trafficking tools. 3) Clinical Laboratory: collaborating with TAUs Workers' Rights clinic to create a legal laboratory in which the potential and limits of the tools examined in the case studies will be tested. 4) Normative: assessing the success of existing strategies and expanding on them to devise innovative tools for a just, practicable, and effective anti-trafficking policy, that can reach significantly more individuals vulnerable to trafficking, by providing them with legal mechanisms for avoiding and resisting exploitation.

Link to the ERC project webpage:

Keywords of the ERC project: Human Trafficking, labor migration, workers rights, corporate responsibility, supply chains, unionization, labor,
labor law, employment law, bilateral agreements,

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:
758149	**reFUEL**	**SH2** Institutions, Values, Beliefs and Behaviour

Principal Investigator:	**Dr JOHANNES SCHMIDT**
Host Institution:	UNIVERSITAET FUER BODENKULTUR WIEN - AT

Going global? Renewable fuel trade and social land-use restrictions in a low-carbon energy system

Recent global integrated modelling studies indicate low intensities in trade of energy commodities between global regions in a future low-carbon global energy system. Also, research based on modelling indicates that deep greenhouse-gas emission cuts are possible in fully electrified renewable energy systems on a continental or country scale from a techno-economic perspective.

However, these modelling efforts partly neglect drivers of globalization and may therefore wrongly project regionalization of energy systems. In particular, (i) new, easily tradable, low-cost renewable fuels (e.g. solar & electric fuels), (ii) global bio-physical variability of renewables (e.g. solar radiation and freshwater availability), and (iii) regional differences in social land-use restrictions associated with the expansion of energy infrastructure can cause an increase of trade flows in the energy sector.

We aim at better understanding how the spatial configuration of renewables in low-carbon energy systems is affected by these drivers and develop a cutting-edge, open-source global renewable energy model that combines elements of energy system and land-use modelling. It takes into account bio-physical conditions for renewable fuel and electricity production, social land availability restrictions, and a map of existing energy infrastructure at unprecedented level of detail. Our approach integrates open data sources from public institutions, user-generated GIS data, and social networks. Existing models for Europe and Brazil are used for validation. Qualitative interviews in local case studies complement the global model and increase our understanding of land-use restrictions on the local scale.

Our project has impacts beyond energy systems analysis: in particular the identification of winning and losing regions in a global renewable energy system is highly relevant in climate change mitigation negotiations, and the generated spatial indicators and maps enable many potential applications.

Link to the ERC project webpage: https://reufel.world

Keywords of the ERC project: renewable energy, land use, trade, global

Keywords that characterize the scientific profile of the potential visiting researcher/s: optimization, gis, land-use, modelling, geography, social sciences, economist, political ecology

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
758671	**GLOBTAXGOV**	**SH2** Institutions, Values, Beliefs and Behaviour

Principal Investigator:	**Dr IRMA JOHANNA MOSQUERA VALDERRAMA**
Host Institution:	UNIVERSITEIT LEIDEN - NL

A New Model of Global Governance in International Tax Law Making

The overall aim of this research project is to assess the feasibility and legitimacy of the current model of global tax governance and the role of the OECD and EU in international tax lawmaking. Unlike the former OECD projects that only provide for exchange of information between countries, in the BEPS Project, the EU Anti-Tax Avoidance Directive, the EU state aid investigations and the EU External Strategy, the OECD and the EU focus on substantive issues that when implemented will change the international tax architecture of developed and developing countries. These initiatives aim to ensure that governments engage in fair competition and that multinationals pay their fair share. Even though these objectives are legitimate, these developments raise the questions what is the role of the OECD and the EU in global tax governance? and under what conditions can the model of global tax governance be feasible and legitimate for both developed and developing countries? These initiatives have generated tensions between developed and developed countries and between EU and third (non-EU) countries. The tensions between countries call for the articulation of a new framework of global tax governance that is legitimate and based on considerations of fairness for all countries participating.
Against this background, my project will first assess the feasibility of the legal transplant of the BEPS minimum standards into the tax systems of 12 countries of research by asking three sub-questions (i) why are these countries participating in the BEPS Project? (ii) how will the BEPS minimum standards be transplanted into the tax system of these countries? and (iii) how can the differences in tax systems and tax cultures of these countries influence the content of these minimum standards? Thereafter, the conditions for the legitimacy of the role of the OECD and the EU will be provided in light of the theories of legitimacy and governance.

Link to the ERC project webpage: https://cordis.europa.eu/project/rcn/213400_en.html

Keywords of the ERC project: taxation, developing countries, governance

Keywords that characterize the scientific profile of the potential visiting researcher/s: multidisciplinary research including work on legitimacy, international relations and/or political science

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
759079	**POLEMIC**	**SH2** Institutions, Values, Beliefs and Behaviour

Principal Investigator:	**Dr GIJS SCHUMACHER**
Host Institution:	UNIVERSITEIT VAN AMSTERDAM - NL

Politics and Emotions Investigated Comparatively

Many claim that politicians make more, and more extreme, emotional appeals than ever before, because these appeals win over the emotional citizen. With highly emotive language people like Donald Trump, Geert Wilders or Marine Le Pen are pounding on the portals to power. Do such emotional appeals affect citizens' political choices? Yes, they can. But, citizens' existing emotional attachments to parties, leaders or issues moderate the success of emotional appeals. POLEMIC will extend existing theory and use novel methods to explain when (types of) emotional appeals are persuasive, and when emotional attachments prevent persuasion.

Do politicians actually make more emotional appeals than in the past? And if so why are they doing it? We lack historical data of emotional appeals so we cannot answer these questions. POLEMIC will provide unique, historical data (1945-now, 9 countries) of emotional appeals by politicians in their speeches. I develop and test 3 alternative theories from different intellectual traditions that explain why politicians make emotional appeals: is it either (1) a vote-maximizing strategy, (2) a product of the personality of a politician or (3) just fashionable?

POLEMIC analyses emotional appeals of politicians and the emotional responses of citizens to these appeals. Emotional appeals are texts, and emotions are experiences by the brain. To measure them POLEMIC will use innovative methods in political science: automated text analysis to extract emotion from appeals; physiological measurement to measure emotions.

POLEMIC offers a ground-breaking combination of a macro-perspective (what politicians say) and a micro-perspective (how citizens respond) and forms a bridge between party politics and political psychology. The project's output will indicate the importance of emotion in the decision-making of citizens, and the level of rationality that is behind politicians' decision to make emotional appeals.

Link to the ERC project webpage: hotpolitics.eu

Keywords of the ERC project: politics, emotions, democracy, political competition

Keywords that characterize the scientific profile of the potential visiting researcher/s: emotions, computational social science, psychology, quantitative methods, experiments

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
759728	**TRICI-Law**	**SH2** Institutions, Values, Beliefs and Behaviour

Principal Investigator:	**Dr PANAGIOTIS MERKOURIS**
Host Institution:	RIJKSUNIVERSITEIT GRONINGEN - NL

The Rules of Interpretation of Customary International Law

This ERC proposal revolves around the rules of interpretation of customary international law (CIL). CIL along with treaties are the rules most often used in international law. However, whereas rules of interpretation of treaties have been enshrined in Articles 31-33 of the Vienna Convention on the Law of Treaties (VCLT), the rules of interpretation of CIL have not been the subject of critical study. This gap becomes even more pronounced if we consider that interpretation plays a key role in every judicial case, and that one of the basic markers of effectiveness of any legal system is its predictability. By not knowing the rules that govern the interpretation of CIL, we end up playing a 'game' the rules of which are unknown, and by consequence predictability is far from guaranteed.

Therefore the aim of this project is to determine the existence and to examine the content of the rules of interpretation of customary international law. It will: 1) prove the theoretical validity of CIL being open to interpretation; 2) induce the rules of interpretation of CIL and their content; 3) track the points of convergence/divergence and reasons thereof amongst rules of interpretation of CIL, treaties and unilateral acts as they evolve through time; and 4) create a set of articles/guidelines on the interpretation of CIL.

The results will influence the study and theory of CIL; will lead to a re-conceptualization of the theory of sources of international law; will spark a long overdue debate on the interaction between sources of international law; will further our understanding of the process of interpretation and of the basic precepts of the international legal system; and its findings will become the staple point of reference by any 'user' of international law.

Its ultimate outcomes will clarify the foundations of the international legal system, reduce normative conflict, and provide greater legal certainty and foreseeability in all international law-related interactions.

Link to the ERC project webpage: https://www.rug.nl/research/groningen-centre-for-law-and-governance/eu-projects/trici-law/about-trici-law

Keywords of the ERC project: international law; interpretation; sources; customary law

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:
682110	**POLICYAID**	**SH2** Institutions, Values, Beliefs and Behaviour

Principal Investigator:	**Dr KLAUS HOEYER**
Host Institution:	KOBENHAVNS UNIVERSITET - DK

Policy, practice and patient experience in the age of intensified data sourcing

The European healthcare services have begun collecting tissue samples and healthcare data from patients on an unprecedented scale. With POLICYAID we suggest the term 'intensified data sourcing' to describe these attempts at getting more data, on more people, of better quality while simultaneously making the data available for multiple uses. Data are used for research, for financial remuneration purposes, for quality assurance, to attract capital and even for police work. POLICYAID investigates how the diverse agendas interact in the making of a new infrastructure for healthcare.

POLICYAID ambitiously aims to understand the drivers for and implications of intensified data sourcing in the biomedical realm across three levels: 1) policymaking, 2) everyday clinical practices, and 3) citizen experiences of health, illness, rights and duties. To achieve this aim we compare four different forms of intensified data sourcing, and analyze the regulatory frameworks guiding the data procurement and use in Denmark, the EU and beyond.

Based on PI's strong inter-disciplinary background and experience, we fuse legal, sociological, anthropological and public health scholarship and develop new methodologies for policy analysis by combining document analysis, interviews, participant observation and register-based methodologies. Instead of simply assuming that data sourcing can be reduced to matters of surveillance, we open up the black box of data sourcing by describing how data are selected; financed; what they are used for; how data practices relate to the involved stakeholders' hopes and concerns, and; who gains which rights to the data. We can thereby explore how intensified data sourcing affects clinical routines and patient experience, as well as understand how Big Data for medical research emerges. POLICYAID thereby arrives at novel understandings of both policy making and what it means to be patient in the age of intensified data sourcing.

Link to the ERC project webpage: www.policyaid.ku.dk

Keywords of the ERC project: social science, data, healthcare, ethics, privacy, Big Data, health data

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:
637768	**EQUALIZE**	**SH3** Environment, Space and Population

Principal Investigator:	**Dr IÑAKI PERMANYER**
Host Institution:	CENTRO DE ESTUDIOS DEMOGRAFICOS - ES

Equalizing or disequalizing? Opposing socio-demographic determinants of the spatial distribution of welfare.

This project aims to investigate the extent to which current trends in family formation, living arrangements and gender-specific education levels are related to the spatial distribution of welfare and the emergence of jobless households in contemporary societies. Inter alia, we aim to explore whether the welfare disequalizing, impoverishing and polarizing effects that are currently associated with recent patterns in assortative mating, lone parenthood and household composition are offset by an unprecedented phenomenon that is sweeping the world during the last decades: the rapid process education expansion in tandem with a reversal of the gender gap in education. The extent to which these two opposing forces occur and which of them is more influential in shaping the distribution of welfare between and within countries is among the main goals of this project. To this end, we will draw upon a variety of household surveys and the world largest sources of census microdata: the Integrated Public Use Microdata Series (IPUMS) project and the Latin American and Caribbean Demographic Centre. Because of their unparalleled geographical coverage and detail, these sources of data constitute exceptional instruments to study socio-demographic phenomena that have been vastly underutilized by the international research community. Triangulating our analysis at the micro, meso and macro levels, we will establish formal linkages between welfare distributions and its socio-demographic correlates to unveil insightful relationships that have been unsatisfactorily explored so far because of the lack of appropriately harmonized, sufficiently detailed and georeferenced datasets. We will strongly emphasize the spatial distribution of variables to unravel local patterns that might take place at highly disaggregated levels, therefore not being discernible to traditional (not as finely-grained) approaches.

