Synergy Grants: Funded Projects

Examples of projects funded under SyG2012 and SyG2013

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Introduction

(extracted from WP2013)
Background
It is increasingly recognised that for complex scientific problems, collaboration between different researchers and their teams, often on an interdisciplinary basis and using shared facilities, can lead to outstanding new ideas and discoveries. Building on of its support to individual researchers, the ERC extends its portfolio of instruments to cover such collaborative research projects to push forward the frontiers of knowledge.

Objectives

ERC Synergy Grants are intended to enable a small group of Principal Investigators and their teams to bring together complementary skills, knowledge, and resources in new ways, in order to jointly address research problems.
The aim is to promote substantial advances at the frontiers of knowledge, and to encourage new productive lines of enquiry and new methods and techniques, including unconventional approaches and investigations at the interface between established disciplines.
The peer review evaluation will therefore look for proposals that demonstrate the synergies, complementarities and added value that could lead to breakthroughs that would not be possible by the individual Principal Investigators working alone.

Size of ERC Synergy Grants

The maximum grant can be up to a maximum of EUR 15 000 000 for a period up to six years (pro rata for projects of shorter duration).

Profile of the ERC Synergy Grant Principal Investigators

Groups applying for the ERC Synergy Grant must be made up of a minimum of two and a maximum of four Principal Investigators and, as necessary, their teams. One of the Principal Investigators must be designated as the Corresponding Principal Investigator. Applications are expected from a group of innovative and active Principal Investigators. ERC Synergy Grants are designed to foster research at the intellectual frontiers. New types of joint effort may be needed that allow for new combinations of skills and disciplines, or the bringing together of researchers from different institutions, sectors or countries. It is therefore expected that the organization of such activities will vary widely, depending on the particular needs of the research.
It is expected that in most cases ERC Synergy groups will be interdisciplinary, often using multidisciplinary approaches. Principal Investigators funded through the ERC Synergy Grants will be expected to spend a minimum 30% of their total working time on the ERC project and a minimum of 50% of their total working time in an EU Member State or Associated Country. They will also have to demonstrate novel working arrangements to ensure face to face contact for significant periods of “core time” in the same place over the course of the project.

With the focus on the Principal Investigators, the concept of an ERC Synergy group is fundamentally different from that of a network or consortium of undertakings, universities, research centres or other legal entities. Proposals of the latter type should not be submitted to the ERC.

SOMICS

Project ID: 609819
Funded under: FP7-IDEAS-ERC

Constructing Social Minds: Coordination, Communication, and Cultural Transmission

From 2015-01-01 **to** 2020-12-31, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 9 618 292,2	ERC-2013-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 9 618 292,2	ERC-2013-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
Hungary	ERC-SyG - Synergy grant

Objective

Human cognition reflects the necessities of living in social groups transmitting cultural knowledge. Human minds are, richly and deeply, social minds. Working together we aim to better understand social minds by testing a new integrated theory with innovative methodologies.

Joint action and communication both build and exploit common ground. At a basic level common ground is tied to shared perceptions and shared action repertoires allowing joint activities. At a second level, established through ostensive communication, common ground includes also general knowledge of enduring relevance. These two levels have been studied separately. We hypothesize that joint action exploits forms of ostension found at the second level, and that ostensive communication draws on forms of coordination found at the first level. Through our integrated study of the two levels we aim to redefine the relation between coordination, communication, and cultural transmission.

Our common program will close gaps between research that has focused on the processes and representations that enable joint action (Call, Knoblich) and research that has addressed intentional communication and its role in cultural transmission (Gergely, Sperber). It will integrate the study of a) embodied cognitive mechanisms for interpersonal coordination, b) shared intentions and shared task representations, c) ostensive communication, d) natural pedagogy, and e) how all of the above provide the micro-mechanisms of cultural transmission.

Integrating the four PIs' research programs will also lead to methodological synergies. We will develop and use in a converging manner experimental procedures for the comparison of infant, children, human adult and primate data, models of cultural evolution, and novel ways of eliciting and using anthropological evidence, leading to a transfer of methodological knowledge and practices across fields.

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Subjects

Scientific Research

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BLACKHOLECAM

Project ID: 610058
Funded under: FP7-IDEAS-ERC

Imaging the Event Horizon of Black Holes

From 2014-10-01 **to** 2020-09-30, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 13 975 744	ERC-2013-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 13 975 744	ERC-2013-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
Netherlands	ERC-SyG - Synergy grant

Objective

Gravity is successfully described by Einstein's theory of general relativity (GR), governing the structure of our entire universe. Yet it remains the least understood of all forces in nature, resisting unification with quantum physics. One of the most fundamental predictions of GR are black holes (BHs). Their defining feature is the event horizon, the surface that light cannot escape and where time and space exchange their nature. However, while there are many convincing BH candidates in the universe, there is no experimental proof for the existence of an event horizon yet. So, does GR really hold in its most extreme limit? Do BHs exist or are alternatives needed? Here we propose to build a Black Hole Camera that for the first time will take an actual picture of a BH and image the shadow of its event horizon. We will do this by providing the equipment and software needed to turn a network of existing mm-wave radio telescopes into a global interferometer. This virtual telescope, when supplemented with the new Atacama Large Millimetre Array (ALMA), has the power to finally resolve the supermassive BH in the centre of our Milky Way – the best-measured BH candidate we know of. In order to compare the image with the theoretical predictions we will need to perform numerical modelling and ray tracing in GR and alternative theories. In addition, we will need to determine accurately the two basic parameters of the BH: its mass and spin. This will become possible by precisely measuring orbits of stars with optical interferometry on ESO's VLTI. Moreover, our equipment at ALMA will allow for the first detection of pulsars around the BH. Already a single pulsar will independently determine the BH's mass to one part in a million and its spin to a few per cent. This unique combination will not only produce the first-ever image of a BH, but also turn our Galactic Centre into a fundamental-physics laboratory to measure the fabric of space and time with unprecedented precision.

