Innovations

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Seasons Greetings from Innovations
STFC & Particle Accelerators and Beams Group workshop on particle accelerators for medicine

On Tuesday February 17th 2015, at 10.00, the STFC will be hosting a joint Workshop in conjunction with the IoP Particle Accelerators and Beams Group, to consider developments in the field of ‘particle accelerators for medicine’. The workshop will provide a high level overview of the work being carried out, the key players in the area and highlight other relevant activities and events that are scheduled to take place. The workshop will be held at the Franklin Theatre at the Institute of Physics, 76 Portland Place, London.

The event will include talks from both UK and international speakers. UK accelerator experts will summarise their work in this area and the international experts will provide perspectives from overseas. These talks will help to stimulate a discussion on how the UK can develop its strategy and optimise its impact in the context of the global programme. The aim of the workshop will be to gather the views of the community and a discussion will be held on the relevant areas in which the STFC and the community can play a leading role.

Event information and registration can be found here.

The CLF’s laser systems are built and maintained by our laser experts Credit: STFC
The STFC Innovations Club is hosting an event on Novel magnetic sensors and their applications. The workshop will address the following type of sensors and their applications:

- Quantum Well Hall Effect (QWHE) sensors
- Portable SQUID magnetometers
- Fluxgate magnetometers
- Characterisation tools for functional magnetic materials

The sensors based on advanced Quantum Well Hall Effect (QWHE) display unprecedented sensitivity and dynamic range (> 180dB) allowing magnetic fields down to 1nT to be measured in an active volume of less than 0.001 mm³.

- These sensors support 2D planar and conformal array geometries on rigid and flexible substrates which opens possibilities not possible with induction techniques.
- There also have advantages in integrated circuits, mass production, repeatability, low power consumption, ease of use and lower costs.

A SQUID (superconducting quantum interference device) is a very sensitive magnetometer used to measure extremely subtle magnetic fields, based on superconducting loops containing Josephson junctions. SQUIDs are sensitive enough to measure fields as low as 5 aT (5×10⁻¹⁸ T).

Applications of magnetic sensors

- High-accuracy magnetometry, long-range position sensing, angular position sensing, current sensing, magnetic scanning of documents
- Non Destructive Testing (NDT), monitoring asset integrity, use of radiation hard camera for nuclear industry
- Magnetic near-field communications and sensing, the markets span oil & gas, defence and niche custom applications with products in low data-rate underwater communications, data logging, sensing and induction power transfer
- Extremely low magnetic fields detection (e.g. detection of underground water level and its salinity).

This workshop aims to pull together the interest from both the academia and industry in order to facilitate knowledge exchange (KE) between STFC funded researchers working in the area of magnetic materials and sensors and industry with a view to exploiting synergies between academic research and industry. The workshop will further highlight funding opportunities to support KE relationships around novel magnetic sensors and materials as well as provide an opportunity to hear a general update on their development and possible applications.

Registration for this event can be found here.

For more information contact: Dr Vlad Skarda, STFC (vlad.skarda@stfc.ac.uk)
Call for Proposals: Newton Agri-Tech in China Network+

STFC RAL Space has won £12m from the Newton Fund to develop a new research and development programme in the area of agricultural technology (agri-tech) in China. This programme has the aim of using the UK's expertise in remote sensing and modelling to work with and aid the agricultural economy and farming community in China. The £12m fund is spread over 5 years and will build on technologies and expertise in STFC RAL space to make use of breakthroughs in satellite imaging, remote sensing, smart sensors and modelling to help provide facilities and technologies that will support research-driven, decision making tools for farmers and policy makers in China.

As part of the initial phase, STFC RAL Space is inviting proposals to manage an Agri-Tech in China Newton Network+. The purpose of the Network+ will be to ensure that the Agri-Tech in China Newton projects funded through the programme and the associated institutes are networked with each other and with the breadth of activities, disciplines and stakeholders in the Agri-Tech/Global Food Security/Nexus space, including other relevant Newton-funded activities led by other Research Councils.

The Network+ will add value to the Programme by facilitating knowledge sharing and the creation of new partnerships and will play a strategic role in ensuring that research is aligned with user needs. Therefore, a key activity of the Network+ will be to support interactions between STFC-funded researchers and appropriate science, technology, industry and end user groups, both in the UK and in China, including social and economic science aspects. To facilitate this, the Network+ will be able to commission small scoping and proof of concept projects.