Link to the ERC project webpage:

Keywords of the ERC project: assortative mating, inequality, poverty, education expansion, global disparities, within and between country inequality, welfare, measurement

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:
639403	**WORKANDHOME**	**SH3** Environment, Space and Population

Principal Investigator:	**Dr DARJA REUSCHKE**
Host Institution:	UNIVERSITY OF SOUTHAMPTON - UK

Reshaping society and space: home-based self-employment and businesses

The aim of WORKANDHOME is to develop a new framework for understanding fundamental changes currently taking place to work that situates individuals as economic actors within the context of their wider life domains, household, home and neighbourhood. This will break new ground in how we understand and classify economic activity, the home, the firm, places of economic activity, labour markets and 'residential' neighbourhoods. Significant and rising numbers of people work from home as a self-employed worker or business owner throughout Europe. This will be the first study that explores social, economic and spatial aspects of homeworking by self-employed workers and business owners including the role of new technologies and social media in dissolving the home-work boundary. This is an important new area for social science research since home-based self-employment and businesses vividly manifest the interconnection of 'home' and 'work' and of the 'economic' and the 'social' as part of an increasingly complex society. WORKANDHOME will integrate theoretical perspectives from economic geography, entrepreneurship and small business research, sociology, economics, housing and neighbourhood studies. In order to investigate new realities of how people work and live, this study will integrate analytical methods across the social sciences and computer sciences and create a new fusion of primary, secondary and 'big' social media data from the UK, the Netherlands, Germany, Europe and the world. WORKANDHOME offers a major step forward in understanding how people live, work, do business and shape space. Its integrated and international approach will stimulate considerable interdisciplinary exchange across disciplines in the social sciences for better understanding and tackling contemporary societal and economic changes and challenges.

Link to the ERC project webpage: www.workandhome.ac.uk

Keywords of the ERC project: small business, micro enterprise, self-employment, gender, neighbourhood, subjective well-being

Keywords that characterize the scientific profile of the potential visiting researcher/s: geography, quantitative analysis, spatial economics, micro data analysis, economic development, entrepreneurship

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
714222	**CHILDMOVE**	**SH3** Environment, Space and Population

Principal Investigator:	**Dr ILSE DERLUYN**
Host Institution:	UNIVERSITEIT GENT - BE

The impact of flight experiences on the psychological wellbeing of unaccompanied refugee minors

Since early 2015, the media continuously confront us with images of refugee children drowning in the Mediterranean, surviving in appalling conditions in camps or walking across Europe. Within this group of fleeing children, a considerable number is travelling without parents, the unaccompanied refugee minors.
While the media images testify to these flight experiences and their possible huge impact on unaccompanied minors' wellbeing, there has been no systematic research to fully capture these experiences, nor their mental health impact. Equally, no evidence exists on whether the emotional impact of these flight experiences should be differentiated from the impact of the traumatic events these minors endured in their home country or from the daily stressors in the country of settlement.
This project aims to fundamentally increase our knowledge of the impact of experiences during the flight in relation to past trauma and current stressors. To achieve this aim, it is essential to set up a longitudinal follow-up of a large group of unaccompanied refugee minors, whereby our study starts from different transit countries, crosses several European countries, and uses innovative methodological and mixed-methods approaches. I will hereby not only document the psychological impact these flight experiences may have, but also the way in which care and reception structures for unaccompanied minors in both transit and settlement countries can contribute to reducing this mental health impact.
This proposal will fundamentally change the field of migration studies, by introducing a whole new area of study and novel methodological approaches to study these themes. Moreover, other fields, such as trauma studies, will be directly informed by the project, as also clinical, educational and social work interventions for victims of multiple trauma. Last, the findings on the impact of reception and care structures will be highly informative for policy makers and practitioners.

Link to the ERC project webpage:

Keywords of the ERC project: unaccompanied refugee youth; transit experiences; psychosocial wellbeing

Keywords that characterize the scientific profile of the potential visiting researcher/s: social/medical sciences; social geography

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
725128	**CIC**	**SH3** Environment, Space and Population

Principal Investigator:	**Dr MICHELLE RYAN**
Host Institution:	THE UNIVERSITY OF EXETER - UK

Context, Identity and Choice: Understanding the constraints on women's career decisions

There has been vast improvement in workplace gender equality, but there remain marked differences in the roles in which women and men work. Explanations for this inequality have focused on the barriers women face. However, as women begin to enter male-dominated roles, a new explanation has arisen: that remaining gender inequality must reflect fundamental differences between women and men, including differences in (a) ambition and desire for power, (b) needs for work-life balance, and (c) willingness to take career risks. Central to this analysis is the assumption that the glass ceiling is broken and thus inequality must be due to women's active choices. This explanation downplays the fact that social context continues to be a barrier to women's success and places responsibility for gender inequality on women themselves. Indeed, there has arisen the suggestion that gender equality necessitates women overcoming 'internal obstacles', 'leaning-in' and altering their choices (Sandberg, 2013), rather than challenging the status quo. I argue that diametrically contrasting structural barriers with women's choices is unhelpful. Instead, I suggest that women's choices are shaped and constrained by the gendered nature of organisational and social contexts and how women see themselves within these contexts. I propose a programme of research, across 3 integrated streams, that investigates how social and organisational structures define identities and constrain women's choices in relation to ambition, work-life balance, and career risk-taking. I have four key objectives: (1) to clarify how organisational and social contexts define identity and constrain women's choices, (2) to use an interdisciplinary, multi-methodological approach, to produce innovative theory and data, (3) to work collaboratively with stakeholders, and (4) to inform practical interventions designed to facilitate the increase of women's participation in hitherto male-dominated roles.

Link to the ERC project webpage: http://psychology.exeter.ac.uk/cic/

Keywords of the ERC project: gender inequality, social identity, sexism, discrimination

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:
759681	**BLOCKCHAINSOCIETY**	**SH3** Environment, Space and Population

Principal Investigator:	**Dr BALAZS BODO**
Host Institution:	UNIVERSITEIT VAN AMSTERDAM - NL

The Disrupted Society: mapping the societal effects of blockchain technology diffusion

Recent advances in cryptography yielded the blockchain technology, which enables a radically new and decentralized method to maintain authoritative records, without the need of trusted intermediaries. Bitcoin, a cryptocurrency blockchain application has already demonstrated that it is possible to operate a purely cryptography-based, global, distributed, decentralized, anonymous financial network, independent from central and commercial banks, regulators and the state.

The same technology is now being applied to other social domains (e.g. public registries of ownership and deeds, voting systems, the internet domain name registry). But research on the societal impact of blockchain innovation is scant, and we cannot properly assess its risks and promises. In addition, crucial knowledge is missing on how blockchain technologies can and should be regulated by law.

The BlockchainSociety project focuses on three research questions. (1) What internal factors contribute to the success of a blockchain application? (2) How does society adopt blockchain? (3) How to regulate blockchain? It breaks new ground as it (1) maps the most important blockchain projects, their governance, and assesses their disruptive potential; (2) documents and analyses the social diffusion of the technology, and builds scenarios about the potential impact of blockchain diffusion; and (3) it creates an inventory of emerging policy responses, compares and assesses policy tools in terms of efficiency and impact. The project will (1) build the conceptual and methodological bridges between information law, the study of the self-governance of technological systems via Science and Technology Studies, and the study of collective control efforts of complex socio-technological assemblages via Internet Governance studies; (2) address the most pressing blockchain-specific regulatory challenges via the analysis of emerging policies, and the development of new proposals.

Link to the ERC project webpage: https://blockchain-society.science/

Keywords of the ERC project: blockchain, regulation, policy, law

Keywords that characterize the scientific profile of the potential visiting researcher/s: economist, legal scholar, social scientist, computer scientist

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
759796	**FACESYNTAX**	**SH3** Environment, Space and Population

Principal Investigator:	**Dr RACHAEL JACK**
Host Institution:	UNIVERSITY OF GLASGOW - UK

Computing the Face Syntax of Social Communication

Social interactions are critical to all societies. One of the most powerful tools for social interaction is the face – a complex system comprising variations of movement (expressions), morphology (shape/structure) and complexion (color/texture). Consequently, the face can elicit myriad rapid social judgments (e.g. personality, emotion, group membership, age, health, social status) with significant consequences (e.g. sentencing/voting decisions, social isolation, job offers). Yet, little is known about how the complex, dynamic face transmits the myriad messages that regulate social interactions in different cultures, how these complex face signals map onto psychological processes (e.g. categorical/dimensional perception) or which signals facilitate or hinder cross-culture communication. This is largely due to fragmented research on social concepts (mental states, personality, emotions), face signals (morphology, movements, complexion) and culture, which, consequently, has overlooked a possible latent algebraic, syntactical structure to social face signals across cultures. My own work hints at such a structure. My ambitious program will unify these fragments to derive the first generative, algebraic and syntactical model of social face signals using innovative methods combining social/cultural psychology, 3D dynamic computer graphics, vision science psychophysical methods, and mathematical psychology. It will thus test and validate a new theoretical framework of social face signals that will unite both categorical/dimensional and universal/culture-specific accounts of social face perception. This framework is highly relevant in the context of globalization and cultural integration where social communication using virtual agents is integral to modern society. It is thus imperative to equip digital agents with the tools to flexibly generate socially and culturally sophisticated face signals. FACESYNTAX will thus transfer the generative model to social robotics.

Link to the ERC project webpage: https://www.gla.ac.uk/schools/psychology/staff/rachaeljack/

Keywords of the ERC project: dynamic facial expressions, computational modelling, culture, social perception, psychophysics, social robots

Keywords that characterize the scientific profile of the potential visiting researcher/s: background in computing/computational skills/appreciation, programming (Matlab) skills, experience in social perception, social psychology, vision science

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
770839	**PARENTIME**	**SH3** Environment, Space and Population

Principal Investigator:	**Dr ALMUDENA SEVILLA**
Host Institution:	UNIVERSITY COLLEGE LONDON - UK

PARENTAL TIME INVESTMENTS AND INTERGENERATIONAL TRANSMISSION OF INEQUALITY

High socio-economic status parents consistently produce high socio-economic status children. The question is how. The objective of PARENTIME is to develop new socio-economic theories that unpack the detailed mechanisms driving the inter-generational transmission of inequality.

Because of data limitations and theoretical traditions, the literature has focused on a narrow conceptualization of parental time (limited to the quantity of time spent with children in different kinds of activities), and a narrow set of child outcomes (limited to educational outcomes and socio-behavioral outcomes during the early years). Thus, while the results from this literature are informative at documenting the phenomenon of inter-generational transmission of human capital, they remain silent about the mechanisms underlying the process. PARENTIME aims to close this gap.

