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Knowledge, funding and progress towards a healthy Europe in 2020

Full credit to the EU for its Nobel Peace Prize nomination marking six decades of promoting peace and reconciliation. But while peace reigns between nations, there is still a war raging in our societies: a battle for Europe's health. Cancer, diabetes, cardiovascular diseases, HIV or Alzheimer's are the enemy of present and future generations. But how can we fight them?

Just like any war, knowledge is key. And it stands to reason why it was chosen as the major theme of the World Cancer Day, under the tagline 'Cancer – Did you know?' In Europe, the Commission pursues a similar objective; with its Public Health Strategy, it aims to spread information. Identifying human health risks, collecting and sharing data, and exchanging best practices pave the way to promising research. Eventually, it will lead to more healthy lifestyles and new treatments.

Money is another of the sinews of war. In the proposal for Horizon 2020, a total of EUR 8.5 billion was set aside to tackle health, demographic and well-being challenges, up from EUR 6.1 billion under FP7. Scientists will be able to pursue their efforts with simpler rules, reducing the time for proposal to grant and more support for market activities.

What about continuity? As we write, about 50 % of health-related FP7 projects are on going, with scientists laying the foundations of future health research. To shed light on their efforts, the focus of this issue of *research*eu results magazine* is 'From FP7 to Horizon 2020: tackling Europe's health challenges'.

This edition includes no less than three interviews focused on EU-funded health projects: Dr Jürgen Hescheler of Cologne University in Germany tells us how a novel toxicity test platform could replace animal testing and speed up chemicals testing, while Dr Wolfgang Weidenhammer of the Technical University of Munich in Germany sheds light on non-conventional medicine in Europe. Finally, Professor Vlad Ratziu of the Assistance Publique — Hôpitaux de Paris (APHP) explains how his project could help tackle liver disease in Europe.

The 'biology and medicine' section continues with other examples of ground-breaking research. These 'specials' start on page 7 with 'Rising to the global challenge of food safety', while others can be found in the 'environment and society' and 'IT and telecommunications' sections.

The 'energy and transport' section opens with an article entitled 'Light weight, high-energy batteries for electric cars', on page 16, while the feature article in the 'environment and society' section is 'Microbes join fight against desertification in North Africa' on page 23.

The 'IT and telecommunications' section begins with 'Product engineering ... a complex marriage' on page 31. Finally, the 'industrial technologies' section starts with the inspiring 'Revolutionising industrial safety in Europe', on page 38.

The issue ends, as usual, with a list of events and upcoming conferences.

We look forward to receiving your feedback on this issue and on the research*eu publications in general. Send questions or suggestions to:

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The editorial team

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Watch this space!

Coming up in issue 19 of *research*eu results magazine* — a special dossier on biodiversity.

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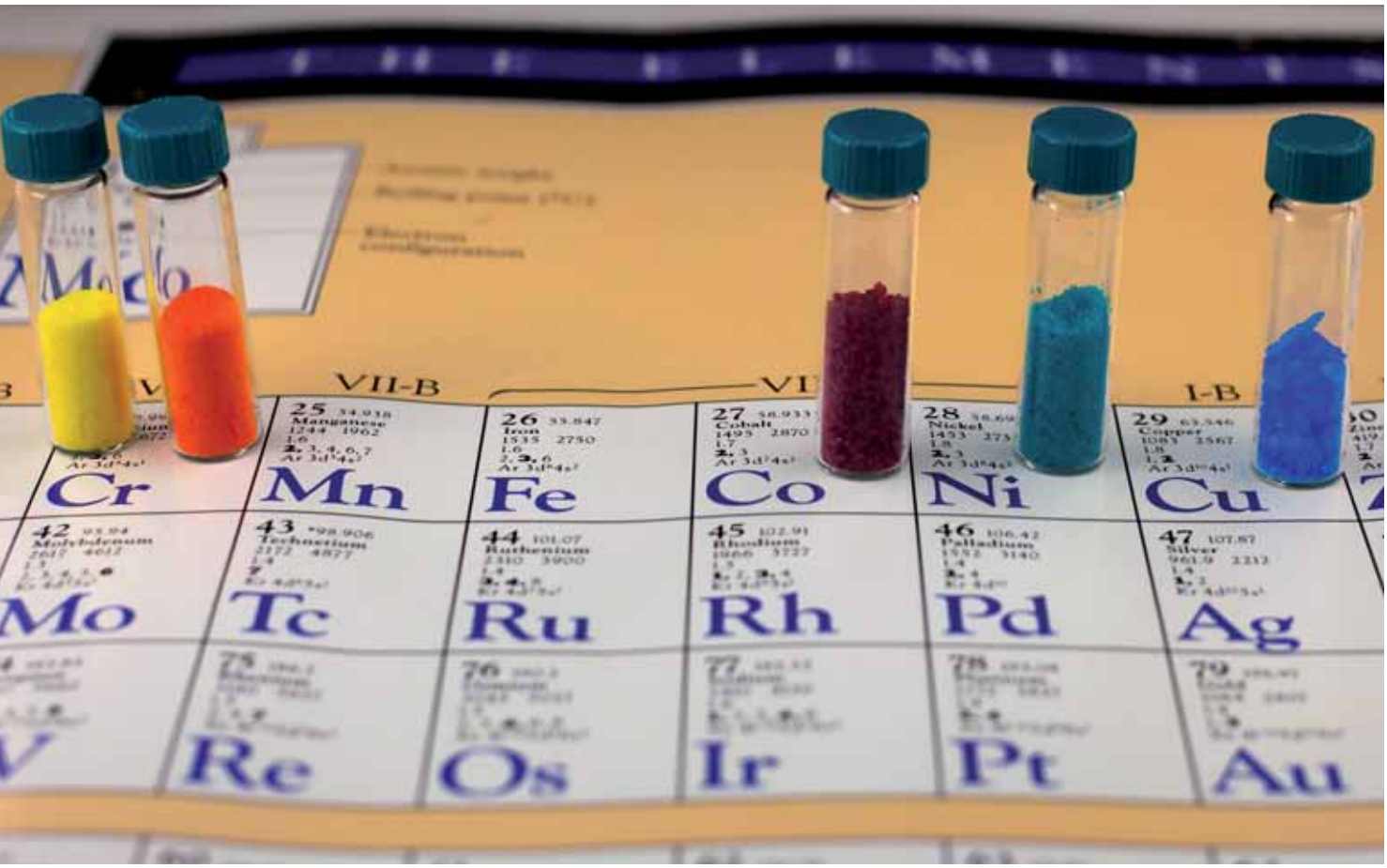

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Interview: An alternative to animal testing for toxicity

There is a huge need for the testing of potential toxins in Europe — whether we are concerned with the effects of pollution, nutrition or cosmetics — and the EU's REACH Directive alone lists thousands of chemicals that need testing for toxicity.

ESNATS[1] aims at developing a novel toxicity test platform based on embryonic stem cells (ESCs), especially human ESC (hESCs), to accelerate drug development, reduce R&D costs and offer an alternative that could 'reduce, refine and replace' animal tests (the '3 Rs' principle). As the project approaches its end in September 2013, research*eu results magazine asked ESNATS coordinator, Prof. Jürgen Hescheler of Cologne University in Germany, to tell us more about it.

The ESNATS project is coordinated by the Klinikum der Universität zu Köln, Germany.

What are the main objectives of the ESNATS project?

When it comes to toxicity testing, animal experiments are widely used but come with welfare and rights concerns — and they don't always reflect accurately the responses of the human body. Using stem cells we can differentiate them into different organ cells and use these to test for toxic effects.

The advantages are that it's the right species, we can test different toxicity effects on different organs, it can be done with a high throughput (1 000 tests at the same time are possible) and of course it avoids animal experiments.

How is the project breaking new territory?

Toxicology testing has not always been that detailed in the past; it tended to look at tissue damage but not at mechanisms. So we hope our tests will deliver more insight into what happens and how toxicity works.

It's not just about cell death; toxins can also change gene expression — leading to tumours. We have used bio-informatics to spot genes that are switched on or off — so we can see what really happens when a toxin enters a cell and understand the mechanism of its toxicity.

From better understanding at the cellular and molecular level we can try to find biomarkers that will indicate damage by toxins and what kinds of damage. The basis of the project is that these techniques can give better results than animal experiments.

What were the main challenges of the project?

Clearly the use of human embryonic stem cells requires careful ethical oversight, and the project included a specialist partner, Edinethics Ltd, in both the project consortium and Steering Committee to provide ethical advice and training.

In order to be funded, the project was also assessed and approved by the European Commission's FP7 ethics committee, and in Germany we needed permission from the

national regulatory authority — the Robert Koch Institute — which has to be consulted for approval of any use of hESCs whether in regenerative medicine or in our field.

Ethically, there's a conflict between reducing animal testing and using human embryonic stem cells, but generally, the advantages of better understanding and predictions of toxic effects on humans from using stem cells adds up to a better ethical outcome. I should also emphasise that there was no need for new embryonic stem cell lines to be created — we only used existing established ones.

And what are the results so far?

One of our major achievements has been getting many different laboratories — in a project involving more than 30 partners — to agree on a battery of experimental procedures for testing neurotoxic effects on the developing brain. The brain is one of the most sensitive organs during a baby's development, so it is important to know what chemicals a mother should not be exposed to.

This requires a complex experiment, using young and mature neurons and whole tissues of neuronal and glial cells in a 'brain-like structure' — and we hope to use it to identify suitable biomarkers in the time we have left on the project.

Some of the other partners in the project have been looking at the liver, and these techniques could be easily exported to other organs. We also decided to focus on the effects of fewer than 50 chemicals in order to be able to gain a detailed understanding of their mechanisms. This is work that complements the US project, Tox21 — on replacing animal tests with tumour cell lines — which is testing 10 000 chemicals but with little analysis of effects and their causes.

We have also shown that, thanks to their standardisation, it is possible to automate our tests and thus scale up to screening 100 000 samples types, concentrations and chemicals at the same time.

© Universität zu Köln

Professor Jürgen Hescheler

1 'Embryonic stem cell-based novel alternative testing strategies'.

Funded under the FP7 specific programme Cooperation, under the theme 'Health'.
For further information see the project website: http://www.esnats.eu/
There are searchable papers published by the ESNATS project available at the EU Open Access site, OpenAire: http://www.openaire.eu

Rising to the global challenges of food safety

Food safety is currently one of the most important challenges confronting consumers, producers and distributors. It is also an issue of extreme interest to scientists and experts due to its significant health, economic, and legal consequences. With this in mind, an EU-funded project has created a 'Centre of Excellence' to address the challenges surrounding food safety.

Most chemical contaminants which find their way into the food chain have been present in the environment for a long time, and many of them occur naturally, although the significance and presence of many are only now being revealed. Researchers say there is an increasing need for reliable data on the occurrence of these existing and emerging food pollutants in order to perform a valid quantitative risk assessment of human exposure.

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Such is the potential threat to health that food safety is seen as a global challenge, and one too large to be met by countries acting alone.

With this in mind, the Cefser[1] project — funded by the EU's FP7 programme — set out to create a unique Centre of Excellence in Food Safety and Emerging Risks at the Faculty of Technology, University of Novi Sad, Serbia. The Centre, which incorporates the faculty's laboratory for chemical contaminants in food and the environment (Labchemcont), is aiming to become a hub for European research projects working in the area of food safety and emerging risks.

Labchemcont is already an internationally recognised research lab focusing on detecting chemical contaminants in food. However, the existing equipment at Labchemcont could not satisfy increasingly stringent regulatory standards.

By utilising EU funds to purchase highly sophisticated analytical instruments — such as an 'Ultra-performance liquid chromatograph' (UPLC), the latest state-of-the-art food safety system — and to upgrade existing equipment, the Centre has already improved its research capacity to a level where it can effectively work within a network of advanced EU institutions. As a result, Cefser has integrated Labchemcont and the Faculty of Technology into the European Research Area (ERA), a first step in building global partnerships aimed at improving food safety.

'With this new UPLC system, the research agenda of the Cefser lab has been broadened, and the research team is now ready to tackle new analytical challenges in the food safety area, some of which have never been investigated in Serbia or even in the wider Western Balkans region,' says >

project coordinator Prof. Biljana Skrbic. 'The research agenda now embraces the whole range of pollutants found either in food commodities or the environment, including regulated contaminants and new, emerging ones.'

Harnessing human potential

The EU funding has also been applied to improve the skills and career development of the research team. This has been reinforced through the hiring of four young researchers in April 2009. The new and existing staff have also benefitted from secondments and visits from experienced researchers from other countries within the ERA.

'Visits to the Cefser Lab by researchers from internationally revered EU institutions have provided great opportunities for our own staff, including the newly employed members, to experience advanced training,' notes Prof. Skrbic.

The improved research capacity of the centre and its staff has led to the involvement of the team in several regional initiatives and proposals for multi-partner FP7 projects. The development of such strategic partnerships through EU-wide networking is seen as a hugely important step towards Cefser's goal of establishing itself as a modern laboratory capable of making a significant contribution to the ERA.

These partnerships will also provide Cefser with the capabilities and experience to meet the increasing challenges of food safety and provide the citizens of Europe and beyond with the information and security they need.

'Cefser has already uncovered the presence of some contaminants in food commodities from the Serbian market, which is very important for the risk assessment of dietary exposure in the population,' says Prof. Skrbic. 'The centre has also been active in raising awareness of research in food safety and quality, acting as [a focal] point for knowledge transfer to the Serbian control authorities and information to the general public.'

The project was coordinated by the Tehnoloski Fakultet Novi Sad in Serbia.

1 'Reinforcing research potential in the laboratory for chemical contaminants at the faculty of technology towards the establishment of the centre of excellence in food safety and emerging risks'.

Funded under the FP7 specific programme 'Capacities' under the theme 'Research potential of convergence regions'. http://ec.europa.eu/research/infocentre > search > 27653

A novel scaffold for pancreatic islet development

Regenerative medicine has emerged as a new approach for treating many disorders, including type I diabetes. A European study is using a novel method to investigate how to overcome the methodological and ethical issues related to the use of stem cells.

The immune system responds to the implantation of bioengineered constructs — regardless of the implantation site — with a non-specific inflammatory response orchestrated by the 'innate compartment' of the immune system.

Subsequent events include the activation of an immune-system response, causing the release of molecules, and the recruitment of cellular elements that mount the initial acute inflammatory response.

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In the case of a persisting stimulus, the acute inflammatory response perpetuates and evolves, often leading to rejection of the implanted material. Evidence points towards the protein interleukin-1b being a key element in such an inflammatory response.

The EU-funded Oxfordwinston[1] project considered developing an *ex vivo* kidney bioengineering approach. More specifically, porcine kidneys were harvested and decellularised with detergents to produce renal 'Extracellular matrix' (ECM) scaffolds. These scaffolds were subsequently used to understand how the immune system reacts following their implantation.

Scientists focused on the role of the cytoplasmic multi-protein complex known as the inflammasome. This complex activates caspases 1 and 5, leading to the processing and secretion of the pro-inflammatory cytokines, interleukin-1b, interleukin-18 and interleukin-33. By using transgenic animal models lacking various immune-system components, scientists found that the acellular ECM triggered an inflammatory response similar to that observed in a whole liver.

These findings indicate that the immunogenicity of the acellular ECM scaffold developed by the Oxfordwinston project needs to be resolved before this promising *ex vivo* kidney regeneration method can be applied in clinics.

The project was coordinated by the University of Oxford in the United Kingdom.

1 'The effects of lineage differentiation into pancreatic beta-cells on the immunogenicity of amniotic fluid stem cells'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions). http://cordis.europa.eu/marketplace > search > offers > 9532

Immune cells in 'love handles' could provide immunity against obesity

A Marie Curie research Fellow has uncovered a potential ally in the fight against obesity, together with a team of international researchers. The ally, found in our 'love handles', is a type of anti-tumour immune cell which protects against obesity and the metabolic syndrome that leads to diabetes.

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The results, part of the EU-funded project iNKT Cells[1] and published in the journal *Immunity*, indicate that the 'Invariant natural-killer T-cells' (iNKT) — which are vital for immunity — are lost when humans become obese, but can be restored through weight loss. Therapies activating iNKT cells could help manage obesity, diabetes and metabolic disease.

The iNKT cells were discovered in human 'omental fat', which had previously been considered as rare in humans. Omental fat is the layer of tissue that lies underneath the muscles in the stomach — commonly referred to as the 'beer gut' or 'love handles'.

'We then found a large population of iNKT cells in fat tissue from mice,' said Dr Lynch, whose Marie Curie Fellowship gave her the opportunity to work with assistant professors of medicine at Harvard Medical School (HMS) and leaders in the field of NKT investigations. 'Now we have identified a role for these cells in the regulation of body weight and the metabolic state, likely by regulating inflammation in adipose tissue.'

This was not their only discovery. They also found that a lipid called 'alpha-galactosylceramide' (aGC) can lead to a dramatic improvement in metabolism, weight loss and fatty liver disease, as well as reversing diabetes by bolstering cells that have been depleted.

Dr Lynch has been following this line of research since 2007 when she worked with Professor Donal O'Shea in the Obesity Clinic at St Vincent's University Hospital in Dublin, focusing on the immune systems of obese patients. 'We knew that not only did obese patients have more heart attacks and a greater incidence of type-2 diabetes than lean individuals, but they also developed more infections than non-obese individuals,' she explained.

Analysis done on blood samples from obese patients revealed that both NKT cells and iNKT cells were low. On the other hand, subsequent studies of fat tissue from a group of obese patients who had lost weight following bariatric surgery showed that iNKT cells had increased to normal levels.

Based on what was already known, Dr Lynch and her colleagues at BIDMC, St Vincent's University Hospital and Trinity College Dublin conducted a series of animal experiments to test their hypothesis that iNKT cells play a role in fat tissue regulation, and protect against the development of inflammation and the metabolic syndrome.

Large numbers of iNKT cells had been described in human and mouse liver tissue by Professors Mark Exley and Cliona O'Farrelly. Dr Lynch's group needed to ascertain that, like humans, mice also harboured these cells in fat, which is exactly what they found.

'We found loads of them'

Having identified what they were looking for, the team then placed the mice on a high-fat diet and studied the outcome. 'Similar to the human subjects we had previously studied, the animals lost their iNKT cells when they became obese,' Dr Lynch commented. 'Once we took them off this diet and put them back on a normal standard-fat diet, they lost the weight — and their iNKT cells increased.'

From this, the authors then set out to better understand the precise role of the iNKT cells by examining two strains of mice, both of which are deficient in iNKT cells, and a group of control mice, all on a high-fat diet.

Although all the animals grew obese, the iNKT-deficient mice grew 30% fatter than the control animals and developed the mouse equivalent of type-2 diabetes over just six weeks. The mice also had greatly increased triglyceride levels, larger fat cells and fatty liver disease.