The aims of the Network+ include:

• To ensure that the Agri-Tech in China Newton projects and the associated institutes are networked with other activities, existing or planned (e.g. the RCUK Global Food Security programme, ESRC Nexus Network, Agri-Tech Catalyst, Satellite Applications Catapult)

• To develop a multi-disciplinary community focused on addressing agri-tech development issues in China

• To deliver scoping and proof of concept studies to test and de-risk ideas

Closing date: 4pm on 16 January 2015

Further information about the call is available here or contact katharine.hollinshead@stfc.ac.uk
The Royal Academy of Engineering MacRobert Award has become synonymous with spotting the 'next big thing' in technology, having been established 45 years ago to identify outstanding innovation with proven commercial promise and tangible societal benefit. The very first award in 1969 recognised the extraordinary Rolls-Royce Pegasus engine, used in the iconic Harrier jets, and in 1972 the judges highlighted the achievement of the first CT scanner - seven years before its inventor Sir Godfrey Hounsfield received the Nobel Prize.

More recently, a number of innovative SMEs have won the prize. The 2013 winner (and Cambridge Network member) RealVNC developed a remote-access technology which demonstrated such potential that judges predicted that they could be a billion dollar company within five years. Thanks to their work with the likes of Google, NASA, DreamWorks and Facebook, they are well on their way to achieving that.

The 2014 winner, Oxford SME, Cobalt Light Systems, developed a liquid scanning system that is now used in 65 airports across the globe, and could spell the end for 100ml limits on liquids. Their technology has also demonstrated huge potential in other areas including real-time diagnostic tools for cancer screening.

2014 MacRobert Award winner announced:

Cobalt Light Systems - For the innovation of the Insight100 airport security liquid scanner

So, are you working on the next big thing in engineering? If so, apply for the MacRobert Award today! For more details, and to apply, see the RAEng website: http://www.raeng.org.uk/grants-and-prizes/prizes-and-medals/other-awards/the-macrobert-award

The closing date for applications is 31 January 2015.
STFC announces that the 2015 Public Engagement Fellowships scheme is open

The call for applications to STFC’s 2015 Public Engagement Fellowships Scheme is now open.

The scheme forms part of the STFC’s Public Engagement Programme and is open to all STFC funded researchers. We seek good communicators with research credibility to act as champions or ambassadors for STFC’s science, technology, engineering and mathematics (STEM) work to schools, the media or public audiences.

The Fellowships purchase a proportion of a researcher’s time to enable them to concentrate more on public engagement activities which will have a significant national or regional impact.

Public Engagement fellowships are aimed at those with significant research experience who have demonstrated a track record in outreach or communications work. The fellowships will recognise and reward current practitioners and enable them to expand the work they do in public engagement.

A list of current Public Engagement Fellows is available.

The closing date for applications is Thursday 26th February 2015 at 4pm.
The Institute of Cosmology Fellowship vacancy

The Institute of Cosmology & Gravitation (ICG) will host a Science and Technology Facilities Council (STFC) Innovations Partnership Scheme (IPS) Fellowship focused on enhancing the innovation, knowledge exchange, potential arising from research in physics (especially astrophysics).

The fellow will develop collaborative projects activity with industrial funders across the South-East Physics Network (SEPnet; www.septnet.ac.uk) with a view to increasing the volume, depth and value of commercialization of this research. Key responsibilities will include the auditing of the breadth, depth and readiness of commercialization of physics research at Portsmouth and other SEPnet universities, identifying companies (of all sizes) and clarifying their business needs and knowledge exchange concepts that could be addressed through available academic research, and provide support and mentorship to increase the level of engagement (of all types) across SEPnet.

The fellow will be based at the ICG but interact with many stakeholders across the University of Portsmouth, STFC and SEPnet, and work in collaboration with Professor Averil McDonald (SEPnet) and Professor Seb Oliver (University of Sussex), and other IPS fellows in the region. The fellow will be expected to work independently and show a high level of motivation and entrepreneurialism. Ideally we are looking for someone with experience in business (technology/industrial/commercial) environment, with a track record in undertaking business development. The fellowship is jointly sponsored by STFC and SEPnet, in collaboration with the Faculty of Technology and Research and Innovation Service (RIS) at the University of Portsmouth.