In PARENTIME I will take a theoretically-driven Big Data approach by linking large representative 24-hour diary survey data of parents and children with very comprehensive and detailed information on child outcomes from administrative data to: First, go beyond the quantity of parental time to explore the inter-connections between family members and their role in the child's acquisition of human capital (i.e., the timing and sequence, co-presence, multi-tasking, and instantaneous parental enjoyment). Second, establish long-term effects of parental time investments by looking at a comprehensive set of child human capital measures all the way into the child's adult life. Third, arrive at a well-coordinated scientific approach, starting at the micro-sequential level of parents and children's everyday life and building progressively to a macro understanding of the (re)production of socio-economic inequality.

Link to the ERC project webpage:

Keywords of the ERC project: Time use, child development, quantitative methods, developmental psychology, economics, demography, inequality, inter generational transmission

Keywords that characterize the scientific profile of the potential visiting researcher/s: Quantitative methods, data scientist, developmental psychology, economist, child development

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
771391	**FORCE-OF-GOSSIP**	**SH3** Environment, Space and Population

Principal Investigator:	**Dr BIANCA BEERSMA**
Host Institution:	STICHTING VU - NL

The unknown force: How gossip shapes the functioning and performance of organizational groups.

Aim: To radically change the field of gossip research, this project builds theory that connects divergent perspectives on the effects of gossip on work group outcomes.
Background: Gossip, informal evaluative talk about absent third parties, is omnipresent in organizational groups. However, for scientists and practitioners alike, it is still an "unknown force" in organizations, because research findings about its effects on group functioning and performance are inconsistent. Whereas some studies point to the disruptive aspects of gossip, others claim it enhances group cooperation.
Innovation: I present the Gossip Origins, Subsequent Social Information Processing, and Performance (GOSSIPP)-framework, a new paradigm that views gossip in groups as a multi-level phenomenon: It, for the first time, systematically connects individual gossipers' intentions to group-level outcomes via social information processing by gossip recipients.
Propositions: Group members may gossip to benefit themselves or their group (proself vs. prosocial intentions, or motives). Receivers' reactions to gossip are affected by how they perceive senders' motives. These reactions in turn affect group-level processes. How these processes affect group performance depends on the type of group task.
Methodology: Four subprojects test the framework, applying a cross-disciplinary multi-method approach. Subprojects 1 and 2 employ laboratory experiments to assess causal effects of gossipers' motives and recipients' reactions on group processes and performance. Subproject 3 examines effects of different group compositions and feedback loops between performance and gossip, employing self-organizing computer modelling. Finally, to assess external validity, Subproject 4 examines work teams. Results will lead to long-sought understanding of when and why gossip is a functional or dysfunctional force and will enable evidence-based advice to organizations about the meaning and functionality of gossip for groups.

Link to the ERC project webpage:

Keywords of the ERC project: Gossip, groups in organizations, social motivation, team performance

Keywords that characterize the scientific profile of the potential visiting researcher/s: Social and organizational psychology, laboratory experiments, agent based models, longitudinal surveys

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
772743	**SOCSEMICS**	**SH3** Environment, Space and Population

Principal Investigator:	**Dr CAMILLE ROTH**
Host Institution:	FONDATION NATIONALE DES SCIENCES POLITIQUES - FR

Socio-Semantic Bubbles of Internet Communities

SOCSEMICS aims at developing a set of integrated, groundbreaking methods to address the possible existence of so-called “filter bubbles” in the digital public space. In all generality, this phenomenon may be construed as communities whose actors are more or less prone to interaction and open to informations coming from “outside” of these communities. SOCSEMICS will contribute to the formalization and operationalization of this question by addressing three current challenges: (i) developing a comprehensive theory of reinforcing and self-sustaining socio-semantic communities by appraising the social, semantic and socio-semantic realms simultaneously, (ii) drastically improving content analysis by replacing classical distributional approaches with clause analysis, and thereby enabling quantitative analyses which render the linguistic complexity of utterances in web corpuses, (iii) fostering the interface between these methods and qualitative approaches, especially through a couple of broad case studies, together with the development of interactive platforms implementing the above innovations and facilitating digital social research.

Link to the ERC project webpage:

Keywords of the ERC project: socio-semantic networks, user confinement, internet bubbles, digital public spaces, reinforcement dynamics

Keywords that characterize the scientific profile of the potential visiting researcher/s: social network analysis, complex system modeling, natural language processing, coevolutionary dynamics, digital public space, information visualization, digital sociology

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
646592	**MAGnUM**	**SH3** Environment, Space and Population

Principal Investigator:	**Dr LUDOVIC LECLERCQ**
Host Institution:	INSTITUT FRANCAIS DES SCIENCES ET TECHNOLOGIES DES TRANSPORTS, DE L'AMENAGEMENT ET DES RESEAUX - FR

A Multiscale and Multimodal Modelling Approach for Green Urban Traffic Management

The MAGnUM project aims to (i) create a consistent set of interrelated dynamic and multimodal traffic models able to capture driver behaviours at the different urban scales and (ii) apply this variety of models to design efficient and green traffic management strategies.

Traffic flow dynamics is well reproduced at a local urban scale by the kinematic wave model and its numerous extensions. Even if this model is parsimonious compared to other modelling approaches, it can hardly be applied at larger urban scales for traffic control applications. Very recently, a new modelling approach has been proposed to represent congestion dynamics at large scales. It relates the total travel production to the vehicle accumulation in a traffic network with for now a restrictive condition about network homogeneity. This approach is very promising for designing new traffic management systems but heterogeneous situations should be handled by properly connecting with the local scale to account for the effects of the local distributions and variations of the driver behaviour (demand) and the network structure (supply). Investigating these relationships and proposing a full set of consistent models representing traffic dynamics at several relevant scales (successive spatial and temporal integration) is very challenging with high potential gains for traffic control applications. This is the primary goal of MAGnUM and will be achieved by mixing analytical investigations on idealized but insightful test cases with explanatory approaches based on data gained from dynamic simulations or serious game sessions on more realistic and complex cases.

The second goal of the project concerns the design of innovative traffic management strategies at multiple urban scales. Breakthroughs will be achieved by considering multiple and competitive objectives when optimizing with a tight focus on environment issues and multi-modality.

Link to the ERC project webpage: magnum.ifsttar.fr

Keywords of the ERC project: Transportation, Traffic, Modelling, Control

Keywords that characterize the scientific profile of the potential visiting researcher/s: Control, Optimization, Data Analysis, Machine Learning

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
756301	**EXPO**	**SH3** Environment, Space and Population

Principal Investigator:	**Dr MAGDALENA WOJCIESZAK**
Host Institution:	UNIVERSITEIT VAN AMSTERDAM - NL

Citizens exposed to dissimilar views in the media: investigating backfire effects

In Europe, understanding and respect for those who hold different opinions are needed more than ever. In this context, exposure to dissimilar content in the media is crucial because encountering views that challenge one's beliefs is hoped to foster tolerance. More and more scholars are interested in media diversity and more and more policymakers encourage citizens to see dissimilar views in the media. However, exposure to difference can also do harm, increasing conflict among citizens with different opinions (backfire effects). Despite these dangers, we lack a comprehensive model that explains when and why exposure to dissimilar views amplifies or attenuates hostilities. What encourages people to see dissimilar political content, on which issues, and in which media? Under what conditions, for whom, and why does exposure to dissimilar views backfire? What can be done to minimize the harms and maximize the benefits of encountering difference? This project addresses these questions. It will advance an evidence-based theoretical model that identifies the individual, social, and system factors that together drive dissimilar exposure and its effects on understanding and respect between citizens with different views. This model accounts for old and new media, various political issues, and intended and incidental exposure.The model will be tested in four projects, each offering methodological breakthroughs. I will use latest techniques in 'big data' research, automated content analyses, panel surveys, qualitative work, and experiments; the first project to use this necessary variety of cutting-edge techniques conjointly and comparatively. This project will advance academic knowledge. Its findings are crucial for scholars across disciplines, policymakers who optimize media diversity policies, and media and campaign designers. Only if we know when, how, and why citizens are affected by dissimilar media will we be able to enhance respect and understanding in diverse societies.

Link to the ERC project webpage:

Keywords of the ERC project: exposure, polarization, computational social science, selectivity

Keywords that characterize the scientific profile of the potential visiting researcher/s: computational social science, deep learning, machine learning, supervised machine learning, big data, python, coding

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
760043	**RIGHTS**	**SH3** Environment, Space and Population

Principal Investigator:	**Dr EVELYN ERSANILLI**
Host Institution:	UNIVERSITEIT VAN AMSTERDAM - NL

The bargaining power of sending countries in influencing the rights of their low skilled migrant workers

This project asks how governments of migrant sending countries can influence the rights of their low skilled migrant workers in receiving countries. The project approaches this question from both the sending and the receiving country side; looking at factors that determine when and how sending states intervene and what determines the responses from receiving countries. The surplus of aspiring migrants and economic importance of remittances would suggest sending states have little bargaining power. Single case studies however suggest that some nevertheless intervene.

A comprehensive overview of the drivers of immigration and emigration policy will result in a set of hypotheses. A survey of policy makers in sending countries will generate an overview of interventions by sending country governments. The project's core is a systematic comparative case study of six sending countries with partly overlapping receiving countries and three of these receiving countries. The sending country cases are three sets of two countries in which migrant remittances constitute a similar share of GDP but involvement with the rights of their workers abroad differ; the Philippines, Senegal, India, Ecuador, Morocco and Vietnam. The receiving countries are South Korea, Saudi Arabia and Italy. These countries vary strongly in the rights for migrant workers and the level of cooperation with sending states. QCA and process tracing will be used to assess the hypotheses.

The project is innovative in 1) providing a systematic analysis of a larger number of cases including countries rarely covered in comparative studies on migrant rights, 2) examining of the actions of both sending and receiving countries, and 3) taking the trade-off between migrant numbers and rights into account. The project will push theory development forward by connecting theoretical fields and expanding geographic scope. It is policy-relevant by providing further insight into how the rights of migrant workers can be improved.

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

Keywords of the ERC project: migration policies; migrants; labour migration; diaspora; migration diplomacy; international relations

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:
771736	**GenTime**	**SH3** Environment, Space and Population

Principal Investigator:	**Dr MAN YEE KAN**
Host Institution:	THE CHANCELLOR, MASTERS AND SCHOLARS OF THE UNIVERSITY OF OXFORD - UK

Temporal structures of gender inequalities in Asian and Western welfare regimes

An important part of sociological understanding of how welfare regimes are shaped by culture and history derives from Esping-Andersen's 'three worlds' account. But these worlds, and later developments in this field, including the extension and application of the framework to gender roles, derive exclusively from Western models. What will emerge as we seek to develop a global perspective on other models of welfare regimes and how they handle gender inequalities? We will answer this question, using newly available data deriving from beyond the conventional Anglophone and European theatres: from China, Japan, South Korea and Taiwan to explore patterns emerging from other cultural and social traditions.

GenTime will be a study of gender inequality in patterns of time use across East Asian and Western societies. We will investigate the development trajectories and provision of unpaid work in different welfare regimes, and the systematic differences between men and women in the amount of time they spend on daily activities and their daily life schedules. It will examine time use as an important parameter of public policies. We will establish if East Asian regimes represent a distinct typology. The project will shed new light on the gender division of labour and social inequality across different regime types.

Furthermore, we will examine how the use of modern technology in care provision and domestic labour may shape the trends in gender inequality. We will investigate the impacts on gender differences in leisure time and enjoyment in daily activities. High quality cross-national and historical comparative time diary data and household panel data will be analysed to study gender inequality 1) at the household level on how couples divide their roles in work and family; 2) at the societal level on the role of welfare regimes in shaping the trends in domestic division of labour; and 3) from a life course perspective on the impacts of time use on later family outcomes.