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Scientific Research

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NANOCOSMOS

Project ID: 610256
Funded under: FP7-IDEAS-ERC

Gas and Dust from the Stars to the Laboratory: Exploring the NanoCosmos

From 2014-08-01 **to** 2020-07-31, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 14 983 261	ERC-2013-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 14 983 261	ERC-2013-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
Spain	ERC-SyG - Synergy grant

Objective

Evolved stars are the factories of interstellar dust. This dust is injected into the interstellar medium and plays a key role in the evolution of astronomical objects from galaxies to the embryos of planets. However, the processes involved in dust formation and evolution are still a mystery. The increased angular resolution of new generation telescopes, will provide for the first time a detailed view of the conditions in the dust formation zone of evolved stars, as shown by our first observations with ALMA.

We propose to combine astronomical observations, modelling, and top-level experiments to produce star dust analogues in the laboratory and identify the key species and steps that govern their formation. We will build two innovative setups: the Stardust chamber to simulate the atmosphere of evolved stars, and the gas evolution chamber to identify novel molecules in the dust formation zone. We will also improve existing laboratory setups and combine different techniques to achieve original studies on individual dust grains, their processing to produce complex polycyclic aromatic hydrocarbons, the chemical evolution of grain precursors and how dust grains interact with abundant astronomical molecules. Our simulation chambers will be equipped with state-of-the-art in situ and ex situ diagnostics.

Our astrophysical models, improved by the interplay between observations and laboratory studies, will provide powerful tools for the analysis of the wealth of data provided by the new generation of telescopes. In addition, new broad-band state-of-the-art High Electron Mobility Transistor receivers will be built, allowing us to perform an unprecedented astronomical survey of evolved stars and providing an invaluable legacy for any scientist in the field. The synergy between astronomers, vacuum and microwave engineers, molecular and plasma physicists, surface scientists, and theoreticians in NANOCOSMOS is the key to provide a cutting-edge view of cosmic dust.

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imPACT

Project ID: 610150
Funded under: FP7-IDEAS-ERC

imPACT – Privacy, Accountability, Compliance, and Trustin Tomorrow's Internet

From 2015-02-01 **to** 2021-01-31, ongoing project

Project details

Total cost:	Topic(s):
EUR 9 257 000	ERC-2013-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 9 257 000	ERC-2013-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
Germany	ERC-SyG - Synergy grant

Objective

The Internet has evolved from a mere communication network used by tens of millions of users two decades ago, to a global multimedia platform for communication, social networking, entertainment, education, trade and political activism used by more than two billion users. This transformation has brought tremendous benefits to society, but has also created entirely new threats to privacy, safety, law enforcement, freedom of information and freedom of speech. In today's Internet, principals are amorphous, identities can be fluid, users participate and exchange information as peers, and data is processed on global third-party platforms. Existing models and techniques for security and privacy, which assume trusted infrastructure and well-defined policies, principals and roles, fail to fully address this challenge.
The imPACT project addresses the challenge of providing privacy, accountability, compliance and trust (PACT) in tomorrow's Internet, using a cross-disciplinary and synergistic approach to understanding and mastering the different roles, interactions and relationships of users and their joint effect on the four PACT properties. The focus is on principles and methodologies that are relevant to the needs of individual Internet users, have a strong potential to lead to practical solutions and address the fundamental long-term needs of the future Internet. We take on this challenge with a team of researchers from relevant subdisciplines within computer science, and with input from outside experts in law, social sciences, economics and business. The team of PIs consists of international leaders in privacy and security, experimental distributed systems, formal methods, program analysis and verification, and database systems. By teaming up and committing ourselves to this joint research, we are in a unique position to meet the grand challenge of unifying the PACT properties and laying a new foundation for their holistic treatment.

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Subjects

Scientific Research

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Ice2Ice

Project ID: 610055
Funded under: FP7-IDEAS-ERC

Arctic Sea Ice and Greenland Ice Sheet Sensitivity

From 2014-08-01 **to** 2019-07-31, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 12 496 330	ERC-2013-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 12 496 330	ERC-2013-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
Norway	ERC-SyG - Synergy grant

Objective

The cryosphere is in fast transition. The possibility that the ongoing rapid demise of Arctic sea ice may instigate abrupt changes on the Greenland Ice Sheet (GIS) is not tackled by current research. Ice cores from the GIS show clear evidence of past abrupt warm events,up to 15 degrees warming in less than a decade, possibly caused by disappearing se ice in the Nordic Seas..Arctic sea ice extent was in 2012 half of the 1979-2000 average. Satellite data document an increasing loss of GIS ice mass since 1990 and temperatures have risen markedly at the GIS summit. Strong transient changes in both Arctic cryospheric entities prompts the question: Is the dramatic decline in Arctic Sea Ice heralding a new phase of abrupt change, similar to those recorded in ocean sediments and ice cores? Such changes would have major consequences for the GIS mass balance and global climate and sea level. Ice2Ice will approach this complex problem by integrating 4 PI teams from three Nordic world class research centres comprising empiricists and dynamicists specialized in Arctic and Greenland atmospheric, oceanic and cryospheric sciences. With an innovative combination of synchronized records of GIS parameters, records of sea ice change and models ranging from global climate models to regional and process models, Ice2Ice will be the first concerted effort to tackle the question of the cause and future implications of past abrupt climate change in Greenland, the main hypothesis being that Arctic and sub-Arctic sea ice cover is key to understand past and future Greenland temperature and ice sheet variations. In Ice2Ice this will be done by:a)describing the nature, timing and extent of abrupt events across climate archives,b)resolving mechanisms behind the sudden demise of sea ice cover,c)identifying the risk that the ongoing rapid diminution of Arctic sea ice cover could give abrupt GIS changes in the future, d)determining the impacts of such changes for the GIS, Arctic and global climate.