The fellowship is for four years with a start date as soon as possible, or by 31st March 2015 at the latest.

For informal enquiries about this position please contact Bob Nichol (email bob.nichol@port.ac.uk), or by calling +44 (0)23 9284 3117

Applications (application form, CV) should be submitted via the online application system at https://port.engageats.co.uk by the closing date. References will be requested prior to interview (please include names and contact details for at least three referees)

Late applications may be considered; please contact the HR Recruitment team viahrrecruitment@port.ac.uk for details on how to apply.

The ICG consists of 12 academic staff, 15 postdoctoral researchers and 20 PhD students, and is a member of the Sloan Digital Sky Survey (SDSS-III and SDSS-IV), the Dark Energy Survey, the UK Low Frequency Array (LOFAR:UK) and the Euclid Consortium. The University of Portsmouth is a member of the South-East Physics Network (SEPnet) and hosts the 1500-core SEPnet-ASTRO supercomputer (SCIAMA). For further information, please visit www.icg.port.ac.uk.

SEPnet has now embarked on its second phase, including the expansion to nine physics-based departments and has received further funding from HEFCE to align its activities with institutional needs to enhance knowledge exchange and commercialisation of research”.

We welcome applications from all qualified applicants, but applications are particularly encouraged from traditionally under-represented groups in science. The University of Portsmouth is member of the Athena SWAN charter and an Institute of Physics Project Juno Supporter; these projects show a commitment to introduce organisational and cultural practices that promote gender equality in science and create a better working environment for men and women.

For detailed information about the vacancy, please select this link: https://port.engageats.co.uk/
Multi-million pound fund to boost UK university spin-outs and research

Innovate UK is supporting the £3.2 million iCURE project which has been launched today, which will help universities across the South of England to commercialise their research and start successful businesses faster than ever before.

The project, which was announced by Universities, Science and Cities minister Greg Clark, is co-funded by the technology experts at Innovate UK and the Higher Education Funding Council for England (HEFCE).

Separately, Innovate UK is also making £6 million available over the next two years to help university spin-out companies develop faster and be more attractive to private investors.

Mark Glover, Director of Strategy at Innovate UK said: "The United Kingdom’s research is world-renowned, but we need to be fast if we’re going to make the most of the business opportunities that research brings with it. Innovate UK helps bridge the gap between concept and commercialisation and this scheme, along with the additional funding we’re making available to the spin-outs, will help some of our best universities move quickly to create successful, high-growth businesses."

You can read more about the project here
Call for interest in using ESA’s inventions

Space companies and organisations from ESA Member States and Canada are invited to submit their interest in using ESA’s inventions.

As a research organisation, ESA encourages, protects and licenses innovations or inventions resulting from its own activities in order to fulfil its mission of cooperation among Member States in space research and technologies and their applications, and supports the worldwide competitiveness of European industry.

ESA patents up to 20 inventions a year and has a portfolio of about 450 patent applications and patents, which cover subjects such as radio-frequency payloads and systems, structures and pyrotechnics, electromagnetic technologies and techniques, material and processes, robotics, optics, electrical power and propulsion.

ESA makes its inventions available free of charge via its Technology Transfer Programme Office on a non-exclusive basis to space industry within its 20 Member States. For use by companies outside of ESA’s Member States or for non-space applications, a different licensing model is in place, allowing the Agency to request royalties.

Licensing templates can be downloaded from links on the right navigation bar as well as more information about ESA’s Intellectual Property policy.

The goal of this call for interest is to make ESA’s portfolio and licensing conditions more openly visible to European space industry and to encourage its use and licensing.

The deadline for the call is extended to 19 March 2014.

Further information:

A. Fill in an Expression of Interest form. This first input will help us to understand your technical needs and make a first assessment with ESA’s inventor of the applicability of the invention.

B. If needed, a conference call with the inventor or an expert will be organised.

C. The license agreement would be concluded.

The list of ESA patents is available here.

For questions, please contact:

Aude de Clercq, ESA Technology Transfer Programme Office Email: aude.de.clercq@esa.int

Advanced spacecraft thrusters under test in vacuum chamber at ESTEC
First human trials show non-invasive diagnosis of bone diseases possible

New research announced on 28 November 2014 could lead to the early diagnosis and treatment of chronic, debilitating conditions such as ‘brittle bone’ and osteoporosis, and help improve the lives of tens of thousands of sufferers in the UK alone. It could enable doctors to identify the bone diseases without having to use invasive diagnostic methods, or exposing patients to radiation associated with the usual X-ray techniques.