Link to the ERC project webpage: https://www.gentime-project.org

Keywords of the ERC project: Gender, Time Use, East Asia, Welfare states, modern domestic technology

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:
671084	**INSOMNIA**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr EUS JW VAN SOMEREN**
Host Institution:	KONINKLIJKE NEDERLANDSE AKADEMIE VAN WETENSCHAPPEN - KNAW - NL

Insomnia's Negative Sequelae On Mood: from Neuroscience to Intervention in the Aged

Major depression is among the most burdening health hazards. Its prevalence is 1-3%, an additional 8-16% have clinically significant symptoms, and prognosis is poor. Unfortunately, less than 20% of the cases are detected and treatment effectiveness is moderate. The Global Consortium for Depression Prevention stresses that our best chance to combat the global burden of depression is provide preventive intervention to identified people at risk. This project targets the strongest modifiable risk factor: insomnia.

With prevalence estimates up to 40%, insomnia is among the most frequent disorders in the elderly population. Meta-analysis shows that no less than 13% of people with insomnia develop depression. This extreme risk and the very high prevalence of insomnia in the ageing population, shows the urgency and promise of: (1) early identification of these 13%, (2) finding mechanisms by quantification of how they differ from insomniacs that do not develop depression with respect to brain structure and function, psychological traits, behavioural habits and environmental exposures; and (3) enrolling them in intervention protocols aimed at sleep improvement and prevention of depression.

The project extends recent findings emerging from the applicant's pioneering, unconventional and innovative approach to insomnia; the proposal that distinct subtypes exist and can be discriminated data-driven by means of multivariate trait analysis and brain imaging. Ignorance of this heterogeneity has obstructed progress in mechanistic understanding and rational treatment. In an unprecedented interdisciplinary way the project (1) identifies the insomnia subtype that develops depression; (2) profiles mechanisms involved; and (3) optimizes effectiveness of internet-supported home-applicable interventions to improve sleep and prevent depression. This approach will identify risks and mechanisms, and facilitate immediate implementation of risk-based prevention strategies and policies.

Link to the ERC project webpage:

Keywords of the ERC project: insomnia, depression, MRI, EEG

Keywords that characterize the scientific profile of the potential visiting researcher/s: Advanced analyses of MRI and EEG data.

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
681296	**CLASS**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr BEN AMBRIDGE**
Host Institution:	THE UNIVERSITY OF LIVERPOOL - UK

Cross-Linguistic Acquisition of Sentence Structure: Integrating Experimental and Computational Approaches

How children acquire their native language remains one of the key unsolved problems in Cognitive Science. This project will answer a question that lies at the heart of this problem: How do children acquire the abstract generalizations that allow them to produce novel sentences, while avoiding the ungrammatical utterances that result from across-the-board application of these generalizations (e.g., *The clown laughed the man)? Previous single-process theories (the entrenchment, preemption and verb semantics hypotheses) fail to explain all of the current English data, and do not begin to address the issue of how learners of other languages solve this learnability problem. The aim of the present project is to solve this problem by developing and testing a new unified cross-linguistic account of the development of sentence structure. In addition to the overarching theoretical question set out above, the research will address four key questions: (1) What do learners bring to the task in terms of cognitive-semantic universals?; (2) How do children form linguistic generalizations in the first place?; (3) Why are languages the way they are; would other types of systems be difficult or impossible to learn?; (4) What is the nature of development?. These questions will be addressed by means of four Work Packages (WPs). WP1 uses grammaticality judgment and elicited production paradigms developed by the PI to investigate the acquisition of basic transitive and intransitive sentence structure (e.g., The man broke the window/The window broke) across six typologically different languages: English, K'iche' Mayan, Japanese, Hindi, Hebrew and Turkish (at ages 3-4, 5-6, 9-10 and 18+ years). WP2 uses the same paradigms to investigate idiosyncratic language-specific generalizations within three of these languages. WP3 uses Artificial Grammar Learning to focus on the issue of language evolution. WP4 uses computational modeling to investigate and simulate development.

Link to the ERC project webpage: https://osf.io/69ehu/

Keywords of the ERC project: Child language acquisition, psychology, linguistics, computational modelling

Keywords that characterize the scientific profile of the potential visiting researcher/s: Child language acquisition, psychology, linguistics, computational modelling, naive discrimination learner, Rescorla Wagner

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
682591	**STRESNET**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr ERNO HERMANS**
Host Institution:	STICHTING KATHOLIEKE UNIVERSITEIT - NL

Stress Resilience and Network-Feedback Training

Acute stress has a profound impact on cognitive functioning: it raises alertness for threat, yet it impairs our ability to think clearly. Repeated exposure to stressors is furthermore a critical transdiagnostic factor in etiology, relapse, and chronification in almost all psychiatric disorders. We know from animal work at the cellular level how stressors trigger a neurochemical cascade that alters properties of widespread neuronal populations. A critical gap in our knowledge, however, is how such cellular effects translate to the level of large-scale neural systems which implement higher-order cognition. Here, I propose a novel framework for understanding such alterations as shifts in network balance: I hypothesize that acute stress causes dynamic shifts in resource allocation at the level of large-scale networks. First, I will leverage recent advances in network connectivity modeling to characterize the spatiotemporal dynamics of such shifts during acute stress and recovery. Using wearable biosensors and mobile applications, I aim to identify which neural markers predict resilience to stress in real life. Second, I will cross-validate these markers in a patient group characterized by high stress sensitivity. Third, to investigate how rapid network shifts are generated, I will examine the distinct roles of noradrenergic and dopaminergic neuromodulatory systems. Fourth, I will test the hypothesis that cognitive functions supported by one network can be disrupted by shifting balance towards another. Finally, I will develop a network-based implementation of functional MRI neurofeedback to train stress-sensitive participants to adaptively reallocate neural resources during acute stress. When successful, this project will yield 1) unprecedented insight into how our brain adapts to acute stress; 2) novel ecologically validated transdiagnostic biomarkers of stress resilience versus sensitivity; and 3) a potentially groundbreaking method for training stress resilience.

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

Keywords of the ERC project: cognitive neuroscience, stress, neuroimaging, stress-related disorders, neuropharmacology, neurofeedback

Keywords that characterize the scientific profile of the potential visiting researcher/s: postdoctoral fellow, cognitive neuroscience

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
693124	**ONOFF**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr KENNETH HUGDAHL**
Host Institution:	UNIVERSITETET I BERGEN - NO

Perception of voices that do not exist: Tracking the temporal signatures of auditory hallucinations

One of the most perplexing phenomena of the human mind is the conviction of perceiving a "voice" in the absence of an external auditory source. This is called an auditory hallucination (AH), and is the most characteristic symptom of the most severe mental disorder, schizophrenia. Understanding the phenomenology, cognitive, and neurobiological underpinnings of AHs will not only provide new insights for explaining schizophrenia, but will also provide new insights into the "complexities of the mind". In my previous research, I have uncovered the neurocognitive markers of the initiation of an AH, focusing on what causes the onset of a hallucinatory episode. The current proposal further narrows the focus, asking a single question; why do AHs spontaneously come-and-go over time, or stated otherwise, why are they not permanently present once initiated? If we believe that the onset of an episode has neurocognitive markers, which all evidence supports, then we must also acknowledge that the offset must have corresponding markers. This question has to my knowledge never been addressed, although it is vital for the understanding of the underlying mechanisms, and for new treatment strategies. I will track the fluctuations of AH episodes in real-time with iPhone app technology, going beyond interview questionnaires. I will track how cognition modulates the onset and offset with an experimental dichotic listening paradigm, going beyond standard tests. I will track what happens in the brain the few seconds before the onset and, in particular the offset of an episode, using component-based fMRI analysis, going beyond "blobology". I will track with MR spectroscopy the interaction of excitatory and inhibitory transmitters that are hypothesized to mediate episode onsets and offsets, respectively, going beyond systems imaging. Thus, I will track AH episodes from the clinical to the receptor level, working vertically through a “levels of explanation” model, from higher to lower levels

Link to the ERC project webpage:

Keywords of the ERC project: auditory hallucinations, schizophrenia, fMRI, brain imaging

Keywords that characterize the scientific profile of the potential visiting researcher/s: psychology or medicine degree, computer skills, experience in cognitive neuroscience

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
714977	**PEP**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr DISA SAUTER**
Host Institution:	UNIVERSITEIT VAN AMSTERDAM - NL

An Empirical Foundation for Understanding Positive Emotions

Positive emotions are of great importance for our physical and mental health and for our social relationships. However, scientific knowledge of positive emotions is lacking, with research to date being both fractionated and scarce. The Positive Emotions Project (PEP) takes on the challenge of formulating a foundational, empirically-based framework of positive emotions. This is accomplished by a set of studies combining methodologies that examine both subjective and objective elements of 17 positive emotions, including gratitude, awe, amusement, compassion, and relief. Central to the investigation is the integration of cross-cultural and developmental approaches, in order to differentiate between consistent patterns and idiosyncratic features. Project 1 will use experience sampling to map out the experience of positive emotions across ten dramatically different cultures, examining subjective elements of emotions, such as antecedent events and psychological states. Project 2 will comprehensively establish which nonverbal facial and vocal signals are associated with different positive emotions across cultures and ages. Project 3 will provide an integrated multi-level account of positive emotions, considering similarities and differences across emotions, taking into account cross-cultural and developmental patterning of subjective and objective features. The empirical and theoretical results of PEP will result in new, innovative paradigms, and substantial, freely available datasets that will help to redress the current dearth of data and approaches for understanding positive emotions. It will also provide the basis for a much-needed scientific, multifaceted account of positive emotion. Such a model will benefit scientists across many disciplines, including affective computing, behavioural economics, and psychiatry, whose work builds on psychological models of emotions.

Link to the ERC project webpage:

Keywords of the ERC project: positive emotions

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:
716321	**FREEMIND**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr JIAXIANG ZHANG**
Host Institution:	CARDIFF UNIVERSITY - UK

FREE the MIND: the neurocognitive determinants of intentional decision

Acting based on intention is a fundamental ability to our lives. Apple or orange, cash or card: we constantly make intentional decisions to fulfil our desires, even when the options have no explicit difference in their rewards. Recently, I and others have offered the first evidence to support that intentional decision and externally guided decision share similar computational principles. However, how the brain implements these principles for intentional decision remains unknown.

This project aims to establish a multilevel understanding of intentional decision, spanning from neurons to brain networks to behaviour, through a powerful combination of novel paradigms, cutting-edge brain imaging, and innovative methods. Central to my approach is formal computational modelling, allowing me to establish a quantitative link between data and theory at multiple levels of abstraction. Subproject 1 will ask which brain regions encode intentional information, when intentional processes occur, and how neurochemical concentration influences intentional decision. Subproject 2 will focus on theoretically predicted changes in intentional decision under behavioural and neural interventions. I will use brain imaging and brain stimulation to test the flexibility of intentional decision within individuals. Subproject 3 will launch the largest study to date on intentional decision. I will characterize individual differences in intentional decision from 2,000 representative samples. I will then investigate, with high statistical power, the contributions of neurochemistry and brain microstructure to individual differences in intentional decision. This project premises to establish the first neurobiological theory of intentional behaviour, and provide mechanistic understanding of its changes within and between individuals. The new theory and innovative methodology will open further research possibilities to explore intentional deficits in diseases, and the neural basis of human volition.