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MERiC

Project ID: 609883
Funded under: FP7-IDEAS-ERC

Mechanisms of Evasive Resistance in Cancer

From 2014-05-01 **to** 2020-04-30, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 11 197 882	ERC-2013-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 11 197 882	ERC-2013-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
Switzerland	ERC-SyG - Synergy grant

Objective

Cancer is a major health problem due to the failure of current therapies to effectively eradicate the disease. Alternative signaling pathways compensate for a therapeutically targeted pathway, a process referred to as 'evasive resistance'. The identities of the alternative signaling pathways and functional interconnections that underlie evasive resistance remain widely unknown. We propose to integrate cutting-edge clinical, molecular, and computational sciences to understand the signaling defects that allow tumors to evade therapy. With its synergistic, interdisciplinary approach, the proposed project is, to our knowledge, unique in Europe and possibly worldwide.
Within the framework of rigorously designed clinical studies, a clinician will provide basic research scientists with diseased tissue isolated before therapy, during treatment or at the time of tumor progression. The tissue, chosen based on medical importance, accessibility to repeated sampling, and ethical considerations, will be from hepatocellular carcinoma. Tumor tissue will be obtained by needle biopsy and snap frozen to preserve in vivo properties. The basic research scientists and a computational biologist will determine, characterize and model the underlying signaling defects. Importantly, using longitudinal clinical samples in combination with mouse and cellular HCC model systems, we will seek to define treatment-related changes in cell signaling that allow tumors to circumvent therapy. This process will be iterative such that changes in treatment strategies will again be monitored in the same patient or experimental model. Insights gained will be used (i) to understand mechanisms of evasive resistance, (ii) to identify novel drug targets and predictive biomarkers, and (iii) to rationally design personalized medicine that ultimately increases therapeutic effectiveness and reduces financial burden. This innovative, comprehensive endeavor will improve diagnosis, treatment and clinical outcome.

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HELMHOLTZ

Project ID: 610110
Funded under: FP7-IDEAS-ERC

Holistic evaluation of light and multiwave applications to high resolution imaging in ophthalmic translational research revisiting the helmholtzian synergies

From 2014-08-01 **to** 2020-07-31, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 11 861 923	ERC-2013-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 11 861 923	ERC-2013-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
France	ERC-SyG - Synergy grant

Objective

The HELMHOLTZ project associates two leading neighbouring institutions: the Institut de la Vision (Fondation Voir et Entendre) and the Institut Langevin (Fondation Pierre-Gilles de Gennes) committed to boost the integration of technological research in photonics, acoustics and ultrasound with translational research on vision impairment, in order to co-develop and validate prototypes for non-invasive in vivo structural and functional dynamic imaging technologies for ophthalmology.
Innovative imaging tools will rely on emerging concepts such as ultrafast ultrasound, laser Doppler holography, full field and ultrafast cell resolution optical coherence tomography (OCT), bi-photon microscopy. These will enable both structural and functional analyses of the ocular tissues, with strong focus on the macula, the central part of the retina which is affected by the most severe disabling conditions, e.g. retinal dystrophies, age-related macular degeneration, glaucoma, vascular diseases, diabetic retinopathy, toxicities. We shall explore: 1) the subcellular and dynamic structure of photoreceptors, 2) changes in vascular flow and 3) functional imaging of the visual system from retina to cortex.
Massive data acquisition and ultrafast numerical signal processing will take advantage of GPU-based parallel computing and of new asynchronous visual sensors. Continuous feedbacks from animal and human studies will lead to refine or redefine the prototypes jointly.
These new diagnostic tools will address unmet medical needs by improving the understanding of retinal pathophysiology, defining new biomarkers for disease progressions and enabling clinicians to select the best suited emerging therapies, from neuroprotection to gene therapy and visual restoration. As the most optically and functionally approachable part of the brain, the retina will thus exemplify and validate major streams of technological innovations for care by enhancing cross-fertilization between biomedicine and physics.

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Subjects

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SC2

Project ID: 610115
Funded under: FP7-IDEAS-ERC

Spin-charge conversion and spin caloritronics at hybrid organic-inorganic interfaces

From 2014-08-01 **to** 2020-07-31, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 9 651 487	ERC-2013-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 9 651 487	ERC-2013-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
United Kingdom	ERC-SyG - Synergy grant

Objective

Organic semiconductors are enabling flexible, large-area optoelectronic devices, such as organic light-emitting diodes, transistors, and solar cells. Due to their exceptionally long spin lifetimes, these carbon-based materials could also have an important impact on spintronics, where carrier spins, rather than charges, play a key role in transmitting, processing and storing information. However, to exploit this potential, a method for direct conversion of spin information into an electric signal is indispensable. Spin-charge conversion in inorganic semiconductors and metals has mainly relied on the spin-orbit interaction, a fundamental relativistic effect which couples the motion of electrons to their spins. The spin-orbit interaction causes a flow of spins, a spin current, to induce an electric field perpendicular to both the spin polarization and the flow direction of the spin current. This is called the inverse spin Hall effect (ISHE). We have very recently been able to observe for the first time the inverse spin-Hall effect in an organic conductor. This breakthrough raises important questions for our understanding of spin-charge conversion in materials with intrinsically weak spin-orbit coupling. It also expands dramatically the range of materials and structures available to address some currently not well understood scientific questions in spintronics and opens opportunities for realising novel spintronic devices for spin-based information processing and spin caloritronic energy harvesting that make use of unique properties of hybrid, organic-inorganic structures. The main objective of the proposed research is to take spintronics to a level that inorganic spintronics cannot reach on its own. The project is based on new theoretical and experimental methodologies arising at the interface between two currently disjoint scientific communities, organic semiconductors and inorganic spintronics, and aims to exploit synergies between chemistry, physics and theory.

