Korte omschrijving onderzoeksprojecten Odysseus

# Cathérine Verfaillie: Stem cell research

First Odysseus project prof. Cathérine Verfaillie, Stem cell institute, K.U.Leuven.

Nominated by K.U.Leuven and recommended by the International Odysseus Jury, prof. Catherine Verfaillie has been assigned the first Odysseus project by the Board of Trustees of FWO to establish the Stem Cell Institute of K.U.Leuven.

The jury gives a very positive appreciation on the following grounds :

* Stem cell research is a hot topic in biomedicine.
* Lots of groups have entered the field, there’s a lot of competition but Prof. Verfaillie is a pioneer in this field. Her discovery of a set of adult stem cells is of high potential and does not have ethical constraints.
* She is a good supervisor, her personality attractive, she trained a lot of people, knows how to distribute knowledge and has a vast network.
* Her research is very innovative and risk full but innovative aspects always cause risks.
* Prof. Verfaillie has a good track record, she has her own niche and she’s an original, excellent investigator, with a lot of excellent publications.
* It’s a real brain gain.

The proposal is well composed and has 3 levels :

* stem cell biology: fundamental
* immunology/rejection: translation to clinical practice
* technological platform

Research is translational and has a very high potential to become important for therapy (diabetes, vascular diseases).

The requested budget is logic and necessary.

The K.U.Leuven is an excellent host university with a lot of infrastructure.

# Jiri Friml: Morphogenetic auxin gradients as an interface between cellular processes and multicellular plant development”

Jiri Friml was born in the Czech Republic in 1973. He obtained a Master of Science in Biochemistry in 1997 at the Masaryk University in Brno, Czech Republic, a PhD in Biology at the University of Köln, Germany and a PhD in Biochemistry at the Masaryk University in Brno, in 2000.

The research of Jiri Friml has always focussed on the cellular and molecular mechanisms behind adaptive development in plants. Based on recent research, Jiri Friml proposed a general model that explains how plants capture multiple internal and external signals and translate them into the extraordinary plasticity and adaptability that characterises their development.

The granted project of Jiri Friml is entitled: “Morphogenetic auxin gradients as an interface between cellular processes and multicellular plant development”. Plants have, contrary to animals, an unprecedented flexibility in terms of growth and survival. Developmental responses to the environment, such as outstanding regeneration abilities, de novo organogenesis and directional growth are witnesses of these capabilities. Past research has shown that differential distribution of the plant hormone auxin within tissues is a general mechanism for these capabilities. These “auxin gradients” are formed by intercellular auxin transport which depends on auxin efflux carriers from the PIN familiy. In this research project, molecular genetics, developmental and cell biology approaches will be employed to identify the cellular and molecular mechanisms of the processes that determine the directional throughput of intercellular auxin flow at the level of individual cells as well as the interpretation of morphogenetic auxin gradients at the level of the whole tissue. Combination of these three approaches will give unprecedented insight into the mysteries of plant adaptive development and, in particular, the ways in which plants capture signals from the environment and translate them into specific adaptation responses.

Jiri Friml has been nominated by Ghent University as a candidate for the Odysseus Group I programme. The Odysseus jury has appreciated very much the impressive publication record in top journals and the international mobility of Jiri Friml. The proposed research project is situated in an emerging field with great potential, has an interdisciplinary character and proposes the usage of novel techniques. Jiri Friml will continue his outstanding research in the world recognised Department of Plant Systems Biology. This institute is embedded in Ghent University and is associated with the interuniversitary Flemish Institute of Biotechnology. This department is renowned for embedding pioneering research.

# Bart Lambrecht: “Exploiting the function of dendritic cells to fight disease”

Bart Lambrecht was born in Belgium in 1968. He obtained a Master in Medicine in 1993 and a PhD in Biomedical Sciences in 1999 at Ghent University, Belgium.

Bart Lambrecht’s research has been in understanding the role of myeloid and plasma cytoid dendritic cells in respiratory immune responses.

The granted project is entitled:“Exploiting the function of dendritic cells to fight disease”. The incidence of immune related pathologies such as asthma, diabetes and MS is steadily increasing in the western world. Crucial in understanding how the immune system deals with pathogens, allergens and self-antigens is the knowledge of dendritic cell biology. Dendritic cells control most aspects of the immune response and can be manipulated to induce protective immune responses to pathogens or tumors or to dampen disease causing immune responses to allergens or self antigens. With allergy as a paradigm, the proposal will exploit the function of these cells to achieve a better understanding of the pathogenesis of allergic sensitization and to achieve a better way to prevent or cure this disease. Firstly, the basic biology of dendritic cells in the mucosal immune system of the lung will be studied. Secondly, the aim is to devise targeted strategies that alter the characteristics of lung dendritic cells so that anti-inflammatory responses can be induced, with an aim of curing asthmatic inflammation. Finally, clinical dendritic cell based therapies will be developed, first in cancer, later with an emphasis on tolerizing immune responses to inhaled allergens or self antigens.

Bart Lambrecht has been nominated by Ghent University as a candidate for the Odysseus Group I programme. The jury appreciates very much the impressive track record of Bart Lambrecht. The proposal will exploit the function of dendritic cells to achieve a better understanding of the pathogenesis of allergic sensitization and to achieve a better way to prevent or cure this desease. It is original, very ambitious and innovative. It brings several exciting new concepts for the pathobiology of allergic asthma. The proposed research will be carried out in Ghent University, well known for clinical research. Bart Lambrecht will act as a leader of the future expertise centre for Clinical Immunology and Allergy.

# Marc Brysbaert: “The centre for reading research – Flanders”

Marc Brysbaert was born in Belgium in 1963. He obtained a Master in Psychology in 1986 and a PhD in Psychology in 1992 at the University of Leuven, Belgium.

Marc Brysbaert is a specialist in cognitive psychology, especially in the domain of visual word recognition, reading, and number processing. He has made significant and numerous contributions to our understanding of the processes involved in word recognition and reading.

The granted project is entitled: “The centre for reading research – Flanders”. In this project, three research lines will be expanded, continuing the applicant’s ongoing research. In the first line of research, a comparison of participants with typical and atypical language dominance will be used to obtain better insight in the brain mechanisms that underlie visual word recognition and text understanding. In the second line of research lexical decision an naming latencies will be collected for all common Dutch words and for monosyllabic English and French words in Dutch/Flemish speakers. Nonlinear regression analyses will be used to determine the factors that influence the word processing times in Dutch/Flemish and to compare them with English and French. In addition, the processing latencies in a second language will be compared to those of native speakers. The resulting explanations will be implemented in existing computational models of visual word processing, to see whether they lead to the expected improvements of the models. The third research line will look at the application of some of our basic research to everyday problems. Two specific proposals are outlined. In the first, on the basis of our current knowledge and new studies, we will critically evaluate and extend current techniques to assess and remediate dyslexia in Flanders. In the second, we will use a recently developed and validated research hypothesis but the applicant to adapt a test that allows health professionals to reliably measure the onset of dementia.

The jury appreciates the research of Marc Brysbaert. The project is well written and very original. The jury is convinced that this project will yield very interesting results that are very relevant for society.

# Tom Taghon: “Characterization of molecular pathways that drive human T cell development”

Tom Taghon was born in 1975 in Belgium. He obtained a Master of Science in Biotechnology in 1997 and a PhD in Medical Sciences in 2002, at Ghent University.

The granted project is entitled:“Characterization of molecular pathways that drive human T cell development”. During development, the acquisition of different cell fates is orchestrated by a complex interplay of cellular events, regulated by different molecular pathways. One of these recurring and conserved signalling cascades comprises the Notch pathway. During blood cell development, it is the major driving force for T lymphocyte development. Within the immune system, T cells are critical for regulating responses against invading pathogens and tumour cells. Occasionally, our immune system fails and disease occurs. For a number of clinical settings (HIV infections, leukaemia and cancer), novel therapeutic approaches are required for improving current therapeutics. Furthermore, in cases such as after myelo-ablative therapy and bone marrow transplantation, T cell reconstitution is late and very inefficient. Using a novel in vitro research tool, the goal of this proposal is to provide novel insights in to normal human T cell development. This will be achieved through a detailed analysis of the effects of several molecular cascades that govern T cell development and their interaction with the Notch pathway which serves as the central player. Because of the frequent involvement of Notch in T cell-Acute Lymphoblastic Leukemias, results can be immediately translated into this clinical model, providing potentially new targets for therapeutic strategies. Importantly, through the experimental approach used, we will be able to optimize the in vitro culture conditions for human T cell development, a necessary step to open up the path towards the generation and design of antigen-specific T cells, designed at targeting for example HIV infections and tumour formation through cell therapy. Finally, we aim at identifying the progenitor cells that reconstitute T cell development in vivo, in order to ensure their presence in hematopoietic stem cells transplantations and wish to expand these cells in vitro to reduce the immune compromised phase of bone marrow transplant patients.

The jury concludes that Tom Taghon has achieved a high profile and prominence within this current field of research in the study of early human T-cell differentiation. His scientific background and track record are superb. The proposal is very clear and challenging. The jury is convinced that it will yield groundbreaking results.

# Geert Van Loo: “Study of the (patho)physiological role of NF‑κB inhibitors A20 and ABINs through genetic modifications in the mouse”

Geert Van Loo was born in 1971 in Belgium. He obtained a Master in Bioengineering in Chemistry in 1994, a Master in Biotechnology in 1996 and a PhD in Biotechnology in 2002, at Ghent University.

The granted project is entitled:“Study of the (patho)physiological role of NF-κB inhibitors A20 and ABINs through genetic modifications in the mouse”. Nuclear factor-κB (NF-κB) is a transcription factor that is a critical regulator of genes involved in innate and adaptive immunity, inflammation, development and suppression of apoptosis. NF-κB-dependent gene expression and apoptosis play crucial roles in numerous cellular processes, and defects in their regulation contribute to a variety of diseases including inflammatory and autoimmune diseases, neurological disorders and cancer. As such, NF-κB signalling needs to be tightly regulated and one of the critical regulators of this process is the cytoplasmic zinc finger protein A20, which has been characterized as a dual inhibitor of both NF-κB activation and apoptosis. Mice deficient for A20 develop severe inflammation and cachexia, are hypersensitive to TNF and LPS, and die shortly after birth, excluding its in vivo study in the adult organism and in diseased pathology. In vivo experiments using conditional gene knockouts and knockins of potentially important mutants are critically important for evaluating the role of a factor in physiological and pathological conditions. The aim of the project is to understand the function, activation and regulation of NF-κB activation by A20 and A20 interacting ABIN proteins, using conditional gene targeting in the mouse. Three particular aims are central in this project: to investigate the physiological role of A20 and ABINs by generating mice with conditional alleles for the gene allowing deletion of the protein by crossing them to cell specific Cre transgenic lines; to study the (patho)physiological role of A20 and ABINs by using the conditional knockout mice in different established inflammatory disease models; and to generate a knocking A20-TAP fusion mutant which would allow us to identify in vivo the binding partners of A20 in different tissues and/or upon stimulation with known activators of the NF-κB pathway and/or in specific disease states.

The jury concludes that Geert Van Loo has undoubtedly the technical and scientific maturity to lead a laboratory. The juy also appreciates that he has well cited publications in a very competitive area. The proposal fits very well in the current research of Geert Van Loo and aims to investigate in vivo the role of negative regulators of NF-κB signalling in physiology and disease pathology. This project will certainly yield very interesting results.

# Guy Boeckxstaens: “The brain and the innate immune system”

Guy Boeckxstaens was born in Belgium in 1963. He obtained a Master in Medicine in 1987 and a PhD in Medicine in 1991 at the University of Antwerp, Belgium.

The research of Guy Boeckxstaens has been in the field of Gastroenterology. It has mainly focused on disease mechanisms. Guy Boeckxstaens set up research lines dealing with the pathophysiology of gastroesophageal reflux disease, functional bowel disease and postoperative ileus.

The granted project of Guy Boeckxstaens is entitled: “The brain and the innate immune system”. In the first research line of the proposal, the anti-inflammatory effect of the vagus nerve will be further investigated. Previously, it has been shown by Guy Boeckxstaens that stimulation of vagal efferents dampens intestinal inflammation by inhibition of macrophages. In this project, the intriguing hypothesis is forwarded that the brain integrates vagal immunosensory information and as part of an inflammatory reflex activates the efferent vagus nerve to locally modulate the immune system. The mediators and receptors involved in the cross-talk between the brain (vagus nerve) and the innate immune system (dendritic cells, resident macrophages) will be identified. The outcome of this programme will lead to a new anti-inflammatory approach for inflammatory diseases. The second research line will focus on the role of mast cells in stress-induced abnormalities in gastrointestinal function. It is hypothesized that mast cell degranulation, induces by psychological or mechanical stress, leads to increased intestinal permeability and activation of the innate immune system. The mechanisms triggering mast cell degranulation and the processes involved in altering gastrointestinal neuromuscular function will be studied in detail. This knowledge is crucial for the development of drugs to treat diseases such as the irritable bowel syndrome and postoperative ileus.