Link to the ERC project webpage:

Keywords of the ERC project: Cognitive Neuroscience

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:
725970	**NATVIS**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr MARIUS VINCENT PEELEN**
Host Institution:	STICHTING KATHOLIEKE UNIVERSITEIT - NL

Characterizing neural mechanisms underlying the efficiency of naturalistic human vision

Our daily-life visual environments, such as city streets and living rooms, contain a multitude of objects. Out of this overwhelming amount of sensory information, our brains must efficiently select those objects that are relevant for current goals, such as cars when crossing a street. The visual system has developed and evolved to optimally perform tasks like these, as reflected in the remarkable efficiency of naturalistic object detection. Little is known about the neural mechanisms underlying this efficiency. NATVIS aims to fill this gap, presenting a comprehensive multi-method and hypothesis-driven approach to improve our understanding of the neural mechanisms underlying the efficient detection of objects in natural scenes. fMRI, MEG, and TMS will be used to study the neural basis of rapid attentional guidance based on scene context and episodic memory, resulting in a full characterization of when, where, and how context- and memory-based expectations interact with attentional templates in visual cortex and beyond. The powerful effects of scene context on object recognition will be studied by testing how context-disambiguated objects are represented in visual cortex, characterizing when context-based predictions bias object processing, and testing for causal interactions between scene- and object-selective pathways in visual cortex. NATVIS will study how the brain uses real-world regularities to support object grouping and reduce clutter in scenes, modelling the cortical representation and neural dynamics of multiple simultaneously presented objects as a function of positional regularity. Finally, advanced multivariate modelling of fMRI data will test the functional relevance and representational content of internally generated templates that are hypothesized to facilitate object detection in scenes. This program of research tackles the next frontier in the neuroscience of high-level vision and attention, embracing the complexity of naturalistic vision.

Link to the ERC project webpage:

Keywords of the ERC project: visual perception, attention, neuroimaging, fMRI

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:
726251	**STYDS**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr BENCE NANAY**
Host Institution:	UNIVERSITEIT ANTWERPEN - BE

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: http://uahost.uantwerpen.be/bence.nanay/ERC.htm

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:
741134	**M and M**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr JEFFREY BOWERS**
Host Institution:	UNIVERSITY OF BRISTOL - UK

Generalization in Mind and Machine

Is the human mind a symbolic computational device? This issue was at the core Chomsky's critique of Skinner in the 1960s, and motivated the debates regarding Parallel Distributed Processing models developed in the 1980s. The recent successes of "deep" networks make this issue topical for psychology and neuroscience, and it raises the question of whether symbols are needed for artificial intelligence more generally.

One of the innovations of the current project is to identify simple empirical phenomena that will serve a critical test-bed for both symbolic and non-symbolic neural networks. In order to make substantial progress on this issue a series of empirical and computational investigations are organised as follows. First, studies focus on tasks that, according to proponents of symbolic systems, require symbols for the sake of generalisation. Accordingly, if non-symbolic networks succeed, it would undermine one of the main motivations for symbolic systems. Second, studies focus on generalisation in tasks in which human performance is well characterised. Accordingly, the research will provide important constraints for theories of cognition across a range of domains, including vision, memory, and reasoning. Third, studies develop new learning algorithms designed to make symbolic systems biologically plausible. One of the reasons why symbolic networks are often dismissed is the claim that they are not as biologically plausible as non-symbolic models. This last ambition is the most high-risk but also potentially the most important: Introducing new computational principles may fundamentally advance our understanding of how the brain learns and computes, and furthermore, these principles may increase the computational powers of networks in ways that are important for engineering and artificial intelligence.

Link to the ERC project webpage: https://mindandmachine.blogs.bristol.ac.uk

Keywords of the ERC project: neural networks; machine learning; vision; connectionism; symbolic computation

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:
758605	**EVOTONE**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr JAMES KIRBY**
Host Institution:	THE UNIVERSITY OF EDINBURGH - UK

The emergence and evolution of linguistic tone

This project will investigate the origins, acquisition, and evolution of linguistic tone: the use of pitch to distinguish between the meaning of words. Despite the typological ubiquity of tone, there is still no phonetic, structural, or psychological model that explains how and why tones emerge (or fail to emerge) in language after language, nor how they evolve once they are formed. This is because there has never been a systematic analysis of the principles that govern the evolution of tone systems. EVOTONE will provide the first comprehensive study of tonal emergence and evolution, combining detailed phonetic and perceptual studies of Himalayan and Southeast Asian minority languages with innovative experimental methodologies and large-scale computational analysis of the structural principles correlated with the emergence of tone.

EVOTONE is guided by a novel hypothesis that, if correct, will have important repercussions for the study of sound change. The core idea is deceptively simple: rather than being the result of small, incremental changes in pronunciation, features like tone come about due to a sudden failure to articulate a particular aspect of a sound. If the risk of focusing on tone is to overemphasize a single feature, the potential reward is enormous: an opportunity to transform our understanding of how physical and cognitive pressures interact to shape human behavior and language change. The outcomes of this project will provide a new empirical foundation for the typology and evolution of tone systems; break new ground in the study of how structural and phonetic factors interact in sound change; and establish, for the first time, an empirically grounded set of principles of tonal evolution. In addition to resolving a number of outstanding questions about tonogenesis, the results will substantially advance our more general understanding of how language changes over time.

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:
769595	**Ctrl-ImpAct**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr FREDERICK VERBRUGGEN**
Host Institution:	UNIVERSITEIT GENT - BE

Control of impulsive action

Adaptive behaviour is typically attributed to an executive-control system that allows people to regulate impulsive actions and to fulfil long-term goals instead. Failures to regulate impulsive actions have been associated with a variety of clinical and behavioural disorders. Therefore, establishing a good understanding of impulse-control mechanisms and how to improve them could be hugely beneficial for both individuals and society at large. Yet many fundamental questions remain unanswered. This stems from a narrow focus on reactive inhibitory control and well-practiced actions. To make significant progress, we need to develop new models that integrate different aspects of impulsive action and executive control. The proposed research program aims to answer five fundamental questions. (1) Can novel impulsive actions arise during task-preparation stages?; (2) What is the role of negative emotions in the origin and control of impulsive actions?; (3) How does learning modulate impulsive behaviour?; (4) When are impulsive actions (dys)functional?; and (5) How is variation in state impulsivity associated with trait impulsivity?

To answer these questions, we will use carefully designed behavioural paradigms, cognitive neuroscience techniques (TMS & EEG), physiological measures (e.g. facial EMG), and mathematical modelling of decision-making to specify the origin and control of impulsive actions. Our ultimate goal is to transform the impulsive action field by replacing the currently dominant 'inhibitory control' models of impulsive action with detailed multifaceted models that can explain impulsivity and control across time and space. Developing a new behavioural model of impulsive action will also contribute to a better understanding of the causes of individual differences in impulsivity and the many disorders associated with impulse-control deficits.

Link to the ERC project webpage: https://fredvbrug.github.io

Keywords of the ERC project: impulse control, emotion, metacognition, inhibition

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:
639445	**NewEat**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr JENS BLECHERT**
Host Institution:	PARIS-LODRON-UNIVERSITAT SALZBURG - AT

Transdiagnostic views on eating disorders and obesity and new approaches for treatment

Eating disorders such as Anorexia Nervosa (AN), Bulimia Nervosa (BN), Binge Eating Disorder (BED) and overweight/obesity are highly prevalent in the EU and worldwide. They cause tremendous suffering, elevate suicide rates, and account for multiple organic effects that increase all-cause mortality. Etiological and maintenance factors are not well understood and transdiagnostic theoretical models across eating and weight disorders are largely missing. The present project aims to develop an integrated theoretical framework by studying psychological factors that contribute to non-homeostatic eating across the full spectrum of eating-related disorders. It is proposed that high levels on psychological traits such as restraint eating (i.e., chronic dieting behaviour), emotional eating (i.e., eating in response to negative emotional events rather than hunger), craving/food addiction (i.e., intense and chronic urge to consume palatable foods), impulsivity (i.e., inadequate food consumption planning and low self-control), and low self-esteem influence neural systems that balance appetitive (mostly bottom-up) with regulatory (mostly top-down) processes. This model is tested in the four patient groups and healthy controls utilizing an integrated set of assessment methods, involving psychometric testing, smartphone based ambulatory assessment, and neurocognitive laboratory measurement. Derived from this model, novel behavioural interventions such as smartphone-based stimulus control and training of cognitive inhibitory control will be developed.
Results will have implications for theoretical models of eating and weight disorders. They will also inform neuroaffective models of appetite regulation and novel treatment designs. Technology assisted treatments might complement current interventions and help alleviate the burden for patients with eating-related mental and physical 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:
648176	**WipeOutFear**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr TOM BECKERS**
Host Institution:	KATHOLIEKE UNIVERSITEIT LEUVEN - BE

How the Brain Learns to Forget - The Neural Signature of Fear Memory Erasure

Can fear memories be erased from the brain? While it sounds like science fiction, recent findings suggest that fear memories can be undone upon their retrieval, through either pharmacological or behavioural interventions. Still, whether such reconsolidation interference techniques genuinely result in permanent erasure of the original fear memory is a topic of considerable controversy.

Purely behavioural work may never settle the debate, as it cannot be excluded that an apparent loss of fear memory reflects a long-lasting failure to retrieve the fear memory rather than its permanent erasure. We argue that a careful look at the brain memory circuits that control the reduced expression of fear after reconsolidation interference, through imaging studies in humans and inactivation studies in rats, does have the potential to resolve the controversy and decide between erasure and retrieval failure as mechanisms underlying reconsolidation interference [WP1].

To open up a memory trace for reconsolidation interference, it is important that retrieval of the memory is accompanied by surprise or prediction error (PE; a discrepancy between the memory and what actually happens), as we demonstrated in a break-through study in Science (Sevenster, Beckers, & Kindt, 2013). Here, we propose that subtle differences in the degree of PE generated during fear memory retrieval may be what demarcates memory erasure from impaired retrieval. To investigate that claim, we will pioneer an objective neural marker of PE in humans [WP2] and use optogenetics to directly trigger dopamine-based PE signals in the rat brain in order to establish the causal role of PE in enabling fear memory erasure. Along the way, we will investigate the generalization of fear to novel cues as both a problem and a potential target for fear memory modification [WP3] and test an innovative method to interfere with reconsolidation that circumvents limitations of current pharmacological and behavioural techniques [WP4].

Link to the ERC project webpage: ppw.kuleuven.be/wipeoutfear

Keywords of the ERC project: fear learning; amnesia; reconsolidation

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:
677758	**CREWS**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr PHILIPPA STEELE**
Host Institution:	THE CHANCELLOR MASTERS AND SCHOLARS OF THE UNIVERSITY OF CAMBRIDGE - UK

Contexts of and Relations between Early Writing Systems

Contexts of and Relations between Early Writing Systems
This project takes an innovative and interdisciplinary approach to the history of writing, redressing lingering problems that have hampered previous research and developing new methodologies for studying scripts and their social context. The staff on the project will work on specific case studies relating to inscriptions of the ancient Aegean, Eastern Mediterranean and Levant (c.2000-600 BC), developing a new and much deeper understanding of writing, literacy and social and cultural interrelations in the area than has ever been possible via the often out-dated traditional methods usually applied to these data. The focus will be on enriching our understanding of both linguistic and social aspects of the borrowing and propagation of writing. This planned research has the potential to change the way we think about writing systems, their societal context and the ways in which ideas were exchanged in early civilisations. Published and publicised through multiple outputs and media, the results will be of importance not only to the specific chronological period and geographical area under close consideration but also to the diachronic study of relationships between population groups and the significance of such relationships for the wider field of cultural history.