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Subjects

Scientific Research

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IMBALANCE-P

Project ID: 610028
Funded under: FP7-IDEAS-ERC

Effects of phosphorus limitations on Life, Earth system and Society

From 2014-09-01 **to** 2020-08-31, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 13 600 579,98	ERC-2013-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 13 600 579,98	ERC-2013-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
Spain	ERC-SyG - Synergy grant

Objective

P is an earthbound and finite element and the prospect of constrained access to mineable P resources has already triggered geopolitical disputes. In contrast to P, availabilities of carbon (C) and nitrogen (N) to ecosystems are rapidly increasing in most areas of the globe. The resulting imminent change in the stoichiometry of available elements will have no equivalent in the Earth's history and will bear profound, yet, unknown consequences for life, the Earth System and human society. The ongoing shifts in C:N:P balances in ecosystems will necessarily affect the structure, function and diversity of the Earth system. P-market crises might put pressure on the global food system and create environmental ripple effects ranging from expansion of agricultural land to P-price-induced changes in land management exacerbating the stoichiometric resource imbalance. Yet, the impacts of this unprecedented human disturbance of elemental stoichiometry remain a research enigma. The IMBALANCE-P-team, that gathers four leading researchers in the fields of ecosystem diversity and ecology, biogeochemistry, Earth System modelling, and global agricultural and resource economics, is formidably positioned to address this Earth System management challenge by providing improved understanding and quantitative foresight needed to formulate a range of policy options that will contain the risks and mitigate the consequences of stoichiometric imbalances. IMBALANCE-P will integrate some of Europe's leading integrated assessment and Earth system models, calibrated using ecosystem nutrient limitation data obtained from field experiments. The project will establish an international process of science-based P-diplomacy.

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Subjects

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4D-GENOME

Project ID: 609989
Funded under: FP7-IDEAS-ERC

Dynamics of human genome architecture in stable and transient gene expression changes

From 2014-06-01 **to** 2019-05-31, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 12 272 645	ERC-2013-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 12 272 645	ERC-2013-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
Spain	ERC-SyG - Synergy grant

Objective

The classical view of genomes as linear sequences has been replaced by a vision of nuclear organization that is both dynamic and complex, with chromosomes and genes non-randomly positioned in the nucleus. Process compartmentalization and spatial location of genes modulate the transcriptional output of the genomes. However, how the interplay between genome structure and gene regulation is established and maintained is still unclear. The aim of this project is to explore whether the genome 3D structure acts as an information source for modulating transcription in response to external stimuli. With a genuine interdisciplinary team effort, we will study the conformation of the genome at various integrated levels, from the nucleosome fiber to the distribution of chromosomes territories in the nuclear space. We will generate high-resolution 3D models of the spatial organization of the genomes of distinct eukaryotic cell types in interphase to identify differences in the chromatin landscape. We will follow the time course of structural changes in response to cues that affect gene expression either permanently or transiently. We will analyze the changes in genome structure during the stable trans-differentiation of immortalized B cells to macrophages and during the transient hormonal responses of differentiated cells. We plan to establish novel functional strategies, based on targeted and high-throughput reporter assays, to assess the relevance of the spatial environment on gene regulation. Using sophisticated modeling and computational approaches, we will combine high-resolution data from chromosome interactions, super-resolution images and omics information. Our long-term plan is to implement a 3D browser for the comprehensive mapping of chromatin properties and genomic features, to better understand how external signals are integrated at the genomic, epigenetic and structural level to orchestrate changes in gene expression that are cell specific and dynamic.

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Subjects

Scientific Research

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AXSIS

Project ID: 609920
Funded under: FP7-IDEAS-ERC

Frontiers in Attosecond X-ray Science: Imaging and Spectroscopy

From 2014-08-01 **to** 2020-07-31, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 13 884 200	ERC-2013-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 13 884 200	ERC-2013-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
Germany	ERC-SyG - Synergy grant

Objective

"X-ray crystallography yields atomic-resolution 3D images of the whole spectrum of molecules ranging from small inorganic clusters to large protein complexes constituting the macromolecular machinery of life. Life is not static, and many of the most important reactions in chemistry and biology are light induced and occur on ultrafast timescales. These have been studied with high time resolution primarily by ultrafast laser spectroscopy, but they reduce the vast complexity of the process to a few reaction coordinates. Here we develop attosecond serial crystallography and spectroscopy, to give a full description of ultrafast processes atomically resolved in real space and on the electronic energy landscape, from co-measurement of X-ray and optical spectra, and X-ray diffraction. This technique will revolutionize our understanding of structure and function at the atomic and molecular level and thereby unravel fundamental processes in chemistry and biology. We apply a fully coherent attosecond X-ray source based on coherent inverse Compton scattering off a free-electron crystal, developed in this project, to outrun radiation damage effects due to the necessary high X-ray irradiance required to acquire diffraction signals [A. Cho, ""Breakthrough of the year"", Science 388, 1530 (2012)]. Our synergistic project will optimize the entire instrumentation towards fundamental measurements of the mechanism of light absorption and excitation energy transfer. The multidisciplinary team optimizes X-ray pulse parameters, in tandem with sample delivery, crystal size, and advanced X-ray detectors. We will apply our new capabilities to one of the most important problems in structural biology, which is to elucidate the dynamics of light reactions, electron transfer and protein structure in photosynthesis. Also, the attosecond source can provide a coherent seed and will help to overcome peak flux limitations of X-ray FELs by introducing chirped pulse amplification to FEL technology."