Guy Boeckxstaens has been nominated by the University of Leuven as a candidate for the Odysseus Group I programme. The jury concludes that Guy Boeckxstaens is a respected researcher in the field of immunity and combines fundamental research and clinical work. The project proposes the development of important clinical tools and promises new ways to treat diseases. Guy Boeckxstaens will continue his research in the world recognized institute of Internal Medicine, embedded in the University of Leuven, in collaboration with top researchers providing the project with complementary knowledge.

# Igor Douven: “Formal Epistemology: Foundations and Applications” (Closed)

Igor Douven was born in The Netherlands in 1963. He obtained a Master in Law in 1990, a Master in Musicology in 1992 and a Master in Philosophy in 1993 at Utrecht University, The Netherlands, and a PhD in Philosophy in 1996 at the University of Leuven, Belgium.

The past decade has seen the rise of formal epistemology, the field of research of Igor Douven. Strong analytical tools, such as formal logic and probability theory, are used in this field. Igor Douven focussed on theories about rational acceptability. He used tools from formal epistemology in discussions about conditionals and on calculating probabilities of conditionals and the consistency of calculating rules. In a forthcoming paper, he advocates a new theory of conditionals, which makes full use of the apparatus of Bayesian epistemology.

The granted project is entitled:“Formal Epistemology: Foundations and Applications”.
An epistemological notion that has received a lot of attention is rational acceptability, although a satisfactory formal analysis of this notion is still missing. The first central aim of this project is to develop a formally precise theory of rational acceptability, built on recent results obtained by researchers working in the area of formal epistemology. The second main aim is to deploy the theory of rational acceptability in an account of various kinds of conditional sentences. In recent work Igor Douven has proposed that for a large class of indicative conditionals, the correct assertability/acceptability conditions are to be stated in terms of rational acceptability. Firstly, this proposal should be extended to other types of conditionals; secondly, various empirical consequences of this proposal should be tested. The third main aim concerns an application of the new theory of rational acceptability to the issue of antirealist truth. The new theory of rational acceptability will help to formulate a formally precise theory of antirealist truth, which today is still missing from the literature.

Igor Douven has been nominated by the University of Leuven as a candidate for the Odysseus Group I programme. The jury concludes that Igor Douven is a very experienced epistemologist, taking part in the transformation of this field worldwide and using sophisticated methods from probability and formal logic to do so. The proposed project is an interdisciplinary project, proposing very advanced and important research. Igor Douven has been appointed since September 2005 as research professor at the University of Leuven and will continue his research in the Institute of Philosophy, a world recognized institute embedded in the University of Leuven.

# Jean-Pierre Locquet: “Nanomaterials with controlled functionality”

Jean-Pierre Locquet was born in Belgium in 1960. He obtained a Master in Physics in 1983 and a PhD in Physics in 1989 from the University of Leuven in Belgium.

The research of Jean-Pierre Locquet focuses on the physics and material science of thin films and devices of complex materials. This includes materials which display a dielectric, magnetic, ferroelectric, superconducting and/or semiconducting behaviour for use in storage, memory and logic devices.

The granted project of Jean-Pierre Locquet is entitled “Nanomaterials with controlled functionality”. The functional response of a nanomaterial is a change of a‘state variable’ which can be a charge or spin density, a spin or dipole orientation, an excited state, a molecular arrangement, etc. Such a state variable is a property of the nanomaterial itself, but controlling how it changes is quite a challenge. It often depends on unknown and uncontrolled surface and interface details which can limit the practical relevance of these materials. This is a generic problem observed in applications ranging from electronics, to materials science, catalysis, energy production as well as medicine. To understand and resolve this problem, one must gain atomic level control on size, shape orientation and composition of the nanomaterial, together with a precise surface and interface engineering, while the functional response is monitored. To achieve this, a new infrastructure with tools for synthesis, lithography, microscopy, spectroscopy, processing and characterisation will be assembled in the Institute for Functional Nanosystems. Realising this objective can lead to many scientific breakthroughs and practical applications in new devices and tools.

Jean-Pierre Locquet has been nominated by the University of Leuven as a candidate for the Odysseus Group I programme. The jury appreciates very much the more than 20 years experience of Jean-Pierre Locquet in this field. The proposal presents a feasible goal, using good methods. Jean-Pierre Locquet will continue his research at The University of Leuven, that will be a perfect environment to establish the Institute for Functional Nanosystems.

# Johannes Vlaeyen: “Psychology of Pain and Disability Research Program”

Johannes Vlaeyen was born in Belgium in 1957. He obtained a master in Clinical Psychology in 1980 at the Free University of Brussels, Belgium, completed his clinical internship at the University of Washington, Seattle, USA, and obtained his PhD in 1991 at the University of Maastricht, The Netherlands.

Johannes Vlaeyen is a clinical pain researcher and has focussed on fear-avoidance phenomena associated with pain. His fear-avoidance model of pain and disability has widely influenced both research and clinical practice in this area.

The granted project of Johannes Vlaeyen is entitled “Psychology of Pain and Disability Research Program”. In the absence of immediate and definitive solutions, and due to its associated suffering and disability, chronic pain poses an intricate challenge for modern healthcare. A major breakthrough was the introduction of the Fear Avoidance model of chronic pain in 2000, presenting a pathway by which people be caught in a downward spiral of increasing avoidance, disability and pain. Numerous studies have found converging evidence demonstrating that pain-related fears are more diabling than pain severity. Nevertheless, there are unresolved issues that merit further scientific attention. The novel aim of this proposal is to study the intriguing possibility that the influence of fear and avoidance processes on pain and disability might vary as a function of the external and internal context within which the fear response occurs. The proposal consists of three complementary research themes, conducted in parallel, and extending the Fear Avoidance model with a further differentiation between cued pain-related fear and more generalized pain anxiety; the role of the social context in terms of empathy, competition, and social exclusion, and the contagious nature of pain-related fear; and the role of achievement goals and goal conflicts that might be responsible for oscillating behaviour patterns typical for chronic pain patients. Translational studies are likely to produce novel treatment approaches that aimed at customizing the cognitive-behavorial management of chronic pain disability.

Johannes Vlaeyen has been nominated by the University of Leuven as a candidate for the Odysseus Group I programme. The jury appreciated very much the translational and interdisciplinary character of the research of Johannes Vlaeyen. The project is very strong and promising. Johannes Vlaeyen will continue his research at the Health Psychology Research Center. This well-known institute is embedded in the University of Leuven and provides a perfect environment to execute the proposed research.

# Kevin Verstrepen: “Tandem repeats as hyper-variable functional modules in genomes – A systems biology approach”

Kevin Verstrepen was born in 1975 in Belgium. He obtained a Master of Science in Biological Engineering in 1999 and a PhD in Applied Biological Sciences in 2003 at the University of Leuven, Belgium. After his PhD, he moved to the U.S., where he served as a postdoctoral scientist in the laboratory of genetics pioneer Gerald Fink at the Massachusetts Institute of Technology (M.I.T.). Two years later, Verstrepen moved to Harvard University where he currently leads a team of scientists interested in fundamental and applied genetics.

The granted project is entitled:“Tandem repeats as hyper-variable functional modules in genomes – A systems biology approach”.
According to classical evolution theory, phenotypic variation originates from random mutations that are independent of selective pressure. However, recent findings suggest that the pace of evolution of different traits varies widely. Some properties are hyper-variable, while others are extremely robust and remain virtually constant over evolutionary timescales. Such differences in“evolvability” of traits opens the interesting possibility that cells may have evolved mechanisms to influence their own heritable phenotypic variability. In other words, cells might be able to induce heritable phenotypic variability when and where it is most needed. The long term goal of this research is to combine theory and experiments to investigate the mechanisms underlying genetic robustness and “evolvability”. Apart from the purely fundamental aspects, we also plan to explore practical facets, including swift evolution of pathogens. We often use the eukaryote Saccharomyces cerevisiae as a model, although we are also venturing into organisms as diverse as microbes, plants and mammals.
In this project, the focus lies on one specific topic, namely the role of tandem repeats as hyper-variable modules in genomes. Tandem repeats, also known as satellite sequences, are traditionally considered to be non-functional“junk” DNA. However, it is hard to believe that nature would foster such a wasteful system. Indeed, recent research shows that repeats function as hyper-variable modules in coding and regulatory sequences. Frequent changes in these repeat regions alter the function and/or expression of genes, allowing organisms to swiftly adapt to novel environments. Hence, repeats may be a common mechanism for organisms to generate potentially beneficial variability in certain regions of the genome, while keeping other regions stable and robust. First bioinformatics will be used to screen various model genomes and identify, categorize and analyze all tandem repeat loci. Subsequently, experimental molecular techniques will be applied in the model eukaryote Saccharomyces cerevisiae to investigate the mechanism and functional consequences of mutations in tandem repeats. The study of repeats in plants, animals and pathogenic microbes will be carried out in various collaborations.

The Odysseus jury concluded that Kevin Verstrepen is an outstanding scientist. He is creative, thoughtful, determined, and does an excellent job of sizing up the most interesting and tractable aspects of a problem. His experience in more applied as well as purely basic research gives him a considerable advantage in seeing the larger significance of a biological problem. The proposal looks very strong, especially in the experimental part: an original approach is suggested and likely to be successful; sufficient backups are considered. The project is well-structured with clearly defined intermediate goals. Kevin Verstrepen will join the internationally recognized Center of Microbial and Plant Genetics (CMPG) in the Faculty of Bioscience Engineering at the K.U.Leuven.

# Maurilio Sampaolesi: “Molecular mechanisms of cardiomyopathy related to muscular dystrophy and stem cell therapy”

Maurilio Sampaolesi was born in Rome, Italy. He obtained a Master in Biological Sciences in 1991 and a PhD in Cardiovascular Pathophysiology in 1996 at the University of Rome, Italy.

The granted project is entitled:“Molecular mechanisms of cardiomyopathy related to muscular dystrophy and stem cell therapy”. In muscular dystrophies a cardiac involvement represent a complication leading the patients to a more dramatic worsening of health condition. In Duchenne muscular dystrophy, Becker muscular dystrophy and, more recently, in some of dystrophinopaties termed sarcoglycanopathies, dilated cardiomyopathy and electrocardiogram abnormalities are frequent findings. The molecular circuits that drive the connection between the muscular dystrophy and the onset of complex cardiac disease are still unknown and our knowledge about that remains primitive.

The project aims to understand the molecular mechanisms of cardiomyopathy related to the sarcoglycan and dystrophin mutations, and to develop a novel stem cell based therapy in mouse models of dilated cardiomyopathy. For the first point of the project, a connection between growth factor-related calcium channel and mutations in sarcoglycans will be considered; primary cardiomyocytes from dystrophic, cardiomyopathic and control mice and dogs will be used as cell model in order to verify their physiological characteristics after stretching and/org drug treatment. For the second point of the project murine, canine and human mesoangioblasts (MABs), a class of vessel-associated stem cells as recently described by Maurilio Sampaolesi (Science 2003; Nature 2006; Nature Cell Biology 2007), will be used to treat respectively beta-sarcoglycan (β-SG) KO mice, scid/beige β-SG KO mice, or GRMD dogs, animal models of dilated cardiomyopathy and muscular dystrophy. The novelty of this project is to establish a molecular link between two hereditary diseases (cardiomyopahty and muscular dystrophy) caused by mutation of sarcoglycan and dystrophin genes. Muscle hypertrophy, that occurs, as compensatory mechanism in the muscular dystrophy as well as in cardiomyophaty is a crucial event leading to a more severe phenotype. Understanding the common compensatory mechanisms is essential for discovering new therapeutic approach. Finally the ultimate goals of the project are to verify the suitability of stem cell therapy in cardiac disease that is such a hot and controversial issue even though so promising.

Maurilio Sampaolesi is an outstanding investigator in the area of mesodermal stem cells with specific interests in skeleltal an cardiac muscle differentiation. He will carry out his research in the Stem Cell Institute Leuven (SCIL) (Univeristy of Leuven). His immediate interest is the application of stem cell therapy in muscular dystrophy, but his research will be of great importance in SCIL interested in stem cells for skeletal as well as cardiac disorders. As the ultimate goal of the development of SCIL is to generate innovative therapies for otherwise untreatable diseases, he is a perfect example of the translational researcher who can fill such a niche.