This research has, for the first time, enabled detection of a genetic ‘brittle bone’ disease known as Osteogenesis Imperfecta (OI) by simply scanning a patient’s limbs. Until now, bone diseases have been diagnosed through X-rays, history of fractures and other clinical symptoms and, in the case of OI, genetic testing.

The researchers, from UCL (University College London), the Science and Technology Facilities Council (STFC) and the Royal National Orthopaedic Hospital (RNOH) used a technique known as Spatially Offset Raman Spectroscopy (SORS) to test for the condition. The technique involves shining a laser through the skin to analyse the underlying chemistry of the bone, and can reveal differences between healthy and diseased bone. The general SORS concept was developed at the STFC Central Laser Facility, based at the Research Complex at Harwell, Oxfordshire.

To obtain a set of control data, the research team carried out tests on a small bone sample taken from a 26 year old female patient with type IV OI. This is a moderate form of the disease that affects growth and can cause bone deformity and spinal curvature.

Using conventional Raman spectroscopy, the team probed the bone and compared it to a non-diseased bone sample, establishing a notable chemical difference in its make-up.
First human trials show non-invasive diagnosis of bone diseases possible

The patient’s body was then scanned extensively and non-invasively, using a laser in a custom-built SORS instrument developed by Cobalt Light Systems. For comparison, a second set of scans were carried out on a healthy female volunteer of a similar age, who does not have the disease.

"Bone is a complex material that has both mineral and protein components," said Dr. Kevin Buckley from STFC’s Central Laser Facility, one of the team working on this project. "Traditional X-ray methods that are used to study bone can only see the mineral but this technique can see both components."

The OI patient’s bone sample was found to be significantly more mineralised than the non-diseased sample, and was therefore structurally brittle.

"The results confirm that SORS can detect abnormalities in the bone composition", added Dr. Buckley. "Osteogenesis Imperfecta is relatively rare, but the hope is that the technology will now allow the early detection of other bone diseases. That would be a step forward because earlier detection would mean earlier treatment and enhanced quality of life."

Professor Allen Goodship from UCL’s Institute of Orthopaedics and Musculoskeletal Science led the research. He said, "The SORS technique represents an improvement on X-ray methods as it can extract more information on the precise chemical make-up safely. I can envisage this developing into a routine tool that your local surgery can use when you go for your annual check-up, enabling early detection of conditions, early prescription and monitoring of medication, and will allow doctors to advise patients on lifestyle changes that could slow the progress of the disease further. With regular screening, SORS can monitor the effects directly."

Osteoarthritis and osteoporosis are on the increase in countries with aging populations. In the UK alone there are more than 70,000 hip fractures associated with osteoporosis and a further 70,000 primary hip replacements associated with osteoarthritis annually.

"Presently, the range of clinical tools for early detection of these diseases is limited”, said UCL’s Dr Jemma Kerns, a researcher and clinical study manager for the project. “In the case of osteoporosis, people at higher risk of a fracture are identified using an association with bone density. However, the successful diagnosis of fracture risk in an individual is currently quite low. The SORS method could improve that rate and pave the way for studies of other bone diseases that have a large societal and economic impact.”

The research was funded by a £1.7M grant from the Engineering and Physical Sciences Research Council, with facility time and other support coming from the Science and Technology Facilities Council. Control bone samples were provided by the Vesalius Clinical Training Centre, Bristol.
Comet landing named Physics World Breakthrough of the Year

The first ever landing of a man-made probe onto a comet has been named Physics World Breakthrough of the Year for 2014.

From a shortlist of 10 highly commended breakthroughs, the historic achievement by scientists working on the Rosetta mission was singled out by the Physics World editorial team for its significance and fundamental importance to space science.

The landing of the Philae probe, which captivated not only the physics community but millions of people worldwide, was the culmination of 10 years’ work by scientists at the European Space Agency (ESA), who successfully guided the Rosetta spacecraft through the inner solar system to finally meet up with Comet 67P/Churyumov–Gerasimenko in August.