Related information

News	Breaking new ground in ultrafast X-ray science

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Scientific Research

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ASIA

Project ID: 609823
Funded under: FP7-IDEAS-ERC

Beyond Boundaries: Religion, Region, Language and the State

From 2014-09-01 **to** 2020-08-31, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 8 053 715,4	ERC-2013-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 8 053 715,4	ERC-2013-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
United Kingdom	ERC-SyG - Synergy grant

Objective

The Gupta dynasty dominated South Asia during the 4th and 5th centuries. Their period was marked by political stability and an astonishing florescence in every field of endeavor. The Gupta kingdom and its networks had an enduring impact on India and a profound reach across Central and Southeast Asia in a host of cultural, religious and socio-political spheres. Sometimes characterized as a 'Golden Age', this was a pivotal moment in Asian history. The Guptas have received considerable scholarly attention over the last century, as have, separately, the kingdoms of Central and Southeast Asia. Recent advances notwithstanding, knowledge and research activity are fragmented by entrenched disciplinary protocols, distorted by nationalist historiographies and constrained by regional languages and associated cultural and political agendas. Hemmed in by modern intellectual, geographical and political boundaries, the diverse cultures, complex polities and varied networks of the Gupta period remain specialist subjects, little-mentioned outside area studies and traditional disciplinary frameworks. The aim of this project is to work beyond these boundaries for the first time and so recover this profoundly influential dispensation, presenting it as a vibrant entity with connections across several regions and sub-continental areas. To address this aim, three PIs have formed an interdisciplinary team spanning linguistics, history, religious studies, geography, archaeology, Indology, Sinology and GIS/IT technologies. This team will establish a scientific laboratory in London that will generate the synergies needed to delineate and assess the significance of the Gupta Age and its pan-Asian impacts. The project's wider objective is to place Central,South and Southeast Asia on the global historical stage, significantly influence practices in Asian research and support EU leadership in Asian studies.

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Subjects

Scientific Research

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MODELCELL

Project ID: 609822
Funded under: FP7-IDEAS-ERC

Building a Model Cell to Achieve Control of Cellular Organization

From 2014-07-01 **to** 2020-06-30, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 7 150 812	ERC-2013-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 7 150 812	ERC-2013-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
Netherlands	ERC-SyG - Synergy grant

Objective

A hallmark of profound understanding of the organization of a living cell is the ability to reconstitute essential cellular functionalities from minimal components. To achieve this breakthrough a concerted effort of cell biology, biochemistry and biophysics is required. Our project brings together this expertise to reconstitute the cell's ability to control the organization of cytoskeletal networks in an artificial 'Model' Cell.

To achieve a mechanistic understanding of how cell organization is regulated, we will develop methods to manipulate cytoskeletal interactions in space and time and study the effects of such manipulation on functional cytoskeletal organization in the confinement of both artificial systems and cells. We will focus on regulatory interactions at dynamic microtubule plus ends, which play an essential role in cell division, polarization, and migration. Using a combination of in vitro, in vivo, and theoretical approaches, we aim at the following goals:
1. Achieve a molecular scale understanding of cooperative and competitive relationships between regulators at microtubule ends, and their effect on microtubule dynamics, microtubule behavior at the cell boundary, and interactions with actin filaments.
2. Generate a quantitative understanding of symmetric and polarized positioning of the microtubule cytoskeleton by microtubule-cell boundary interactions during cell division and cell migration.
3. Obtain a mechanistic view of microtubule-actin co-organization driven by regulatory effects at microtubule ends, with and without the additional contribution of microtubule-cell boundary interactions, and apply this knowledge to manipulate cell polarization and migration.

Synergy between our complementary expertise, tools, infrastructure and local collaboration networks is key to achieving these goals. Our groups are located within short travel distance from each other, allowing the coupling of infrastructure and resources on a daily basis.

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Scientific Research

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UQUAM

Project ID: 319278
Funded under: FP7-IDEAS-ERC

Ultracold Quantum Matter

From 2013-07-01 **to** 2019-06-30, ongoing project | UQUAM Website

Project details

Total cost:	**Topic(s):**
EUR 9 827 280	ERC-2012-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 9 827 280	ERC-2012-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
Germany	ERC-SyG - Synergy grant

Objective

Quantum mechanics is the basis of our understanding of the microscopic world. It is also central to the collective behaviour of matter at low temperatures, leading to unique properties that defy our classical intuition. The comprehension of such ‘quantum matter’ and the ability to master it using a newly developing set of ‘quantum technologies’ is not only of fundamental interest but holds the promise of revolutionizing material and information science as well as metrology. Our aim is to take this interdisciplinary research field to a qualitatively new level, by taking advantage of the most recent spectacular advances in the control of ultracold atomic and molecular systems. To this end, we have gathered a team of PIs with well-recognized and complementary expertise in the domains of quantum optics, atomic and condensed matter physics, and information science.

Our project is structured around three grand challenges: (i) Produce, understand and classify novel states of matter, including strongly correlated and topological quantum phases, and establish connections with simulation of field theories; (ii) Explore novel aspects of many-body dynamics, identify its universal regimes, and implement new classes of dissipative evolution; (iii) Engineer quantum matter to propose and implement new paradigms for information processing. We believe that only a joint effort, combining experimental tools beyond the state-of-the-art and novel theoretical approaches, will allow us to reach these outstanding goals. An essential element of the project, which will embody the synergy between the different perspectives brought by the PIs, will be the joint construction of an experiment employing transformative technologies. Our overall research program will allow us to address key questions on the nature of quantum matter and its potential high impact applications.

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NEXUS1492

Project ID: 319209
Funded under: FP7-IDEAS-ERC

NEXUS 1492. New World Encounters in a Globalising World

From 2013-09-01 **to** 2019-08-31, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 14 826 037	ERC-2012-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 14 826 037	ERC-2012-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
Netherlands	ERC-SyG - Synergy grant