In the next step, the authors removed iNKT cells from a normal mouse and injected them into obese NKT-deficient mice.

'We actually reversed the diabetes, and even though the mice continued to eat a high-fat diet, they lost one to two grams of weight [normal mouse weight being 20 to 25 grams] and exhibited a host of features that suggested reduced inflammation, including improved insulin sensitivity, lower triglycerides and leptin, and shrunken adipocytes,' Dr Lynch noted.

Finally, to see whether the remaining diminished pool of iNKT cells in obesity could be activated to improve metabolism, the scientists tested aGC, a lipid known to activate iNKT cells. They found that administering a single dose of aGC caused a dramatic improvement in metabolism and fatty liver disease, loss of much of the weight gained, and reversal of diabetes in the obese animals.

'aGC has been tested in clinical trials for the treatment of certain cancers, including melanoma, and proven safe and produced few side effects in humans,' said Prof. Exley. 'The effect of NKT stimulation, whether by aGC or other means, on weight loss, obesity, and metabolic disorder has not been investigated until now and may provide a new avenue for the treatment of obesity and metabolic syndrome, which have now reached epidemic proportions worldwide.'

In the European Union, statistics show that 10-30% of adults are affected by obesity while 30-70% are overweight. Meanwhile, the number of overweight babies and children in the World Health Organisation (WHO) European Region rose steadily from 1990 to 2008; 60% of children who are overweight before puberty will be overweight in early adulthood.

Childhood obesity has been associated with health risk factors for cardiovascular disease, type-2 diabetes, orthopaedic problems, mental disorders, underachievement in school and lower self-esteem. Statistics like these highlight the importance of research into ways of combating obesity.

The project was coordinated by Trinity College, Dublin in Ireland.

1 'Omental iNKT cells as an immunological tools in obesity and cancer'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/news > search news > 35088

BIOLOGY AND MEDICINE

Delivering affordable and effective new treatments

Improved access to state-of-the-art and affordable medical care — especially in oncology and cardiology — is vital to ensuring that Europe's ageing population is capable of taking care of itself in the future. New therapeutic options, such as externally triggered local drug release, represent one promising route currently being explored by European researchers.

Around 50 % of patients diagnosed with cancer undergo chemotherapy to treat their disease. Chemotherapy drugs flow through the bloodstream in search of rapidly dividing cells like cancer cells. But in their quest to fight disease, these potent drugs end up attacking normal, healthy dividing cells which leads to undesirable side effects. A targeted delivery method could be one way to tackle this issue.

This is the objective of the EU-funded project Sonodrugs[1]. The team believes that nanomedicine, the application of nanomaterials and nanotechnology to health care, can lead to cost-effective treatments with fewer side effects, less burden on the patient, and faster recovery time.

Revolutionising drug delivery

'Sonodrugs is addressing clinical needs by developing novel drug-delivery technologies for localised treatment of cancer and cardiovascular disease,' explains project coordinator Charles Sio. 'It is developing innovative concepts where drug release can be triggered by focused ultrasound-induced pressure or temperature stimuli within the diseased tissue.'

To achieve this, new drug-loaded nanocarriers are being designed for tailored drug-delivery systems that respond to either of these two stimuli. Magnetic resonance imaging and ultrasound imaging will then be used to guide, follow and quantify the drug-delivery process, at the nanoscopic level.

'Following research on a broad range of materials and drugs, two nanocarriers have ultimately been selected, optimised and evaluated in combination with image-guided delivery tools and methods,' says Dr Sio. 'The aim is to bring a promising new therapy option forward.'

The potential benefits are tremendous — locally triggered release increases the delivery of drugs to the sites in the body where they are needed, enhancing the effectiveness of the drug in attacking the disease while decreasing the body's exposure to possible toxicity and related side effects.

Long-lasting impact

Now in its final stages, this highly interdisciplinary project combined chemistry and technology, diagnosis and therapy, and called on the expertise of academic partners, university hospitals, SMEs and large industry. The project has resulted in eight patents on nanocarriers, hardware and methods, 36 publications in high-ranking journals and over 100 presentations at international conferences. During the course of the project, three PhD trajectories have been finished successfully, two PhD theses are in preparation, and at least five more are in the pipeline.

Thanks to the team's dedicated work — both fundamental research and applied science — significant advancements have been made in the development of novel treatment methods. A body of knowledge has been built up, and young European scientists are now experts in this field. This increases the potential for healthcare innovations by European academic institutions, hospitals, and industries, backed by patents on several key findings.

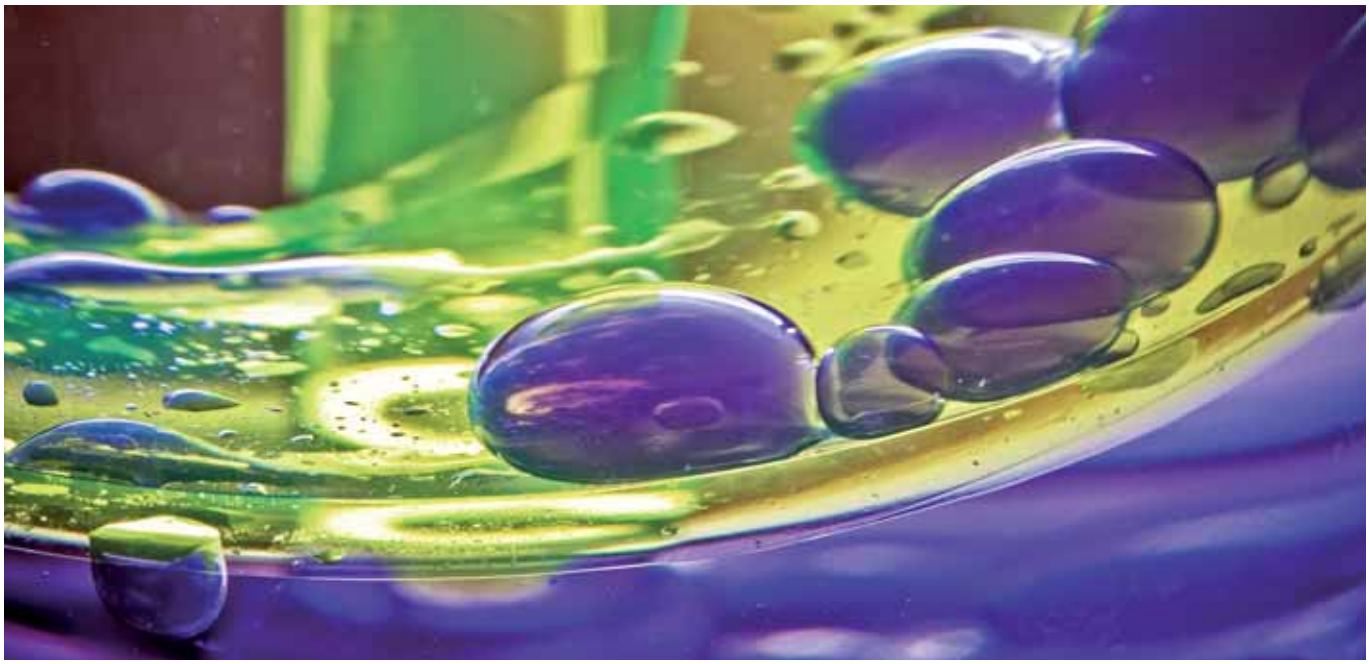
'Our concepts have been successfully tested in preclinical studies for the delivery of the anti-cancer drug doxorubicin and RNA-based compounds against cardiovascular diseases,' says Dr Sio. 'Extrapolating these results, the platform can potentially be used for many different drugs, providing opportunities for European pharmaceutical companies.'

Perhaps more importantly, however, patients may have access to treatments with higher efficacy and fewer side effects, which may improve their quality of life and reduce the debilitating effects of these dreadful diseases. What's more, doctors may have access to new treatment methods and, overall, the costs to society of the disease may be reduced.

The project was coordinated by the Philips Electronics Nederland B.V. in the Netherlands.

1 'Image-controlled ultrasound-induced drug delivery'.

Funded under the FP7 specific programme 'Cooperation' under the theme 'Nanosciences, nanotechnologies, materials and new production technologies'.
http://ec.europa.eu/research/infocentre > search > 27553



The role of beta-cell regeneration in type-2 diabetes

In an effort to tackle type-2 diabetes, the 'epidemic of the 21st century' according to World Health Organisation (WHO), a study is focusing on understanding the mechanisms underlying insulin resistance and the role of beta-cell regeneration.

Type-2 diabetes develops through a step-wise process. It starts with the inability of the body to use insulin effectively, which then causes pancreatic beta cells to produce more insulin in an attempt to compensate for this phenomenon. Eventually, the beta cells become exhausted and cannot produce enough insulin to overcome insulin resistance — at this point, the condition can progress to diabetes.

A substantial decrease in the number of beta cells due either to extensive cell death or decreased proliferation, or an impairment of insulin secretion are considered the most likely mechanisms underlying type-2 diabetes. The EU-funded BCELL-T2D[1] project is aiming to delineate these mechanisms and study the potential of beta-cell regeneration in therapy.

To achieve this, scientists have characterised a mouse model carrying a mutation in the receptor that binds the fat-cell-specific hormone leptin. These animals are prone to obesity and type-2 diabetes.

Results so far indicate that insulin resistance starts at four to nine weeks of age, progresses to frank diabetes (10–18 weeks of age) and finally to advanced diabetes and its complications (after 19 weeks of age). Assessment of the beta-cell mass at each stage has shown an initial expansion in the insulin compensatory phase that disappears with the evolution of the disease.

As a therapeutic intervention, scientists are looking to overcome the proliferation shortage of beta cells by providing cyclin-C, a protein that controls cell-cycle entry. Ongoing research will determine if sustained beta-cell proliferation has the potential to prevent the onset of diabetes.

By studying the type-2 diabetes mouse model, scientists have revealed a novel insight into the disease development and pathophysiology. Project findings hold great potential of being translated into new therapies to prevent and treat this devastating disease and its complications.

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The project was coordinated by the Fundación para la Gestión de la Investigación Biomédica de Cádiz in Spain.

1 'Role of pancreatic beta-cell regeneration in the pathophysiology and treatment of insulin resistance and type-2 diabetes'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9459

Controlling bacterial cell morphogenesis

A European team is investigating the role of the bacterial cell wall and the cytoskeleton in mediating cell shape. Results are expected to have broader implications for cell biology.

A fundamental question in cell biology is how a cell determines and regulates its shape. The current understanding is that the cell is dynamically divided into compartments, with the cytoskeleton playing a central role by spatially coordinating key cellular functions.

The EU-funded SHAPE[1] project builds on the discovery that bacteria possess an actin-like (MreB family) cytoskeletal structure that may regulate cell morphogenesis. Its key objective is to elucidate the factors controlling bacterial cell-wall morphogenesis while determining the different functions of the bacterial cytoskeleton and the mechanisms underlying them.

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The actin-like MreB protein family is believed to form a filamentous network within bacterial cells. It coordinates the movement of chromosomes or other macromolecules, thus playing a role analogous to the eukaryotic cytoskeleton in trafficking. However, the mechanistic details and the effectors used by MreB proteins to fulfil these roles have yet to be elucidated.

Using the Gram-positive bacterium Bacillus subtilis as a model, the SHAPE team is proposing to unmask MreB-binding proteins, targets and effectors and determine the spatio-temporal organisation of the MreB cytoskeleton.

Results so far indicate that MreB do not form extended filaments in vivo but instead generate patches that move perpendicularly to the long axis of the cell. This also suggests that the movement of MreB is powered by the cell-wall-synthesising complex.

The SHAPE project is looking into the determinants of cell shape, concentrating on the role of the MreB cytoskeleton. Apart from providing valuable insight into the underlying mechanisms that regulate MreB dynamics and function, study results could potentially be utilised as novel antimicrobial targets.

The project was coordinated by the Institut National de la Recherche Agronomique in France.

1 'Control of cell morphogenesis: Bacterial cell wall and actin-cytoskeleton'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9466

BIOLOGY AND MEDICINE

Novel DNA architecture for nanotechnology

The DNA double-helix structure, as revealed by Watson and Crick, is pivotal to its stability and replication. Replacement of the DNA base-pairs with other molecular entities is providing new functions for DNA and is thus receiving considerable attention.

Nanoscientists are looking into the possibility of using DNA molecules in self-assembling and self-directing processes at the nanoscale level. For this purpose, they are investigating the construction of novel base-pairs and the ability of DNA molecules to transport electrons over long distances through the oxidation of guanines.

The objective of the EU-funded ET DPHEN DNA[1] project was to synthesise DNA containing aromatic nucleobase surrogates that can facilitate electron transfer in a DNA double helix. In addition, scientists aimed to discover and design novel electron acceptors with a fluorescent moiety that would enable monitoring of electron transfer.

Various pyrene and phenanthrene aromatic nucleobase surrogates that varied in their electron affinity were synthesised. With respect to the electron donors, phenothiazine and 1,5-diaminonapthalene electron donors were produced, compatible with oligonucleotide synthesis.

Instead of substituting known fluorescent nucleobases with a fluorescence quencher, scientists decided to conjugate fluorescent molecules to the natural nucleobases. To this end, they attached a fluorescently quenched anthracene to deoxyuridine and observed that quenching was preserved.

Incorporation of these electron donors into DNA will aid the monitoring of the electron transfer by fluorescence, a property which could be exploited in DNA-based biosensors by attaching the DNA to a gold surface and observing electron transfer through nanoelectrochemistry.

The ET DPHEN DNA work has broadened our understanding of electron transfer through DNA. Furthermore, it is envisioned that this novel DNA architecture and future designs may be applied in the area of DNA nanomaterials and in new bioanalytical methods for detecting DNA damage.

The project was coordinated by the Universität Bern in Switzerland.

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1 'Electron transfer through multiple consecutive phenanthrenyl containing DNA'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9460

'Eyesee' looks into treatment for vision loss

Incidence of vision loss and impairment is increasing with advancing longevity. An EU-funded project is developing a system of gene therapy complete with non-viral vectors to address this growing problem.

Excessive formation of blood vessels in the eye is known as ocular neovascularisation. Medically, this process is important because it is a cause of vision impairment or loss. The condition is associated with diabetic retinopathy and age-related macular degeneration — the most common causes of severe vision loss in developed countries.

Current therapy can delay the disease but not restore lost vision. To date, gene therapy has severe limitations due to the viral vectors used. Problems arise as a result of severe immune response and integration of the genes into the subject's genome.

The Eyesee[1] project has acknowledged the need for the development of alternative therapies to treat ocular neovascularisation. It used non-viral vectors such as polymer-based carriers to deliver molecules for anti-angiogenesis that would prevent the abnormal growth of blood vessels.

To modulate the activity of genes that encourage and discourage formation of blood vessels, Eyesee looked into the use of 'plasmid DNA' (pDNA). Project scientists manipulated the genetic content of the pDNA to avoid problems associated with gene plasmids, such as gene silencing and loss at cell division. Results so far indicate that these gene systems are interesting candidates for future research for gene expression in the retina.

For the gene carriers, Eyesee looked into polymer-based vehicles that would condense, transport and release the DNA where required. Three polymers, including chitosan and 'polylactic acid' (PLA), formed nanoparticles measuring less than 500 nm with a charge suitable for gene delivery. Moreover, the materials were shown to be non-cytotoxic and able to condense DNA and protect it from degradation. One problem, poor release of DNA, is currently on the research agenda with the aim of improving performance.

By the end of the project, Eyesee expects to have developed delivery mechanisms for genes to remedy ocular neovascularisation and effective and efficient polymer-based carriers. The ultimate aim is to combine these two biotechnologies for a flexible system of gene delivery into any organ where gene therapy would be beneficial.

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The project was coordinated by the Universidade do Algarve in Portugal.

1 Development of new gene therapy approaches for the treatment of ocular neovascularisation'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9524

Dissecting the processes of skill learning

European scientists are investigating the involvement of different neuronal circuits in the brain during skill learning and execution. Project findings could be used to understand the mechanisms underlying skill learning disorders.

Learning of new skills takes place in a specific part of the brain known as the striatum. There are two competing pathways — the direct and the indirect — for signal transmission through the striatum, both affecting movement. However, the detailed mechanisms and circuits underlying the role of the striatum in the acquisition and consolidation of skills are not understood.

Preliminary experimental evidence acquired through the recording of the neural activity in the striatum of mice revealed region-specific changes during the different phases of skill learning. These changes correspond to long-lasting and training-specific modifications in excitatory synaptic transmission.

Building on these observations, the EU-funded Neuroaction[1] project wishes to delineate the precise involvement of the direct and indirect pathways in skill acquisition and consolidation. In order to dissect the different aspects of motor learning, scientists are using mice that express fluorescent proteins in the direct and indirect striatal pathways. They have also developed a self-paced operant task in which mice have to press a lever at increasingly faster speeds to obtain a food reward.

Observations so far indicate that stimulating the direct and indirect pathways either before or after sequence initiation has different effects on skill performance. Equally, speed and precision depend on different circuits. The researchers also found that neurons from the direct and indirect pathways are differentially involved at different phases of skill execution.

The Neuroaction findings will have important implications for understanding the processes of skill learning and execution, and the impairments observed in basal ganglia disorders like Parkinson's disease and Huntington's disease.

The project was coordinated by the Fundacao Calouste Gulbenkian in Portugal.

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1 'Neural mechanisms of action learning in mouse models'.

Funded under the FP6 programme 'Life sciences, genomics and biotechnology for health'.
http://cordis.europa.eu/marketplace > search > offers > 9468

Reprogramming cardiac cells

Stem-cell therapy and regenerative medicine rely heavily on the use of stem cells to generate tissue-specific cells. Reprogramming somatic cells to an embryonic state has excellent potential for future cell-based therapy. This guarantees the ample provision of patient-specific stem cells, overcoming potential ethical and legal obstacles.

The ability of nearly all somatic cells to artificially become pluripotent stem cells, or 'Induced pluripotent stem cells' (iPS cells), through the enforced expression of four transcription factors has revolutionised stem-cell biology. The most appropriate system for generating iPS from various cell types has been the focus of extensive research.

The scientific aim of the EU-funded Induvir[1] project is to improve current knowledge of the generation, maintenance and characteristics of iPS cells — focusing on their differentiation towards cardiac cell lineages.

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Scientists have generated various DNA constructs for reprogramming of mouse somatic cells into iPS cells by minimal integration into the host genome. For this purpose, they have used a non-viral, transposon-mediated approach or excisable lentivirus-based vectors.