Link to the ERC project webpage: https://crewsproject.wordpress.com/

Keywords of the ERC project: writing,languages,Classics,Ancient Near East, Mediterranean,scribes,inscriptions,epigraphy,linguistics,archaeology,social change

Keywords that characterize the scientific profile of the potential visiting researcher/s: epigraphy,archaeology,writing

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
682779	**ETI**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr JARI KAUKUA**
Host Institution:	JYVASKYLAN YLIOPISTO - FI

Epistemic Transitions in Islamic Philosophy, Theology and Science: From the 12th to the 19th Century

Not very long ago, it was still common to hold that little of interest took place in Islamic philosophy, theology and science after the death of the Peripatetic commentator Averroes in 1198. Recent research has produced increasing evidence against this view, and experts now commonly agree that texts from the so-called post-classical period merit serious analysis. That evidence, however, is still fragmentary, and we lack a clear understanding of the large scale and long run development in the various fields of Islamic intellectual culture after the twelfth century.

This project will investigate debates concerning the nature and methods of knowledge in four of the most ambitious strands of Islamic theoretical thought, that is, philosophy, theology, natural science, and philosophically inclined Sufism. Its temporal scope extends from the end of the twelfth century to the beginning of the colonial era, and it focuses on foundational epistemological questions (how knowledge is defined, what criteria are used to distinguish it from less secure epistemic attitudes, what methods are identified as valid in the acquisition of knowledge) as well as questions concerning knowledge as the goal of our existence (in particular, whether perceptual experience is inherently valuable).

Our study of the four strands is based on the hypothesis that the post-classical period is witness to a sophisticated discussion of knowledge, in which epistemic realism, intuitionism, phenomenalism, and subjectivism are pitted against each other in a nuanced manner. Hence, the project will result in a well-founded reassessment of the common view according to which post-classical Islamic intellectual culture is authoritarian and stuck to an epistemic paradigm that stifles insight and creativity. Thereby it will provide new ingredients for projects of endogenous reform and reorientation in Islam, and corroborate the view that our future histories of philosophy should incorporate the Islamic tradition.

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

Keywords of the ERC project: Islamic philosophy, Islamic theology, history of philosophy, history of science

Keywords that characterize the scientific profile of the potential visiting researcher/s: Islamic philosophy, Islamic theology, medieval philosophy, history of science

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
714166	**NARMESH**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr MARCO CARACCIOLO**
Host Institution:	UNIVERSITEIT GENT - BE

Narrating the Mesh: Ecology and the Non-Human in Contemporary Fiction and Oral Storytelling

Today's ecological crisis prompts us to rethink our attitude towards physical and natural realities that have traditionally been seen as opposed to human subjectivity and agency. What emerges from this "non-human turn" is a sense of our interdependence on things like the bacteria in our intestines or the carbon atoms supporting life on Earth. Ecological theorist Timothy Morton uses the metaphor of the "mesh" to express this idea of human/non-human interconnectedness. This project will map the formal and thematic strategies through which contemporary narrative practices engage with the non-human and envisage this interconnectedness.

Storytelling is an indispensable tool for making sense of experience by establishing temporal and causal relations. But it is also biased towards the human-scale realities of action and social interaction. How can narrative overcome this bias? How does it convey phenomena that challenge our belief in the ontological and material self-sufficiency of the human?

Comparing fictional narratives in print (novels and short stories) and conversational storytelling, we will systematically explore the ways in which narrative can forge connections across levels of reality, weaving together the human and the non-human into a single plot. The assumption is that narrative is a field where fictional practices are in constant dialogue with the stories told in everyday conversation—and with the culture-wide beliefs and concerns those stories reflect.

Through its three sub-projects, the proposed research charts this complex dialogue while greatly advancing our understanding of how stories can be used to heighten people's awareness of the mesh and its significance. The project builds on a combination of methods (close readings of novels, qualitative analysis of interviews), aiming to open up a new field of study at the intersection of literary scholarship and the social sciences—with narrative theory serving as a catalyst for the interdisciplinary exchange.

Link to the ERC project webpage: http://www.narmesh.ugent.be/

Keywords of the ERC project: Ecocriticism, human-nonhuman, narrative theory, psychological effects of literary reading, qualitative research

Keywords that characterize the scientific profile of the potential visiting researcher/s: Ecocriticism, literary studies, narrative theory, social psychology, anthropology

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
714874	**DiGe**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr RENATA SÕUKAND**
Host Institution:	UNIVERSITA CA' FOSCARI VENEZIA - IT

Ethnobotany of divided generations in the context of centralization

Understanding the logics of obtaining, managing and perceiving of local natural resources, particularly plants, is crucial for ensuring sustainability of human life, as the use of plants is a key for survival of humans. The proposed research will create an advanced understanding of the mechanisms of changes in ethnobotanical knowledge experienced by traditional societies/minor ethnic groups when authoritative regime, led by dominating group, try to unify and/or erode this practical knowledge. It will also evaluate the effects of the sudden cease to existence of such regime and centralization and following impact of the trial of revival of discontinued traditional etnobotanical knowledge. Research will evaluate the effect of several social, cultural and political factors on the evolution of ethnobotanical knowledge of four compact, but divided ethnic minorities that had experienced for shorter (25 years) or longer (70 years) period different influences affecting their plant use and very different social (including welfare and economy), and political conditions. As a long-term outcome, based on the result of present and consequent studies scientists will be able to predict the extent and depth of the changes occurring in the ethnobotanical knowledge and as a applied outcome learn to direct and educate people in the way that the knowledge necessary for sustainable maintenance and utilization of local plant resources will be constantly evolving in the way supporting health and well-being of different populations.

Link to the ERC project webpage: https://www.unive.it/dige

Keywords of the ERC project: Cultural studies, cultural identities and memories, cultural heritage, ethnobotany, cross-cultural, cross-border, adaptation, change

Keywords that characterize the scientific profile of the potential visiting researcher/s: Cultural studies, cultural identities and memories, cultural heritage, ethnobotany, cross-cultural, cross-border, adaptation, change, effect of centralization, interrupted tradition

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
716181	**HOM**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr NIDESH LAWTOO**
Host Institution:	KATHOLIEKE UNIVERSITEIT LEUVEN - BE

Homo Mimeticus: Theory and Criticism

Mimesis is one of the most influential concepts in Western thought. Originally invoked to define humans as the "most imitative" creatures in classical antiquity, mimesis (imitation) has recently been at the centre of theoretical debates in the humanities, social sciences, and the neurosciences concerning the role of "mimicry," "identification," "contagion," and "mirror neurons" in the formation of subjectivity. And yet, despite the growing confirmations that imitation is constitutive of human behaviour, mimesis still tends to be confined to the sphere of realistic representation. The HOM project combines approaches that are usually split in different areas of disciplinary specialization to provide a correction to this tendency.
Conceived as a trilogy situated at the crossroads between literary criticism, cinema studies, and critical theory, HOM's outcomes will result in two monographs and accompanying articles that explore the aesthetic, affective, and conceptual implications of the mimetic faculty. The first, radically reframes a major proponent of anti-mimetic aesthetics in modern literature, Oscar Wilde, by looking back to the classical foundations of theatrical mimesis that inform his corpus; the second considers the material effects of virtual simulation by looking ahead to new digital media via contemporary science-fiction films; and the third establishes an interdisciplinary dialogue between philosophical accounts of mimesis and recent discoveries in the neurosciences. Together, these new perspectives on homo mimeticus reconsider the aesthetic foundations of a major literary author, open up a new line of inquiry in film studies, and steer philosophical debates on mimesis in new interdisciplinary directions.

Link to the ERC project webpage: http://www.homomimeticus.eu

Keywords of the ERC project: mimesis, interdisciplinary humanities, subjectivity, affective contagion

Keywords that characterize the scientific profile of the potential visiting researcher/s: Interdisciplinary humanities, literary theory and criticism, contemporary continental philosophy, film studies, digital studies

European Research Council
Executive Agency

Established by the European Commission

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 - UK

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: www.arcticcultures.org

Keywords of the ERC project: Arctic, Cultural History, Anthropology, Human Geography, Indigenous Peoples, Museum Studies

Keywords that characterize the scientific profile of the potential visiting researcher/s: Arctic, Cultural History, Anthropology, Human Geography, Indigenous Peoples, Museum Studies

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
771383	**Global Horizons**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr BEATE FRICKE**
Host Institution:	UNIVERSITAET BERN - CH

Global Horizons in Pre-Modern Art

The horizon is the line that seems to separate earth from sky, the line that divides all visible categories into two categories: those that intersect the earth's surface and those that do not. The horizon is key to the experience of space; it defines our perspective on the visible world. The GLOBAL HORIZONS project will investigate the historical meanings and functions of the horizon in visual and intellectual cultures of the pre-Modern world on a global scale. Examining how pre-Modern cultures conceived of the horizon opens a crucial line of inquiry into understanding the many different ways in which humans have conceived of the relationship between an invisible cosmos and the visible world.

Non-western art history is rarely taught at European institutions although countless important works of Non-Western art are kept in museum collections all across Europe. Including non-western concepts of pictorial space is key to the project, however, for Eurocentric models of art history have generally privileged the rise of the linear perspective. This framing has limited our understanding of the horizon's complex rhetorical, visual and epistemological roles.

The project's specific question connects a variety of objects and epistemological categories, such as panel painting, manuscript illumination, profane und religious objects, cartography, travel accounts, and cosmological treaties. The applied methodological approaches will range from art history, visual studies and cultural anthropology. They will also draw upon interdisciplinary expertise, such as technologies of art production, history of science and philosophy. The project thus makes an important contribution to global art history, a highly innovative area in which only very few pre-modern topics have been addressed. It is the ultimate goal of GLOBAL HORIZONS is to suggest a new history of representation in Western medieval art.

Link to the ERC project webpage: http://www.ikg.unibe.ch/forschung/forschungsprojekte/global_horizons_in_pre_modern_art/index_ger.html

Keywords of the ERC project: Representation, Horizons, Pictorial Space, Global Art History, Pre-Modern Art

Keywords that characterize the scientific profile of the potential visiting researcher/s: Interest in modes of representation in pre-modern Art, image theory, pictorial space

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
786314	**CRAACE**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr MATTHEW RAMPLEY**
Host Institution:	THE UNIVERSITY OF BIRMINGHAM - UK

Continuity and Rupture in Central European Art and Architecture, 1918-1939

When new political elites and social structures emerge out of a historical rupture, how are art and architecture affected? In 1918 the political map of central Europe was redrawn as a result of the collapse of Austria-Hungary, marking a new era for the region. Through comparative analysis of the visual arts in 3 states built on the ruins of the Habsburg Empire (Austria, Hungary and [former] Czechoslovakia), this project examines how such political discontinuity affected art and architecture between 1918 and 1939. The project is organised into 4 themes, each resulting in a monograph:

1. Vernacular modernisms, nostalgia and the avant-garde
2. Presenting the state: world fairs and exhibitionary cultures
3. Piety, reaction and renewal
4. Contested histories: monuments, memory and representations of the historical past

It is the first systematic and comprehensive trans-national study of this type, based on the claim that the successor states to Austria-Hungary belonged to a common cultural space informed by the shared memory of the long years of Habsburg society and culture. The project focuses on the contradictory ways that visual arts of artists and architects in central Europe adapted to and tried to shape new socio-political circumstances in the light of the past. The project thus examines the long shadow of the Habsburg Empire over the art and culture of the twentieth century.