At 15:35 GMT on 12 November, a signal was received in the ESA control room confirming that the Philae lander had completed its seven-hour descent and had landed safely on the surface of Comet 67P. While the landing was not as smooth as mission scientists would have liked, the Philae lander still managed to collect a large amount of data before entering hibernation mode.

To celebrate the achievement, Physics World will be hosting a Google Hangout with members of the Rosetta team on Friday 12 December at 14:00 GMT.

Dr Hamish Johnston, editor of physicsworld.com, says: “By landing the Philae probe on a distant comet, the Rosetta team has begun a new chapter in our understanding of how the solar system formed and evolved – and ultimately how life was able to emerge on Earth. As well as looking forward to the fascinating science that will be forthcoming from Rosetta scientists, we also acknowledge the technological tour de force of chasing a comet for 10 years and then placing an advanced laboratory on its surface.”

The Physics World editorial team has recognized a further nine achievements from 2014 in a range of topics from nuclear physics to nanotechnology. The top 10 breakthroughs were selected using the following criteria: fundamental importance of research; significant advance in knowledge; strong connection between theory and experiment; and general interest to all physicists.

Dr Johnston continues: “In what was an exciting year for the field of physics, we commend the work of the nine runners-up, each of which represents an important step forward made by a team of creative and talented researchers. Our congratulations are extended to all of those involved.”
Comet landing named Physics World Breakthrough of the Year

The remaining breakthroughs (in no particular order) are:

**Quasar shines a bright light on cosmic web**
To Sebastiano Cantalupo, Piero Madau and Xavier Prochaska of the University of California Santa Cruz and Fabrizio Arrigoni-Battaia and Joseph Hennawi of the Max-Planck-Institut für Astronomie in Heidelberg for using the radiation given off by a quasar to catch the first glimpse of a filament of the cosmic web.

**Neutrinos spotted from Sun’s main nuclear reaction**
To the Borexino collaboration for being the first to detect neutrinos from the main nuclear reaction that powers the Sun.

**Laser fusion passes milestone**
To Omar Hurricane and colleagues at the National Ignition Facility (NIF) of the Lawrence Livermore National Laboratory and the Los Alamos Laboratory in the US for being the first to obtain a ‘fuel gain’ of greater than one in a laser-driven nuclear fusion experiment.

**Physicists sound out acoustic tractor beam**
To Christine Démoré and Mike MacDonald of the University of Dundee in the UK, Patrick Dahl and Gabriel Spalding of Illinois Wesleyan University in the US and colleagues for creating the first acoustic ‘tractor beam’ that can pull an object by firing sound waves at it.

**Lasers ignite ‘supernovae’ in the lab**
To Gianluca Gregori, Jena Meinecke of the University of Oxford and an international team for using one of the world’s most powerful laser facilities to create tiny versions of supernova explosions in the laboratory.

**Electrons’ magnetic interactions isolated at long last**
To Shlomi Kotler, Nitzan Akerman, Nir Navon, Yinnon Glickman and Roee Ozeri of the Weizmann Institute of Science in Israel for being the first to measure the extremely weak magnetic interaction between two single electrons.

**Disorder sharpens optical-fibre images**
To Arash Mafi and colleagues at the University of New Mexico, University of Wisconsin-Milwaukee, Corning Incorporated and Clemson University for using the phenomenon of ‘Anderson localization’ to create a better optical fibre for transmitting images.

**Data stored in magnetic holograms**
To Alexander Khitun and Frederick Gertz at the University of California Riverside in the US and Alexander Kozhevnikov and Yuri Filimonov at the Kotelnikov Institute of Radioengineering and Electronics in Russia for creating a new type of holographic memory device based on the interference of spin waves.

**Quantum data is compressed for the first time**
To Aephraim Steinberg and colleagues at the University of Toronto for being the first to demonstrate a quantum analogue of data compression in the lab.
Boosting UK competitiveness using cognitive computing and big data

Government investment of £113 million in new high performance computing capability is expected to give UK business a two-year head start over international competitors, Science Minister Greg Clark has said.

The investment, announced in the Autumn Statement on 3 December, will substantially expand the data-centric cognitive computing research capabilities of STFC’s Hartree Centre at Sci-Tech Daresbury, through enhanced collaboration with IBM.

Universities, Science and Cities Minister Greg Clark said “The Government’s investment will create an exciting innovation environment that will enable UK industry to exploit value from advanced computing and big data to create new and improved products, services and manufacturing processes.”