Successful generation and characterisation of iPS cells has so far been achieved from different mouse genetic backgrounds. These cells have been verified to behave like embryonic stem cells. The aim is to optimise the conditions for directing them towards the cardiac differentiation pathway after removing the reprogramming cassette from the iPS cells.

The Induvir project findings are expected to contribute significantly towards cell therapy for the treatment of heart disease. The developed technology has the capacity to generate therapeutically safe iPS cells from the patient's own cells, thereby preventing rejection.

The project was coordinated by the Biotelantum Tudasfejleszto KFT in Hungary.

1 'Improved gene transfer system to iPS cells in mouse'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9465

BIOLOGY AND MEDICINE

Interview: Reviewing complementary medicine in Europe

'Complementary and alternative medicine' (CAM) is an umbrella term for treatment practices mainly used outside conventional medicine. The most prominent CAM disciplines in the EU are herbal medicine, acupuncture, homeopathy and manual therapies (like massage, osteopathy and reflexology), but CAM also includes such practices as anthroposophic medicine and naturopathy. CAM is practised mostly in private practice by medical doctors and practitioners trained in the specific disciplines.

© Cambrella project

Dr Wolfgang Weidenhammer

The Cambrella[1] project has been looking into the current situation of CAM in Europe. As the project concludes at the end of 2012, *research*eu results magazine* asked Cambrella's coordinator, Dr Wolfgang Weidenhammer of the Kompetenzzentrum für Komplementärmedizin und Naturheilkunde, at the Technische Universität München in Germany, to explain the project's work.

What first drew you to research in this area?

I have been working in the area of CAM for nearly 20 years. Being educated in psychology, and working in medical psychology for years, I have seen that psychological concepts prove to be useful in various medical fields. Complementary medicine in particular is open to exploring unspecific effects whose modes of action are at least partially explainable by psychological theories.

This underlying holistic conception clearly includes the perception of the individual's mind. 'Placebo' or 'nocebo' effects are interesting examples of this, which are discussed with regard to CAM with some controversy. Complex interventions are very often used, and these can be addressed methodologically — similar to empirical psychology — by taking into account a multidimensional view of phenomena.

What was the aim of the project?

We have been working to establish sound knowledge of the core issues and current status of CAM in the EU.

The detailed aims[2] of Cambrella were to: create a knowledge base on patients' demand for CAM and the prevalence of its use in Europe; review the current legal status of CAM in EU countries and associated states; explore the needs and attitudes of EU citizens with respect to CAM; explore the providers' perspective on CAM treatments in the EU; look at the global dimension of CAM research and development strategies; propose an appropriate strategy to improve understanding of CAM use and its effectiveness; and facilitate and foster the sustainable collaboration and networking of CAM researchers in Europe.

What was new about the Cambrella project and the way it addressed these issues?

Although some CAM research has been funded by the EU previously, Cambrella is the first project which has been explicitly assigned to CAM, with the European Commission acknowledging the relevance of this field of medicine being investigated on a European level.

Unlike collaborative research projects, since Cambrella is a 'coordination action' like the FP7 project on 'Traditional Chinese medicine' (GP-TCM), the intention is to prepare the ground for future research by describing the current status comprehensively and — taking these findings into account — developing a strategic plan.

How was it participating in an EU project?

It is highly attractive to widen the regional or national perspective of research topics to the European level — and EU-funded Framework Programme projects enjoy a good reputation in the academic world. It makes a substantial difference whether you just consider scientific work from the international literature or you actually meet and talk and discuss with colleagues from different countries.

This kind of intensive communication is vital, especially in fields which are represented by a smaller research community — such as the area of complementary medicine. Europe is an ideal geographical frame which, despite a lot of common features, includes country-specific variations that can be very inspiring for finding new and unconventional solutions.

What are the project's results so far?

We have created a special issue of a peer-reviewed scientific journal — to be presented at our Cambrella final conference[3]. All the articles are publicly accessible, free, on the journal's website.

In terms of findings, we noted that CAM has no clear terminology, with definitions varying from one language and culture to another. There is a clear demand, however, with EU citizens wishing to have access to increased and diverse CAM provision, as well as more support and trustworthy information from medical professionals. But there is a lack of reliable data on the prevalence of CAM — most prevalence studies published so far are too small or not comparable due to different methodology.

We could not identify a common approach in Europe with respect to provision (including training) or regulation of CAM; around half of EU countries have general legislation for CAM, in the form of a specific CAM law or sections on CAM in other health laws, while some countries have regulations on specific CAM treatments.

In general, CAM is a neglected area of research. An EU research strategy for CAM should reflect the needs of the citizens, patients, providers and other CAM stakeholders taking into account the real-world environment of healthcare in Europe. We recommend that a centralised and academically supported EU CAM centre should make this research strategy operational.

What are the next steps for the project, or next topics for your research?

One task for the project was the development of a 'roadmap' for future CAM research in Europe. We have identified the research areas which should guide any plan for future research projects.

Having finished the project does not mean that efforts towards a better evidence base on CAM has come to an end. The project has been a first step, with a commitment to continue the work. We would be happy if the Horizon2020 programme provides opportunities for the research projects needed to investigate the potential benefits of CAM for patients in Europe.

1 'A pan-European research network for complementary and alternative medicine (CAM)'.
2 Weidenhammer W, Lewith G, Falkenberg T, Fønnebø V, Johannessen H, Reiter B, Uehleke B, von Ammon K, Baumhöfener F, Brinkhaus B. 'EU FP7 project "Cambrella" to build European research network for complementary and alternative medicine'. Forsch Komplementmed 2011;18:69-76.
3 Walach H, Weidenhammer W (eds.). 'Insights into the current situation of CAM in Europe: major findings of the EU project Cambrella'. Forsch Komplementmed 2012;19 (S2).

Funded under the FP7 specific programme Cooperation, under the theme 'Health'. For further information see the project website: http://www.cambrella.eu/

Interview: Tackling fatty liver disease, Europe-wide

'Non-alcoholic steatohepatitis' (NASH) has become one of one of the most frequent causes of chronic liver disease in developed countries, due to growing epidemics of obesity and diabetes.

The aim of the FLIP[1] project was to improve understanding and prevention of NASH. As the project nears its end in June 2013, *research*eu results magazine* asked FLIP's coordinator, Professor Vlad Ratziu of the Hôpitaux de Paris, to explain the project's work.

The FLIP project is coordinated by the Assistance Publique — Hôpitaux de Paris (APHP) from France and was endorsed by the European Association for the Study of the Liver (EASL). The FLIP consortium has 15 members, including two SMEs.

What are the main aims of the project?

The FLIP project centres on NASH, a liver disease associated with obesity and diabetes. NASH is increasingly common, yet there was no coordinated effort to undertake a large collaborative multinational research programme at the European level. We set up a consortium of clinical hepatologists and laboratory scientists in order to study the mechanisms of disease progression, its spectrum of severity, to improve diagnosis, and to determine preventive and patient education strategies.

In particular, we wanted to define risk factors for disease severity to identify non-invasive biomarkers for screening, and to understand the progression of the disease from fat alone to inflammation and 'fibrogenesis' — the mechanism that leads to cirrhosis and liver cancer.

What first drew you to research in this area?

NASH has become one of the main chronic liver diseases and a growing cause of liver cancer. It is a global disease, with clear emergent trends in developing countries. It can also be severe as it increases mortality rates by 30 to 40 % and liver-related mortality ten-fold (compared to an age and sex-matched control population). In the US, it is the third most common indication for liver transplantation. Therefore, there is a pressing medical need that remains unmet.

Both Europe and the US have issued guidelines on managing the disease and Europe needs its own research network on the topic. The US National Institutes of Health (NIH) has established a very large project on NASH. Because of the need for large volumes of data we decided to create a similar-scale network for Europe — which should also lead to increased visibility of European researchers in this field.

What are the concrete results from the research to date?

The project has built a large, transnational cohort of 600 well-phenotyped NASH patients with standardised inclusion criteria. We aim to follow up with these patients for at least three years to collect data and build a bio-bank. This will help future research into the mechanisms of liver injury, hepatic and cardiovascular complications, and support the development of new preventive and therapeutic strategies.

In addition, we have set up an observational registry of more than 250 patients with primary liver cancer due to NASH, in order to better describe risk factors of carcinogenesis in this condition. So far, most reports of liver cancer in NASH sufferers have been isolated case records, or in small numbers, and this is the first large European prospective description of this cancer in NASH patients. Our consortium has completed the first European 'Genome-wide association study' (GWAS) of genetic predisposition towards the disease. And we are in the final stages of building and validating a consensual histological classification of NASH.

Current diagnostic methods rely on liver biopsy, an invasive procedure, not adapted for large-scale diagnosis. Together with a few SME partners, we tested different non-invasive biomarkers and patented an imaging method based on 'Magnetic resonance imaging' (MRI).

Our consortium also created a web-based programme to facilitate behaviour changes and motivate NASH patients to take up healthier lifestyles and dietary changes, an important complement to pharmacological approaches.

Numerous sub-projects within FLIP are dedicated to several aspects of basic research on NASH: mechanisms of lipotoxicity, fibrogenesis, gut flora-liver interaction, drivers for fibrosis, molecular mediators of inflammation, cellular and molecular hepatic effects of exercise, cross-talk between adipose tissue and fatty liver, etc.

As you complete this EU project, what are the next steps for your research?

Since NASH is a multidisciplinary disease, we are developing collaborations with researchers in diabetes and endocrinology — and will work on dissemination of FLIP's technical innovations, such as the MRI imaging technique. The next challenge will be to continue beyond the FP7 funding period by building a European research network on NASH in the spirit of FLIP, with a core membership based on the current consortium members and expanded to other European experts on NASH.

© FLIP poject

Professor Vald Ratziu

1 'Fatty Liver: Inhibition of Progression'.

Funded under the FP7 specific programme Cooperation, under the theme 'Health'.
For further information see the project website: http://www.flip-fp7.eu/
There are 30 or more searchable papers published by the FLIP project available at the EU Open Access site, OpenAire: http://www.openaire.eu

ENERGY AND TRANSPORT

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Lightweight, high-energy batteries for electric cars

In its effort to reduce carbon dioxide emissions in the transport sector, the EU is focusing on electric vehicles. EU-funded scientists are developing a novel lightweight battery pack for cars that should make the technology even more attractive.

Given their low energy density (useful energy stored compared to overall system volume), battery packs of the near future will be relatively large and heavy. Contrasting with most battery research programmes, a European consortium has focused on reducing their overall weight.

In the EU-funded Smartbatt[1] project, scientists are optimising housing structure and intelligent vehicle integration. In a male-dominated sector, they also emphasised women's participation.

The consortium has developed innovative simulation tools and employed new lightweight materials. In addition, theoretical risk assessments covering electrical, thermal and chemical hazards as well as crash and fire hazards have resulted in two generic battery designs.

Final selection of a single concept for testing is pending experimental safety evaluations —currently being conducted — and final approval from all partner organisations.

The battery case is anticipated to be completed shortly after this reporting period. It will no longer be separate but rather a fully integrated structural component of the vehicle underbody, with intelligent interfaces to on-board electrical, cooling and monitoring systems.

Overall, Smartbatt promises to advance the state of the art in electric car battery systems, enhancing the competitiveness of the European automotive industry while contributing to reducing climate change.

The project was coordinated by the Österreichisches Forschungs und Prüfzentrum Arsenal GES.M.B.H. in Austria.

1 'Smart and safe integration of batteries in electric vehicles'.

Funded under the FP7 specific programme 'Cooperation' under the theme 'Transport'.
http://cordis.europa.eu/marketplace > search > offers > 9592

Novel gears with no-contact magnetic teeth

EU-funded scientists are developing a novel gear system with magnetic, non-contact teeth capable of functioning in very cold environments. Use in satellites is just one of many potential applications.

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Power-transmission components are, as their name suggests, devices used to transmit power or energy while gears are a type of mechanical power transmission element. Consisting of a toothed wheel, gears can alter the speed of driven parts — such as the wheels of a car — relative to the speed of a driving mechanism (in this case, a car's engine).

Gear reduction is a process by which the spinning of the drive mechanism is reduced to a level appropriate for the driven parts. A typical motor spins at over 1000 revolutions per minute (rpm). That may be fine for turning the wheels of a car but it would cause a robot to run out of control or a machine part to move at a frenzied and erratic pace.

In such cases, harmonic drive-gear systems provide enhanced performance compared to traditional ones. They tend to be compact and lightweight, with high gear-reduction ratios as well as good resolution and repeatability.

European scientists sought to develop a low-friction harmonic drive capable of working under very low (cryogenic) temperatures over a long lifetime with no wear, which is exactly what is needed in a satellite.

EU funding of the Magdrive[1] project is providing these scientists with a chance to develop such a drive. The concept is based on employing non-contact magnetic teeth. It exploits soft magnetic materials and superconductors.

Preliminary performance tests of the reduction gears provided important insight, useful in the development of two prototypes. One was meant for preliminary room-temperature tests and the other for cryogenic tests. Final testing should lead to optimisation of Magdrive designs.

The new non-contact gear mechanism for cryogenic environments will undoubtedly be welcomed by satellite producers. It could find use in Earth-based systems as well.

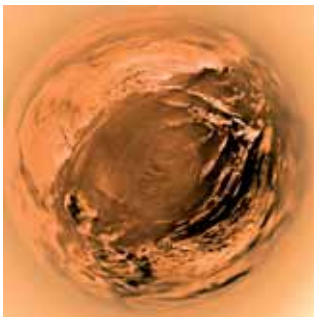
The project was coordinated by the Universidad Carlos III de Madrid in Spain.

1 'Magnetic-superconductor cryogenic non-contact harmonic drive'.

Funded under the FP7 specific programme 'Cooperation' under the theme 'Space'.
http://cordis.europa.eu/marketplace > search > offers > 9593

Unravelling the composition of Titan's atmosphere

Scientists have long been fascinated by the dense atmosphere of Titan, the largest satellite of the planet Saturn. An EU-funded study has looked into the composition of Titan's atmosphere, paying particular attention to the chemistry of certain novel compounds.



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Evidence from a recent space mission has shown the presence in Titan's ionosphere (1000 km above the moon surface) of negatively charged ions. According to scientists, this constitutes an important discovery, not only because such molecules had not been predicted, but also because their chemistry is unknown to Earth.

In order to understand the processes that lead to the formation of such negatively charged ions, the EU-funded Tactic[1] project proposed to develop models of Titan's ionospheric chemistry. Scientists had to perform chemical reactions and measure their rate constants, as well as obtain structural information concerning these negative ionic species.

Using mass spectrometry and with the guidance of planetary scientists in Arizona in the United States, it has been possible to establish kinetic modelling of Titan's ionosphere. Nitrogen-rich compounds known as tholins — only detected in the outer solar system — have been synthesised by the Tactic scientists, and their molecular and structural composition under negative ionisation conditions is being investigated.

Furthermore, by implementing instrumentation for gas mixture production, the Tactic project aimed to recreate the Titan ionosphere by generating negatively charged ions.

Collectively, the project's findings will not only shed light on the composition of Titan's ionosphere but will provide important tools for investigating and practising new chemistry.

The project was coordinated by the Centre National de la Recherche Scientifique (CNRS) in France.

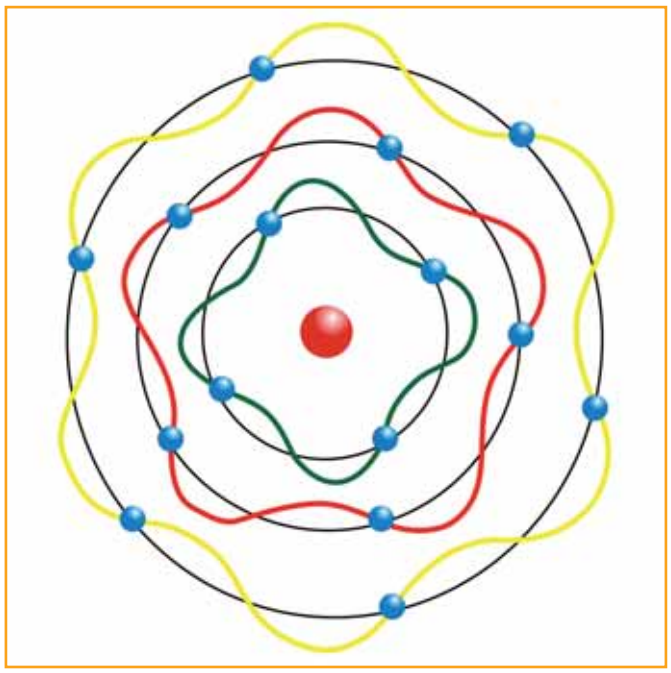
1 'Titan atmospheric composition: Tholins and ionospheric chemistry'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9526

ENERGY AND TRANSPORT

The changing shape of an atomic nucleus

The nucleus of an atom can have different shapes that coexist. EU-funded scientists investigated nuclear shape change with advanced experimental techniques, establishing the EU as a leader in a rapidly growing field.



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Most people are familiar with the general structure of an atom, made up of a nucleus — consisting of protons and neutrons — around which electrons orbit. An element's identity and its position in the Periodic Table of Elements is defined by the number of positively charged protons in the nucleus (atomic number), which is equivalent to the number of negatively charged electrons.

A different number of protons (and thus electrons) means a different element. However, a given element can have several forms (isotopes) depending on the number of neutrons in the nucleus. Isotopes of an element have different masses resulting in different properties related to relative stability, type of radio active decay and the like.

One of the goals of nuclear physics is to understand the nature of coexisting nuclear shapes and their relationship to fundamental interactions such as nuclear vibrations or rotations.

The field of macroscopic nuclear shape change has exploded in recent years due to important technological advancements enabling experimental detection of nuclear shape changes. Lead (Pb) isotopes have proved to be useful as case studies of coexisting nuclear shapes and have been studied extensively.

European researchers have initiated the Heavyrib[1] project to study the nuclear structure of neutron-deficient nuclei. They employed nuclear excitation and advanced experimental detection technology: the novel MINIBALL gamma-ray detector and the series CD-particle detector system.

Heavyrib also developed novel methods for manipulation and preparation of radioactive beams. Experimental results include a number of firsts. Analysis of data will allow a study of the systematic behaviour of mixing between different coexisting nuclear shape structures.

In addition, the researchers have also initiated another important project to enable simultaneous detection of gamma-rays and conversion electrons previously only possible in isolation.

The Heavyrib project made important advances in understanding the nature and behaviour of coexisting atomic nuclear shapes and their role in interactions among nuclear constituents. The results help position the EU as a leader in this new and rapidly growing field of research.

The project was coordinated by the European Organization for Nuclear Research (CERN) in Switzerland.