The project also considers the impact of the political and ideological imperatives of the three successor states on the visual arts; how did governments treat the past? Did they encourage a sense of historical caesura or look to the past for legitimation? How did artists and architects respond to such new impulses? In answering these questions the project analyses the conflicts between avant-gardes and more conservative artistic movements; the role of the visual arts in interwar memory politics; the place of art in the nexus of religion, national and state identity.

Link to the ERC project webpage: craace.com

Keywords of the ERC project: Austria; Hungary, Czechoslovakia; Modernism; Cultural Memory; Habsburg Empire; Visual Arts;

Keywords that characterize the scientific profile of the potential visiting researcher/s: Art History; Central Europe; Modernism;

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
724557	**ALTERUMMA**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr OLIVER SCHARBRODT**
Host Institution:	THE UNIVERSITY OF BIRMINGHAM - UK

Creating an Alternative umma: Clerical Authority and Religio-political Mobilisation in Transnational Shii Islam

This interdisciplinary project investigates the transformation of Shii Islam in the Middle East and Europe since the 1950s. The project examines the formation of modern Shii communal identities and the role Shii clerical authorities and their transnational networks have played in their religio-political mobilisation. The volatile situation post-Arab Spring, the rise of militant movements such as ISIS and the sectarianisation of geopolitical conflicts in the Middle East have intensified efforts to forge distinct Shii communal identities and to conceive Shii Muslims as part of an alternative umma (Islamic community). The project focusses on Iran, Iraq and significant but unexplored diasporic links to Syria, Kuwait and Britain. In response to the rise of modern nation-states in the Middle East, Shii clerical authorities resorted to a wide range of activities: (a) articulating intellectual responses to the ideologies underpinning modern Middle Eastern nation-states, (b) forming political parties and other platforms of socio-political activism and (c) using various forms of cultural production by systematising and promoting Shii ritual practices and utilising visual art, poetry and new media.
The project yields a perspectival shift on the factors that led to Shii communal mobilisation by
- analysing unacknowledged intellectual responses of Shii clerical authorities to the secular or sectarian ideologies of post-colonial nation-states and to the current sectarianisation of geopolitics in the Middle East
- emphasising the central role of diasporic networks in the Middle East and Europe in mobilising Shii communities and in influencing discourses and agendas of clerical authorities based in Iraq and Iran
- exploring new modes of cultural production in the form of a modern Shii aesthetics articulated in ritual practices, visual art, poetry and new media and thus creating a more holistic narrative on Shii religio-political mobilisation.

Link to the ERC project webpage:

Keywords of the ERC project: Shiism, transnationalism, clerical authority, diaspora, Iran, Iraq

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:
758502	**COMICS**	**SH5** Cultures and Cultural Production

Principal Investigator:	**Dr MAAHEEN AHMED**
Host Institution:	UNIVERSITEIT GENT - BE

Children in Comics: An Intercultural History from 1865 to Today

Owing to their visual essence and status as a popular, modern medium, comics – newspaper strips, comics magazines and graphic novels – provide valuable insight into the transformation of collective consciousness. This project advances the hypothesis that children in comics are distinctive embodiments of the complex experience of modernity, channeling and tempering modern anxieties and incarnating the freedom denied to adults. In testing this hypothesis, the project constructs the first intercultural history of children in European comics, tracing the changing conceptualizations of child protagonists in popular comics for both children and adults from the mid-19th century to the present. In doing so, it takes key points in European history as well as the history of comics into account.

Assembling a team of six multilingual researchers, the project uses an interdisciplinary methodology combining comics studies and childhood studies while also incorporating specific insights from cultural studies (history of family life, history of public life, history of the body, affect theory and scholarship on the carnivalesque). This enables the project to analyze the transposition of modern anxieties, conceptualizations of childishness, child-adult power relations, notions of liberty, visualizations of the body, family life, school and public life as well as the presence of affects such as nostalgia and happiness in comics starring children.

The project thus opens up a new field of research lying at the intersection of comics studies and childhood studies and illustrates its potential. In studying popular but often overlooked comics, the project provides crucial historical and analytical material that will shape future comics criticism and the fields associated with childhood studies. Furthermore, the project's outreach activities will increase collective knowledge about comic strips, which form an important, increasingly visible part of cultural heritage.

Link to the ERC project webpage: -

Keywords of the ERC project: comics, graphic novels, childhood studies, children's literature, modernity, body, affect

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:
617777	**UP-North**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr RHIANNON STEVENS**
Host Institution:	UNIVERSITY COLLEGE LONDON - UK

COLONISATION AND CULTURAL DIVERSIFICATION IN UNFAMILIAR LANDSCAPES

This project explores the relationship between climate change and human behaviour. During the harshest conditions of the last ice age European human populations abandoned northern latitudes, with their range contracting to southern regions. By the time ice sheets retreated and large areas of land became available for resettlement there had been a hiatus of at least 7000 years. This project examines the recolonisation of these Northern regions which took place during a period of rapid climate change, the last major global warming event on earth. As people move eastwards and northwards increasing diversification is seen in their stone and bone tool industries which indicate human development. This project examines whether climate a) drove the human dispersal and development, b) played a more indirect role, or c) was of little significance to humans at this time. State-of-the-art scientific techniques (radiocarbon dating, DNA, stable isotope, clumped isotope and charcoal ring width analyses) will be used to create integrated chronological, palaeoclimatic and palaeoecological frameworks that are directly linked to the Late and Final Palaeolithic archaeological record. Temporal and spatial trends in climate change, prey abundance and behaviour, and technological development will be compared and considered in light of regional and global climate trends and archaeological evidence for hunting strategies, human mobility and landscape use. Such data will provide an insight into the conditions Palaeolithic people experienced and how this influenced their perceptions of the landscape they inhabited and the decisions they made.

Link to the ERC project webpage:

Keywords of the ERC project: stable isotopes, radiocarbon dating, ancient DNA, palaeolithic

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:
648115	**DISABILITY**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr MONIKA BAAR**
Host Institution:	UNIVERSITEIT LEIDEN - NL

Rethinking Disability: the Global Impact of the International Year of Disabled Persons (1981) in Historical Perspective

Approximately 10% of the world's population is estimated to be disabled and this number is expected to rise in the next few decades. People in different cultural settings ascribe different meanings to disability; consequently, its repercussions are both culturally contingent and universal. This project brings together the local and global dimensions of disability and examines the interaction, tension and conflict between these two aspects by undertaking the first comprehensive study of the far-reaching political, societal and cultural implications of the International Year of Disabled Persons (IYDP) which was organized under the auspices of the United Nations in 1981. A landmark event which appears to have gone done virtually unrecognized in scholarship; the IYDP was the first occasion to place disability into a global context by endorsing it authoritatively as a human rights issue and thereby raising the question as to how the concept may be understood in a multicultural world. There will be four closely-related objectives: 1. to examine the IYDP's impact on human rights discourses and to scrutinize their applicability within global settings; 2. to document the IYDP's contribution to emancipation and social change and to consider the different trajectories of emancipation in various parts of the world; 3. to assess the ways in which the IYDP influenced everyday life experiences, galvanized identity formation and inspired the emergence of a distinct subculture; 4. to analyze the transnational exchanges and knowledge transfer in conjunction with the IYDP and to examine how the Western oriented discourses penetrating the developing world interacted with the local environment. The project's innovative contribution and academic impact lies in connecting the IYDP to broader political, social and cultural processes in the last quarter of the twentieth century and thereby bringing disability in a global context to the attention of mainstream historical scholarship.

Link to the ERC project webpage: http://rethinkingdisability.net/

Keywords of the ERC project: disability, human rights, welfare state, international organizations, neoliberalism, social movements, global 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:
695573	**COLOUR**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr CRISTIANA BASTOS**
Host Institution:	INSTITUTO DE CIENCIAS SOCIAIS - PT

THE COLOUR OF LABOUR: THE RACIALIZED LIVES OF MIGRANTS

This project is about the racialization of migrant labourers across political boundaries, with a main focus on impoverished Europeans who served in huge numbers as indentured labourers in nineteenth-century Guianese, Caribbean and Hawaiian sugar plantations and in the workforce of late nineteenth and early twentieth century New England cotton mills.

With this project I aim to provide major, innovative contributions on three fronts:

(i) theory-making, by working the concepts of race, racism, racialization, embodiment and memory in association with migrant work across political boundaries and imperial classifications;

(ii) social relevance of basic research, by linking an issue of pressing urgency in contemporary Europe to substantive, broad-scope, and multi-sited anthropological/historical research on the wider structures of domination, rather than to targeted problem-solving research of immediate applicability;

(iii) disciplinary scope, by proposing to unsettle historical anthropology and ethnographic history from within the boundaries of a single empire, and to overcome the limitations of existing comparative studies, by inquiring into the flows and interactions between competing empires.

I will also:

(iv) strengthen the methodology for multi-sited, multi-period research in anthropology;

(v) contribute to an anthropology of global connections and trans-local approaches;

(vi) promote the multidisciplinary and combined-methods approach to complex subjects;

(vii) narrate a poorly known set of historical situations of labour racializations involving Europeans and document the ways they reverberate through generations; and

(viii) make the analysis available to both academic audiences and the different communities involved in the research.

Link to the ERC project webpage: www.colour.ics.ulisboa.pt

Keywords of the ERC project: labour; race; plantation; migration; anthropology and history; cross-empires mobility

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:
714033	**MEDEA-CHART**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr JOAQUIM GASPAR**
Host Institution:	FCIENCIAS.ID - ASSOCIACAO PARA A INVESTIGACAO E DESENVOLVIMENTO DE CIENCIAS - PT

The Medieval and Early Modern Nautical Chart: Birth, Evolution and Use

Of all the technical and scientific developments that made possible the early modern maritime expansion, the nautical chart is perhaps the least studied and understood. This fact is very surprising as it was through those charts that the newly discovered world was first shown to the amazed eyes of the European nations. Although the History of Cartography is a well-established academic discipline and old charts have been examined for many years, their detailed technical study is still in its infancy. What is the origin of the pre-Mercator nautical chart, how charts evolved technically over time and how they were used at sea are all critical questions that remain to be answered. I intend to approach these challenges in a truly interdisciplinary way, by using innovative and powerful tools as a complement to the traditional methods of historical research: analytical cartometric methods, numerical modelling and the examination of the manuscripts through special lighting. By applying these tools to a large sample of charts of various periods and origins, I aim to unveil hidden graphic content related to their construction and use, to characterize their main geometric features, to establish meaningful connections with contemporary navigational methods and exploration missions, and to numerically simulate their construction by taking into account the explanations given in the textual sources. The effectiveness of those techniques has already been demonstrated in my previous studies, such as in the solution of an historical enigma which had been alive for more than a century: the construction of the Mercator projection, in 1569. Now, I propose to handle a broader and more complex set of questions, which has eluded the historians of cartography for even a longer period. The clarification of these issues will have a ground-breaking impact, not only in the strict field of the History of Cartography, but also in the context of the intellectual history at large.