Professor John Womersley, Chief Executive of STFC, said: “Harnessing data intensive science to the needs of industry could transform every business sector as well as every scientific discipline. Currently, even data experts find it difficult to extract insights from many existing large data sets. The Government’s five-year investment in the Hartree Centre will deliver a step-change in capability, and plans to bring in significant knowledge and expertise from IBM which will help ensure our science and industry remains at the very forefront of research and development.”

Cognitive computing systems ‘learn’ in similar ways to human development. The goal is to enable not only scientists, but doctors, bankers, retailers and others to extract the full value of their data and thus make better, more accurate and more timely decisions and discoveries.

As well as creating the new structures, architectures and tools needed to help non-scientists take advantage of big data, the Hartree Centre will deliver computing capability to the international Square Kilometre Array project through its headquarters at Jodrell Bank, and to a variety of national projects including the Turing Centre in London, and the new national materials institute in Manchester.
Baroness Neville-Rolfe, who is parliamentary undersecretary of state for business, innovation and skills and minister for intellectual property, said she had been “utterly delighted” to have been given the intellectual property brief, because it was essential for the UK to make the most of its intellectual assets, of which physics was a key part.

Underlining the importance of physics to the UK economy, she said the government recognised this and was soon to announce a new science and innovation strategy. Congratulating the four companies who were receiving awards, she said: “I think the winners tonight are wonderful.”

The IOP Innovation Awards recognise companies in the UK and Ireland that have built success on the innovative application of physics.

Lady Audrey Wood, co-founder and former director of Oxford Instruments and of the Oxford Trust, also spoke at the reception to commend the award winners. She described how the company that she and her husband had founded had grown from a small spin-out from the Clarendon Laboratory at the University of Oxford to be a highly ranked FTSE company. The world market for its high-field magnets had initially consisted of fewer than 10 laboratories, she said, but it had grown and exploited the new technology of superconducting magnets, which became the basis for MRI scanners.

Andrew Miller MP, who chairs the Science and Technology Committee of the House of Commons, said there was a genuine belief in parliament that British science deserved support and was a key part of the future of the UK. He thanked the learned societies for their role in helping MPs and peers to get to grips with science and technology and said the IOP had “done a fantastic job over the years.”

The IOP’s chief executive, Prof. Paul Hardaker, told the guests from industry, parliament and scientific bodies that although the four companies to receive the awards for 2014 were also presented with them at the IOP’s Awards Dinner in October, the event at the House of Commons was an opportunity to celebrate their outstanding achievement.

Before handing the awards to representatives of the companies, the IOP’s president, Frances Saunders, referred to the challenges that the companies had had to face in taking an idea from the lab and turning it into something that people would want to buy. She said: “I think it is a tremendous achievement for these companies to have developed products that are innovative but also successful in terms of sales.”

The winning companies were:

**Gas Sensing Solutions Ltd.** For developing and commercialising an optical carbon dioxide gas sensor. The low-power sensor allows for greater accuracy and energy savings for customers in a range of markets.

**Gooch & Housego.** For the development of a fibre-coupled acousto-optic modulator device for integration into fibre-laser systems. The Fiber-Q is used to modify the laser beam in systems used in a range of markets and applications, from oil and gas security to medical lasers.

**Magnox Ltd.** For developing and implementing an innovative method of refuelling the Wylfa nuclear power station Reactor 1. The transfer of fuel from Reactor 2 has allowed for continued energy generation at the site.

**MBDA.** Missile Systems For the development of a missile-system upgrade which combined two guidance modes for greater precision. The innovation has provided new capability for UK and coalition armed forces.

Read more about the Innovation Awards and the winners.
Downing Street ceremony heralds the International Year of Light

Switching on the lights on the Downing Street Christmas tree not only marked the festive season, but also signalled the lead-up to 2015, the International Year of Light (IYOL).

A trio of lights was placed on the Downing Street tree on December 9th to mark the coming year. The lights feature a seasonal interpretation of the IYOL symbol – a parade of reindeer in a spectrum of colours that is also used in the IYOL’s sun logo.

The year was designated by the United Nations and will be a year-long celebration with aims including promoting light-based technologies, raising awareness of light pollution and energy waste and championing sustainable lighting in the developing world.