Objective

NEXUS1492 investigates the impacts of colonial encounters in the Caribbean, the nexus of the first interactions between the New and the Old World. This Synergy Programme intends to rewrite a crucial and neglected chapter in global history initiated by European colonisation by focussing on transformations to indigenous, Amerindian cultures and societies. NEXUS1492 will address intercultural Amerindian-European-African dynamics at multiple temporal and spatial scales across the historical divide of 1492. The unique trans-disciplinary synergy of four PIs and their teams of archaeologists, social, natural and computer scientists, and heritage experts will pioneer new analytical tools, and apply multi-disciplinary cutting-edge techniques, theoretical frameworks and skill sets to provide a novel perspective on New World encounters in a globalising world. NEXUS1492 will work with local experts to develop sustainable heritage management strategies, creating a future for the past. This past is under threat from looting and illegal trade, construction development and natural disasters (e.g., climate change, earthquakes, and volcanic eruptions). By placing the Caribbean's indigenous past within a contemporary heritage agenda, this programme strives to increase the awareness and protection of heritage resources. The innovative approach and outcomes of NEXUS1492 will be of global scientific significance and high societal relevance.
Four interlocking projects will address:
1. Transformations of lifeways and deathways, landscapes, and material culture through archaeological investigations.
2. Human mobility and the circulation of materials and objects through isotope geochemistry and archaeometry.
3.Socio-cultural relationships and interactions through the reconstruction of archaeological networks.
4. Heritage preservation through investigation of regulatory, legislative, and curatorial standards and community engagement efforts.

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Subjects

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Permalink: http://cordis.europa.eu/project/rcn/109229_en.html

Q-MAC

Project ID: 319286
Funded under: FP7-IDEAS-ERC

Frontiers in Quantum Materials Control

From 2013-10-01 **to** 2019-09-30, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 9 966 873	ERC-2012-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 9 966 873	ERC-2012-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
Germany	ERC-SyG - Synergy grant

Objective

The overarching goal of the present proposal is to exploit materials design, coherent optical methods and multiple theoretical approaches to deterministically control ordered states of strongly correlated electron materials, also referred to as “quantum” or “complex” materials. The underlying ideas can be applied to vast number of problems in materials physics, but the stated goal is that of optimizing superconductivity at higher temperatures than achieved so far, possibly even at room temperature. The proposal starts from research strands that follow challenging but well-establish paths, such as the use of complex-oxide heterostructures and strain engineering at interfaces to modulate the electronic properties. In a second class of investigations, coherent optical control of lattice dynamics with strong field THz transients is proposed to “anneal” the competing order quenching superconductivity. This builds on our recent discovery of light-induced transient superconductivity in high temperature cuprates, a remarkable process not yet understood or optimized. We will use a combination of femtosecond optical and x-ray experiments with Free Electron Lasers, together with time dependent real-materials simulations. Perhaps the most ambitious goal will be to develop laser-cooling techniques to reduce quantum phase fluctuations between planes of cuprate superconductors. Finally, we propose to use static and dynamic techniques to engineer new phases of condensed matter, for example by engineering new materials with a single band crossing the Fermi level, to optimize superconductivity. A unique combination of complementary expertise, from materials design, to coherent and ultrafast optical and x-ray physics, with materials and quantum optics theory, will be key in making true progress in these areas.

Related information

News	A quantum leap for the next generation of superconductors

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Subjects

Scientific Research

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HETERO2D

Project ID: 319277
Funded under: FP7-IDEAS-ERC

Novel materials architecture based on atomically thin crystals

From 2013-11-01 **to** 2019-10-31, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 13 352 308	ERC-2012-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 13 352 308	ERC-2012-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
United Kingdom	ERC-SyG - Synergy grant

Objective

We propose a new paradigm in materials science – heterostructures based on two-dimensional atomic crystals (and their hybrids with metallic and semiconducting quantum dots and nanostructures), and develop several devices which are based on such concept. Two-dimensional (2D) atomic crystals (such as graphene, monolayers of boron nitride, molybdenum disulphide, etc) possess a number of exciting properties, which are often unique and very different from those of their tree-dimensional counterparts. However, it is the combinations of such 2D crystals in 3D stacks that offer truly unlimited opportunities in designing the functionalities of such heterostructures. One can combine conductive, insulating, probably superconducting and magnetic 2D materials in one stack with atomic precision, fine-tuning the performance of the resulting material. Furthermore, the functionality of such stacks is “embedded” in the design of such heterostructure. We will create several types of devices based on such heterostructures, including tunnelling transistors, charge and spin drag, photodetectors, solarcells, lasers and other optical and electronic components. As the range of available 2D materials broadens, so the possible functionality of the 2D-based heterostructures will cover larger and larger area. We will concentrate on creating and understanding of the prototypes of such hetersotructures and apply efforts in developing methods for their mass-production suitable for various applications. The development of such novel paradigm in material science will only by possible by bringing together a Synergy group of researchers with complementary skills, knowledge and resources.

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Subjects

Scientific Research

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Permalink: http://cordis.europa.eu/project/rcn/110794_en.html

i2MOVE

Project ID: 319818
Funded under: FP7-IDEAS-ERC

An Intelligent Implantable MOdulator of Vagus nervE function for treatment of Obesity

From 2013-04-01 **to** 2018-03-31, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 7 175 339	ERC-2012-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 7 175 339	ERC-2012-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
United Kingdom	ERC-SyG - Synergy grant

Objective

Obesity is one of the greatest public health challenges of the 21st century. Affecting over half a billion people worldwide, it increases the risk of stroke, ischaemic heart disease, diabetes, many cancers, depression and complications in pregnancy. Bariatric surgery is currently the only effective treatment available but is associated with significant risks of mortality and long-term complications. New and innovative treatments are thus required.
The signals to and from the gut during eating and digestion are passed through the vagus nerve. Despite this, our knowledge of vagus nerve function comes from studies in which the nerve is cut. This fails to provide any impression of the complex signal received by appetite centres in the brain.
We propose to use obesity as a paradigm for development of a new generation of neural interface that will combine novel electrode materials, structures and sensing modalities with ultra-low power electronic neural recording, analysis, stimulation and wireless communication. Several steps beyond state-of-the-art, this will allow, for the first time, detailed study of the entirety of vagus nerve function. We will develop neural stimulation that mimics the response of the vagus nerve to ingestion of food, thus providing a new treatment for obesity.
The synergy between our groups will thus combine complementary interests to develop an innovative technological solution for a major public health crisis. The sensing capability will deliver, for the first time, real-time and long-term recordings, providing new insights into peripheral nerve activity. The impact will thus extend beyond appetite and the vagus to many other neurally regulated processes and diseases.