Link to the ERC project webpage: https://www.medea-chart.org/

Keywords of the ERC project: History of nautical cartography; History of marine navigation; Portolan charts; Early-modern nautical charts; Cartometric methods; Numerical modelling of old maps

Keywords that characterize the scientific profile of the potential visiting researcher/s: Historian of cartography; Historian of marine navigation; Medievalist; Expertise in cartometric and numerical methods

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
724114	**HealthScaping**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr GUY GELTNER**
Host Institution:	UNIVERSITEIT VAN AMSTERDAM - NL

Healthscaping Urban Europe: Bio-Power, Space and Society, 1200-1500

Medieval public health is mired in modern myth: without centralized governments, democratic values and advanced medicine, promoting health at the population level was purportedly either unthinkable or simply impractical. Offering a radically different view, HealthScaping will document, analyze and disseminate knowledge about preventative public healthcare between 1200-1500, an era of accelerated urbanization followed by massive demographic decline, with the onset of Black Death (1347-51). This long-term and comparative perspective will fundamentally revise the narrative of European public health by tracing the development and impact of pertinent government policies, medical discourses and social and religious action in the continent's two most urbanized and richly documented regions, Italy and the Low Countries. The project taps numerous written, material and visual sources and archaeological data from several sites, and examines them also by critically engaging the insights of governmentality studies, cultural-spatial analysis and actor-network theory. A multidisciplinary team, working in a Geographical Information Systems environment and generating innovative urban health maps, will recover earlier societies' struggles with domestic and industrial waste, travel and labor hazards, food quality, and social and religious behaviors considered harmful or dangerous. As such, the project's implications will be broad and profound, for it will 1) dislodge bio-power from its accustomed place in modernity; 2) historicize the concept of the public sphere from a health perspective; and 3) challenge the privileged role given to epidemic disease as a catalyst for environmental interventions in premodernity. It will also 4) generate new insights for public health scholars and practitioners working today around the globe, by rethinking the feasibility of preventative interventions under highly diverse forms of government, culture and topography.

Link to the ERC project webpage: https://premodernhealthscaping.hcommons.org/

Keywords of the ERC project: premodern public health, urban history, infrastructure studies, medieval history

Keywords that characterize the scientific profile of the potential visiting researcher/s: medical history, knowledge networks, urban history, Italy, Low Countries

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
741095	**PASSIM**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr EVA HEMMUNGS WIRTÉN**
Host Institution:	LINKOPINGS UNIVERSITET - SE

Patents as Scientific Information, 1895-2020

"History will remember Barack Obama as the great Slayer of Patent Trolls." The headline from the 2014 March 20 issue of Wired credits POTUS with, perhaps, an unexpected feat. Referring to companies in the sole business of enforcing patents beyond their actual value, trolls are a recent installment in the history of an intellectual property whose ubiquitousness the Latin word PASSIM ("here and there, everywhere") neatly captures. In the eye of the storm stands the patent bargain: disclosure of information in return for a limited monopoly. This contractual moment makes patents a source of information, the basis of new innovation. Or does it? By posing this simple question, PASSIM's bold take on the legitimacy of intellectual property in the governance of informational resources follow patents as legal and informational documents during three historical "patent phases," producing a visionary and theoretically savvy interpretation of intellectual property that stems from its humanities-based and interdisciplinary project design. PASSIM shows a way out of current analytical gridlocks that earmark the understanding of the role of intellectual property in knowledge infrastructures—most notably the enclosure/openness dichotomy—and provides a fresh take on the complexity of informational processes. A key steppingstone in the PI's career, her own contribution to PASSIM will be a work of synthesis, highlighting major tendencies in the history of patents as scientific information from 1895 to the present. Four complementary empirical studies target specific themes that strengthen PASSIM's validity and impact: questions of copyrights in patents, scientists' patenting strategies both historically and today, the relationship between bibliometrics and patentometrics, and the status of the patent as a legal and informational document. Outputs include workshops, articles, monographs, policy papers and documentation of the project's experiences with interdisciplinary self-reflexivity.

Link to the ERC project webpage: www.passim.se

Keywords of the ERC project: Patents, Information, Documents, Media history, Networks, Interdisciplinary, Science

Keywords that characterize the scientific profile of the potential visiting researcher/s: Patents, intellectual property, interdisciplinary, history, theory, science, documentation,

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
741520	**Locus Ludi**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr VERONIQUE DASEN**
Host Institution:	UNIVERSITE DE FRIBOURG - CH

Locus Ludi: The Cultural Fabric of Play and Games in Classical Antiquity

Play and games were ubiquitous in antiquity, among free men and slaves, men and women, adults and children, in town and country. Even gods played. Ludic culture created communities from early childhood to a ripe old age. Did these groups play together, or did they play different games, with distinct rules? And did they play similar games to us? This interdisciplinary project will provide the first comprehensive study of the evidence. Written, archaeological and iconographic sources are abundant, but forgotten in museums and libraries. This neglect is due to the modern Western view of games as children's pastime, if not a waste of time. Ancient play and games reflect the gendered, religious, economic, and political fabric of a society, as much as they shape the lives of players by transmitting a cultural identity and an intangible heritage. Ludic culture evolves over time and this project intends to provide a benchmark by reconstructing this history in the Greek world, from the birth of the city-state, c. 800 BCE, to the Roman conquest in 146 BCE, and in the Roman world from the Republican age, c. 500 BCE, to the end of the Western Roman Empire, c. 500 CE.

Locus Ludi will identify, categorize, and reconstruct games and play thanks to close linguistic, historical, archaeological, typological, topographical, iconographic, and anthropological studies. Ludic culture also mirrors interactions between different populations, as in the romanisation process, and religious shifts. The research will be informed by theoretical studies of the past as well as by gender and education studies. It will generate a new vision of the cultural fabric of ancient society, provide models for training and research in related fields, as well as up-to-date material for schools, museums, and libraries. Understanding the educational, societal and integrative role of play in the past is important to understand the present and widen the debate on high tech toys and new forms of sociability.

Link to the ERC project webpage: locusludi.unifr.ch

Keywords of the ERC project: play, game, toy, childhood, gender

Keywords that characterize the scientific profile of the potential visiting researcher/s: cultural history, anthropology, ludic culture

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
772353	**DICTATOREXPERIENCE**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr KATE FERRIS**
Host Institution:	THE UNIVERSITY COURT OF THE UNIVERSITY OF ST ANDREWS - UK

Dictatorship as experience: a comparative history of everyday life and the 'lived experience' of dictatorship in Mediterranean Europe (1922-1975)

'Dictatorship' conventionally conjures an image of a charismatic, dogmatic (male) leader ruling from on high, through magnetism, propaganda and violence, a pliant population alternately rallied in fervent support or cowed into submission. Such images belie the crucial reality that dictatorships were experienced subjectively – and in some respects put into practice - by the men, women and children who lived (through) them. Individuals encountered the dictatorial state not only in official policies, propaganda and rituals but also in everyday settings: the market; the factory; the bar; the street; the home. These venues were sites where dictatorships were made – and unmade. Whilst the 'everyday life history' of the mid 20th-century dictatorships in Germany, the USSR and (less often) Italy has been compared, this project will be the first to comparatively examine the 'lived experience' of dictatorships in four countries bordering the northern Mediterranean: Italy; Spain; Portugal; Greece. Framing this study within the context of Mediterranean Europe allows us to interrogate some of the institutions and cultural practices often assumed to connect and characterize this region and how, if at all, these intersected with the subjective experience of dictatorial rule. These include: certain family structures and practices; diet; temporal rhythms and spatial dimensions; and the perceived disjuncture between pays leal and pays real. How did Mediterranean populations experience dictatorship? Could shared socio-cultural institutions and practices, if detected, offer common tactics for negotiating daily life? Using a series of analytical concepts including subjectivity and agency, multiplicity, and everyday 'spaces', the project will reveal the complex ways in which dictators' ideology and practices were enacted on an intimate scale and the fragmented and multivalent encounters between individuals and the state which constituted the 'actually-existing' dictatorship.

Link to the ERC project webpage:

Keywords of the ERC project: history; everyday life; lived experience; dictatorship; Mediterranean

Keywords that characterize the scientific profile of the potential visiting researcher/s: historian; lived experience; everyday life; subjectivity; agency; practice

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
715423	**BRASILIAE**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr MARIANA DE CAMPOS FRANCOZO**
Host Institution:	UNIVERSITEIT LEIDEN - NL

Indigenous Knowledge in the Making of Science: Historia Naturalis Brasiliae (1648)

This project is an interdisciplinary study of the role of indigenous knowledge in the making of science. Situated at the intersection of history and anthropology, its main research objective is to understand the transformation of information and practices of South American indigenous peoples into a body of knowledge that became part of the Western scholarly canon. It aims to explore, by means of a distinctive case-study, how European science is constructed in intercultural settings.

This project takes the book Historia Naturalis Brasiliae (HNB), published in 1648 by Piso and Marcgraf, as its central focus. The HNB is the first product of the encounter between early modern European scholarship and South American indigenous knowledge. In an encyclopedic format, it brings together information about the natural world, linguistics, and geography of South America as understood and experienced by indigenous peoples as well as enslaved Africans. Its method of construction embodies the intercultural connections that shaped practices of knowledge production in colonial settings across the globe, and is the earliest example of such in South America. With my research team, I will investigate how indigenous knowledge was appropriated and transformed into European science by focusing on ethnobotanics, ethnozoology, and indigenous material culture.

Since the HNB and its associated materials are kept in European museums and archives, this project is timely and relevant in light of the growing concern for the democratization of heritage. The current debate about the societal role of publicly-funded cultural institutions across Europe argues for the importance of multi-vocality in cultural and political processes. This project proposes a more inclusive interpretation and use of the materials in these institutions and thereby sets an example of how European heritage institutions can use their historical collections to reconnect the past with present-day societal concerns.

Link to the ERC project webpage:

Keywords of the ERC project: Indigenous Knowledge; Natural History; Early Modern Science; Historical Anthropology; Museum Collections

Keywords that characterize the scientific profile of the potential visiting researcher/s: Anthropology; History: Ethnobiology

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
610028	**IMBALANCE-P**	**SYG** Synergy

Principal Investigator:	**Dr JOSEP PENUELAS REIXACH**
Host Institution:	CENTRO DE INVESTIGACION ECOLOGICA YAPLICACIONES FORESTALES - ES

Effects of phosphorus limitations on Life, Earth system and Society

P is an earthbound and finite element and the prospect of constrained access to mineable P resources has already triggered geopolitical disputes. In contrast to P, availabilities of carbon (C) and nitrogen (N) to ecosystems are rapidly increasing in most areas of the globe. The resulting imminent change in the stoichiometry of available elements will have no equivalent in the Earth's history and will bear profound, yet, unknown consequences for life, the Earth System and human society. The ongoing shifts in C:N:P balances in ecosystems will necessarily affect the structure, function and diversity of the Earth system. P-market crises might put pressure on the global food system and create environmental ripple effects ranging from expansion of agricultural land to P-price-induced changes in land management exacerbating the stoichiometric resource imbalance. Yet, the impacts of this unprecedented human disturbance of elemental stoichiometry remain a research enigma. The IMBALANCE-P-team, that gathers four leading researchers in the fields of ecosystem diversity and ecology, biogeochemistry, Earth System modelling, and global agricultural and resource economics, is formidably positioned to address this Earth System management challenge by providing improved understanding and quantitative foresight needed to formulate a range of policy options that will contain the risks and mitigate the consequences of stoichiometric imbalances. IMBALANCE-P will integrate some of Europe's leading integrated assessment and Earth system models, calibrated using ecosystem nutrient limitation data obtained from field experiments. The project will establish an international process of science-based P-diplomacy.

Link to the ERC project webpage: http://imbalancep-erc.creaf.cat/

Keywords of the ERC project: Global change, phosphorus, nitrogen, nutrients, carbon cycle, Tropical Earth bioms, Earth System Models, Integrated Assessment Models, fertilizers

Keywords that characterize the scientific profile of the potential visiting researcher/s: Global change, phosphorus, nitrogen, nutrients, carbon cycle, Tropical Earth bioms, Earth System Models, Integrated Assessment Models, fertilizers