# Arjen van Witteloostuijn: “Demographic diversity and the evolution of social entities”

Arjen van Witteloostuijn was born in 1960 in The Netherlands. He Obtained a Bachelor of Science in Economics and Business in 1982, a Bachelor of Science in Psychology in 1983, a Master in Economics and Business in 1985, at the University of Groningen, The Netherlands, and a PhD in Economics in 1990 at the University of Maastricht, The Netherlands.

Arjen van Witteloostuijn is a multidisciplinary researcher in behavioural, economic and social sciences. Much of his work relates to issues of the antecedents and consequences of demographic diversity at different levels of analysis.

The granted project is entitled:“Demographic diversity and the evolution of social entities” or “The ecological study of the behaviour and performance of teams, organizations, industries, networks and communities”. The project deals with the antecedents and consequences of demographic diversity in the realm of teams, organizations, industries, networks and communities. Demographic diversity refers to groups of people or organizations. Both can be more or less divers in terms of, e.g., age, gender and personality (people) or age, size, strategy (organizations). The key questions are where this extent of diversity comes from and what it implies for the behaviour and performance of the social entities involved. At the team level, for instance, the metabolism of executive boards of corporate enterprises will be studied. What types of managers enter into and leave from such boards, and what is the impact of this turnover and the implied (change in) demographic diversity on the organization’s strategy and performance? At the community level, for example, the focus is on the origin and effect of a city’s population diversity (age, ethnicity, religion, etc.). “Why is Antwerp more or less diverse than Rotterdam, and what does this imply for these cities’ social cohesion and economic performance?” is a typical question. The proposed research programme is groundbreaking by providing centre stage to demographic diversity of social entities. It is unique in its multi-method, multi-disciplinary and multi-level approach. First, theory will be developed by building models using mathematical and simulation techniques, whilst the empirical studies will analyze novel panel datasets by applying advanced multivariate statistical tools. Second, insights from different economic and social science disciplines will be combined and integrated, notably economics, public administration, economics, economic geography, political science, psychology and sociology. Third, the multi-level perspective will be explored systematically, implying that interactions across different levels of analysis will be investigated.

The jury appreciates the impressive track record of Arjen van Witteloostuijn and is convinced that he is a creative, very active and interdisciplinary researcher. The project is ambitious, broad and daring and proposes an interdisciplinary and multi-level approach. Arjen van Witteloostuijn will carry out the proposed research. With his group, a new centre of excellence will be established in the University of Antwerp, that will bring together a group of high-quality researchers.

# Vyacheslav Misko: “Nonlinear Dynamics in Nanosystems: Flux Quanta in Nanostructured Superconductors, Colloids, Nanoclusters.”

Vyacheslav Misko was born in 1965 in the Republic of Moldova. He obtained a Master of Science in Physics in 1989 and a PhD in Physics in 1993 at the State University of Moldova, Kishinev, Moldova.

The granted project is entitled:“Nonlinear Dynamics in Nanosystems: Flux Quanta in Nanostructured Superconductors, Colloids, Nanoclusters.” Nano-structured superconductors (NSSC) play a special role due to the macroscopic quantum state of the superconducting charge carriers and the appearance of quantized flux lines (vorices), which develop in the presence of a magnetic field. The proposed research is devoted to the in-depth study of the nonlinear dynamics of flux quanta in NSSC and includes several related and interdisciplinary topics. The main targets are the implementation of new approaches to study the nonlinear dynamics of magnetic flux quanta in NSSC and the creation of new efficient ways to control the flux motion and critical parameters of NSSC; understanding of the nonlinear dynamics of antivortices in NSSC; understanding and calculation of the behaviour of the critical temperature on the size and shape of superconducting nanograins; the study of the nonlinear dynamics and the principles of self-assembly of colloidal binary mixtures and understanding of the growth kinetics of nanoclusters, influence of the environment and surface formation.

The jury concludes that Vyacheslav Misko has demonstrated excellent project management and ability to do independent research. He has extended international collaboration with scientists in the US, EU and Japan. The proposed research dealing with nonlinear dynamics, superconductors and nanostructures is a challenging area of topical materials research. The project is challanging but has a good balance between novelty of research and feasibility to achieve the goals.

# Georgios Pavlakos: investigation of the impact of globalization on the concept of law from the point of view of General Legal Theory and the Philosophy of Law

Georgios Pavlakos was born in 1970 in Greece. He obtained a Master in Law in 1993 at the University of Athens, a LLM in Legal Theory in 1994 and a PhD in 2001, at the Edinburgh School of Law, Edinburgh, United Kingdom.

The proposed research undertakes an investigation of the impact of globalization on the concept of law from the point of view of General Legal Theory and the Philosophy of Law. In addition, extensive use is made of contemporary debates in the Philosophy of Action, Social and Political Theory and Sociology. Given its interdisciplinary scope, the project focuses on structural as well as substantive aspects of legal orders with an eye to offering an explanatory framework of legal phenomena that lives up to the challenges of the globalised era. Such a framework, it is argued, needs to combine a dynamic understanding of how legal norms and categories evolve in the light of the social, economic and political changes globalization effects, with an account of the specifically normative structure of law as a source of authority, which is legitimate from the point of view of those agents who engage in globalised contexts. The two aspects, it is suggested, may be combined through an analysis of the dual character of Law as a system of co-ordination of action: on one hand, the factual aspect that pertains to legal institutional arrangements; on the other, the ideal aspect that refers to the claim law raises to be a legitimate source of normative authority.

Georgios Pavlakos is a reputed researcher with a lot of international mobility. He enjoyed a prestigious Alexander von Humboldt Research Fellowship. From the early days of his career, Dr Pavlakos has engaged in original research of international quality, a fact illustrated by the rich and consistent record of his publications. Seeking to understand the dynamics of the aspirations of political supra-national formation and of the role played by law as a social practice is nowadays a very interesting question. The proposal to find answers in a thoroughly interdisciplinary way is encouraging.

# Filip Meysman: “Quantifying Darwin’s last idea: the influence of bioturbation on the biogeochemistry of marine sediments, and its impact on the global carbon cycle.” (Closed)

Filip Meysman was born in 1970 in Belgium. He obtained a Master of Science in Chemical Engineering in 1993 at the University of Leuven, a Master of Science in Marine Biology in 1996 and a PhD in Biogeochemistry-Oceanography in 2001 at Ghent University.

The granted project is entitled:“Quantifying Darwin’s last idea: the influence of bioturbation on the biogeochemistry of marine sediments, and its impact on the global carbon cycle.” Biogeochemical cycling is at the base of the functioning of our planet and human action is rapidly impacting on its natural course. To understand how biogeochemical cycles are regulated, the field of biogeology has emerged, stimulated by new insights about how biological feedbacks are steering the entwined evolution of both life and the abiotic environment. To date, most attention has been directed towards geomicrobiology, which investigates the influence of the “small players” on global variables, like atmospheric O2 and CO2 levels. In this project, the focus lies on the impact of“large players”, that is rooting plants and burrowing invertebrates, whose biological reworking of soils and sediments is termed bioturbation. The importance of bioturbation for local soil processes was first realised by Charles Darwin, who devoted his last scientific book to the subject. Recent palaeo-ecological investigations indicate that bioturbation has played a key role in the Cambrian explosion, that is, the rapid evolution of multicellular life on the ocean floor around 540 Million years ago. The emergence of a new burrowing life-style caused a biogeochemical state change of the ocean floor, to which Cambrian bottom-dwellers had to adapt. In this project, we investigate the biogeochemical details of this state change, and more generally, the repercussions of marine bioturbation for carbon burial and the global carbon cycle. This is done by creating a kind of “virtual ocean floor”. This is a computer-simulation environment of marine sediments, in which we can explore the geochemical effects due to construction and ventilation of burrows (worms, midge larvae), and due to growth and exudation of root systems (seagrasses, mangroves). These model simulations will provide quantitative and mechanistic insights into the impact of marine bioturbation on organic matter processing and the global carbon cycle.

Filip Meysman has an impressive record of publications. His MEDIA model was the best available at the time of its release. His work on modelling of bio-irrigation is a classic. His paper in Trends in Ecology and Evolution is groundbreaking and will set the tone of research in that field for some time. The project has a focus on marine sediments, which cover about two thirds of the earth surface. Similar as was done for terrestrial plants, the question is how the bioturbation activities of marine organisms affect sediment biogeochemistry, and how this could have affected global biogeochemistry over geological time scales.

# Hans-Gerd Boyen: “Exploring new pathways towards molecular electronics”

Hans-Gerd Boyen was born in 1957 in Germany. He obtained a Master of Science in Physics in 1986, a PhD in Physics in 1990, at the University of Karlsruhe, Germany, and a Habilitation in Physics in 1995 at the University of Basel, Switzerland.

The granted project is entitled:“Exploring new pathways towards molecular electronics”. Molecular electronics has evolved into one of the fastest growing areas in nanoscience because it has the potential to supplement and finally replace the well established, silicon-based technology. As a vision, at the ultimate limit of miniaturization, nanoscaled organic entities (single molecules, small groups of molecules) with tailored physical and chemical properties will act as, e.g., electronic switches, as memory cells or sensor for biomolecules. Just to give a few examples, nanoscaled organic entities can offer the prospect of fabricating ultra-high density electronic circuits as components of molecular computers or van be applied as molecular electronics to detect functional bio-molecules as the single-molecule level. For molecular electronics to become reality, however, all basic factors controlling, e.g., the charge transport across a metal-molecule-metal junction or the interaction between individual molecules in biosensor applications need to be established. Therefore, new experimental and theoretical concepts are required in order to interrogate how factors such as metal-molecule coupling, molecule-molecule coupling, the molecular structure and the choice of electrode materials finally influence the characteristics of the desired molecular devices. In the project, new pathways will be explored aiming: to improve our basic understanding of phenomena related to the attachment of metal electrodes to molecules in molecular junctions; to find new strategies for the utilization of self-assembly of molecular structures to increase the packing desity of nanoscaled electronic units by means of cost-effective parallel processes; and to manipulate functional biomolecules depending on the interactions between each other.

Hans-Gerd Boyen has an excellent track record. A wide spectrum of domains is covered with his publications. A series of ground-breaking papers appeared, that led to publications in the top journals, such as Science, Nature Materials, Advanced Materials and Physical Review Letters. Since april 1, 2007, Hans-Gerd Boyen is appointed as a research professor at the University of Hasselt, where he will carry out this research project. The quality of the proposal is outstanding and the approaches are smart. The results of this research will certainly increase the international visibility of the University of Hasselt.

# Martin Grünewald: “Heavy Particle Physics with the CMS Experiment at the LHC”

Martin Grunewald was born 1962 in Hagen, Germany. He obtained a German "Physikdiplom" in 1988, an MSc and PhD in Physics at the California Institute of Technology, and a Habilitation at Humboldt University Berlin.

The granted project is entitled: "Heavy Particle Physics with the CMS Experiment at the LHC". The Large Hadron Collider (LHC), a world-wide unique project in fundamental physics, recently started operations at the European Laboratory for Particle Physics, CERN, Geneva, Switzerland. This particle accelerator collides protons at a centre-of-mass energy of up to 14 TeV, which is a factor seven higher than before, and with orders of magnitude higher intensity. The particle collisions are measured with the CMS detector, built and operated by the international CMS collaboration involving some 30
nations, 150 institutes and more than 2000 scientists and engineers, among them a new group from Ghent university funded by FWO.

The specific interest of this proposal lies in the measurement of the properties of heavy particles, most notably the top quark, the heaviest fermion known today, and the Higgs boson, a particle required by theory to solve the problem of mass generation (c.f. P.Higgs and two Belgians, F.Englert and R. Brout) but not yet seen in experiment. The production and decay of top quarks at LHC energies, never attained before, will be studied, allowing to make precision measurement of top-quark properties, in particular its mass. The foundations for these measurements need to be established for the CMS detector, including (i) identification of leptons, photons and jets, appearing in the decay of top quarks and Higgs bosons, (ii) reconstruction and energy calibration of jets for best possible resolution, (iii) missing energy reconstruction to identify neutrinos, and (iv) trigger and selection algorithms to select only the interesting signal events involving heavy-particle production among the overwhelming rate of background events. These areas also underpin the measurements of the properties of the Higgs boson once it is found. Also for this particle, the measurement of its mass, besides its lifetime and the rates for each decay mode, are of crucial importance in particle physics. Within its theoretical framework, mathematical relations between the masses of the heavy particles occur, such that the measurement of all heavy-particle masses tests the theoretical
foundation and our understanding of nature at a level never possible before, allowing us to discriminate between more or less complicated hypothetical extensions of our theoretical model with implications for astrophysics and cosmology.