1 'Nuclear structure studies of neutron-deficient nuclei in light Pb region using radioactive ion beams'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9522

Seaplanes take to the skies

Increasing air traffic and constraints on building new airports has led to renewed interest in seaplanes that can utilise Europe's lakes, rivers and shorelines. As a result, an EU-funded consortium of aircraft manufacturers, operators and aeronautical research institutes have investigated the use of seaplanes as a viable form of transport.

The Fusetra[1] project has investigated ways of improving the current seaplane and amphibian aircraft transport system. Seaplanes can be defined as fixed-wing aircraft capable of taking off and landing on water, whereas amphibian aircraft are seaplanes that can also take off and land on airfields.

Researchers identified four main challenges to the increased use of seaplanes. The first was that the aircraft operate in two different environments — air and water — and that the approval of different public bodies, including aviation, naval, police and local authorities, are required for establishing an airline. This could be a lengthy and costly process for prospective seaplane operators. A second drawback is the limited number of qualified pilots and examiners due to current low levels of seaplane traffic in Europe. As a result, pilots need to be recruited from outside the EU, requiring work visas and validation of licences.

Existing commuter seaplanes were designed 30 to 40 years ago and do not comply with the cost, emission and performance requirements of modern aircraft. The project examined possible

modifications to modern aircraft and the concept of a new boatplane. However, these would require new infrastructure that must first be assessed for environmental impact. The final and most critical issue was profitability and the opening up of new markets in the face of other modes of transport, such as ferries.

Fusetra identified a large number of potential locations for seaports, which could provide jobs and drive regional economic development. Researchers also highlighted the need for modern, cost-effective aircraft that comply with environmental regulations and have an operating range of up to 1000 kilometres, thereby benefiting the manufacturing industry. Seaplanes and amphibian aircraft are also well suited to firefighting and low-altitude surveillance and can help combat wildfires and illegal immigration. These aircraft are also suitable for search and rescue at sea as they are cheaper and have a longer range than helicopters.

The project has had a direct impact on future regulatory issues by improving European rules for operating seaplanes and encouraging greater cooperation between local and European authorities. The most important benefit, however, will be the creation of a safe, efficient and environmentally friendly seaplane transport system for EU citizens.

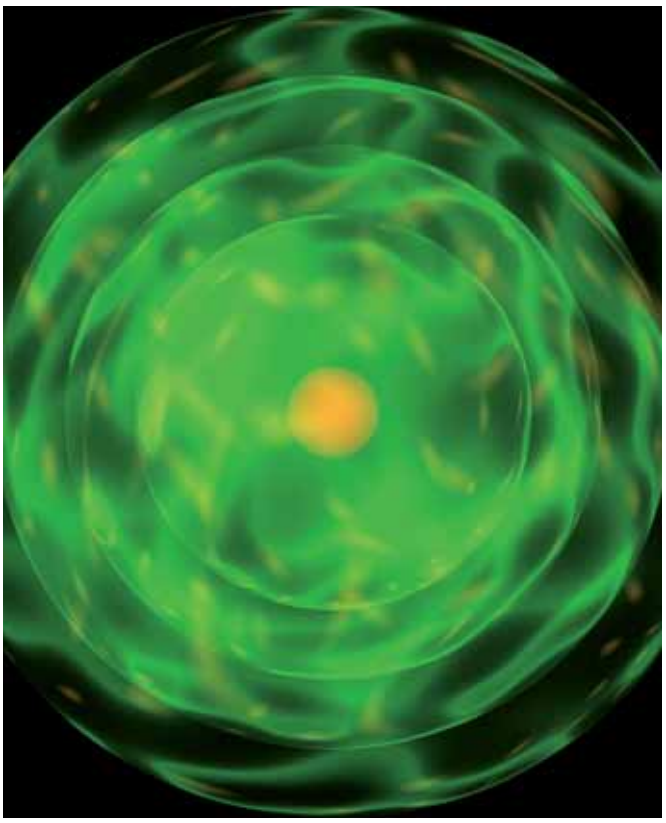
The project was coordinated by Dornier Aviation GmbH in Germany.

1 'Future seaplane traffic — transport technologies for the future'.

Funded under the FP7 specific programme 'Cooperation' under the theme 'Transport'.
http://cordis.europa.eu/marketplace > search > offers > 9591

Particle reconstruction at CERN

The European Organization for Nuclear Research (CERN) addresses fundamental questions in physics by conducting high-energy experiments. Using particle accelerators and specific detectors, scientists studied the properties of the charged particle, the muon.



The discovery of the muon has puzzled scientists for decades. Muons are charged particles, like electrons and positrons, but 200 times as heavy.

To study properties and phenomena related to such particles, large accelerators such as the 'Large hadron collider' (LHC) are used. They can accelerate elementary particles like protons to speeds close to the speed of light.

The different particles and phenomena produced in high-energy collisions in the LHC are detected by the 'Compact muon solenoid' (CMS) that resembles a large cylindrical onion. The layers of detectors measure the different particles, and this information is used to answer questions regarding the origins of matter and the forces in the Universe.

The objective of the EU-funded CMSMURECOTRIGBSM[1] project was to optimise muon-particle reconstruction with the CMS — obtaining the best possible resolution and efficiency.

Data collected from the muon detectors was thoroughly investigated to extrapolate time-of-flight measurements. Also, the muon trigger requirements and paths were studied in the context of commissioning and integration for the LHC.

Future aims of the proposed work are to support the potential of the CMS to study muons in their final state.

The project was coordinated by the European Organization for Nuclear Research (CERN) in Switzerland.

1 'Muon reconstruction and trigger optimization towards early, beyond the standard model, discovery at the LHC with the CMS detector'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9462

ENERGY AND TRANSPORT

Detecting ancient stars

EU-funded scientists have detected and characterised elusive 'white dwarf' (WDs) stars — among the oldest objects in the known universe — to shed light on the origin and evolution of our galaxy.

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Stars form vast groups known as galaxies, among which is our Milky Way, with between 200 and 400 billion stars. They have their own life cycles — they are born, they evolve and they die.

WDs are the typical end point in the evolution of 'smaller' stars up to eight times as massive as our Sun. They are among the oldest objects in the known universe. Studying these 'fossil stars' could provide vital information about the formation and evolution of our galaxy.

However, WDs are characterised by their low luminosities. They are so faint that very few of them have been identified so far.

European researchers have set out to exploit recent technological advancements in stellar observation and experimentation in order to detect and classify WDs. EU funding of the Galfos[1] project made this possible.

When seen from the edge, a spiral galaxy resembles a stereotypical flying saucer. Stars in spiral galaxies such as the Milky Way form three main regions — namely the bulge, disk and halo. The bulge is the central concentration of stars. Surrounding it is a flat rotating disk that contains stars and interstellar matter. Further out is a faint halo of stars.

The location of a star in the galaxy structure is loosely related to the star's age. The disk consists of two different populations: younger, more rapidly rotating stars in the thin disk, and mainly older and more slowly rotating stars in the thick disk.

Based on stacked images acquired on a monthly basis, scientists measured with extremely high accuracy the relative movements (called 'proper motion') of all the stars identified. Proper-motion criteria enabled clear definition between thin-disk WDs, on the one hand, and thick-disk and halo WDs on the other. Investigators thus developed a list of WD candidates with high proper-motion and characterised them.

The Galfos project identified numerous WDs and analysed them, yielding critical information about the history of our galaxy.

The project was coordinated by the University of Hertfordshire Higher Education Corporation in the United Kingdom.

1 'Unveiling the history of the Galaxy with its fossil stars'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9508

Optimising chemical reactions for tomorrow's fuel cells

Important advances have been made in characterising the molecular structure and function of compounds involved in chemical reactions of particular relevance to fuel-cell technology.

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Catalysts are compounds that speed the rate of a chemical reaction without themselves being altered by it. They can be reused again and again. A special type of catalyst, electrocatalysts, are acting at the electrode surface and facilitating reactions taking place there.

With the advent of nanotechnology and the interesting functionalities of nanoscale materials, it is only natural that such materials would find relevance in electrocatalytic applications.

Using EU funding, European scientists sought to systematically characterise factors affecting activity and selectivity of nanocrystalline oxide electrodes in the NOSOE[1] project.

Scientists focused on oxygen and 'Chlorine evolution reactions' (CERs) in acidic solutions. These reactions are used to generate molecular oxygen (O_2) and chlorine (Cl_2) via electrolysis of acids.

In particular, the NOSOE consortium sought to elucidate the mechanisms and active sites — where the catalyst binds to the reactant(s) — of oxide electrocatalysts. Knowledge of catalyst action along with the use of advanced synthetic approaches could lead to the development of a new class of oxide-based electrocatalytic materials with controlled activity and selectivity.

The consortium optimised synthetic procedures for specific electrocatalysts of interest. They characterised them with advanced X-ray diffraction techniques and tested their activity for oxygen and chlorine evolution in acidic media. The catalysts were highly selective for oxygen evolution even at high chloride-ion concentrations.

Investigators then developed detailed structural models (using X-ray absorption spectroscopy), including distribution and bonding arrangements of certain chemical species as well as prospective active sites on the oxide catalyst surface.

Results of the NOSOE project have been presented in international journals and at international conferences. They are expected to have an important impact on the development of catalysts for fuel cells and to enhance the use of renewable wind and solar energy.

The project was coordinated by the J. Heyrovsky Institute of Physical Chemistry in the Czech Republic.

1 'Nanocrystalline oxides for selective oxidative electrocatalysis'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9569

The makings of a stellar explosion

EU-funded scientists have provided critical evidence for the source of a particular type of supernova stellar explosion. The results help answer one of the most important questions in stellar astrophysics.

Supernovae (SNe, or singular SN) are explosions of stars whose initial brightness can momentarily outshine the intensity of an entire galaxy. SNe are classified as Type Ia, Ib, Ic or Type II. A Type Ia SN is thought to result from the explosion of a 'white dwarf' (WD), a star that has completed its normal life-cycle and no longer exhibits nuclear fusion.

Sometimes the mass of the WD increases beyond a certain limit, the so-called 'Chandrasekhar limit', either by accumulating mass from a binary companion star — the 'single-degenerate' (SD) model — or by merging with another WD — the 'double-degenerate' (DD) model.

When this occurs, the WD will begin to collapse on itself due to the gravitational force of the large mass itself. Its temperature will rise past the nuclear fusion ignition point and will initiate an uncontrolled nuclear reaction.

Despite decades of intensive research, the progenitor systems of Ia supernovae remain elusive. Yet the unsolved problem has important implications for stellar evolution and evolution of galaxies.

Most data on Ia-type SNe have been accumulated from distant SNe outside our own galaxy. However, the large distances prohibit precise measurements of key parameters.

European researchers set out to conduct a detailed study of Ia-type 'SNe remnants' (SNRs) and binary WDs in the Milky Way and other close galaxies with EU funding for the project Sniaprog[1].

Scientists identified two interesting binary WDs that may be relevant to the DD model. Data are currently being analysed and prepared for publication.

Investigators also studied WD mergers, consisting of two similar and relatively low-mass WDs. Perhaps the most exciting result of the Sniaprog project, published in numerous forums, is that the frequency of WD mergers is similar to the frequency of Ia-type SN events, providing important support for the DD progenitor model.

Fruitful results of numerous other collaborations and scientific visits are helping to solve the mystery of the Ia-supernova progenitors.

Taken together, the Sniaprog project results have significantly advanced understanding of the source of Ia-type SNe, one of the most important unanswered questions in stellar astrophysics.

The project was coordinated by the Tel-Aviv University Research Authority in Israel.

1 'A close look at type Ia-supernova progenitors'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
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ENERGY AND TRANSPORT

Accumulating stellar 'stuff' to form galaxies

To gain insight into the growth and evolution of galaxies, researchers have studied the accumulation of stellar material on to stars and black holes.

Looking up at the night sky, one might think the stars and their formations have been — and will be — there forever. The truth is that the Universe is constantly changing, albeit on an observationally slow scale. Stars are born, die and galaxies are constantly evolving.

One phenomenon that appears to be involved in the growth of galaxies is accretion. Accretion is the attraction and accumulation of gas and dust onto compact objects such as stars and planets. It is due to the gravitational pull associated with their large masses. It is accompanied by various forms of high-energy jet bursts that can be observed as an increase in the object's luminosity.

Many galaxies have supermassive accreting black holes at their centre, referred to as 'Active galactic nuclei' (AGN). Accretion onto black holes or neutron stars produces quasars in distant galaxies as well as extremely high-energy gamma-ray bursts and stellar 'X-ray binaries or bursts' (XRBs).

Astronomers have observed a so-called scaling relationship between the growth of AGN and the growth of the galaxies themselves. More massive galaxies have more massive black holes.

European scientists have sought to extend their previous work on discovered scaling relationships between XRBs and AGN. They wanted to produce a unified model of all accreting sources and to study phenomena regulating the growth of galaxies. With funding for the XRBGAL[1] project, the team pursued its goals. Investigators directly detected inefficient flows in XRBs and were able to experimentally explain prevalent underlying theories.

They also demonstrated numerous observational similarities previously thought not to exist between accreting 'white dwarfs' (WDs), another class of stars, and XRBs. Finally, using the scaling relationships developed, the team calculated the mass limits of the black hole at the centre of the globular cluster NGC 6338.

Understanding stellar and other galactic events through experimentation and numerical modelling provides insight into the origins and evolution of galaxies. The XRBGAL project yielded important observational and mathematical results vital to this understanding.

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The project was coordinated by the Commissariat à l'Energie Atomique in France.

1 'Exploitation of the connections from X-ray binaries to active galactic nuclei'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
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Origins of cosmic high-energy bursts

Scientists have managed to observe and quantify previously unknown galactic phenomena associated with some of the brightest observable bursts of light seen in the sky.

Compact stellar objects with high masses and densities — such as stars, planets and black holes — accumulate and incorporate stellar dust and gas in a process called accretion.

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The large mass of the object pulls the dust and gas towards it due to its gravitational field. The swirling gas and dust forms a rapidly spinning accretion disc around the compact object and is then incorporated into the object, adding to its mass.

Jets, or tremendous bursts of matter and energy observed in the form of light, seem to be associated with all accreting systems, yet the basis of disc-jet coupling is largely unknown.

European scientists set out to investigate the physics of jets in accreting black holes, neutron stars and 'white dwarfs' (WDs), as well as the nature of disc-jet coupling.

With EU funding of the Jetvar[1] project, the team took advantage of newly available experimental techniques together with advanced analysis methods.

Jetvar studied a wealth of jet data in relation to rapid changes in emission over the entire 'electromagnetic spectrum' (EM), including X-ray, infra-red, optical (visible) and radio observations. In particular, they were interested in comparing the jet variability data from the different stellar sources to gain insight into the role of black-hole spin in producing and powering jets.

The Jetvar project has enabled the collection of a tremendous amount of data, using newly available fast photometers (instruments that measure light intensity) on large telescopes. For the first time, scientists were able to study fast, multi-wavelength variability in accreting compact objects.

This led to a number of firsts in terms of results. The Jetvar team produced the first independent estimate of the magnetic field in a jet and an estimate of jet speed.

Overall, Jetvar successfully initiated what is now considered a new field of research, and one that has been selected for study in a space mission by the European Space Agency (ESA).

The project was coordinated by the University of Southampton in the United Kingdom.

1 'Exploitation of the connections from X-ray binaries to active galactic nuclei'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
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Microbes join fight against desertification in North Africa

Desertification continues to present a serious problem in many areas of Tunisia, contributing to water scarcity, lack of food production, and a steady exodus of people from rural communities to the cities. In a bid to reinvigorate arid arable land, a project is researching the use of microbial biotechnology to solve agricultural problems in desert environments.

Tunisia suffers from drought and aridity and, like others in Northern Africa, is one of the countries most vulnerable to climatic extremes. The Mediterranean region — North Africa and the eastern Mediterranean in particular — faces potentially catastrophic climate change in the future, which could critically undermine sustainable development efforts.

While among the countries worst affected by desertification, Tunisia is also one of the most active in developing research efforts to counteract this on going problem. The University of Tunis El Manar, along with the University of Ioannina in Greece, joined with the University of Milan to develop the FP7-funded Biodesert[1] initiative. The project aims to research and exploit the activities of micro-organisms that inhabit extreme environments such as deserts.

Micro-organisms living in harsh environments possess important properties that could be exploited in agriculture to improve soil water retention, fertility and plant protection in arid ecosystems. By exploiting these properties, the partners hope to uncover new ways to help crops overcome the different kinds of stresses put on them by desertification, and to use 'Microbial resource management' (MRM) strategies to improve agricultural productivity.

The project has already uncovered a number of desert microbes showing potential to improve agriculture. 'Besides a series of hardy microbes — extremophiles — inhabiting the inland and natural coastal saline lakes of Southern Tunisia, the Biodesert research team has characterised stone-dwelling micro-organisms that are capable of resisting stressful solar radiations together with exposure to toxic heavy metals,' says project coordinator Professor Daniele Daffonchio. 'These micro-organisms are a potential source of novel enzymes and metabolites for many applications.'

Supporting local expertise

A molecular microbial ecology research platform already exists in Tunisia, actively performing collaborative research for the development of straightforward MRM strategies for agriculture in arid environments. Biodesert aims to expand the existing platform and improve the related technical and research knowledge which, in turn, supports the development of a bio-economy in the region.

The project thus set out to create the conditions — purchasing advanced research equipment through EU funding and promoting knowledge exchange — for developing research in the field of microbial applied biotechnology. The team is working on harnessing the survival skills and >

adaptability of extremophiles living in the arid and desert environments which characterise Tunisia and North Africa, and to apply this to agricultural and environmental processes.

The project has already recorded a number of successes in this context, according to Prof. Daffonchio. 'We are getting exciting results that provide perspectives in exploiting bacteria for promoting plant growth in arid ecosystems,' he notes.

'For example, we have found a root-associated microbiome that is effective in enhancing the resistance of plants to water stress. We also have data and experiments in progress that show how the bacteria can promote plant growth and resist drought.'

Through the recruitment of experienced researchers and a training programme in partner laboratories in Italy and Greece, the Tunisian team will be able to improve its research potential in the field of microbial biotechnology. Biodesert's dissemination strategy is already leading to improved knowledge being spread throughout the scientific community, Tunisian society and other North African countries, promoting the application of MRM for improving agriculture sustainability in the face of desertification.

'With the help of the two European partners from Italy and Greece, the team at the University of Tunis El Manar is now ready to develop advanced research in the area of desertification and the management of the microbial resource for improving agriculture in arid lands,' confirms Prof. Daffonchio.

The project was coordinated by the Universita degli Studi di Milano in Italy.

1 'Biotechnology from desert microbial extremophiles for supporting agriculture research potential in Tunisia and Southern Europe'.