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Subjects

Scientific Research

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dHCP

Project ID: 319456
Funded under: FP7-IDEAS-ERC

The Developing Human Connectome Project

From 2013-09-01 **to** 2019-08-31, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 14 974 313	ERC-2012-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 14 974 313	ERC-2012-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
United Kingdom	ERC-SyG - Synergy grant

Objective

Few advances in neuroscience could have as much impact as a precise global description of human brain connectivity and its variability. Understanding this 'connectome' in detail will provide insights into fundamental neural processes and intractable neuropsychiatric diseases.
The connectome can be studied at millimetre scale in humans by neuroimaging, particularly diffusion and functional connectivity Magnetic Resonance Imaging. By linking imaging data to genetic, cognitive and environmental information it will be possible to answer previously unsolvable questions concerning normal mental functioning and intractable neuropsychiatric diseases.
Current human connectome research relates almost exclusively to the mature brain. However mental capacity and neurodevelopmental diseases are created during early development. Advances in fetal and neonatal Magnetic Resonance Imaging now allow us to undertake The Developing Human Connectome Project (dHCP) which will make major scientific progress by: creating the first 4-dimensional connectome of early life; and undertake pioneer studies into normal and abnormal development.
The dHCP will deliver:
• the first dynamic map of human brain connectivity from 20 to 44 weeks post-conceptional age, linked to imaging, clinical, behavioural and genetic information;
• comparative maps of the cerebral connectivity associated with neurodevelopmental abnormality, studying well-characterized patients with either the adverse environmental influence of preterm delivery or genetically-characterised Autistic Spectrum Disorder; and
• novel imaging and analysis methods in an open-source, outward-facing expandable informatics environment that will provide a scalable resource for the research community and advances in clinical medicine.

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Subjects

Scientific Research

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Permalink: http://cordis.europa.eu/project/rcn/109197_en.html

BioQ

Project ID: 319130
Funded under: FP7-IDEAS-ERC

Diamond Quantum Devices and Biology

From 2013-07-01 **to** 2019-06-30, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 10 293 309	ERC-2012-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 10 293 309	ERC-2012-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
Germany	ERC-SyG - Synergy grant

Objective

Many of the most remarkable contributions of modern science to society have arisen from interdisciplinary work of scientists enabling novel imaging and sensing technologies (NMR, X-ray diffraction, electron microscopy). BioQ will revolutionize the state of the art to create novel sensing technologies for the broad field of life sciences research that provide unprecedented access and insight into structure and function of individual bio-molecules under physiological conditions and apply these to the observation of biological processes down to the quantum level and with atomic resolution. At this level quantum properties are predicted to play an important role for the function of biological systems subject to environmental noise. BioQ will unravel the interplay of quantum coherent dynamics, molecular vibrations and environmental noise due to molecular vibrations in biological processes and design and carry out experimental tests of its predictions. BioQ will achieve new levels of understanding and control of biological systems, culminating in new ways to interface biological systems with quantum devices. To this end BioQ will exploit the ability of biological systems to arrange themselves into highly ordered structures to form novel hybrid materials of functionalized nano-diamonds that are capable of harnessing complex quantum dynamics at room temperature.

A deeper understanding of biological processes will open new roads towards drug design and bio-imaging. The elucidation of energy transport processes and dynamics may pave the way towards the design of more efficient light harvesting systems. Self-assembled hybrid bio-quantum devices provide a novel perspective towards quantum nanotechnology. The broad challenges that this ambitious programme present will be solved by an interdisciplinary team led by three PIs from experimental solid-state physics, theoretical quantum physics and bio-chemistry whose combination of expertise is essential for the success of BioQ.

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Subjects

Scientific Research

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ToPAG

Project ID: 318987
Funded under: FP7-IDEAS-ERC

Toxic protein aggregation in neurodegeneration

From 2013-06-01 **to** 2019-05-31, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 13 927 098	ERC-2012-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 13 927 098	ERC-2012-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
Germany	ERC-SyG - Synergy grant

Objective

Formation of amyloid-like protein aggregates is the hallmark of a number of neurodegenerative diseases, but how the aggregation process is linked with cytotoxicity and cell death remains unclear. The goal of this pro¬ject is to elucidate the basic mechanisms of aggregate toxicity and how it affects the biological system in its entirety. We will analyse cell culture and mouse models of Huntington's disease, amyotrophic lateral sclero¬sis and Alzheimer's disease using a trans-disciplinary approach combining cellular biochemistry, quantita¬tive proteomics and 3D cryo-electron tomography. The effects of aggregating protein species (APS) formed by designer proteins and authentic disease proteins will be compared to define general and disease-specific toxicity mechanisms. The main aims of this project are:
1. To determine the sequence of cellular events occurring during toxic protein aggregation. Live cell imaging and single molecule fluorescence fluctuation measurements will be employed to monitor how APS evolve from diffusible oligomers to large inclusions and quantitative proteomics will define signatures for cells with different forms of aggregates.
2. To identify the mechanisms of aggregation toxicity through a systematic interactome analysis of APS in cell culture and mouse brain. The cellular localization of APS and their potential association with membrane structures and cellular machinery will be determined by cryo-ET.
3. To elucidate why cellular protein quality control fails in neurodegenerative disease. Specially designed proteostasis sensors will be used to monitor the status of the protein folding machinery as aggregate pathol¬ogy develops. The potentially protective pathways of inclusion body formation will be explored using cryo-ET and laser capture dissection coupled with highly sensitive proteomics.
Understanding aggregation toxicity will be invaluable in developing novel therapeutic strategies for some of the most debilitating diseases of our time.