# Liliane Haegeman: “Comparative syntax. Layers of structure and the cartography project”

Liliane Haegeman was born Belgium in 1954. She studied Germanic Philology at the University of Ghent, where she obtained her Ph.D. in English linguistics. She was professor of English and general linguistics at the University of Geneva from 1984 till 1999 and from 2000-2008 she was professor of English linguistics at the University of Charles de Gaulle, Lille III. Her research is in the field of linguistics – more specifically comparative syntax - and adopts the generative approach to formal syntax. It focuses on the study of syntactic variation covering both the study of microvariation, i.e. variation between closely similar languages and/or dialects and macrovariation, i.e. variation between languages which display wider variation. A major part of her research has dealt with the syntax of West Flemish, her native language.

The Odysseus project (Comparative syntax. Layers of structure and the cartography project) adopts the cartographic approach to syntax, whose aim it is to decompose the sentence in its primitive syntactic components. The research project has three main lines of enquiry. A first project line deals with the syntax of the left periphery of the clause, i.e. the constituents to the left of the subject position. The goal is to determine to what extent the left periphery of the clause may be structurally deficient and whether the deficiency can be derived from independent principles of the grammar. The second line of the project examines the demarcation of the left periphery (‘CP’) and the core sentential domain (‘TP’) in the light of recent proposals in cartographic approaches and raises the question of the status of the subject position in relation to CP and TP. The third strand of research examines to what extent the internal structure of the nominal projection can be assimilated to that of the clause.

# Leo Kestens: “Engineering of 3D microstructures in metals: bridging ten length scales of functionality”

Leo Kestens was born on June 26th1964 in Aalst, Belgium. More than twenty years ago he has graduated as an Engineer in Physics from Ghent University in Belgium. From Ghent he moved to Leuven where he has made the switch from physics to materials science and obtained his PhD in 1994 with a dissertation on the role of crystallographic textures in electrical steels which are used as magnetic flux carriers in a wide variety of applications. After his promotion he has continued his research in the field of steel metallurgy, first as a postdoc in the group of Prof. John J. Jonas at McGill University in Montreal and afterwards at the Centre for Research in Metallurgy (CRM) which is the collective research centre of the Benelux steel industry. In 1998 he returned to Ghent University where he has started his own research group on the crystallographic aspects of physical metallurgy and since 2005 he was appointed at TU-Delft where he holds the chair on Microstructure Control in Metals.

The research that he is carrying out with his group is entirely focused on the microstructure of metals. To a certain extent, the goal of this work can be compared to the attempt of unveiling the DNA code of the (human) genome. On the basis of ab-initio principles materials scientists know that all macroscopic materials owe their properties to their microstructural features which can be revealed with various microscopes with resolutions that vary from a few microns to less than 1 Å. Whereas physicists consider idealized matter (i.e. systems which are strongly conditioned by severe boundary and initial values) materials engineers rather work with matter as it is used in the real world. Such materials, which in our society are very often available as commodity goods such as steel, aluminium or copper, exhibit an amazing abundance of complex microstructural features such as grain boundaries, crystal orientations, different crystal phases and nano-sized particles. In a very broad way all of these microstructural features can be considered as defects of the perfect crystal lattice. Hence the mission of the materials science engineer is to control and design the structure of these lattice defects so as to obtain the desired macroscopic properties. Most often it is the complexity of the interactions between such defects which constitutes the most challenging obstacle in reaching this goal. One simple example may illustrate this complexity: although the stress field around one single dislocation is precisely known as well as the interaction behavior between a limited number of dislocations, material scientists still struggle today with the complex (but organised) patterns that arise when huge numbers of dislocations start to interact. Brutal computing force will not be sufficient to solve this problem as in the next foreseeable future computers will not be powerful enough to take into account all of the (non-linear) interactions. Hence, clever abstractions are required which extract the essential state variables from the microstructure under consideration and which are of relevance to the property of interest. This can only be obtained by a concerted effort of computational modelling in combination with advanced experimental observation of microstructures.

# Bart Baesens: “Intelligent information systems: new techniques and applications”

Bart Baesens is an assistant professor at the Department of Decision Sciences and Information Management, Faculty of Business and Economics, K.U.Leuven (Belgium). He has done extensive research on predictive analytics, data mining, classification and credit risk management. His findings have been published in well-known international journals and presented at international top conferences.

The immense popularity of the Internet and recent technological innovations in storage technology have caused a true tsunami of data. The need to build intelligent information systems, targeted at learning patterns from data and subsequently deploying them in key business processes, is now stronger than ever before. In this research project, we study how to build intelligent information systems by developing new predictive algorithms for rule extraction using both Support Vector Machines (SVM) and Ant Colony Optimization (ACO) techniques, with extensions for dealing with domain knowledge, small data sets and networked observations. We will validate the newly developed algorithms in several practical, real-life problem settings. It will be noted that the suggested research is multi-disciplinary in nature, having a core management informatics focus, but with clear links to finance, marketing and statistics.

# Jan Beyers: “Multi-level political institutions and the changing politics of interest representation”

Jan Beyers' research covers social science research methods, comparative political institutions and interest group politics. He studied political science at the University of Antwerp (BA and MA), the University of Leuven (PhD) and statistics at the Catholic University of Brussels. He held a visiting scholar position at the University of Oslo, ARENA (2000-2003). In 2003 he joined the Department of Political Science at the Leiden University (the Netherlands) where he taught theories of international relations, European Union Politics and research methods. His publications appeared in several top-tier journals such as International Organization, the Journal of Common Market Studies, the European Journal of Political Research, Comparative Political Studies, and European Union Politics. In 2005 he was (with Jarle Trondal) awarded the Vincent Wright Prize for the best article published in West European Politics vol. 27.

The central aim of this Odysseus project is to answer the following question: how do political organizations adapt to multi-level political opportunities in terms of internal organization, political strategies as well as their programmatic policy agenda? The answer to this question will contribute to a more fine-grained understanding of why some political interests are able to take advantage of the growing transnationalization of politics while other interests are on the loosing side. The project integrates a multitude of theoretical approaches including organization theory, different strands of institutionalism as well as population ecology. It is the combination of different frameworks into a systematic and well-integrated research design that will lead to a substantial empirical enrichment of ongoing theoretical debates. This ambitious enterprise builds on three interlinked empirical projects that each deal with the organization of political interests in different institutional contexts. The first project aims to establish a grounded understanding of the conditions under which multi-level venue shopping takes place. The second project investigates the development of the WTO transnational trade interest group system. Finally, a third project builds a theoretical framework in order to explain different forms of territorial representation at the EU-level.

# Nick Van Remortel: “Exploration of the light Higgs Boson sector at the LHC”

Nick Van Remortel was born in Belgium in 1976. He studied Physics at the University of Antwerp, where he obtained his Ph.D. in 2003. He was Research fellow from 1998 till 2002 and Post-doctoral researcher from 2003 till 2004 at the Research Foundation – Flanders (FWO). He was also Post-doctoral researcher EU Research Training Network at the University of Helsinki from 2004 till 2006 and Research assistant from 2006 till 2007 at the same university. He is currently professor at the University of Antwerp.

In 2009, the Large Hadron Collider (LHC) at CERN in Geneva, Switzerland, will deliver the first data in an unexplored energy regime and an exciting era for particle physics will start. The proposed research investigates the experimental signatures of a light Higgs boson with a mass in the range between 114 – 135 GeV, by using data collected by the CMS experiment at the LHC collider. We focus on the distinct topology where the Higgs boson decays into a pair of b quarks and is accompanied by the production and decays of two top quarks: ttH->bbWWbb. Recent precision measurements of the top quark and W-boson masses at the Tevatron collider, Fermilab, USA, imply the existence of a relatively light Higgs boson with a mass less than 144 GeV at 95% C.L. inside the Standard Model (SM) of elementary particles. There is consensus in our field that a light Higgs will be the most challenging to observe, however it is vital to rule out or prove unambiguously its existence in order to establish the nature of the mechanism behind electroweak symmetry breaking and the origin of mass of elementary particles.

# Kerensa Broersen: “An analysis of the effects of Alzheimer’s disease-associated risk factors on the toxicity of Abeta aggregation”

Kerensa Broersen was born in 1975 in Hoorn, The Netherlands. She obtained an MSc in Nutrition and Food Management in 1998 at the University of Huddersfield, UK and a PhD in the biophysical characterisation of food protein aggregation in 2005 at the University of Wageningen, The Netherlands. Her first postdoctoral research at the Medical Research Council in Cambridge, UK, concerned the study of protein-lipid interactions involved in Parkinson’s disease. She is now appointed as a professor at the University of Brussels and works in the field of Alzheimer’s disease.

The granted project is titled: “An analysis of the effects of Alzheimer’s disease-associated risk factors on the toxicity of Abeta aggregation”.Aggregation of the Abeta peptide is believed to cause Alzheimer’s disease. We will study how natural (in-brain) effectors of Abeta oligomerisation interfere with the mechanism and stability of Abeta oligomers and, hence, augment or diminish the toxic action of Abeta in the brain. Results will be verified in vivo using cell culture and animal behaviour assays. The outcome of this study will be used to develop therapeutic strategies using chemical compound screening assays.

# Han Remaut: ‘Structural biology of Helicobacter pylori virulence factors’

Han Remaut was born in 1976 in the United States. He obtained a Master of Science degree in Biochemistry at Ghent University, Belgium in 1998, followed by a PhD in Biochemistry in 2003. As postdoctoral scientist, he then joined the lab of Prof. Gabriel Waksman at the Institute of Structural Molecular Biology, Birkbeck College, London.

For most pathogenic bacteria, a crucial initial step in the establishment of infection is the recognition and colonization of the host tissue by specific attachment via surface-exposed adhesion molecules. In gram-negative bacteria, these adhesins are displayed on the outer membrane as single proteins (e.g. autotransporters or two-partner secretion systems) or can be incorporated into filamentous polymers (chaperone/usher pili, type II pili, type IV secretion pili and curli). Adhesin-mediated attachment can simply serve as a means of avoiding clearance through mechanical shear, or can trigger more complex host responses like cytoskeleton reorganization and cell invasion, or provide the required proximity to the host cell to enable other virulence mechanisms to come into action (ea. effecter injection through type III and type IV secretion systems).

In an era of increased antibiotics resistance and difficulties in controlling hospital-acquired infections, it is essential to gain a better understanding of the fundamental principles governing the infectious process. The new group will study the structural molecular biology of bacterial adhesins and cell surface filaments with respect to their function in bacterial pathogenesis, with the ultimate aim of developing a new generation of virulence-targeted antimicrobials.

Virulence-targeted drug design is a novel concept in the development of new generation antimicrobials. Targeting virulence factors forms a potential alternative means of fighting infectious disease by selectively disarming pathogens, without placing immediate selective pressure on the bacteria. Due to its extreme persistence in the host and the known involvement of a complex adherence profile in maintaining infection, Helicobacter pylori forms an ideal proof-of-principle case for the development of anti-adhesin drugs.

# Nick van Eijndhoven “Neutrino Astronomy with IceCube and its Deep Core extension”

Nick van Eijndhoven was born on April 11th 1960 in's-Hertogenbosch, The Netherlands.

He graduated in experimental high-energy physics at the University of Nijmegen (NL) in 1983. From Nijmegen he moved to the University of Amsterdam (NL) to work on deep

inelastic (anti)neutrino-Deuterium scattering with the high-energy neutrino beams of the CERN accelerator complex in Geneva, Switzerland. He obtained his PhD in 1987 with a dissertation on the determination of the chiral coupling constants of u and d quarks.

After obtaining his PhD he became a CERN staff fellow to work on the LEP electron-positron collider experiment DELPHI, with a focus on the development of physics criteria to detect the decay of a light Higgs particle. In 1991 he became a tenured staff member at the University of

Utrecht (NL), where he introduced a new research line in the field of ultra-relativistic heavy-ion collisions with the CERN accelerator facilities. Within various international collaborations he played a role as coordinator of both the design of detector systems (simulation studies)

and the development of innovative analysis methods and in 1998 he was appointed associate professor at the Utrecht University. In 2002 he has taken the initiative to start an activity in the interdisciplinary field between astrophysics and particle physics, called Astroparticle Physics. In collaboration with colleagues from the Utrecht astrophysics department and the Netherlands Institute for Space Research (SRON) this resulted in a participation within the

IceCube project; the world's largest neutrino telescope at the South Pole. Within IceCube he is the projectleader of the Dutch group and his scientific focus is on transient phemomena, i.e. Gamma Ray Bursts and flares of Active Galactic Nuclei, which are believed to be the most violent cosmic events and the sources of the most energetic Cosmic Rays that hit the Earth.

Astroparticle Physics revolves around phenomena that involve (astro)physics under the most extreme conditions. Black holes with masses a billion times greater than the mass of the Sun, accelerate particles to velocities close to the speed of light. The produced high-energy particles may be detected on Earth and as such provide us insight in the physical processes underlying these cataclysmic events.