Funded under the FP7 specific programme 'Capacities' under the theme 'Stimulating the realisation of the full research potential of the enlarged European Union Community'.
http://ec.europa.eu/research/infocentre > search > 27693

New material puts pressure on greenhouse gases

Researchers at the University of Nottingham in the United Kingdom recently discovered a novel material that could be used by sophisticated technologies to fight global warming.

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Could a new material called NOTT-300 substitute for carbon dioxide (CO_2) absorption? This is a possiblity raised by a study funded in part by a European Research Council (ERC) Advanced Grant worth EUR 2.5 million. This study, which was awarded to Professor Martin Schröder for the Coordspace[1] project, was recently presented in the journal *Nature Chemistry*.

'Our novel material has potential for applications in carbon capture technologies to reduce CO_2 emissions and therefore contribute to the reduction of greenhouse gases in the atmosphere,' says research leader Prof. Schröder of the University of Nottingham. 'It offers the opportunity for the development of an "easy on/easy off" capture system that carries fewer economic and environmental penalties than existing technologies. It could also find application in gas separation processes where the removal of CO_2 or acidic gases such as SO_2 is required,' he adds.

According to the researchers, their findings could help us understand how to solve the problem of greenhouse gases. 'It is widely accepted that it is imperative that the CO_2 footprint of human activity is reduced in order to limit the negative effects of global climate change,' Prof. Schröder explains. 'There are powerful drivers to develop efficient strategies to remove CO_2 using alternative materials that simultaneously have high adsorption capacity, high selectivity for CO_2 and high rates of regeneration at an economically viable cost.'

NOTT-300 covers all these criteria. Thanks to its properties, it could boost environmental and chemical sustainability. With regards to cost, this material is also synthesised from relatively simple and inexpensive organic materials. The only solvent is water.

'The material shows high uptake of CO_2 and SO_2,' the Nottingham researcher says. 'In the case of SO_2, this is the highest reported for this class of materials to date. It is also selective for these gases, with other gases — such as hydrogen, methane, nitrogen, oxygen — showing no or very little adsorption into the pores.'

Additionally, the team found that the material facilitates the release of absorbed gas molecules through pressure loss, and it has high chemical stability to all common organic solvents. NOTT-300 is also stable in water and is resistant to high temperatures up to 400°C.

The project was coordinated by the University of Nottingham in the United Kingdom.

1 'Chemistry of coordination space: extraction, storage, activation and catalysis'.

Funded under the FP7 specific programme 'Ideas'.
http://cordis.europa.eu/news > search news > 35174

Scientists find genes protect against arsenic

Do genes play a role in people being more resistant to toxic substances? A new international study suggests they do. Investigating Argentinean villagers in the Andes, researchers discovered the prevalence of a gene variant that produces efficient and less toxic metabolism of arsenic by the bodies of the local population compared to other regions.

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The Andes is known for being an area in which the water contains high levels of arsenic. For the first time, researchers led by Lund University and Uppsala University in Sweden investigated whether people in specific regions have protective genes against arsenic.

Presented in the journal *Environmental Health Perspectives*, the study was funded in part by the PHIME[1] project, which was supported under the 'Food quality and safety' theme of the EU's Sixth Framework Programme (FP6) with EUR 13.4 million.

'We know that many bacteria and plants have genes that increase resistance to arsenic, a highly toxic substance that is found in soil and water in many parts of the world,' said Professor Karin Broberg from Lund University. 'There has been no previous research on whether the people in these regions also have protective genes against arsenic.'

Past studies found a connection between high levels of arsenic in potable water and health problems, such as heart disease and diabetes, as well as increased child morbidity and cancer risk. This problem recently emerged in some areas of the planet, such as in Bangladesh. However, in the Andes, the potable water has contained arsenic for thousands of years, mostly due to high levels of the toxic substance in bedrock and also because of mining activity since the pre-colonial era. Researchers had previously discovered 7 000-year-old mummies from northern Chile contained high levels of arsenic in their hair and internal organs.

For the purposes of their study, the researchers examined the genes of Atacameño Indian villagers in San Antonio de los Cobres in Argentina, who have lived in the area for many generations. They compared their genes with those of various indigenous and Mestizo groups from Peru and indigenous groups from Colombia and Mexico. More than 66 % of the Argentinian villagers carry a gene variant that speeds up the metabolism of arsenic versus 50 % of the Peruvian villagers and just 14 % of the other indigenous groups, according to the researchers.

'We found that people up in the mountains in Argentina had unusually efficient metabolism of arsenic,' said Prof. Broberg, a specialist in occupational and environmental medicine. 'This meant that the toxin left the body rapidly and less toxically instead of accumulating in tissue.'

The project was coordinated by Lund University in Sweden.

1 'Public health impact of long-term, low-level mixed element exposure in susceptible population strata'.

Funded under the FP6 specific programme 'Food'.
http://cordis.europa.eu/news > search news > 35161

Environmental forcing sheds light on carbon levels

European research has studied a terrestrial biosphere model to elucidate the mechanisms behind annual variations of carbon in European forest ecosystems.

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There are many ways in which the behaviour of an ecosystem can be measured. Healthy ecosystems have a predictable amount of a substance leaving and re-entering, sometimes building up certain substances like carbon as the system develops. 'Net ecosystem exchange' (NEE) is the measurement used to determine how much carbon is entering and leaving the system.

Varying values of NEE between years, driven by weather and climate, are known to contribute to global carbon dioxide (CO_2) levels, but understanding of the underlying processes is scant. Knowledge on the varying responses of the biotic component (living part) to environmental forcing could help scientists to predict future levels of global CO_2 more accurately.

The EU-funded Police[1] project aimed to assess the effects on Europe's carbon balance of extreme climate spells, as in 2003, compared with those of a 'normal' year. The summer of 2003 saw the highest recorded temperatures throughout the continent.

The Police scientists optimised all critical parameters of Orchidee, the new land-surface scheme of the 'Laboratoire

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des sciences du climat et de l'environnement' (IPSL). They assessed the limits of this process-based model to simulate eddy covariance measurements, an atmospheric measurement technique to calculate vertical turbulent fluxes within atmospheric boundary layers. It is commonly used to determine gas exchange rates of water vapour and CO_2, for example.

Refining climate prediction models with data on climate changes and their impact can lead to a better understanding of the forces in play and a more accurate forecasting of parameters crucial to the Earth's changing climate.

The project was coordinated by the Commissariat à l'Energie Atomique (CEA) in France.

1 'Parameter optimisation of a terrestrial biosphere model to link processes to inter-annual variability of carbon fluxes in European forest ecosystems'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions). http://cordis.europa.eu/marketplace > search > offers > 9574

City planning for climate change

'Be prepared' has been the official Scout motto since 1907; a new tool will help city planners do just this in preparing cities to face changing weather patterns, and in creating more sustainable cities.

The instrument in question is a web-based planning, prediction and training tool, which can be used to support decisions in long-term urban planning. This tool was developed by the Sudplan[1] project, which has received more than EUR 2.5 million in funding under the 'ICT for environmental services and climate change adaptation' theme of the EU's Seventh Framework Programme (FP7).

The tool's developers believe that the changing climate will expose European cities to new and different environmental pressures compared to the past. Sudplan will help assure a population's health, comfort, safety and quality of life, as well as the sustainability of investments in utilities and infrastructures in the context of a changing climate. With its open nature and architectural design, Sudplan contributes to a shared information space in Europe. The research team achieved this by predicting climate change and distilling its impact to the city level.

Lars Gidhagen, from the Swedish Meteorological and Hydrological Institute (SMHI) in Norrköping and coordinator of the project, explains: 'You will be able to see things in 3D. If you are looking at flooding on a street, you can look at how it extends in relation to surrounding buildings.'

Many European cities are already dealing with the impact of climate change, notably the increase in occurrences of river flooding. These are linked to precipitation and melting snow in upstream river basins rather than phenomena in the city itself. Sudplan makes it easier to plan for such flooding, as well as for other scenarios such as storm-water flooding or, at the other extreme, droughts and water shortages. Rising air pollution can also be assessed against national standards and environmental goals, and projected to a future when the climate has changed.

One city that is already trying to deal with the consequences of flooding is Wuppertal in Germany. Wuppertal boasts a population of 350 000 and is located in a hilly landscape. During heavy rainfall, the city's storm-water sewage system is quickly blocked by swollen creeks, causing the precipitation to run off on to the surface. This storm water run-off often damages valuable public infrastructure and private property.

To make the situation even worse, climate change is considered to have an increasing impact on the frequency of heavy storm-water events in Wuppertal. These factors make this North Rhine-Westphalia industrial hub an ideal test city for the Sudplan project.

'Wuppertal has severe problems with flooding, with floods flowing like rivers down the streets. They can use this simulation tool to see the measures taken to change the city's topography, perhaps building small-scale barriers on streets, and lifting pavements to prevent water entering houses,' Mr Gidhagen says.

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The tool was tested in other cities, too. Stockholm in Sweden and Prague in the Czech Republic were selected for air quality testing, while Linz in Austria was chosen for its water sewer systems.

Sudplan's 3D visualisation component, which comprises the most challenging part of Sudplan's 'Scenario management system' (SMS), is currently available for public testing. This component is capable of handling the visualisation of Sudplan data and results in a geographical 3D context. Using the World Wind 'Software development kit' (SDK), it integrates 'Geographic information system' (GIS), visualisation and simulation results. The data types supported by the Sudplan 3D Component range from 1D data (e.g. geo-referenced measurements of precipitation), to temporal 3D data sets (e.g. 3D air-pollution time series).

The project was coordinated by the Sveriges Meteorologiska och Hydrologiska Institut in Sweden.

1 'Sustainable urban development planner for climate change adaptation'.

Funded under the FP7 specific programme 'Cooperation' under the theme 'Information and communication technologies'. http://cordis.europa.eu/news > search news > 35078

Organic food certification: What does it cost and how can it be improved?

Certification is a key part of organic farming as it allows the consumer to shop with confidence by ensuring the integrity of organic produce. It notably helps prevent fraudulent products from entering the supply chain. The Certcost[1] project has carried out a comprehensive economic analysis of existing certification systems.

Effective organic certification systems must involve the food supply chain. As a result, their investigation faces a number of challenges. These include gathering information about costs in different EU countries and assessing the role of private and public certification bodies.

With respect to risk, two aspects need to be distinguished for organic certification systems: the probability of non-compliance with the regulations, and the magnitude of the possible damage caused by different types of non-compliance. However, greater frequency of inspection can lead to less non-compliance and may thus result in benefits for the organic sector. By targeting operators least likely to follow the regulations, and the increased likelihood of damage due to non-compliance, a risk-based inspection system within an economic context can be achieved.

The Certcost project aimed to provide research-based recommendations for improving the efficiency, transparency and cost effectiveness of organic food certification systems in Europe. Results were used to create a baseline for information about the organic certification systems. They also create standard-setting procedures within the EU and the associated European countries of Switzerland and Turkey. This included a database, a review of relevant international regulations, and improvement of the current theoretical framework for the economic analysis of organic certification systems.

Project partners studied the implementation of different certification systems. They reviewed the transaction cost along the food supply chain in different EU regions, as well as in Switzerland and Turkey. Finally, they assessed the benefits of certification systems and the consumer response to different organic logos. Economic models were developed that enabled researchers to assess the factors that determine non-compliance with the regulations governing organic produce — and to conduct an overall assessment of organic certification systems.

Project recommendations on how to increase the effectiveness and the efficiency of organic certification were developed for the European Commission, national bodies and private actors. These recommendations can serve as a basis for improving the current certification system in the European Union, Turkey and Switzerland.

The project was coordinated by the Universitaet Hohenheim in Germany.

1 'Economic analysis of certification systems for organic food and farming'.

Funded under the FP7 specific programme 'Cooperation' under the theme 'European knowledge-based bio-economy'.
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ENVIRONMENT AND SOCIETY

Dry soils make for a stormy brew

The global water cycle plays a central role in global atmospheric circulations. Recent EU research indicates that afternoon storms are more likely to develop when soils are parched.

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The study was funded in part by the WATCH[1] project, which was backed with EUR 9.9 million under the 'Sustainable development, global change and ecosystems' theme of the EU's Sixth Framework Programme (FP6). Focusing on how water controls the global energy cycle (through latent heat) as well as the carbon, nutrient and sediment cycles, it examined hydrological processes across six continents.

Published in *Nature*, the results compiled by the research team have important implications for the future development of global weather and climate models — models which may currently be simulating an excessive number of droughts. The scientists examined imagery from weather satellites which track the development of storm clouds across the globe. When they matched up where new storms appeared alongside images of how wet the ground was, they were somewhat surprised.

Dr Christopher Taylor, from the Natural Environment Research Council (NERC) Centre for Ecology & Hydrology in the UK, explained: 'We had been looking at storms in Africa and knew that rain clouds there tended to brew up in places where it hadn't rained in the previous few days. We were surprised to see a similar pattern occurring in other regions of the world such as the US and continental Europe. In those less extreme climates, with more vegetation cover, we expected the soil wetness effect would be too weak to identify.'

The researchers then compared their observations with six global weather and climate models used to simulate climate change. What they discovered surprised them. They found that existing climate models do the wrong thing, triggering rain over wetter soils.

This implies that climate models that currently exist are more likely to go into a vicious circle whereby dry soils decrease rainfall, leading to even drier soil conditions, and so on. The paper concludes that fixing this problem is a priority for scientists developing the climate models.

Dr Taylor added: 'Both heat and moisture are critical ingredients for rain clouds to build up during the afternoon. On sunny days the land heats the air, creating thermals which reach several kilometres up into the atmosphere. If the soil is dry, the thermals are stronger, and our new research shows that this makes rain more likely.'

Co-author Dr Françoise Guichard from CNRM-GAME (CNRS and Meteo-France) said: 'We need to improve climate models so that we get a better idea of what global climate change will mean on smaller regional scales over land.'

The WATCH project brought together hydrological, water resources and climate communities to analyse, quantify and predict the components of the current and future global water cycles and related water resources. It evaluated their uncertainties and clarified the overall vulnerability of global water resources related to the main societal and economic sectors.

The project was coordinated by the Natural Environment Research Council in the United Kingdom.

1 'Water and global change'.

Funded under the FP6 specific programme 'Sustainable Development, Global Change and Ecosystems'.
http://cordis.europa.eu/news > search news > 35162

Genetics of fruit development

A European study has investigated the regulatory network that controls the process of fruit opening. The project outcomes are of economic interest and are expected to prevent seed losses caused by premature pod shattering.

Fruits consist of seeds enclosed in the mature ovary of a flowering plant. Through the sequential effect of different hormones, the seeds expand and cause the developing fruit to ripen. Extensive research in fruit patterning has revealed a number of molecules involved in the process. However, little is known about the molecular interactions that control this fundamental process for plant reproduction.

The research plan of the EU-funded Dehicis[1] project was to understand how networks of transcription-factor genes and their target sequences control flower and fruit development, and how this varies in different species. Scientists concentrated on the study of the gene 'Replumless' (RPL) which is required for the development of a specialised structure, the 'replum', involved in the fruit's opening process in order to release seeds. Their primary focus was on plants of the mustard family, Arabidopsis and Brassica.

Elements involved in the regulation of RPL were studied, and potential variations in these regulatory sequences were investigated, in terms of fruit development and pod shattering between Arabidopsis and Brassica. Scientists discovered that mutation of a single conserved element in RPL correlated with variation in replum morphology. This particular nucleotide change is also used

to reduce seed shattering in rice domestication.

Components involved in the biosynthesis of the plant hormone 'gibberellin' were also identified. The discovered genes were studied in terms of their effect on separation layer development and on increased resistance to pod shattering.

This knowledge was used in the final aim of the Dehicis project to exploit the variations found in the flower/fruit gene regulatory network for practical use. Good candidate genes included 'JAGGED' which was found to lead to reduced pod opening and seed loss.

Deliverables of the Dehicis project have important implications for the agriculture of Brassica plants by reducing pod shattering and thereby seed loss.

The project was coordinated by the John Innes Centre in the United Kingdom.

1 'Dynamic and evolution of cis-regulatory elements involved in fruit development in Arabidopsis and Brassica'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions). http://cordis.europa.eu/marketplace > search > offers > 9527

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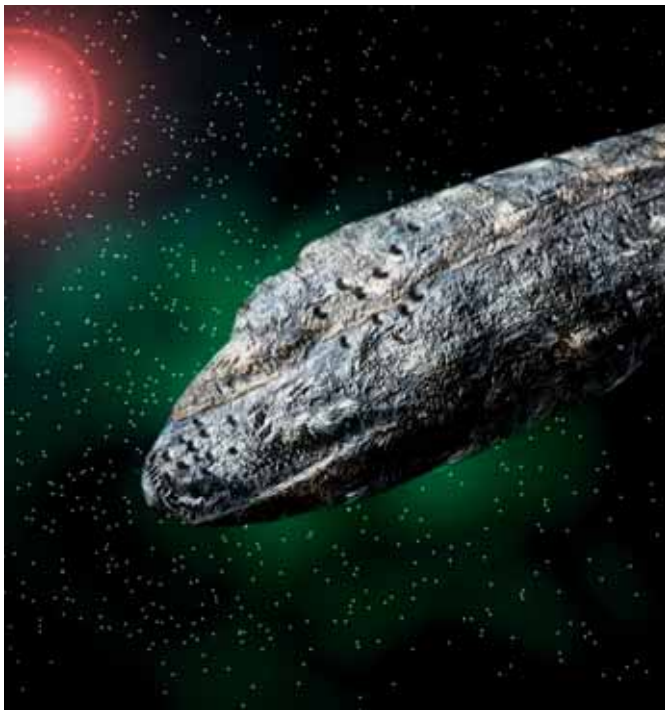
Studying non-planetary objects orbiting the Sun

EU-funded scientists studied the surface properties of asteroids and other small bodies orbiting the Sun. These elements are remnants of the primordial beginnings of our Solar System, with important implications for future missions.



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Our Solar System consists of eight planets and two so-called belts. The inner belt, called the Asteroid Belt, separates the four small, rocky planets from the four 'gas giants'. The outer one, beyond Neptune, is called the Kuiper Belt. Many smaller bodies orbit the Sun in these inner and outer belts of our Solar System.

Asteroids are pieces of rock — a few metres to a few kilometres in diameter — too small to be considered planets. The Asteroid Belt is so named because the majority of asteroids orbit the Sun in this region between the planets Mars and Jupiter.

The Kuiper Belt contains thousands of icy, slow-moving objects of around 10 to 50 km in diameter beyond the orbit of Neptune. They are called trans-Neptunians. Pluto, formerly classified as a planet, is now also considered to be one of these.

Discovery of a vast amount of Kuiper Belt objects has resulted in a completely new view of our Solar System and the formation and evolution of planets. Because these small objects are likely remnants of the very early Solar System, researchers are interested in their compositions.