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Subjects

Scientific Research

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Permalink: http://cordis.europa.eu/project/rcn/108649_en.html

COMBATCANCER

Project ID: 319661
Funded under: FP7-IDEAS-ERC

Combination therapies for personalized cancer medicine

From 2013-05-01 **to** 2019-04-30, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 14 580 558	ERC-2012-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 14 580 558	ERC-2012-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
Netherlands	ERC-SyG - Synergy grant

Objective

All cancers arise due to alterations in their genomes. Although insight into the genetic lesions in tumours by genome sequencing does already assist in selecting some drug regimens, it rarely results in disease eradication due to the emergence of drug-resistant clones. More sophisticated combination therapies in which several oncogenic pathways are targeted simultaneously or in a particular sequence are believed to hold more promise. However, at present we are unable to extract and interpret the necessary information from tumours to predict which drug regimen will be most adequate. The genetic make-up of the individual, the heterogeneity of the tumour, epigenetic alterations, cell-of-origin of the tumour, and complex interactions between tumour cells and stromal cells appear important confounding factors influencing response. In addition, we are still ignorant of many of the intricate complexities of signalling networks in cells and how tumours exploit these to acquire drug resistance.
It is the ambition of the team formed by members of the Netherlands Cancer Institute (NKI) and the Cancer Genome Project at the Wellcome Trust Sanger Institute (WTSI) to unravel the genomic and phenotypic complexity of human cancers in order to identify optimal drug combinations for personalized cancer therapy. Our integrated approach will entail (i) deep sequencing of human tumours and cognate mouse tumours; (ii) drug screens in a 1000+ fully characterized tumour cell line panel; (iii) high-throughput in vitro and in vivo shRNA and cDNA drug resistance and enhancement screens; (iv) computational analysis of the acquired data, leading to significant response predictions; (v) rigorous validation of these predictions in genetically engineered mouse models and patient-derived xenografts. This integrated effort is expected to yield a number of combination therapies and companion-diagnostics biomarkers that will be further explored in our existing clinical trial networks.

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Subjects

Scientific Research

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DD.POP

Project ID: 319475
Funded under: FP7-IDEAS-ERC

Domestic Devotions: The Place of Piety in the Renaissance Italian Home

From 2013-09-01 **to** 2017-08-31, ongoing project

Project details

Total cost:	**Topic(s):**
EUR 2 333 162	ERC-2012-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 2 333 162	ERC-2012-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
United Kingdom	ERC-SyG - Synergy grant

Objective

Domestic Devotions brings together the study of books, buildings, objects, spaces, images and archives in order to understand how religion functioned in the Renaissance household. In opposition to the enduring stereotype of the Renaissance as a 'secular age', our research is premised on the view that religion played a key role in attending to the needs of the laity, and presents the period 1400-1600 as an age of spiritual revitalization. Devotions, from routine prayers to extraordinary religious experiences such as miracles or exorcisms, frequently took place within the home and were specifically shaped to meet the demands of domestic life – childbirth, marriage, infertility, sickness, accidents, poverty and death. This tight bond between the domestic and the devotional was neither institutionally nor legally defined. It cannot be adequately traced in any one type of source nor by means of a single approach. A rare combination of expertise and experience across several disciplines – social history, textual scholarship, and the study of art and architecture – is required to reveal the pivotal place of piety in the Renaissance home.

The project moves beyond traditional research on the Renaissance in two further ways. Firstly, it breaks free from the golden triangle of Venice, Florence and Rome in order to investigate practices of piety in three significant zones: Naples and its environs; the Marche in central Italy; and the Venetian mainland. Secondly, it rejects the standard focus on Renaissance elites in order to develop our understanding of the artisanal household. Inspired in part by the rich historiography on the Protestant family, Domestic Devotions will shed new light on the roles of women and children in the Catholic home, and will be attentive to gender and age as factors that conditioned religious experience. Our multidisciplinary approach will enable unprecedented glimpses into the private lives of Renaissance Italians.

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Subjects

Scientific Research

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QC-LAB

Project ID: 319360
Funded under: FP7-IDEAS-ERC

Quantum Computer Lab

From 2013-11-01 **to** 2019-10-31, ongoing project

Project details

Total cost:	Topic(s):
EUR 15 000 000	ERC-2012-SyG - ERC Synergy Grant
EU contribution:	**Call for proposal:**
EUR 15 000 000	ERC-2012-SyG See other projects for this call
Coordinated in:	**Funding scheme:**
Netherlands	ERC-SyG - Synergy grant

Objective

The world of atoms is governed by the rules of quantum mechanics. Over the past century, quantum-mechanical phenomena such as superposition and entanglement have been observed and studied with great precision. Today, we are entering a new era in which we can hope to explore quantum mechanics in larger objects. The science of quantum mechanics in more complex objects is barely known and as a result quantum mechanics is rarely explicitly used in technology. Theoretically, superposition and entanglement could be exploited as a new resource in a wide variety of future applications. We focus on information science and investigate the use of quantum mechanics in computing, i.e. a quantum computer (QC). If information is encoded in quantum superpositions and processed by exploiting entanglement, a QC can solve computational problems that are beyond the reach of conventional computers. Building a QC is, however, an enormous scientific challenge because the fragile quantum bits need to be protected from and corrected for even the smallest disturbances by the environment. Meeting this challenge requires a synergetic effort combining the best of quantum theory, electrical engineering, materials science, applied physics and computer science. This proposal aims to achieve a robust, exemplary QC. We propose a circuit containing processor qubits (two types: superconducting transmon qubits and spin qubits in silicon quantum dots), memory qubits (two types: topological qubits with nanowires and donor qubits), and a quantum databus (superconducting striplines). Our goal is to demonstrate a 13-qubit circuit that incorporates fault-tolerance through implementation of a surface code. We will demonstrate back-and-forth quantum state transfer between processor and memory qubits. Our team brings together the required expertise into a single “QC-lab” enabling us to bring our understanding of quantum mechanics to the next level and push QC to the tipping point from science to engineering.

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