Neutrinos are special astronomical messengers; only they can carry information from cosmological events at the edge of the Universe directly towards the Earth. Furthermore, since they are hardly hindered by intervening matter, they are the only messengers that can provide information about the central cores of the cosmic accelerators.

Observation of extraterrestrial high-energy neutrinos would have an enormous impact on the field of astrophysics and cosmology. It would open a completely new window on the Universe, revealing parts not accessible by other messengers and as such neutrino astronomy is poised to yield new, unexpected discoveries. The situation could probably best being compared with the advent of radio astronomy, which also revealed a large scala of new phenomena.

With IceCube, the world's largest neutrino observatory at the South Pole, a world wide effort has been initiated to search for high-energy neutrinos from cosmic phenomena. IceCube (http://www.icecube.wisc.edu) is a neutrino telescope consisting of an array of optical sensors, located in the icecap of the South Pole at depths between 1450 and 2450 m. Currently an additional dense array of sensors is being installed down to the largest possible depths in the Antarctic ice and completely surrounded by the standard IceCube sensors, acting as a veto.

This additional detector component is dubbed the Deep Core extension and it will allow us to search for cosmic neutrinos with unprecedented sensitivity. The focus of the proposed research is on the most violent cosmic explosions, i.e. Gamma Ray Bursts and flares of Active Galactic Nuclei. Combination of satellite observations with the data of IceCube with its Deep Core extension opens up the possibility of identifying high-energy neutrinos originating from these transient cosmic events for the first time in history.

# Jeroen Raes “Systems-level analysis of the human microbiome in health and disease”

Jeroen Raes was born in 1976 in Belgium. After his masters in Biochemistry (UA, 1998) and masters in Bioinformatics (FUNDP, 2001) he did his PhD in bioinformatics and comparative genomics in the lab of Pierre Rouze and Yves Van de Peer (VIB-PSB, UGent), focusing on the role of gene and genome duplication in evolution and the birth of novel gene functions. After an IWT postdoc with CropDesign on the identification of novel yield target genes, he moved to the European Molecular Biology Laboratory (EMBL) in Heidelberg, Germany, for a postdoc in the lab of Peer Bork on computational analysis of environmental sequence data (metagenomics), where he was later promoted to scientist, focusing on the integration of heterogenous environmental‘omics’ data. Jeroen Raes is a very productive young researcher with several high ranked publications. Computational metagenomics is a field that is growingextremely fast in Europe, but also in the US and Asia.

The bioinformatic methods that wil be used in this project are new, original and groundbraking for studying human microbiota and just such move that is needed for successful research of this area.

The functioning of the human body constitutes a complex interplay of human processes and ‘services’ rendered to us by the 1000 trillion microbial cells we carry. Disruption of this natural microbial flora is linked to infection, autoimmune diseases and cancer, but detailed knowledge about our microbial component remains scarce. Recent technological advances such as metagenomics and next-generation sequencing permit, for the first time, to study the various microbiota of the human body at a previously unseen scale. These advances have allowed the initiation of the International Human Microbiome Project, aiming at genomically characterizing the totality of human-associated microorganisms (the “microbiome”).

However, the complexity of metagenomic datasets makes their analysis a major bottleneck. This allowed the birth of a new, exciting subfield in computational biology which will eventually permit classical, cellular level systems biology progress towards modeling of entire communities (“eco-systems biology”), and untangling interspecies networks of competition, collaboration and communication at the molecular level.

Raes will combine large-scale, next-generation sequencing with novel computational approaches to investigate the functioning and variability of the healthy human microbiome at the systems level and investigate the role of host properties on the native flora. In addition, he will study the microbiota dysbiosis in inflammatory barrier diseases to further understand the microbial component in disease onset and progression. This approach will hopefully allow the development of novel treatments and the discovery of predictive and/or diagnostic markers.

# Sebastiaan Eeltink “Design and development of self-structuring nanomaterials for liquid chromatography”

Sebastiaan Eeltink is a young researcher and has obtained an excellent education in analytical chemistry at the University of Amsterdam. He has a great experience in the field of chromatography and electro-chromatography. The proposed project dealing with the design and development of nanomaterials to be used in liquid chromatography is original and very important for those working in the field of analytical chemistry.

The complexity of questions to be answered using chemical analysis is exponentially increasing. Yesterday’s separation systems are unable to solve today’s problems, and a completely new approach is needed to find the answer for tomorrow’s challenges. The present proposal aims at the design and development of revolutionary, self-structuring nanomaterials for liquid chromatography targeting the complex challenges posed by biomarker discovery and clinical diagnostics. The novel polymer nanomaterials will provide revolutionary and unmatched possibilities for high-resolution liquid chromatography-mass spectrometry (LC-MS) separations.

The morphology and surface chemistry of the nanomaterials will be tailored towards the requirements of tomorrow’s separation techniques: ultra-high-pressure LC, high-temperature LC, and two-dimensional chromatography. In addition, a new device will be developed for the separation of the future, spatial chromatography. In spatial chromatography components are separated in the space domain with each peak being characterized by its coordinates in a plane or a three-dimensional separation space offering to separate thousands of components without extending today’s time scale.

The nanomaterials of the future will be developed in capillary and microfluidic formats and applied to advanced life-science applications, including:

* Fingerprinting of complex protein and peptide samples using optimized one- and multi-dimensional LC-MS.
* Advanced on-chip bioanalytical separations, including on-chip spatial chromatography.
* Development of quantitative structure-retention relationships for one-dimensional LC separations to improve identification of peptides in LC with MS/MS data analysis.

The promise of this project is to help tackle the truly complex separation problems and to revolutionize biomarker discovery and contribute to our understanding of disease pathways. Tomorrow’s faster medical diagnostics and novel therapy regimes require new tools like the proposed analytical techniques.

The planned research activities would fit seamlessly in the activities of the Chemical Engineering department of the VUB. With its emphasis on applications in life sciences and biotechnology, the present proposal would strengthen the position of the department in these timely research fields and would strengthen and extend intra- and inter-university collaborations.

# Gennaro Melino

The p53 family includes three genes, TP53, TP63, 1P73, codifying for the corresponding transcription factors acting as tumor suppressor. While p53 was identified in 1979, the other two members of the family have been identified twenty years later. A strong effort has been focused in revealing the p53 transcriptome, given the essential, well-known role of this crucial tumor suppressor gene in the aetiology and development of cancer.

Despite much experimental evidence and epidemiological studies pointing to a role for p63/p73 in cancer, clean, unbiased data are only very recent. These studies revealed the pleiotropic nature of these transcription factors and led to the unexpected finding that p63 is crucial for epidermal development and p73 for neuronal development; and that both p63 and p73 play an important role in immunity and inflammation One of the reasons for this delayed discovery is the complexity inherent to the 1P73/TP63 genes. In fact, 1P631TP73 are transcribed as wide variety of isoforms (14 different proteins). I have a leading position on this area, which I would like to expand with local (University of Ghent, Faculty of Natural Sciences, Faculty of Health and Medical Sciences, VIB, other Belgian universities) and international collaborations, aiming at elucidation the role of p63/p73 in cancer development and inflammation. In particular: (i) develop new reagents (transgenic mice, antibody), (H) identify the protein structure of p63/p73 and their molecular interactions, (ii!) investigate their transcriptbme including small non coding RNA, (iv) clarify their role in cancer progression and their role in diagnosis, monitoring, prognosis, (v) investigate their involvement in inflammation, (vi) investigate their role in other pathologies, including the epidermis, and the nervous system, (vii) develop potential small molecule compounds able to modify the p63/p73 pathway and explore them at preclinical stage.

# Frank Verstraete

Among the most defining events in physics during the last decades were the spectacular advances made in the field of quantum many-body systems: the observation of quantum phase transitions in optical lattices, the creation of long-range entanglement and the realization that many-body quantum correlations can be used to build quantum computers are only a few of the remarkable breakthroughs. The description and simulation of such strongly correlated quantum systems and their associated entanglement structure represent some of the biggest challenges and opportunities in theoretical physics, and the investigation of those topics forms the central objective of this proposal.

Our main body of research is concerned with the description of the relevant wavefunctions of quantum many-body systems. The identification and quantification of the precise quantum correlations present in those wavefunctions has opened up the possibility for formulating variational classes of wavefunctions that capture all the relevant physics needed for describing them, which will allow to simulate quantum many-body systems that cannot be simulated with other methods due to e.g. the sign problem. We will address and reformulate problems in the fields of quantum magnetism, quantum

chemistry and quantum field theory, and develop novel algorithms for simulating those systems in the regimes where strong quantum correlations are present. Related issues on the topics of quantum computation, computational complexity and mathematical physics will also be explored.

We are confident that this work will impact the way we understand, observe and manipulate the quantum world. This is especially relevant since quantum effects will play an increasingly dominant role in future technologies, and success of future miniaturization efforts will crucially depend on our ability to deal with them.

# Georg Alexander Halder

My lab studies mechanisms of growth control that regulate organ size and tissue homeostasis using functional analysis of newly identified genes. Although growth control is a fundamental aspect of animal development, surprisingly little is known about the mechanisms that control organ size. We use *Drosophila* as a model system and perform genetic screens to discover novel signaling pathways that control organ growth and tissue homeostasis.

Over the last few years we discovered a novel tumor suppressor pathway, termed the Hippo pathway. Flies with defects in Hippo signaling produce severely overgrown tissues. Strikingly, the Hippo signaling pathway is highly conserved in vertebrates and defects in Hippo signaling are associated with many types of cancer. Thus, the Hippo pathway is a key regulator of organ growth and an important new cancer pathway. The focus of our current and future research is how this pathway is regulated and how defects in Hippo signaling cooperate with other cancer pathways to cause cancer.

In a first project, we will elucidate the molecular mechanisms of two novel signals that regulate the Hippo pathway and determine how Hippo signaling synergizes with other cancer pathways to promote cancer. In a second project, we will study a novel tumor suppressor mechanism whereby normal cells can cause the killing of pre-cancer cells and determine how cancer cells can evade this elimination. In a third project, we will use synthetic lethal screening to discover vulnerabilities of cancer cells that could be exploited for cancer therapy.

Together, our studies will lead to a better understanding of the defects that cause cancer and potential therapeutic approaches. We will initiate collaborations with cancer researchers at the University of Leuven to test the function and potential therapeutic value of the discovered genes in mouse and human models to translate our findings into the clinic.

# Zoe Kourtzi

Learning from experience and adapting to new situations is a fundamental skill for our everyday interactions. But what are the brain mechanisms that mediate an individual's ability to improve during training and make successful decisions? Here, I propose an integrated multidisciplinary study of learning-dependent plasticity that brings together behavioral measures, neuroimaging methods, physiological recordings, state-of-the-art interventions, and advanced computational approaches for modeling these rich biological data across species (i.e. human and non-human primates). My research program aims to: a) investigate the role of learning in shaping cortical circuits, neural functions and cognitive abilities that guide our perceptual decisions, b) advance our understanding of brain plasticity mechanisms at multiple levels from single neurons to small neural ensembles and cortical circuits, and c) test for brain-plasticity profiles that relate to variability in learning capacity across individuals of all ages and determine why some people learn better than others. The proposed work will provide novel methodological tools and theoretical insights in understanding the brain plasticity signatures of learning for decision making in the individual brain. This interdisciplinary approach promises groundbreaking advances in understanding the link between sensory input, brain plasticity and adaptive behavior across the lifespan and has potential implications for the design of a) biologically-inspired artificial expert recognition systems, and b) educational and intervention programs that facilitate normal development and rehabilitation in healthy ageing and disease.

# Cornelis Van Leeuwen

Despite extensive progress in the neuro- and cognitive sciences, a central problem has come little nearer to a solution: the relation between brain activity and conscious experience. Amongst the dynamic patterns that characterize brain activity, traveling waves are a most ubiquitous feature, occurring over a wide variety of mental tasks. Traveling waves provide cortical activity with unity and duration. Unity and duration are constitutive of conscious experience; this motivates a close look at the correspondence between cortical wave activity and consciousness. The proposed project aims to use psychophysical methods, in combination with eye-tracking and the measurement of cortical activity (EEG and MEG) to study in detail the correspondence between the duration of whole-head wave activity and that of experienced events. At the same time, the project is to extend earlier observations on the relationship between local wave activity and the communication of information between brain areas. These observations are providing insight into the relation of local brain activity and information processing. The project's ultimate goal is to connect local and global wave activity in brain processes, in order to cast a perspective on how consciousness and information processes are related. In realizing this objective, the project is moving towards an encompassing understanding of the triangle of conscious experience, information processing, and the brain.