European scientists initiated the Astrosurface[1] project to derive characteristics of the top-most layers of these small, atmosphere-less bodies. They combined observational data of the objects, obtained by various techniques (photometry, polarimetry and spectroscopy). The consortium then analysed the data through a combination of semi-empirical and numerical modelling to obtain the first systematic analysis of small bodies from the inner and outer parts of the Solar System.

Results suggest that surface microscopic properties of inner and outer belt bodies are quite different. Importantly, using asteroid-like models to describe trans-Neptunian objects may lead to false conclusions.

In addition, studies on the polarisation of light by these bodies provide insight for deriving theoretical descriptions of light-scattering by atmosphere-less surfaces.

Astrosurface's results characterised surface properties of small objects in our Solar System that are likely remnants of its primordial beginnings. They will also be important in calibration, analysis and interpretation of data from future exploratory missions.

The project was coordinated by the Observatoire de Paris in France.

1 'Modelling the surface properties of small bodies of the inner and outer solar system'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions). http://cordis.europa.eu/marketplace > search > offers > 9559

ENVIRONMENT AND SOCIETY

The mathematics behind predator-prey interactions

EU-funded scientists have advanced an important field of mathematics by describing the behaviour of numerous physical and biological systems.

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'Dynamical systems theory' (DST) is a branch of mathematics devoted to describing the behaviour of complex physical and biological systems that change with the passage of time. In fact, the state of a dynamical system at any time is described by a fixed mathematical rule.

The fundamental utility of DST is that it helps clearly identify the immediate future or possible states of a system based on its present state. When only one possible future state exists, the system is 'deterministic'; when more than one possibility exists, the system is 'stochastic' or random.

DST is relevant to many different fields including economics, biology and astrophysics. It has recently been applied to modelling athletic performance, human development, predator-prey dynamics and even limb regeneration in insects.

In DST, the so-called state space is defined as an n-dimensional vector space — similar to a three-dimensional (3D) Cartesian space — that describes the state of the system at any given time. Using the evolution law, one may determine the next state of all parameters.

Bifurcation theory describes the situation of a small perturbation in a parameter producing a large (qualitative) change in the system's behaviour.

European researchers initiated the Quribius[1] project to address previously unexplored topics in this field. Among the important project results, scientists produced a wealth of new bifurcation diagrams resulting from a specific bifurcation. They also carried out an exhaustive study of another type of dynamical system subjected to various perturbations.

Given the widespread application of DST, mathematical advances achieved by the Quribius team in describing dynamical systems should have an important impact on many fields.

The project was coordinated by the Imperial College of Science, Technology and Medicine in the United Kingdom.

1 Qualitative theory and non-degenerate and degenerate bifurcations in n-dimensional dynamical systems'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9514

Stonewalling microbial attack on stone artefacts

A European project has just completed an in-depth study of microbial deterioration of cultural heritage stoneworks.

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Our cultural heritage is being threatened by far more than physical and chemical forces like weathering and acid rain. The biological foes in this case are microorganisms that can withstand a barrage of adverse conditions including high ultraviolet (UV) radiation and salt as well as an oligotrophic environment that offers very little in the way of nutrition.

To tackle this microbial attack on outdoor stonework, the Bioattach[1] project identified the members of the microbial community that are causing the damage. Moreover, the microbes' specific roles and active components in the processes have been pinpointed.

The Bioattach scientists studied sandstone artefacts at Portchester Castle near Portsmouth in the United Kingdom. The research included an *in situ* analysis of the stone changes involving the exfoliations and the black crust layer. Further data was obtained from laboratory chamber studies on artificially enriched stone discs looking at the growth and development of the communities in accelerated weather chambers.

Extracted DNA and RNA samples were analysed with a whole range of state-of-the-art procedures. These included 'polymerase chain reaction' followed by 'gene sequencing by 454 pyrosequencing', '16S rRNA gene sequence analysis' and 'electrophoresis'.

Results from the genetic material extractions revealed the most predominant microbes to be Chloroflexi, Actinobacteria, Deinococcus, Proteobacteria, Cyanobacteria, Bacteroidetes and halophilic Archaea. In the stone alterations, there was a higher diversity in the bacterial members than in the Archaea. Trophic groups present included ammonia oxidisers and denitrifying bacteria.

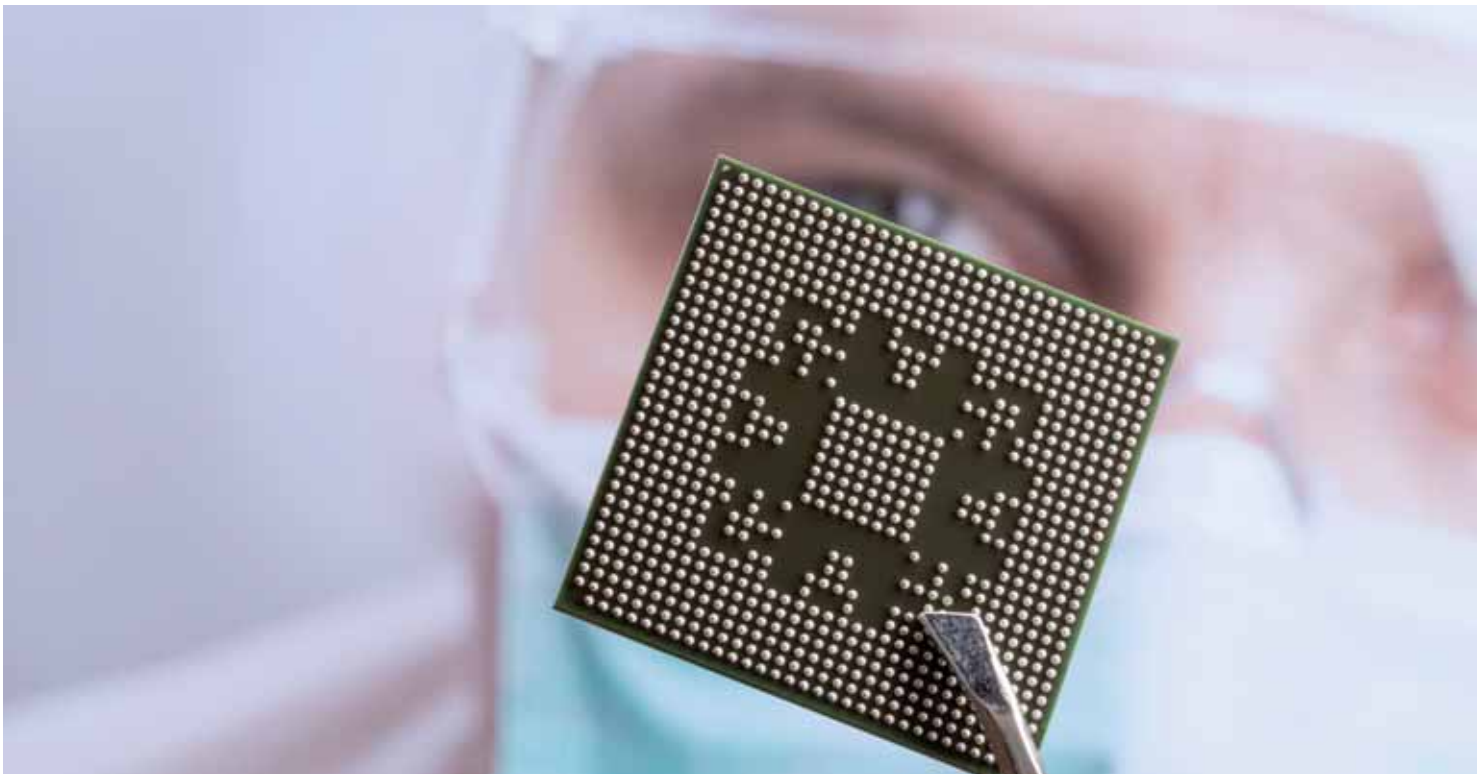
Cultivation studies and rRNA gene sequence analysis gave an indication of the metabolic activity of the microorganisms. Once again, there was a significant presence of ammonia oxidising bacteria such as Nitrosospira and halophilic representatives of the Streptococcus and Pseudomonas genera. The analyses also provided information on the microbial succession in the surface colonisation of stone discs.

Bioattach deliverables are numerous. They include new international collaborations between institutions interested in heritage conservation and a high level of European excellence in bio-deterioration of stone artefacts. More importantly perhaps, the application of cutting-edge technology to the problem of deteriorating stoneworks means that research is on the verge of finding a sustainable solution.

The project was coordinated by the University of Warwick in the United Kingdom.

1 'Biological agents that actively attack cultural heritage stoneworks'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9570



Product engineering … a complex marriage

Modern cars and aircraft have scores of tiny electro mechanical systems and technologies keeping them safely on the road or in the air. Thank goodness! But these 'Micro- and nanotechnologies' (MNT) are difficult to design and build, especially for SMEs which struggle with such complex product engineering. A European research team has the solution.

Manufacturing 'Micro-electromechanical systems', or MEMS as they are known, is a long and complex process. It sometimes involves hundreds of different steps, each controlled by a dozen or more parameters, including varying pressures, temperatures and material compounds, etc. Customer needs play a key role in terms of what MEMS are developed, and to what specifications.

The automotive industry, for example, uses a range of MEMS — such as micro-scale accelerometers — to trigger airbags or sensors to keep vehicles in line. Each one of them combines electrical and mechanical functions with tiny embedded computers etched out of silicon wafers. This 'marriage' of electro mechanical and microchip technology is not always a happy one.

Engineering is traditionally wedded to the world of visible, moving parts. But progress in microcomputing and electronics means MEMS-related 'product engineering' (PE) and 'Electronic design automation' (EDA) must get much cosier with developments in micro- and nanotechnology.

This relationship forms something of a chicken and egg problem, suggests Kai Hahn, an expert in the field at Siegen University. Because unlike PE for integrated circuits, the inherent structure, or so-called 'third dimension' needed to design MEMS, calls for potentially wholesale changes to technology parameters. To resolve this, a deep understanding of the entire PE process for MNT and MEMS is critical. But no one has achieved this … until now.

Great start … better finish

The EU-funded Corona[1] project is the first to develop an integrated design flow, taking into account the process-design stages — from product idea to manufacturing — and with special emphasis on the end-to-end needs of customers and small MEMS manufacturers in the value chain.

'When Corona started in 2008, there was no dedicated PE methodology for MNT. The tool supply for this high-tech segment was also very poor, so we definitely saw an opportunity,' notes Dr Hahn, a key researcher in the consortium. With partners representing key stages along the MNT PE chain, Corona had a head start on competing research groups. It also benefited from an earlier European project, called Promenade, which built software to support the design of MEMS manufacturing sequences.

The team took Promenade's work further by linking its new methodology and tools to current commercial standards, making Corona's MNT PE more user-friendly. 'This was important because the customer is the only one who really knows the exact product specifications and can decide on go/no-go gates within the PE process,' says Dr Hahn.

Mission complete

Corona has achieved all its main objectives: methodology for all design-processing stages of MNT PE; software, middleware and applications supporting the methodology; and real-life MEMS demonstrations.

'The demos carried out by our partners XFAB (Erfurt, Germany), ITE (Warsaw, Poland), ELMOS (Dortmund, Germany), Theon (Athens, Greece) and Cambridge University (United Kingdom) validated Corona's approach and were very helpful to improve our methods and tools,' confirms the researcher.

>

Commercialisation of several tools emanating from Corona is under way. Notably, project partner Coventor (Paris, France) has commercialised its clever design simulator ('SEMulator3D'). Another partner, Process Relations (Dortmund, Germany), has developed 'XperiDesk' for managing myriad design collaboration tasks, from idea to rapid prototyping.

Meanwhile, several prototypes, such as the 'Hedoris' platform developed by academic partner ITE and 'Process recommender' suite by University of Siegen, are undergoing further research. Corona's 'Electronic product-engineering flow manager' is also being put to good use internally by its creator, the firm ELMOS.

IVAM, the project's coordinator, is putting its connections as the industrial association for MNT to good use by communicating Corona's results to its member community. The wider public can also read about the project's achievements and methods in a new book due to be published by Springer in 2012.

The project was coordinated by Ivam e.v. in Germany.

1 'Customer-oriented product engineering of micro- and nano-devices'.

Funded under the FP7 specific programme 'Cooperation' under the theme 'Nanosciences, nanotechnologies, materials and new production technologies'.
http://ec.europa.eu/research/infocentre > search > 27113

Fighting cyber-threats, making the future more secure

If you are reading this online, you probably own a computer and therefore, at some time or another, you have probably been a victim of cybercrime. You may have lost data to a virus, been infected by a worm, or even lost money to hackers or a phishing scam. Your computer might even be infected right now, secretly sending information via botnets for a range of insalubrious uses.

At any given time, an estimated 150 000 viruses and other types of malicious code are circulating across the internet, infecting more than a million people every day. Anti-virus software developer McAfee counts 75 million unique pieces of malicious malware code on its databases, and estimates that botnets spewing out spam account for a third of all the emails sent every day.

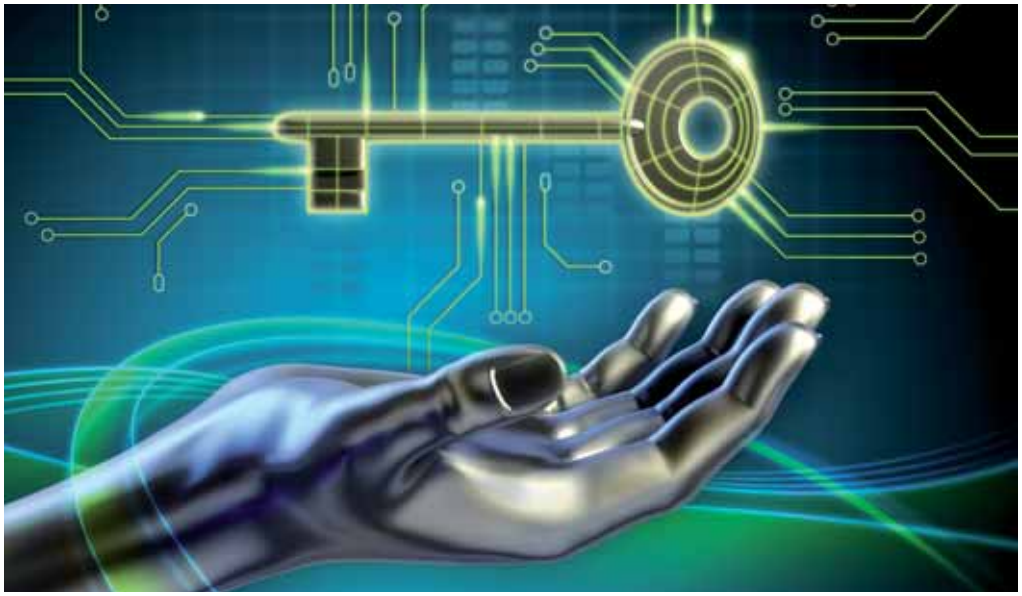
While an individual may find themselves paying a hundred euros or so to get their computer cleaned or recover data lost to a virus, globally the financial impact on citizens, companies and governments is enormous. One high-end estimate from McAfee puts the worldwide cost of cybercrime as high as USD 1 trillion annually if wasted time, lost business opportunities and the expense of fixing problems are taken into account.

Given society's increasing dependence on the internet for business and communications, cybercrime is a growing global problem that no company or country can tackle alone. Within Europe, therefore, a range of organisations — from the European Commission and national governments to SMEs and universities — are pooling resources among themselves and with others around the world. Together they aim to develop effective strategies, policies and technologies to fight the epidemic.

The European Commission intends to publish 'A European Strategy for Cybersecurity', focused on preparedness, prevention and response, in the near future. A permanent 'Computer emergency response team' (CERT-EU) has been set up. At the same time, EU funding is being directed into a range of pan-European projects aimed at improving cyber-security.

Over the last two years, the European Commission has contributed EUR 2.5 million to establish Syssec[1], a European 'Network of Excellence' (NoE) built on the age-old concept that prevention is better than cure. The NoE is focused on developing solutions for predicting threats and vulnerabilities before they occur, enabling potential victims of cyber-attacks to build defences before threats materialise. The project has set up a 'Virtual centre of excellence' to consolidate the systems-security research community in Europe and empower collaborative research. It is working on an active research roadmap and a range of cyber-security education initiatives.

'The Syssec Network of Excellence takes a game-changing approach to cyber-security: instead of chasing the attackers after an attack has taken place, Syssec studies emerging threats and vulnerabilities ahead of time. The network's main thrusts are to identify a roadmap to work on threats and to build infrastructure to boost education in system security — to provide the expertise needed to deal with these emerging threats,' Evangelos Markatos, the project coordinator, and Herbert Bos, a fellow Syssec researcher, note in a paper on the project.



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Security by design

While Syssec takes a global approach to predicting threats, another EU-funded NoE, Nessos[2] is focused specifically on fostering the design and development of secure software and systems for the 'Future Internet'. The aim is to ensure engineers and developers address security concerns at the very beginning of system analysis and design, with the team

focusing on six key areas: security requirements for Future Internet services, creating secure service architectures and secure service design, supporting programming environments for secure and composable services, enabling security assurance, establishing a risk-aware and cost-aware software development cycle, and delivering case studies for future internet application scenarios.

The security-by-design approach is perhaps best exemplified by another project. In SecureChange[3], researchers from nine European countries developed the methodology, techniques and tools to make the entire software life cycle — from requirements engineering, through design, development, testing and verification, to deployment and updating — more efficient, more flexible, more secure and far less costly in terms of time and money.

SecureChange coordinator Fabio Massacci describes the problem this way: 'You have secure software, for example. You ship it to the customer and then you need to update it, perhaps to add features to stay ahead of the competition. If you need to start from scratch every time and verify all code — even if only a small part of it has changed — you face considerable time and financial costs.'

For example, an analysis conducted by the SecureChange team, spanning five years and six major version updates of the open source Firefox browser, found that only around a third of the software code changed from one version to the next. In addition, a significant number of vulnerabilities were inherited by each new version from its predecessor, a phenomenon also common to other browsers like Chrome and IE. The need for quick updates means there is less time to do testing and verification. The SecureChange approach makes it possible to test only the new parts and maintain the security and integrity of the entire system.

Looking ahead to the Future Internet — in which users will move away from today's static services toward mixing and matching components and services, depending on availability, quality, and price — the Aniketos[4] project is focusing on bringing security and trust to this heterogeneous environment. In such a world, applications are likely to be composed of multiple services from many different providers. The end-user will have little way of guaranteeing that a particular service or service supplier actually offer the security they claim. The Aniketos team, which includes major industrial players and research institutes, is therefore developing new technology, tools and security services to support the design-time creation and run-time dynamic behaviour of secure composite services. It also develops methods for analysing, solving and sharing information on how new threats and vulnerabilities can be mitigated.

Toward an internet of secure things

Much of the focus of cyber-security to date has been on defending traditional computing systems, software and devices such as PCs, servers and databases. However, the rapid development of new technologies, such as embedded computing, the 'Internet of things' (IoT) made up of ubiquitous sensors and actuators, and cloud computing means that the approach to cyber-security must also evolve.

'Trusted Computing', for example, is a well-established technology that uses both software and hardware for verification and implementation of integrity and security in personal computers. It is now making the leap into embedded systems.

Unlike a traditional PC or laptop, embedded systems are computer systems designed to work 'hidden' (embedded) inside everyday equipment and devices. They transmit data between your mobile phone and the mobile network. They manage your home internet connection and prevent network attacks. They control the traffic lights on your street: they are in aeroplanes, cars and even power stations. But as more embedded systems are used in devices that are always turned on and always connected to the internet, they are also becoming increasingly vulnerable to being hacked or infected with viruses and other malware.

The TECOM[5] project has helped bring Trusted Computing to embedded systems, by adapting technology originally developed for PCs to run on everything from smart phones to smart electricity meters.

'The range of applications for TC in embedded systems is huge. In TECOM we have built the technological framework that makes implementing this technology possible, and we have shown how it can work,' Klaus-Michael Koch, whose company oversaw the TECOM project, says. 'Over the coming years, we will start to see this in use in many different environments.'

The IoT goes hand in hand with cloud computing in which data is distributed and instantly accessible from anywhere at any time. Cloud infrastructure therefore also needs to be secure and trustworthy just as much as the applications and services that run on it.

With the goal of building trustworthy clouds, the Tclouds[6] project is focused on achieving security, privacy and resilience in a way that is cost-efficient, simple and scalable and, by proxy, ensuring the continued expansion of cloud infrastructure, resources and services for many years to come.

Cryptic solution

When it comes to securing data, be it in the cloud or on your network server, cryptography plays a major role — every time you use a credit card, access your bank account online or send a secure e-mail cryptographic algorithms are running behind the scenes. But as computers become more powerful, network speeds increase and data storage grows, the current methods of protecting information are being challenged.

The Ecrypt project and its successor Ecrypt-II[7] addressed these challenges. A NoE that brought together 32 leading research institutes, universities and companies, the initiative developed improved cryptographic algorithms, ciphers and hash functions. It studied protocols and implementation methods, and worked on more robust algorithms for digital watermarking.

Among the team's main achievements were eight new algorithms with the capacity to outperform the Advanced Encryption Standard (AES) developed by two Belgian researchers in the 1990s and subsequently adopted by the US government to protect classified information.

'There are three big issues facing cryptographers,' says Bart Preneel, the project coordinator: 'Cost, speed and long-term security.'

The same could be said for cyber-security in general, but those issues and many others are likely to be successfully addressed over the coming years by European research, helping to keep computer users everywhere at least one step ahead of the hackers, trojans and viruses plaguing the online world today.

1 'A European Network of Excellence in managing threats and vulnerabilities in the Future Internet: Europe for the world', coordinated by Forth-ICS in Greece.
2 'Network of Excellence on engineering secure Future Internet software services and systems', coordinated by the Consiglio Nazionale delle Ricerche in Italy.
3 'Security engineering for lifelong evolvable systems', coordinated by the Universita degli Studi di Trento in Italy.
4 'Secure and trustworthy composite services', coordinated by Stiftelsen Sintef in Norway.
5 'Trusted embedded computing', coordinated by Technikon Forschungs und Planungsgesellschaft MBH in Germany.
6 'Trustworthy clouds? Privacy and resilience for internet-scale critical infrastructure', coordinated by Technikon Forschungs und Planungsgesellschaft MBH in Austria.
7 'European Network of Excellence in cryptology — phase II', coordinated by the Katholieke Universiteit Leuven in Belgium.

Funded under the FP7 specific programme 'Cooperation' under the theme 'Information and communication technologies'.
http://cordis.europa.eu/marketplace > search > offers > 9596

IT AND TELECOMMUNICATIONS

Predicting robotic motion and disease inheritance

EU-funded scientists have developed improved mathematical models applicable to robotics and bioinformatics.

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The topic of probabilities can be a daunting mathematical course for most. It is, in fact, something used quite commonly in everyday life where we need an estimate of the likelihood of an event occurring — such as the weather forecast providing the probability of rain, or someone wondering about the probability of getting a job offer.

Probabilistic models are widely employed in science in real-world situations such as cognitive thought processes, data mining and the like. They predict or estimate the likelihood of something happening (basically, of a variable having a certain value) based on previous data. This is often done by a process called approximate inference.

Given that approximate inference techniques are important in many real-world applications, development of improved techniques will lead to better solutions to such problems. European researchers wanting to develop probabilistic models and approximation techniques applicable to robotics and bioinformatics (genetic data models) initiated the Infprobmod[1] project.

Project scientists successfully developed a method for segmenting time-series data (data that is changing over time) such as that relevant to human movement. The numerical technique should be important for the generation of basic movement libraries relevant to the robotics field.

The researchers also extended a popular genetic model to include mother-father-child relationships, opening the door to more general analysis of genetic data from related individuals. The model is particularly relevant to complex inherited diseases.

Both models were carefully implemented with user-friendly software requiring minimal human intervention or knowledge of modelling.

Infprobmod results should be welcomed by both the robotics and the genetic modelling communities with important implications for extension to numerous other similar mathematical models.

The project was coordinated by the University of Cambridge in the United Kingdom.

1 'Approximate inference in probabilistic models'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9503

'Entangling' photons to unravel quantum computing mysteries

EU-funded scientists explored the generation of complex quantum states of light for application to future quantum computers.

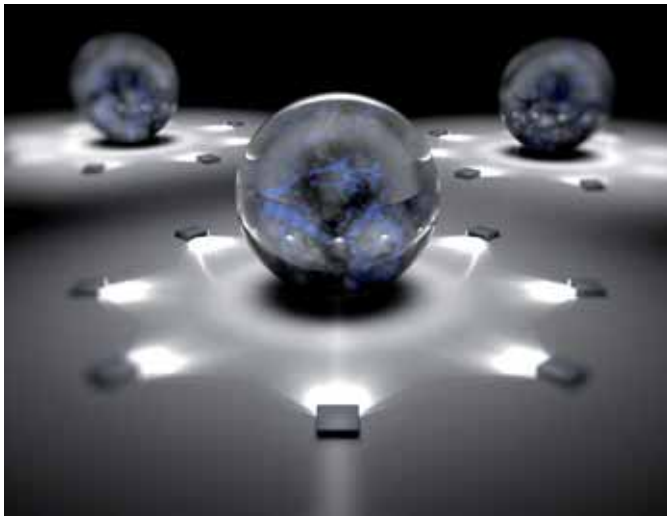
Quantum physics is focused on describing quantum properties or nature, where a quantum is the smallest discrete unit of energy or matter. A qubit is a quantum of information, the quantum equivalent of the classical bit. It is the building block of quantum computers. Whereas a classical bit exists in one of two states (0 or 1), a qubit can exist in two states simultaneously offering the potential for an exponential increase in computing power.

A photon is a quantum of light or electromagnetic radiation. It can exist in more than one state simultaneously. Quantum properties of light are being explored for their use in future quantum computers. In quantum computing, 'cat' states are special states in which two opposite states exist at the same time (named after Schrödinger's Cat, the thought experiment in which a cat is both alive and dead). In other words, it is the coherent superposition of two coherent states. It has been proposed that cat states can form the basis of qubits.

European researchers sought to generate highly non-classical coherent states, the so-called 'two-mode entanglement' of cat states, to be used as building blocks of quantum gates for quantum computing.

The EU-funded Prometeo[1] project developed new experimental tools for generating the high-quality resource states required by such a photonics-based architecture.

They not only developed a device extending the capabilities for state generation but also developed methods for analysing the hardware of photonics-based architectures.



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Prometeo investigators made significant progress towards the understanding and exploitation of coherent-state quantum computing, bringing Europe one step closer to commercial development of a quantum computer.

The project was coordinated by the Centre National de la Recherche Scientifique (CNRS) in France.

1 'Processing of mesoscopic time-pulsed entangled optical fields'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9563

Semiconductors with electric and magnetic properties

EU funding enabled European scientists to develop solid-state semiconductor components with magnetic properties, a prerequisite for a new generation of electronic devices exploiting both the charge and the spin of electrons.

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Conventional electronics are based on the flow of electrons, negative charge carriers. Magnetic systems rely on principles governing electron 'spin', a quantum physical phenomenon related to angular momentum.

The angular momentum associated with spin produces a magnetic field. In most materials, magnetic fields of individual atoms cancel one another. In magnetic materials of various types — generally metals — atomic dipole moments become aligned (polarised), producing macroscopic magnetic fields.

Magnetic storage devices are based on the use of different patterns of magnetisation corresponding to information in stored data. With the advent of nanotechnology and the interest in building functional systems on the scale of atoms and molecules, a new field known as 'spintronics' has emerged.

Spintronics, short for spin electronics and also known as magneto-electronics, exploits electron spin in addition to charge. It uses them together to lay down and read back bits of data on semiconductor (solid-state) material and could provide the foundation for entirely new computational paradigms.

One of the most direct methods of introducing spin-polarised electrons into a semiconductor is by adding metal 'dopants' (impurities that modify the semiconductor's properties) to produce co-called 'Dilute magnetic semiconductors' (DMS).

European scientists seeking to develop a suitable electro-deposition process to synthesise DMS nanowire structures and semiconductor junctions have initiated the MAJIC-SPIN[1] project.

The consortium successfully produced doped nanowires via a direct electro-deposition technique. They then studied their compositions, structures and magnetic properties via a variety of advanced experimental techniques, including X-ray absorption-based methods and a 'Superconducting quantum-interference device' (SQUID).

In the case of cobalt (Co)-doped nanowires, scientists demonstrated full incorporation of Co into the lattice and the presence of a magnetically ordered phase.

MAJIC-SPIN project results illustrated the effectiveness of electro-deposition in producing functional DMS, solid-state semiconductors with magnetic properties. Optimisation and commercialisation could have an important impact on tomorrow's novel nano-spintronic devices.

The project was coordinated by Imperial College, London in the United Kingdom.

1 'Doped magnetic ZnO p-n junction heterostructures for nano-spintronic devices'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9576

Wireless and wireline on a single platform

Technology for the future convergence of wireless and wireline communications has been validated, experimentally and theoretically, into a common infrastructure.

The information revolution demands continuously increasing speed and reliability with virtually limitless access. The next step in the evolutionary process is a convergence of wireless and wireline transmission into a common infrastructure.

Phase-modulated 'Radio-over-fibre' (RoF) technology is an important candidate for implementing multi-channel — via so-called 'Wavelength-division multiplexing' (WDM) — wireless-wireline access networks.

RoF integrates fibre-optic networks with wireless ones. Radio signals are transported from a radio base station to a remote antenna via optical fibres, and then radiated through the air via end-users' mobile stations.

Radio waves are part of the electromagnetic spectrum that consists of all possible wavelengths of light in the form of photons. The photons travel in waves defined by peaks and troughs, much as water rippling out from a stone thrown in a pond.

The distance from one peak to another (or one trough to another) is the wavelength. The distance from centre line to peak or trough is the amplitude, which is related to the intensity of the light. The phase of a signal is the position of the wave at a certain time relative to a reference: imagine ripples spreading out in a pond passing by a stationary object such as a reed.

Modulating data to be transmitted based on the phase of the carrier signal (phase modulation) has important benefits compared to conventional intensity modulation.

European researchers have set out to experimentally and theoretically evaluate the performance of multi-channel phase-modulated RoF optical links in transmission of wireless-wireline signals.

With EU funding of the Woprof[1] project, they also compared the latter performance to that of conventional intensity-modulated RoF links. They created a phase-modulated RoF link and conducted convergence experiments with broadband wireline services and high-speed wireless signals.

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Finally, the team also identified a new wireless technology for short-range in-home applications that has been met with great enthusiasm worldwide.

Woprof results have advanced the communications sector toward convergence of wireless and wireline systems into a common infrastructure. Along the way, the Woprof team may have come up with tomorrow's fastest technology to transfer videos and pictures from a cell phone to a PC.

The project was coordinated by the Danmarks Tekniske Universiteit in Denmark.

1 'WDM optical phase-modulated radio-over-fibre systems'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9509

Atomic clocks and high-precision global positioning

EU-funded scientists have combined several state-of-the-art particle detection and measurement techniques with ground-breaking results for high-precision timekeeping and global positioning.

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Interferometers are instruments that rely on the interference between electromagnetic waves. Interference data yield useful quantities such as very precise measurements of small displacements as well as inertial measurements related to gravity and rotation.

When it comes to atoms, inertial sensors based on ultra-cold neutral atoms and atom interferometry techniques outperform conventional light interferometry.

Cold atoms are stable oscillators, vibrating in well-defined ways. Their stable oscillation facilitates their use in extremely precise measurements — hence, high-precision atomic clocks.

The sensitivity of such measurements is limited by the quantum (shot) noise of the atomic source. Light is quantised, coming in packets of light called photons. Quantisation results in unpredictable uncertainties in light properties (amplitude and phase) and so-called quantum noise.

A technique called quantum squeezing can be used to reduce phase uncertainty at the expense of amplitude uncertainty. It results in ground-breaking quantum noise reduction.

European researchers combined atom interferometry and the squeezing of cooled atoms to enable sub-shot noise sensitivity, thanks to EU funding of the QNDINTERF[1] project.

They further combined these state-of-the-art techniques with 'Quantum non-demolition' (QND) measurements. Whereas most particle detection and measurement techniques destroy the particle in the measurement process, QND measurements do not. The same experiment could theoretically be performed on exactly the same atoms or particles, over and over again.

Combining ultracold atom interferometry with squeezing and QND measurement, the scientists achieved continuous read-out interferometry at sub-quantum noise levels.

The project's pioneering results have applications in fields including timekeeping and global positioning, in addition to obvious implications for particle physics.

The project was coordinated by the Centre National de la Recherche Scientifique (CNRS) in France.

1 'Atom interferometry at the Heisenberg limit using an in-cavity Bose-Einstein condensate and quantum non demolition detection'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9562

Networks for flexible, transparent electronic devices

Novel processing technologies for tomorrow's flexible and transparent electronic devices based on carbon nanotechnology are being developed by European researchers.

'Carbon nanotubes' (CNTs) are, as their name suggests, hollow cylinders with nano-scale diameters (scale of single atoms and molecules) formed from carbon. They have unique properties that make them particularly attractive to the electronics industry. These include very high strength and conductivity and the ability to pack it all into a very small space.

CNTs form networks that can be transparent. In addition, the networks are flexible, making it possible to employ them on plastic substrates. Transparent, conductive CNT networks are in their infancy and performance is below expectation. This is in large part due to non-homogeneous tube types in the same sample, impurities, defective tubes and interconnection problems.

European scientists sought to explore control of macroscopic organisation of CNTs to realise enhanced performance and tunability with EU support for the Cannela[1] project.

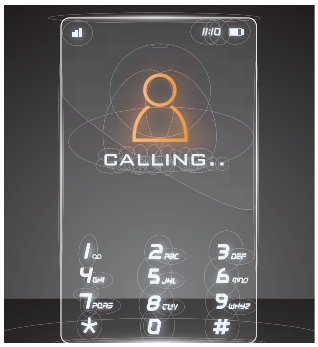
The first reporting period focused on development of CNT alignment methods and effects of various configurations on both performance (conductivity) and transparency. Scientists exploited 'liquid crystal' (LC)-induced alignment of CNTs. In particular, they chose conductive LCs of discotic morphology.

LCs are transparent and thus do not interfere with the goal of optical transparency. Conduction enables connection of any possible gaps between tubes with conductive paths formed by the liquid crystals themselves.

As their name suggests, discotic LCs are disc-shaped. They can be stacked, allowing electrical current to flow while influencing the orientation of 'single-walled' (SW) CNT alignment.

Thus, the first half of the Cannela project paved the way to the realisation and control of thin films of organised LC-CNT composites. Fabricated thin films were stable, well organised and optically invisible.

Continued work will integrate the LC-CNT thin films into device configurations such as 'Liquid crystal displays' (LCDs) for television screens and computer monitors.



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The project was coordinated by the Ente per le Nuove Tecnologie, l'Energia e l'Ambiente in Italy.

1 'Carbon nanotube networks for electronics applications'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9560

Controlling single electrons for novel devices

Ground-breaking single-electron experiments have resulted in exciting results for the field of nanoelectronics and quantum computing.

Quantum computers are based on the exploitation of qubits, the quantum analogue of the classic bit. While the classical bit can exist as either a 0 or a 1, qubits can exist in more than one state simultaneously and, in fact, in an infinite number of superpositions of two states at any one time.

The qubit stores information based on the spin of an electron (sometimes referred to as 'spin up' and 'spin down'), a property related to the orientation of its intrinsic angular momentum. Controlling and manipulating electron spin is thus the basis of tomorrow's quantum computing devices.

Excellent control of single electron spin has been achieved in small pieces of semiconductor material (quantum dots). However, the coherent transport of electron spin from one place to another and thus the possibility of non-local interactions between qubits is the missing piece of the puzzle.

Supported by EU funding of the Spintransfer[1] project, European scientists sought to provide the missing piece by demonstrating coherent transfer between two quantum dots.

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Having successfully developed the techniques for nanofabrication of dot structures and the technology to detect electron state, they demonstrated efficient transfer of a single electron from one quantum dot to another one at a distance.

In addition, the transfer occurred on a nanosecond timescale critically important to use of the technology in fast calculations required by quantum computing.

Among the most important results, the Spintransfer team demonstrated the ability to separate two electrons in a singlet state (paired with opposite spins) to potentially produce a distant pair of entangled electrons. Entanglement means that the state of one induces a correlated state in the other, although they may separate from each other and no longer be paired.

The findings were published in the prestigious journal *Nature* and a number of press articles worldwide.

Spintransfer's ground-breaking experiments and scientific advances open the door to exciting new routes of investigation for coherent single-electron transport. They have brought the scientific and consumer communities one step closer to advanced spintronics devices exploiting electron spin for novel functionalities.

The project was coordinated by the Centre National de la Recherche Scientifique (CNRS) in France.

1 'Coherent transport of a single electron spin in semiconducting nanostructures'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
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Revolutionising industrial safety

The prevention of man-made and natural disasters is a major concern for every sector of industry. A recent EU-funded project aimed to establish new standards for risk assessment.