# Thomas Hertog

A wide range of features of the world we observe find their ultimate explanation in the physical laws that govern the early universe. String theory is a rigid structure, based on a simple set of principles, that provides a unifying framework of the physical laws that should apply in the early universe. The principal goal of this project will be to work towards a physical cosmology that is based on string theory.

Such a 'string theory cosmology' would not only deepen our understanding of some of the most profound questions one might ask about our universe, but it would also further establish the early universe as a prime testing ground of fundamental high-energy physics.

Concretely, we plan to elucidate the quantum dynamics near the big bang and to study in particular how our usual classical notions of space and time emerge in string theory, starting from a formulation of the theory that is based on so-called holographic dualities.

We will also investigate how a precise meaning can be given to the quantum state of the universe in a string theory cosmology, and we will develop techniques to extract its observational consequences. The quantum state acts as a cosmological measure that selects the universe we observe from the set of all possible universes in string theory. It therefore plays a key role in the observational verification of the theory.

Finally we aim to derive a set of explicit predictions for the pattern of gravitational waves emitted in various processes in the early universe.

# Tom Van Doorsselaere

This project aims to advance coronal seismology by using the "forward modelling" technique. This is necessary to

accurately compare the models for coronal oscillations with the SDO/AIA observations (Solar Dynamics Observatory/Atmospheric Imaging Assembly). The Atmospheric Imaging Assembly is a collection of telescope on board the Solar Dynamics Observatory (the latest NASA satellite for studying our Sun), which is designed to observe the corona in different temperatures simultaneously.

The sun is surrounded by the hot corona, which is a plasma that is structured into coronet loops and active regions by the magnetic field. Because of the low density, the corona is optically thin. This makes it very difficult to measure the physical quantities in the solar corona directly. Coronal seismology is the technique that compares models and observations of coronal oscillations to (indirectly) measure the physical quantities in the solar corona. This technique was the first to give an accurate measurement of the coronet magnetic field.

This project applies the forward modelling technique in coronal seismology. This technique starts from existing (analytical and numerical) models. It computes the theoretical emission from these models and views it through instrument filters. It computes an artificial observation of the considered model as it would be seen by a certain instrument. It places the models on the same level as the observations, and allows for a direct, quantitative comparisonof the models and observations. This project is extremely timely. The SDO satellite has begun observing in the first half of 2010. It currently delivers a huge data stream with observations of coronet phenomena, including coronet oscillations. In order to cope with this data stream, it is necessary to advance coronal physics (and in particular coronal seismology) to a quantitative understanding now.

# Peter Tompa

Intrinsically disordered (ID) proteins (IDPs) exist and function without well-defined structures, defying the classical structure-function paradigm, Structural disorder is widespread in eukasyotic proteomes and is prevalent in proteins of regulatory, signaling and chaperone functions. The P1 of this proposal recognized the prevalence of structural disorder in RNA- and protein chaperones, he suggested an entropy-transfer" model for their molecular mechanism and provided evidence for the chaperone activity of several loPs, including the plant dehydrin early response to dehydration 14 (ERDI 4). The proposal suggests a systematic in-depth analysis of the mechanism of action of disordered ERD 14 to promote our understanding of how an IDP can carry out chaperone function in vitro and also to provide evidence for such a function in vivo. In a proteomic screening he will identify the physiological substrates of ERD 14 in A. thaliana cells. The substrates will be used to set up in vitro assays for the molecular characterization of the chaperone effect and dissection of the interactions of ERD 14 with its partners, complemented by detailed NMR characterization of its structural ensemble both in the absence and presence of its partners. 15N- and 15N-13C-labeled ERDI4 will then be delivered into live bacterial and plant cells to characterize its disordered structure in vivo by in-cell NMR. By applying dehydration stress (e.g. freezing and high salinity), it will explored how much overexpressed ERDI4 and its mutants can protect live cells and provide protection to particular substrates against denaturation, while undergoing structural transitions in the disordered state. These studies will present the first detailed structure-function analysis of a disordered chaperone both in vitro and in vivo, they will help elucidate its molecular mechanism of action in terms of the entropy-transfer" model and possibly open new avenues for practical applications of ID chaperones in generating stress-resistant cell-lines or organisms.

# Freya Blekman

At the presently accessible energies, elementary particle interactions are well described by the Standard Model. The Standard Model however has some fundamental limitations, and is expected to be no longer valid at energies that are easily accessed by the Large Hadron Collider (LHC), which started data taking in 2010. The LHC will eventually collide protons at a centre-of-mass energy of 14 TeV, which is a factor 7 higher than Tevatron, the most powerful accelerator in operation Today, and a factor two higher than the current energy of 7 TeV at which the accelerator is operated at the moment.

The LHC has been designed for the discovery of new physics in mind, with one of the key motivations the potential discovery of a range of new particles at higher interaction energy. There are many possible ways (some very spectacular) in which the breakdown of the Standard Model is predicted to be observable, but one of the most elegant solutions is the introduction of Supersymmetry. I propose to use the Compact Muon Solenoid (CMS) detector to examine the LI-IC data for new physics phenomena. Particularly popular extensions to the standard model are Supersymmetric models, which are highly tuneable and can produce very spectacular signatures. A dominant background for Supersymmetric particle production at the LHC is the production of top quarks that mimic the production of new physics.

I am convinced that the discovery of new physics at the LHC will be done by detailed studies of wellunderstood physics. The VUB/JIHE group already has a complementary activity in top quark physics, and I choose to focus on this particular experimental signature as it combines a solid experimental base in which I already have expertise with an environment in which Supersymmetry is very likely to be observed. If Supersymmetry or for that matter any new physics, like new particles, extra dimensions or additional symmetries exist in nature, top quark physics will be its background. I intend to use this event topology that is familiar to me as a gateway to more general Beyond-the- Standard Model physics studies at CMS.

# Benny Geys

Fuelled by a vast academic literature linking civic engagement to positive societal outcomes, policymakers - at both national and EU level (see Abram and Vike, 2008) - have shown increasing support to 'civil society" (and, especially, voluntary organisations). Still, two crucial problems may impair this literature's policy implications: I) the theoretical link between association membership and societal outcomes remains 'sketchy and underdeveloped' (Anheier and Kendall, 2002; Schneider, 2009); ii) the institutional setting in which voluntary associations develop and operate is often disregarded (Tarrow, 1996; Skocpol, 1996).

The present project is first to simultaneously engage with both criticisms. It a) tackles the theoretical 'sketchiness' by developing and testing micro-level explanations for the engagementtrust relation and b) addresses two specific effects of variations in countries' distributional institutions (epitomised in their welfare state systems; cf. Esping-Andersen, 1990, 1999). Specifically, we evaluate how such distributional institutions affect I) which types of civic engagement - e.g., bridging vs. bonding - thrive; and ii) the integration process within (different types of) voluntary organisations. The project's explicit comparative approach aims to provide more adequate policy conclusions about the development or retraction of civic engagement; whether in general, or limited to certain types of networks or institutional environments.

# Bence Nanay

The aim of this research project is to argue that the vast majority of what goes on in our mind is very similar to the simple mental processes of animals. Our complex, sophisticated, rational and linguistic abilities could be described as the icing on the cake. The right methodology for philosophy of mind is to understand those simple mental capacities that we share with animals first and then explain those uniquely human, highly intellectual mental capacities that make the human mind so remarkable.

My claim is that the human mind can be better understood if we consider what I call 'actionguiding perceptual representations' to be the basic units of our mental capacities. The human min,hd4, the mind of non-human animals, has been selected for allowing us to perform actions successfully. A the vast majority of our actions, like the actions of non-human animals, could not be performed without perceptual guidance. The mental state that mediates between perception and action is the basic building block of the human mind. I call mental states of this kind action-guiding perceptual representations.

Action-guiding perceptual representations are the immediate mental antecedents of action. And they are also genuine perceptual states. They guide, and often monitor, our ongoing bodily activities and the)' are also bonafide perceptual states: they provide a direct mediation between perception and action.

If we accept that the basic building blocks of the mind are action-guiding perceptual representations, then most classic questions in philosophy of perception and of action will look very different. The goal of this research project is to trace the various consequences of this way of thinking about the mind in a number of branches of philosophy as well as in other disciplines.

# Michiel Wouters

The subject of the research project is the theory of semiconductor nanostructures and ultracold atomic gases in the regime of strong light-matter coupling, with the goal to advance the theoretical models, to elucidate conceptual issues and to devise technological applications.

In solid state microcavities, strong light-matter coupling results in the bosonic, so-called polariton, quasi-particles that combine significant interactions with good quantum coherence. These favorable properties have resulted in a vigorous research activity that ranges from a conceptual understanding of their behavior to exploiting them for technological applications.

The Bose-Einstein condensed state of polaritons is a lively subject of fundamental research, where the most promising applications of microcavity polaritons are ultralow threshold lasing, generation of entangled photon pairs and miniaturized nonlinear optical devices.

A fundamental issue that will be addressed in this project, is the effect of the finite polariton life time - that impedes the polariton gas to reach thermal equilibrium - on the phase transition from the normal to superfluid state. With respect to technological applications, we will explore the possibilities of polaritons for polarization dependent nonlinear quantum optical devices. The main theoretical techniques that will be used are classical field theory (generalizations of the Gross- Pitaevskii equation), path integrals for many body systems and variational Monte Carlo. The further development of these techniques forms an important part of the research project.

Ultracold atomic gases are exceptionally controllable physical systems, that are excellently suited to mimic the properties of solid state systems. Strong light-matter coupling in ultracold atomic gases is emerging as a new frontier in this field. We will investigate the properties of polaritons in an artificial crystals of ultracold atoms. A Green's function technique will be used to analyze the polariton propagation. We will examine the tunability of the interactions between polaritons, aiming at enhancing the polariton-polariton interactions.

# Thomas Junkers

One of the most prominent synthesis strategies for conjugated polymer systems is the so-called Gilch or Gilch-type polymerization (GTP). In GTP, a monomer precursor is used that upon reaction with a strong base forms an active quinodimethane system that can undergo radical polymerization. For its radical mechanism, GTP is an attractive synthesis route since it allows for relatively mild reaction conditions and high tolerance towards functional groups. The aim of the proposed research program is to develop control methodologies that allows to synthesize poly(phenylvinylene)s or other poly(arylvinylene)s in a precise manner as known from controlled/living radical polymerization techniques in the realm of conventional radical

polymerization (which techniques so far show, however, no effective control over GTP). At the present stage, no control mechanisms are known which leads to the synthesis of conjugated polymers with high dispersity, insufficient control over the average molecular weight and functionality. If a controlled GTP can be achieved, conjugated polymers with narrow molecular weight distribution, exactly pre-determinable molecular weight and high endgroup fidelity will become available. With such material at hand, block copolymers of various types become available, either in sequential or in modular design approaches.

In this research a bottom-up approach is followed. first, the existing procedures are analyzed and a concise mechanistic and kinetic understanding of the polymerization is build up. With this knowledge at hand, a kinetic model is developed which can then be used to test control strategies and to predict the success rate of chosen synthesis routes. The most promising synthesis procedures are executed and tested via polymer characterization. After controlled GTP has become available, the method is used to synthesize different kinds of polymer architectures to provide new devices in the field of plastic electronics.

# Jeroen Huisman

Higher education systems, institutions (HEIs) and governments are increasingly confronted with challenges. Governments (supranational, national and regional) are trying to get the best out of their higher education systems and do so by trying to develop and put into practice appropriate governance mechanisms - e.g. regulations, funding, market mechanisms (competition) - to guide these systems towards maximum performance and an effective and efficient use of public and private resources. But what exactly are the impacts of governmental policies and governance mechanisms? And, which balance of system governance mechanisms should be strived for in light of the systems' objectives?

Taking the perspective of the HEIs, for these the question is how to respond to governance mechanisms. Given their relative autonomy, HEIs not only respond to, but also anticipate and contest governance imperatives. This leads to questions regarding which institutional strategies and positioning activities HEIs engage in, and how they shape institutional governance (e.g. strategies, positioning, marketing, identity-building).

Obviously there is a link between the two types of governance: In contemporary higher education systems, a dynamic interplay takes place between multiple actors in multiple environments and at multiple governance levels. The aim of the project is to increase our knowledge of higher education system and institutional governance theoretically and empirically, by bridging the field of higher education with the relevant disciplines (political sciences, [organizational] sociology, public administration and business administration). Theoretically, the project aims to improve our understanding of system and institutional governance processes and outcomes. Empirically, the project aims to analyse (a) whether and how system governance has changed (over time and in a comparative perspective) and how this has impacted HEIs and its constituents; (b) whether and how HEIs have changed (over time and across systems), in particular in relation to their strategies, positioning initiatives, marketing, identity and image, etc.