In the past, industrial risk assessment in Europe has been characterised by diversity and fragmentation. This lack of overall coordination represents both a safety threat and a missed opportunity. By pooling resources and sharing best practices, European industry has the chance to establish the highest possible safety levels across a number of different fields.

This is where the EU-funded IRIS[1] project comes in. This international collaborative project, which was completed in March 2012, aimed to identify, quantify and mitigate existing and emerging risks in a number of sectors, leading to increased industrial safety and a reduced environmental impact. IRIS was industry-led, and the consortium behind the project represented over 1 million workers. The initiative, which focused on saving lives through implementing more effective risk assessment, now has the potential to revolutionise Europe's approach to industrial safety.

Identifying emerging risks

'From the beginning, we were looking into industrial safety in a number of different sectors: power generation, chemicals, construction and mining,' explains project coordinator Helmut Wenzel. 'The idea was to create an IT platform that would be able to show safety conditions online, and provide an early-warning system.'

The IRIS team began by examining the main safety problems across these sectors, investigating how to transform specific requirements and how to better integrate knowledge-based safety technologies, standards and services. Project partners were selected on the basis of their compatibility, non-competition and commitment to the subject of industrial safety.

'A major factor in our success was our ability to bring together all these different industries,' says Prof. Wenzel. 'This enabled the cross-fertilisation of ideas: practices in the chemical industry were applied to the nuclear industry, for example, and the highly innovative bridge-engineering sector was able to bring new ideas to other sectors.'

The scientific and technical work plan was based on the pre-existing knowledge of the partners. Real test cases were then selected at a nuclear power plant and a toxic chemicals plant. At the same time, a mock-up was designed for destructive testing in the laboratory.

Sealing the deal

After simulation and measurement, new sensors and actuators were developed. Sealing technologies dealing with material problems at the nano-scale were also optimised to eliminate a significant cause of failure. The end result of all this testing and development was the creation of a prototype, comprising hardware and software tools capable of providing more accurate industrial risk assessment.

'The real legacy of this project is that industry will be safer as a result,' says Prof. Wenzel. 'The software can now be used in real situations. It has, for example, been applied to bridge construction in Canada, China, Sweden and the UK, to bridges built in the 1950s [and] to newly built bridges which need an accurate life cycle to ensure optimal maintenance planning.'

The success of the IRIS project has shown how important it is for different industries to share information, experience and knowledge in order to achieve a common objective. In this case, taking steps towards preventing major industrial accidents will have a significant positive societal impact, as well as an economic one, since the direct and indirect costs of disasters can be huge.

Ultimately, the IRIS project is an important milestone in making European industry safer through implementing the latest advances in risk assessment. The project has shown the importance of sharing cross-sector experience, and underlined the fact that a pan-European approach is required to fully exploit this.

The project was coordinated by the Universitaet Linz in Austria.

1 'Integrated European industrial risk reduction system'.

Funded under the FP7 specific programme 'Cooperation' under the theme 'Nanosciences, nanotechnologies, materials and new production technologies'.
http://ec.europa.eu/research/infocentre > search > 27393

Enhanced recovery of propylene

New chemical process-engineering techniques have been developed thanks to a trans-Atlantic collaboration. The cost- and energy-efficient technology will enable high-purity recovery of one of the most important industrial chemical intermediates.

Propylene, a flammable hydrocarbon gas, is a major industrial chemical intermediate. It is used as a building block for a variety of chemical and plastic products.

Cryogenic distillation to separate propane/propylene mixtures is one of the most energy-consuming processes in the petrochemical industry. Various studies have been conducted to find an alternative.

Among the most promising technologies seems to be the 'Simulated moving bed' (SMB) for separating gas mixtures. In contrast to other processes studied, the SMB apparatus yields high recovery rates of high-purity propylene with much lower energy consumption. However, further investigations are required to prove its industrial competitiveness.

The Laboratory of Separation and Reaction Engineering at the University of Porto-Portugal (LSRE-FEUP) was integral in conducting relevant preliminary studies. To finish the job, researchers from the lab teamed up with one of the most important groups in chemical process design, simulation and optimisation — at MIT, in the United States.

With EU funding for the GPSMB-PPSPLITTER[1] project, scientists have simulated the entire process, optimising it with development of new routines and solutions, and conducting a complete financial and economic analysis.

As a result, the researchers produced robust numerical routines for optimisation and evaluation of conventional and vapour recompression distillation. They also developed a new synthesis process for sugars using the SMB reactor.

Project findings promise to lead to important advances in the field of SMB technology and validation of its economic feasibility when used for sustainable, energy-efficient propane/propylene separation.

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The project was coordinated by the Universidade do Porto in Portugal.

1 'A new hybrid solution for the propane/propylene separation: the gas-phase simulated moving bed PP splitter'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
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Versatile imaging technology for molecular structure

EU-funded scientists have developed novel atomic and molecular imaging technology that has the potential to provide new levels of sensitivity.

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The simplest model of an atom includes a nucleus of protons and neutrons around which electrons orbit. 'Photoelectrons' are electrons emitted from atoms and molecules when ionised by energy in the form of incident photons.

Kinetic energy (energy associated with motion) and the angular distribution of emitted electrons are highly sensitive indicators of the electronic structure and symmetry of atoms and molecules in a sample. Thus, photoemission investigative techniques are important in characterising samples.

European scientists sought to develop advanced technology and techniques for imaging gaseous samples of biological interest using purines and pyrimidines, the building blocks of nucleic acids, as a case study.

With EU funding of the Imagingelectrons[1] project, they developed a versatile detector in combination with a novel 'vacuum ultraviolet' (VUV) light source. The source covers a large range of radiation frequencies and wavelengths that permits a number of targets to be investigated simultaneously.

The photoelectron imaging apparatus has been used in experiments combining visible and VUV light, enabling the study of single-photon ionisation of rare-gas atoms and small molecules in greater depth than previously possible.

Numerous adaptations and novel methods have been inspired by the results of the Imagingelectrons team's initial experiments. Use of the instrument and analysis routines to study biological molecules resulted in the building of a supersonic jet source coupled to the photoelectron instrument — with increasingly complex systems being considered for the future.

The project also investigated the effects of soft X-ray radiation on organic molecules. In addition, the apparatus has been adapted for use with the FERMI 'Free-electron laser' (FEL).

The Imagingelectrons project resulted in numerous publications in peer-reviewed journals and has advanced the state of the art in photoelectron imaging not only through its own work but through collaborations with others.

The project was coordinated by the Consiglio Nazionale delle Ricerche in Italy.

1 'Photoelectron imaging and spectroscopy of biomolecules using VUV light'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9564

INDUSTRIAL TECHNOLOGIES

New nanocoats reduce friction and pollution

Nanocoat[1], an EU project, has developed new self-lubricating coatings for dynamic parts in contact in a system. The novel surface properties confer lower complexity, weight and cost as well as improved performance by reducing friction and wear.

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The multidisciplinary consortium combined electrochemistry, hydrodynamics, reaction kinetics, co-deposition mechanisms, material science and engineering to form novel coatings based on molybdenum disulphide/tungsten disulphide (MoS_2/WS_2). The nanocomposite coatings were developed using low-cost electrodeposition of cobalt-tungsten (Co-W) alloys impregnated with MoS_2 and tungsten carbide (WC).

Applying the new processes and materials achieves a high degree of hardness and mechanical strength conferred by the WC particles and self-lubrication from the MoS_2 particles in a Co-W matrix. Nanocoat set out to develop new coatings that would be viable alternatives to hard chrome. The new coatings have intrinsic self-lubrication properties and this do not have to use liquid lubricants (a source of pollutants).

Significant deliverables include thin MoSx coatings containing fullerenes, nanotubes and nanoribbons on nickel phosphide (NiP) and Co-W substrates by electrodeposition. Simultaneous electrodeposition of Co-W alloy and WC and MoS_2 particles formed Co-W-WC nanocomposite coatings. Incorporation of WC particles into the Co-W matrix was found to have a profound influence on wear-and corrosion-resistance properties and a moderate improvement in hardness.

Nanocoat has achieved its goal of producing superior coatings for industrial processes that confer improvements in wear, corrosion and friction coefficient. An added value is that, unlike liquid lubricants, the release of toxic chemicals to the environment can be reduced or avoided.

The project was coordinated by the Katholieke Universiteit Leuven in Belgium.

1 'Development of self-lubricating nanocomposite coatings impregnated with *in-situ* formed MoS_2 for tribological applications'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9519

Modelling laser-based application of surface layers

EU-funded investigators are developing a comprehensive computational model of the processes involved in laser-based application of surface layers to metal components.

Post-processing of component parts with a surface treatment or coating, such as a laser-clad surface layer, has become routine. Added surface layers can enhance strength, protect against corrosion and wear, and add shock absorption characteristics.

Lasers are often used to add materials to the surface in processes including laser cladding and laser alloying. These techniques are based on injecting a powder stream into a moving, laser-induced melt pool on the surface of the substrate.

Modelling of such techniques is quite complex given the different phases and phase changes (solid, liquid and gas), as well as mass flow patterns and temperature gradients. However, precise models are increasingly important to a growing number of end-users, including the aerospace sector which demands particularly tight controls and reliability.

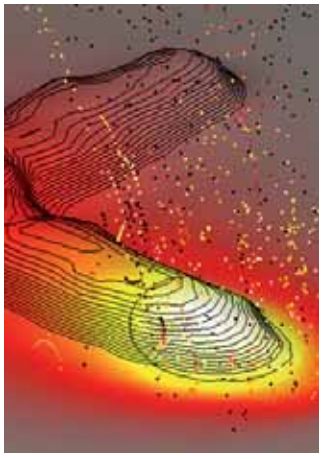
A European team, consisting of one of the largest laser research groups in the United Kingdom and an engineering simulation and software development company, set up the Inlade[1] project to address these challenges.

Its goal was to develop a unified model capable of representing all relevant processes. This includes powder flow and interaction with the laser beam above the melt pool, dispersion into the melt pool, melt-pool thermodynamics and heat flow, and microstructure and stress formation in the substrate.

The scientists are working on modular 'Computational fluid dynamics' (CFD) models of the powder stream and injection process (particulate-gas phases, flows and boundaries) and the melt pool (gas-liquid and liquid-solid phases). These will be combined with a 'Finite-element model' (FEM) of the substrate component undergoing laser processing. Lastly, the team will evaluate final deposit geometry and microstructure as well as deposit and substrate residual stress.

Although other integrated models have become available since the beginning of the project, the Inlade software package is expected to be unique in predicting both final stress and microstructure distributions and comprehensive in its handling of interactions of the melt pool with the incoming material and the substrate.

In addition, its flexibility should make it not only a comprehensive model of laser cladding but also a foundation for other models of laser welding and melt-pool processes.



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The project was coordinated by Lancaster University in the United Kingdom.

1 'Integrated numerical modelling of laser additive processes'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9511

Invisible transistors for transparent electronics

The future of the electronics industry, particularly consumer electronics, may well be miniaturised, flexible and transparent devices. EU-funded scientists are making progress toward developing the appropriate transistors.

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Transparent devices essentially rely on invisible electronic and optoelectronic circuits. In order to have invisible circuitry, optically transparent 'Thin-film transistors' (TFTs) are required. Conventional semiconductor materials and technology are not easily adapted to such applications.

Traditional organic semiconductors absorb light in the visible range of the electromagnetic spectrum, making them visible to the naked eye. In addition, their performance is inhibited when processed from a solution, as is necessary to produce TFTs.

Scientists in the EU-funded Organic Electronics[1] project set out to develop new materials and their processing methods for making transparent electronics and displays. To date, they have developed new materials tested in 'Organic thin-film transistor' (OTFT) architectures. Calculations based on 'Density-functional-theory' (DFT) have greatly enhanced experimental results.

The researchers have developed organic semi conducting structures including nanowires and 'carbon nanotubes' (CNTs), and tested the most promising materials in transparent TFT structures. The structures demonstrate electrical performance (charge-carrier mobility) competitive with that of state-of-the-art materials, among the highest of those reported in the literature.

Continued work promises to push the frontiers of flexible, transparent electronics with optimisation of materials and processing technology for superior-performance, transparent TFTs.

The project was coordinated by the Universidad de Malaga in Spain.

1 'Optimisation of organic thin-film transistors for plastic electronics: towards transparent components in new devices'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9561

Designing lighter parts for transport vehicles

EU-funded scientists are using advanced experimental techniques to develop models that optimise the design of lightweight metallic parts for the transport industry.

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Lighter metallic parts result in lower weight and thus less fuel consumption by transport vehicles. In turn, less fuel consumption translates to fewer 'greenhouse gas' (GHG) emissions.

The use of alloys — combinations of various metals — has proved beneficial in enhancing performance characteristics while reducing weight. Combinations of metals can be chosen for their specific properties, and a process called precipitation-hardening can be used to strengthen most structural alloys.

European researchers have decided to optimise the light-alloy design process, focusing on aluminium alloys, through a combination of experimental investigations and development of advanced modelling tools to characterise medium-scale (mesoscopic) behaviour in materials.

EU funding of the Nemolight[1] project is enabling them to pursue their goals. Using various model systems, the scientists are characterising heat and deformation effects during the precipitation procedure with unprecedented precision using world-class electron microscope facilities.

The team has also modified precipitation models accordingly, resulting in a robust model applicable to any thermodynamically well-defined system. Furthermore, they have initiated a study evaluating the relationship between the microstructure of the precipitate and its electrochemical behaviour.

To date, the Nemolight project has published five notable papers and presented its work at conferences and an international summer school course. The project is expected to advance the state of the art in optimising the design of light weight alloys for transport applications. Commercialisation of concepts should provide a significant boost to EU competitiveness in the field.

The project was coordinated by the Institut Polytechnique de Grenoble in France.

1 'Novel experimental and modelling approach for optimisation of light alloys'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
http://cordis.europa.eu/marketplace > search > offers > 9507

EVENTS

Symposium on principles of programming languages

The 40th 'Symposium on principles of programming languages will take place from 23 to 25 January 2013 in Rome, Italy.

A programming language is an artificial language designed to communicate instructions to a machine. The symposium will be a forum for the discussion of all aspects of programming languages and systems, with an emphasis on how principles underpin practice.

For further information, please visit:
http://popl.mpi-sws.org/2013/

Workshop on 'Complex disease genetics for clinicians'

A workshop entitled 'Complex disease genetics for clinicians' will take place from 24 to 25 January 2013 in Hinxton in the United Kingdom.

Complex diseases are defined as diseases that are ultimately determined by several genetic and environmental factors. Although there are many technologies and strategies that can be used to detect genetic factors, these technologies and strategies have inherent limitations.

Targeting practicing clinicians, this workshop will serve as an introduction to the field of complex disease genetics. Recent progress, such as genome-wide association studies, new biological insights and next-generation sequencing technology, will also be discussed.

For further information, please visit:
http://registration.hinxton.wellcome.ac.uk/display_info.asp?id=309

International Argospine symposium

Argospine — the 'Association of research groups for spinal osteosynthesis' — will hold its 17th international symposium from 31 January to 1 February 2013 in Paris, France.

Depending on where spinal cord and nerve roots are damaged, the symptoms of a spinal-cord injury can vary widely, from pain to paralysis and incontinence. Research into treatments has looked at approaches as diverse as controlled hypothermia and stem cells — although many treatments have not been studied thoroughly and very little new research has been implemented in standard care.

The conference will be a forum for surgeons looking to encourage applied research in the area of spinal surgery. It will focus on biomaterials, infection and hardware, bone-graft substitutes, stem cells, 3D imaging and navigation, intraoperative monitoring and neuromonitoring.

For further information, please visit
http://www.argospine.org/cadaver-course.php

'Biomarkers for brain disorders: challenges and opportunities' conference

A conference entitled 'Biomarkers for brain disorders: challenges and opportunities' will take place from 3 to 5 February 2013 in Cambridge in the United Kingdom.

The discovery and validation of biomarkers in neurological and neurodegenerative diseases is an important challenge for the early diagnosis of disease and the development of therapeutics.

This meeting provides an opportunity for scientists from academia and the commercial sector to discuss the current state of the art in biomarkers, and will aid future investment decisions in both sectors.

For further information, please visit:
http://registration.hinxton.wellcome.ac.uk/display_info.asp?id=303

Symposium on the fate of repository gases

A symposium on the fate of repository gases will take place from 5 to 7 February 2013 in Luxembourg City, Luxembourg.

The many scientific and technical areas relevant to geological disposal of long-lived radioactive waste are now well developed. However, there is a need to document such development with 'safety cases' — that is, a structured collection of arguments supported by a body of evidence that provides a compelling, comprehensible and valid case for repositories.

The event will disseminate the outcomes of the 'Fate of repository cases' (FORGE) project, and other recent work on the generation and migration of gases, in the context of geological repositories for the disposal of radioactive waste.

For further information, please visit:
http://www.bgs.ac.uk/forge/luxembourg2013/home.html

Bioinformatics 2013

The fourth 'International conference on bioinformatics models, methods and algorithms' (Bioinformatics 2013) will take place from 11 to 14 February 2013 in Barcelona, Spain.

Bioinformatics entails the creation and advancement of databases, algorithms, computational and statistical techniques, and theory to solve formal and practical problems arising from the management and analysis of biological data.

The conference will bring together researchers and other stakeholders to discuss the application of bioinformatics to the field of molecular biology.

For further information, please visit:
http://www.bioinformatics.biostec.org/

International conference on nanoscience and nanotechnology (nanoPT 2013)

The 'International conference on nanoscience and nanotechnology', also known as 'nanoPT 2013', will be held from 13 to 15 February 2013 in Porto, Portugal.

Over the next couple of decades — thanks to research and development — nanotechnology should bring benefits to every industrial sector, including health care. It does, however, pose new challenges to the scientific community. International cooperation is essential for its development, since scientific and technical challenges are huge and reaching a critical mass is beneficial.

This conference aims to encourage industry and universities working on nanotechnology to present their research project and look for collaborators.

For further information, please visit:
http://www.nanopt.org/12EN/index.php

International conference on the utilisation of wetland plants: reed as a renewable resource

The 'International conference on the utilisation of wetland plants: reed as a renewable resource' will take place from 14 to 16 February 2013 in Greifswald, Germany.

Wetlands are one of the world's most important environmental assets, containing a disproportionately high number of plant and animal species compared to other areas of the world. Due to their capacity to shift energy fluxes in favour of latent heat, they have been used experimentally as an alternative energy source in northern Europe. Reed canary grass, for instance, is easy to produce, cost-efficient and sustainable.

The event will bring together stakeholders from research, governance and other actors who deal with the utilisation of reed canary grass. They will be able to network, analyse research demand and share experience and information.

For further information, please visit:
http://www.rrr2013.de/

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