# William Alexander

While recent years have seen rapid advances in our understanding of the network of brain regions associated with cognitive control and decision making, the precise function of these regions remains highly ambiguous. A single region may appear to perform several different functions depending on the experimental task as well as the methodology used to measure neural activity. One particularly important region in this respect is medial prefrontal cortex (mPFC), In recent months, two groups working independently have published computational models of mPFC that account for a range of effects observed within the region under different experimental tasks and measurement methodologies. The formulation of the predicted response-outcome (PRO; Alexander & Brown, 2011) and the reward value and prediction (RVPM; Silvetti, Seurinck & Verguts, 2011) models is informed by reinforcement learning theory, and interprets mPFC function as signaling predictions of future outcomes as well as deviations from those predictions. These models have an unprecedented ability to comprehensively account for activity in nPFC based on well-known reinforcement learning formalizations. This suggests that the network of regions involved in cognitive control, including mPFC but also other areas such as dorsolateral prefrontal cortex, may implement some form of reinforcement learning. This project will test this hypothesis through a combined program of empirical investigation using tMRI and computational modeling based on our recently published work.

# Martin Guilliams

As barrier to the outside world the lung is in constant contact with innocuous environmental antigens, but is also the entrance site for many pathogens. Similarly, as one of the main sites of entrance of food antigens through the portal vein, the liver plays a central role in oral tolerance but the liver is also a major infection site. Importantly, loss of immune tolerance against environmental or oral antigens causes severe clinical complications, including allergic asthma or inflammatory bowel disease. Dendritic Cells (DC5) and Macrophages (MFs) play an essential role in the regulation of immune responses. Thus liver and lung DCs and MF5 appear to mediate two seemingly incompatible functions: maintaining tolerance against harmless antigens while retaining the capacity to response powerfully to invading pathogens. This Odysseus project is based on the hypothesis that the different functional tasks performed by tiCs and MF5 in the lungs and the liver are in fact mediated by distinct subsets of DCs and MF5. Unfortunately current available research tools cannot properly address the contribution of the individual DC or MF subsets in the regulation of pulmonary and hepatic immune responses. Therefore, this project proposes to utilize state-of-the-art techniques to generate the first knock-in mouse models that will allow to unambiguously study the specific role of the major lung MF subset, i.e. Alveolar Macrophages, the major liver MF subset, i.e. Kupifer Cells and the major antigen-presenting cells upon inflammation, i.e. Monocyte-de rived DCs, in vivo. This research project should lead to a better understanding of the functional role of these distinct MF and DC subsets in the regulation of specific pulmonary and hepatic immune responses, including allergic asthma, flu infection, oral tolerance and non-alcoholic fatty liver disease, which ultimately could lead to the design of more efficient immune intervention strategies to fight lung and liver diseases.

# Pieter Van Vlierberghe

T-lineage acute lymphoblastic leukemia (1-ALL) is an aggressive hematologic malignancy that requires treatment with intensified chemotherapy. Despite recent progress in clinical outcomes in this disease, 25% of children and over 50% of adult T-ALL cases show primary resistant disease or respond only transiently to chemotherapy and relapse. Moreover, studies of the long-term effects of chemotherapy in patients with 1- ALL show that recent gains in leukemia-free survival have been achieved at the cost of significant increases in

the rates of life-threatening and debilitating toxicities. Thus, further advances in the treatment of T-ALL will require the development of effective and highly specific molecularly targeted antileukemic drugs.

This imperative is particularly urgent in the case of early immature T-ALLs resembling early T-cell progenitors, which have been associated with early relapse and poor prognosis in pediatric 1-ALL. Importantly, I recently identified truncating mutations in the ETV6 gene as the first recurrent somatic mutation that is uniquely present in ETP-T-ALL, suggesting that ETV6 might be a crucial player in the biology of this novel subtype of poor prognosis T-ALL.

The goals of this research proposal are to define the molecular and cellular functions of .ETV6 mutations in 1- cell transformation and to analyze the oncogenic effects of mutant .ETV6 in vivo. The experiments described here will provide important novel information on the mechanisms of action of ETV6 mutations and the pathogenesis of early immature 1-ALL. Finally, the generation of an animal model of mutant ETV6 driven leukemia will be instrumental to test the efficacy of novel drugs and drug combinations for treatment of this aggressive disease.

# Andy Wullaert

The healthy gastro-intestinal tract is home to trillions of microbes living in peaceful harmony with the mucosal immune system. Maintenance of this intestinal immune homeostasis is regulated by a cross talk between the gut microbiota, mucosal immune cells and intestinal epithelial cells, three factors that are influenced by the host 'inflammasomes'. The latter are a set of multi-protein complexes that upon activation of their central caspase component mediate pro-inflammatory cytokine maturation and sometimes also induce cell death. While all inflammasomes until very recently were thought to be centred around caspase-1, brand new evidence has now revealed the existence of caspase-1 1-dependent inflammasomes. However, nothing is currently known about the respective roles of caspase-1 and -11 in colitis and intestinal inflammation. To remedy this situation, this project's central aim is to delineate and to understand the differential contributions of caspase-1- and caspase-1 1-dependent inflammasomes in the maintenance of intestinal immune homeostasis. For achieving this goal, we will evaluate the responses of conditionally targeted cell type-specific caspase-1 and -11 knockout mice in three different models of intestinal inflammation that recapitulate aspects of the environmental, genetic and infectious factors underlying intestinal disease development in humans. In addition to characterising the roles of the respective inflammasome types as well as the cell types in which they act, we will elucidate the intracellular, immunological and 'gut ecological' mechanisms by which caspase-1 and caspase-1 1 differentially modulate host susceptibility to intestinal inflammation. By establishing the mechanisms and cell types through which inflammasomes modulate intestinal host-microbe communication, this work will markedly advance our understanding of how infiammasome signalling determines intestinal disease susceptibility, and may reveal novel opportunities for preventing and treating inflammatory bowel disease in humans.

# Marco Davare

The hand is the principal organ through which we interact with our environment Grasping and manipulating objects with high dexterity requires the brain to extract useful information from multiple sensory modalities, in particular vision and touch. The integration of multiple sensory sources that convey information to the brain at different times during movement is a major challenge. I will study how the human brain integrates vision and touch for the planning and online control of skilled hand movements. To address these issues, I will develop a novel virtual reality environment in which vision and touch can be controlled independently while subjects grasp and manipulate objects. First, I will investigate how grasp movement parameters are influenced by visual and tactile cues. This will demonstrate the sensory rules used by the brain to integrate multisensory information during action. Second, by using a combination of transcranial magnetic stimulation (TMS), a method to stimulate the brain non-invasively, and functional brain imaging (WI), I will shed light on which parts of the brain are causally involved in integrating visual and tactile cues during action. New techniques to decode brain activity will further provide me with a precise topography of brain areas related to the processing of vision and touch- Third, I will determine how these specific brain areas transfer multisensory information to the motor cortex, which will in turn generate a precise motor command. By using a paired-pulse TMS technique I recently pioneered, I will quantify functional connectivity within the cortical network controlling grasping movements. A better knowledge of how the brain controls hand movements will directly benefit patients suffering from a loss of hand function and improve robotic grasp technologies that are used in brain-machine interfaces and neuroprosthetics.

# Joris De Wit

Precise synaptic connectivity is essential for the assembly of functional neural circuits. This proposal aims to unravel the molecular mechanisms that specify synaptic connectivity in developing circuits, and determine how perturbations in this process affect cognitive function.

During brain development, neurons connect with specific target cells. Synapses between different types of neurons have widely varying structural and functional properties. Understanding how this extraordinary precision in connectivity is achieved is important, as recent insights suggest that a loss in synaptic connectivity underlies cognitive disorders such as autism, schizophrenia and Alzheimer's disease. My work focuses on identifying the molecules and mechanisms that specify synaptic connections in the vertebrate brain.

Synaptic adhesion molecules are key organizers of connectivity that are required for normal synapse function. In my preliminary studies I have discovered a large and diverse complex of novel synaptic adhesion molecules. This complex is ideally suited to confer precise synaptic connectivity. I hypothesize that this molecular diversity determines the specificity of synaptic connections and contributes to the diversity of synapses. Synapse-specific combinations of adhesion molecules would thus determine the proper assembly of functional circuits.

We will determine how these novel adhesion molecules regulate synapse development and function in cultured neurons and in neural circuits in vivo. We will use mouse conditional genetics, in utero electroporation and viral vectors to manipulate their expression in specific cell types. We will analyze whether these adhesion molecules contribute to synaptic diversity by manipulating them at specific synapses onto defined neurons in vivo. Finally, we will characterize how perturbations in synaptic connectivity affect cognitive function, using behavioral testing in mice. Together, these studies will yield new insights into the mechanisms that establish precise synaptic connectivity under normal and pathological conditions. Ultimately, these insights will guide the development of new strategies for improved diagnostics and treatment.

# Kian Koh

In mammalian cells, a major epigenetic modification of DNA is methylation of cytosine. DNA methylation is critical during mammalian development, generally represses transcription when present at gene promoters and regulates cell lineage-specific gene expression programs. Conversely, during cellular reprogramming, efficient erasure of DNA methylation is essential for reactivation of previously silenced genes and for attaining pluripotency. The identity of such "DNA demethylase(s)" has been elusive until our recent discovery of the Tet family of dioxygenases. As a research fellow in Anjana Rao's group, I first reported that TEl proteins convert 5-m ethyl cytosine to 5- hydroxymethylcytosine in DNA, a novel epigenetic modification that can facilitate DNA demethylation and is associated with pluripotency. I further demonstrated that Tel] and Tet2 are highly expressed in mouse embryonic stem cells (ESCs) and regulate cell fate specification. ESCs depleted ofTetl by RNAi show diminished expression of the Nodal antagonist Leftyl, resulting in hyperactive Nodal signaling and skewed differentiation toward definitive endoderm in vitro. In Fgf4- and heparin-supplemented culture, let] -depleted ESCs activate the trophoblast stem cell determinant E1f5 and can colonize the placenta in midgestation embryo chimeras. Consistent with these findings, TetI-depleted ESCs form aggressive hemorrhagic teratomas with increased endoderm and ectopic appearance of trophoblastic giant cells. This proposal aims to address (I) the detailed mechanisms by which Tet proteins regulate the transition between ESC self-renewal and differentiation into distinct lineages; (2) how Tell regulates development of the early mouse embryo and (3) how Tel expression affects the differentiation potential of induced pluripotent stem cells (iPSCs). Insights from these studies will open new avenues to improve derivation of specific cell lineages from ESCs and iPSC5 by modulating Tel expression and/or activities, with potential applications in disease modeling and cellular replacement therapies.

# Joost Van Dongen

The aim of this research project is to investigate the metabolic and molecular adaptive responses of plants to low-oxygen stress. The knowledge that will be obtained with this research will help to increase stress tolerance of crop species and provide support to improve modern agricultural and horticultural production and storage processes. Oxygen is an essential substrate for respiratory energy production. Although the green parts of a plant are able to produce oxygen by themselves via photosynthesis, roots and fruits depend on oxygen from the environment for respiration. In contrast to most animals, plants can survive periods of low-oxygen availability for many hours or even days. During the last years, knowledge has accumulated about the molecular and biochemical adaptive responses that enable plants to do so. The research described in this application aims to expand our knowledge further and to apply this on the cultivation methods and storage procedures that are currently used for crop species such as tomato, apple and pear that have economical relevance for Belgium and Europe as well as (sub)tropical species such as rice and banana. This research is based upon recent discoveries by my current research team, such as the identification of the oxygen sensing mechanism in plants, and the non-cyclic mode of the Krebs cycle during low oxygen stress. The experiments combine the use of natural variation between varieties and modern molecular biology tools. Adaptive responses of energy metabolism will be investigated by using mass spectrometry driven metabolic profiling.

Mathematical modeling will be applied to investigate the interaction between various metabolic pathways. The results obtained by this project will improve our fundamental knowledge about metabolic stress reactions in plants, and will have an impact on commercial agricultural and horticultural practice in Europe and the tropics.

# Patrick Viatour

The Retinoblastoma gene (Rb) was the first identified tumor suppressor gene, more than 20 years ago. Together with the other Rb family members p107 and p130, Rb plays a critical role in the control of cell cycle activity by regulating the activity of E2F transcription factors. The Rb family members are integrated in the Rb pathway, where their activity is under the control of Cyclin/DKs complexes. This pathway is modulated by a wide range of pro-mitogenic stimuli, which ultimately leads to cell cycle entry. While it is known that the Rb pathway is inactivated in the vast majority of human cancer, the consequences of inactivating the Rb pathway during tumor initiation are poorly understood. In particular, recent evidences, including from our group, have suggested a new model for the Rb pathway, which involves the regulation of multiple biological activities beyond cell cycle. However, these new functions of the Rb pathway, while critical for its tumor suppressor functions, are particularly poorly defined. The overarching goal of my laboratory is to characterize the cellular and molecular functions of the Rb pathway, beyond the regulation of cell cycle activity, and identify downstream factors that play a critical role in tumor initiation upon its inactivation.

In particular, our data in the blood and the liver have shown that the Rb pathway plays a critical role in the regulation of stem cell populations, and inactivation of the Rb pathway leads to tumors (leukemia and hepatocellular carcinoma) originating from the stem cell compartment. Over the next five years, I intend to develop multiple strategies to understand the physiological and pathological roles of the Rb pathway in these two models. Ultimately, these avenues of research will lead us to the identification of new molecular targets to establish therapeutic strategies to cure these deadly diseases.

# Benedikt Szmrecsanyi

The project is situated at the crossroads of research on English as a World Language, usage-based theoretical linguistics, variationist linguistics, and cognitive sociolinguistics. It specifically marries the spirit of the PROBABILISTIC GRAMMAR FRAMEWORK (which posits that grammatical knowledge is experience-based and partially probabilistic) to research along the lines of the ENGLISH WORLD-WIDE PARADIGM (which is concerned with the dialectology and sociolinguistics of post-colonial Englishspeaking communities around the world). The overarching objective of the proposed research program is to understand the lectal plasticity of probabilistic knowledge of English grammar, on the part of language users with diverse regional and cultural backgrounds. Empirically, the project taps into a large corpus database sampling naturalistic language usage in some ten different varieties of English, and conducts a supplementary rating-task experiment. Utilizing modern analysis, modeling, and interpretation techniques, the project aims to probe the probabilistic factors constraining three syntactic alternations in the grammar of English: the genitive alternation (the president's speech versus the speech of the president), the dative alternation (we sent him a letter versus we sent a letter to him), and particle placement (he looked the word up versus he looked up the word). Research questions to be addressed include the following: What is the extent to which varieties of English share a core probabilistic grammar that is explanatory across different varieties? Which of the individual probabilistic constraints are universal, and which are culturally malleable? Are lectal differences random, or can they be explained by considering variety type (e.g. mother-tongue versus indigenized second-language varieties)? The proposed project is innovative in that it synthesizes two hitherto rather disjoint lines of research into one unifying project, thus injecting methodological and theoretical rigor into research in the English World-Wide paradigm, and providing the Probabilistic Grammar framework with a challenging, new empirical testing ground.

# Jeroen Van Boxtel

The relationship between selective attention and awareness (sometimes called consciousness) is at the center of a longstanding debate. Both attention to, and awareness of a visual event, shape the perception of subsequent events, yet how they determine our perception is still largely unknown. Arriving at an empirical and functional distinction between attention and awareness allows us to study the core problem: identifying the necessary and sufficient neural causes of a conscious percept Research often confounds the influences of attention and awareness, causing psychophysical experiments (including those used as diagnostic tools in clinical settings) to be difficult to interpret. Psychologists have tried to investigate each process in isolation; however, without controlling for possible influences of the other, leaving a potential confound unstudied. However, using afterimage stimuli,we recently have I) optimally separated the influences of attention and awareness, and 2) found that attention and awareness can have opposite effects on subsequent visual perception. These results contributed to our central hypothesis that attention and awareness are distinct processes and can be dissociated. The research proposed here will provide (I) a thorough description of the parameter regions of synergy and antagonism between attention and consciousness; (2) a clear conceptual and computational model of how the interaction takes place; (3) the identification of a mechanism that explains why people differ so greatly in the way attention influences their behavior, and provide insight into how certain patient groups (esp. people with autism) differ from 'neurotypicals" in this respect. This may lead to better diagnosis, better treatment, and plainly, a better understanding of the patient groups; (4) pinpoint neurobiological origins of attention and consciousness. The proposal should decipher whether the relationship between attention and awareness is monolithic, unchangeable, and permanent; or more delicate, malleable, and perhaps even adaptive.

# Ine Van Hoyweghen

Advances in the life sciences such as postgenomics and personalised medicine have renewed interest in the impact this health information will have on private life insurance practices in its contribution to new forms of human difference, discrimination, and solidarity. This project is the first comprehensive study to develop a sociology of postgenomic solidarity by studying the appropriation of genomic health information in European private life insurance with the overall aim of identifying underlying mechanisms through which difference and solidarity are being configured. Four objectives underpin this research into European life insurance: (I) developing a conceptual and methodological framework for the study of the appropriation of genomic health information; (2) enhancing empirical understanding of the appropriation of genomic health information; (3) systematicall y theorize how solidarity is (re-)configured in the postgenomic era; (4) thinking through the normative and political implicationsof.European life insurance in the postgenomic era. Using an innovative comparative, multi-sited research design, the project follows the appropriation of genomic health information in three societal practices: insurance underwriting; people's lived experiences; and policymaking and law. Allowing for the comparison across and between these practices, studies will take place in different European countries and on a trans- and supranational level, focusing on three paradigmatic diseases: obesity, breast cancer and schizophrenia. Several groundbreaking outcomes are expected: (1) a systematic account of a novel source of social dynamics: the role of the life sciences in generating new social and economic relations; (2) the advancement of social science thinking concerning solidarity; (3) the development of a novel framework for studying conflations between biology and sociality, and the life sciences and society; (4) a modification of central concepts pertaining to difference and solidarity in Western democracies.

# Hans Janssen

What if we were able to exploit the relation between the pore structure and the hygric behavior of building materials to analyse and design the moisture performance of building materials,building components and buildings ? More particularly, what if we could calculate the moisture transfer in building materials at the pore-scale level, what if we could explicitly quantify this processas the moisture storage and transport in a network of pores ? Such 'pore-network modelling' of moisture transfer in building materials will yield a substantial progress in the fundamental understanding and in the practical applicability of moisture transfer in building materials. To us as engineers, pore- network modelling will allow predicting the hygric properties of building materials directly from information on their pore structure, highly facilitating the hygric analysis and design of building materials. To us as scientists, pore-network modelling will moreover permit judging the origins and impacts of dynamic effects, air entrapment and hysteresis, leading to new insights on the physical model for moisture transfer in building materials.

This project therefore focuses on the development of pore-network models for unsaturated moisture transfer in building materials. Input is provided by a complete characterisation of the pore structure of selected building materials, validation is made possible by a thorough measurement of the hygric properties of selected building materials. A concluding 'proof of concept' will finally demonstrate the feasibility of hygric design of building materials supported by network models.

The numerical and experimental research activities put forward in this project application ultimately converge into a fundamental progress in the practical applicability and the essential understanding of moisture transfer in building materials, and thus in an important advancement of the state-of-the-ad.

# Wim Thielemans

Nature builds very complex, multifunctional systems by assembling simple building blocks in a directed manner compared to ic/nc/i most manmade structures are relatively simple.

In a hiotnimetic approach, we aim to create hierarchical mu/ti-functional one-, two- and three-dimensional structures with controlled long-range order through self-assem b/v of multifunctional rodlike nanoparticles. To achieve this, we will inodif-; the suiface of rod-like cellulose nanocrvstals at their three distinct sw/ace functionalities: primary and secondary hydroxyl groups and aldehydes. Using the difference in reactivity of their lateral surface primary and secondary hydroxv/ groups and of the aldehydes located at one cellulose chain end extremity, we will introduce assembly-directing groups, as well as other functionalities such as fluorescence, (electro)hromism, and redox and electron hopping capability. Ordered structures will he formed by self-assembly on solid surfaces, at liquid-liquid and liquid-gas interfaces, in hulk, and under flow, with and without addition of metal nanoparticles or di- or inultffunctiona/ linkers. Flexibility and spacing of the grafts will provide additional control over the self asseinhlv behaviour and performance of the additional •functionalities. This work builds on recent successes by the applicant in preparing cellulose nanocrvsta/s functionalised to alter membrane and templating behaviour, to add new functionalities such as fluorescence, to enable charge hopping along the nanowhisker surface. and to prepare bioanalytical sensors. Wim Thielemans is a highly motivated chemical engineer with a multidisciplinary and multinational track record, giving him unique skills to head this research efihrt. He will assemble a teacim of multidisciplinary researchers to s ynthesize novel surface-modified cellulose nanoparticles, elucidate ke y se/f-assembly relations and develop truly innovative mu/i/functional materials to drive advances in intelligent materials design. This project will deliver high calibre en ultidisciplinary researchers, reversing a strategic skills shortage and retaining them for future employment and benefit to science, industry and societ y in Flanders, Belgium and the European Research Area.

# Steven Lowette

One of the key questions in high-energy particle physics pertains the existence and the nature of the Dark Matter in the universe. The search for signatures of Dark-Matter production at colliders provides an exciting complementary avenue to the many ongoing searches trying to detect existing Dark-Mailer through the interaction of these particles with themselves or with ordinary mailer, The Large Hadron Collider (LHC) is particularly well suited to explore the production of Dark Matter in its new energy regime.

This project aims to define, develop and perform simplified benchmark analyses for the general search for Dark Matter with the CMS detector at the LHC, thereby covering an as large as possible set of theoretical models beyond the Standard Model of particle physics which may embed Dam-Mailer candidates. The development of such a coherent approach towards Dark-Matter detection in CMS will happen through an interdisciplinary feedback with theorists and with experimentalists working in he field of astro-particle physics in the home institute and beyond.

Secondly, the project aims to contribute to the online selection algorithms to ensure these searches can be performed when the LHC will in the future operate at the highest interaction rates. As such it will necessitate developments, driven by physics requirements, of innovative methods both on the side of readout electronics as well as reconstruction algorithms.

The envisaged results of the Dark-Matter search will consist of either the discovery of Dark Mailer, and subsequent study of its properties, or the most stringent limits from colliders to date and for a long time to come. The tracker project aims to lead to a key contribution in defining the physics potential of the upgraded CMS detector in the next decade.

# Stuart Maudsley

Inherited and sporadic neurodegenerative disorders, such as Alzheimer's disease, Parkinson's disease, frontal temporal lobar degeneration and cognitive impairment, place a huge economic burden upon the European community. While considerable insight into the genomic basis of these disorders has been gained, relatively less information concerning how these genomic alterations then generate the disease pathophysiological phenotype has been gathered. The generation of an in-depth post-genomic appreciation of these central nervous degenerative disorders will be the primary goal of this project. A post-genomic profile of these diseases will be generated using analyses that cover the range of biochemical processes that facilitate the disease phenotypic expression, i.e. transcription, protein translation and biochemical metabolism. To create significant added value to this project, we will assess both individual disease paradigms and then investigate potential common mechanisms between them. For example, while these disorders are associated with specific genomic mutations they also share multiple functional mechanistic components, e.g. protein aggregation, oxidative stress, attenuated neurotrophic and calcium signaling, and altered receptor function. Therefore, despite their distinct genomic etiologies, disruption of central and peripheral neuronal physiology involves perturbation of shared cellular and systemic functionalities, suggesting that in-part a 'generic' neurodegenerative process exists. Using combined analyses of biofluids and tissues from identified patients, we intend to develop a multidimensional (transcriptomic, proteomic, metabolomic) phenotypic 'signature' for the specific and 'generic' central; nervous system diseases. Bioinformatic analysis of the molecular factors involved in these specific and generic 'signatures' will inform the generation of novel diagnostics, as well as novel therapeutic targets. With a comprehensive appreciation of the molecular signaling events that create the degenerative phenotype, it may also be possible to deploy this knowledge to understand and diagnose the more prevalent sporadic forms of neurodegeneration in the European Union.

# Paolo Azzurri

The main objective of this project proposal is the discovery and study of a Higgs boson produced in vector boson fusion (VBF) processes at the LHC and decaying to b-quarks. This is a promising channel for Higgs boson production in the 115- 130 GeV mass range. With the VBF process two quarks from the two colliding protons radiate a W or 7 boson pair that fuse to produce a Higgs boson, while the two quarks continue in the forward and backward direction and can be detected as "tag jets". Searching for a Higgs decay in this channel is an extremely motivating and challenging task. For a minimal standard Higgs boson, it would be the signal search with the largest expected production crosssection, but also the most difficult in terms of background reduction and separation.

In parallel to the Higgs boson analysis, the project will aim to measure and study complementary electroweak VBF productions of Z and W bosons. These productions present obvious similarities but also intriguing differences with respect to the VBF Higgs productions, and can be used to validate the Higgs sector measurements, while also allowing an assessment of Standard Model trilinear gauge self-couplings. Finally, with the data sample that will be collected at the LHC in four years from now, the project will concentrate on the intriguing aspects of W-pair scattering, with the goal of revealing possible new physics interaction between the fusing W-pairs.

To achieve these goals the project presents the opportunity to make use of a variety of both conventional and innovative data analysis techniques for high energy physics that are outlined in the proposed methodology.