The year marks a number of inspirational scientific anniversaries including the 1000th anniversary of the publication of early works on optics by Islamic scholar Ibn Al-Haytham and 200 years since Augustin-Jean Fresnel proposed the notion of light as a wave.

In the UK, over 40 individuals and organisations representing science, engineering, culture and the arts are working together to mark the year through an impactful national programme of events and activities.

Dr Beth Taylor, Chair of the UK National Committee for IYOL, commented: “We couldn’t wish for a better start to the year than to have it celebrated in the lights of the Downing Street Christmas tree. This gives us a great foundation to build on as we work to make an impact, and achieve our key goals, throughout 2015. I am very grateful to the team at 10 Downing Street and the lighting specialists who have made this possible.”
It was announced that the green light has been given for construction of the world’s biggest optical and infrared telescope, the European Extremely Large Telescope (E-ELT), will provide huge opportunities for the UK astronomy community and UK Industry.

Preparation of the site for the European Southern Observatory (ESO) E-ELT began in Chile in 2014 and today’s announcement allows contracts for the construction of the telescope itself to be agreed in 2015. This will offer significant industrial opportunities for UK companies to participate in this exciting project. UK companies have already secured more than £9million in contracts and this figure could rise at least ten-fold before construction is completed.

STFC’s Professor Colin Cunningham, UK E-ELT Programme Director, said: “The UK E-ELT Project Office is very happy that the E-ELT project will now move into full construction phase. This means that the contracting process can now begin for the big-ticket items like the Dome and Telescope Main Structure and Primary Mirror Segments. Building the world’s biggest optical and infrared telescope provides huge opportunities for both the UK astronomy community and UK Industry. The telescope will enable discoveries at all scales of the Universe, from measurements of life-marker gases in the atmospheres of exoplanets to understanding the birth and evolution of stars and galaxies in the early Universe.”

The first phase of construction, at an approximate spend of one billion Euros, will deliver a fully working telescope with a suite of powerful instruments and first light targeted in ten years time. The largest ESO contract ever, for the telescope dome and main structure, will be placed within the next year.

The E-ELT’s 39-metre diameter optical mirror, consisting of over 600 hexagonal segments, will help unlock the mysteries of our universe, capturing 15 times more light than any other optical telescope currently in existence and creating images 16 times sharper than those produced by the Hubble Space Telescope.

The Science and Technology Facilities Council (STFC) supported by significant UK government investment, is one of the 15 ESO members involved in the E-ELT. As a result, UK scientists and engineers are already successfully securing a pivotal role in construction and eventual operation of the E-ELT project, as well as in the development of the cutting edge instrumentation.

The University of Oxford’s Professor Niranjan Thatte, who leads the design and development of HARMONI, a first light instrument for the E-ELT, said: “We are delighted that construction of the world’s largest telescope has commenced. The UK is leading the consortium that will build the first light spectrograph for the E-ELT. Spectroscopy allows us to understand the physics of a wide range of astrophysical objects – from planets around other stars to the very first galaxies in the Universe. UK astronomers are delighted that this flagship project is now underway. By allowing studies of the faintest objects in exquisite detail, it will dramatically improve our understanding of the cosmos.”

Professor Patrick Roche, also of the University of Oxford and a member of ESO Council, said: “Today ESO Council has confirmed that construction of an extraordinarily powerful new telescope will begin in 2015. At the end of the decade long construction period, the E-ELT will turn years of dedicated research and design in Universities and institutes in the UK and other ESO member states into a world-leading astronomical facility with unprecedented capabilities.”

View the full ESO press release for more detailed information on the two construction phases of the E-ELT.
On solid ground

Lovers of architecture and history can rest easy: the stability of historical buildings can now be monitored in real time by a new technique with its roots in space.

In the past, if you feared the land beneath your house or road might be shifting, the only method was to install measuring devices, and wait – often for months – to find out. Today, landowners can determine whether or not they have a problem much faster, thanks to a company that taps into existing space data to trace changes over time.

Roman Forum
Civil engineers started to worry a few years ago about the Basilica di Massenzio in Rome. The largest of the ancient buildings that make up the Roman Forum, the Basilica has survived largely intact since the third century.

Tunnelling was planned nearby as part of the construction of Rome’s new metro line. Could the underground work, coupled with the unrelenting vibrations of modern-day Roman traffic, destabilise the magnificent Basilica’s old walls?

The city turned to Natural Hazards Control and Assessment, a company founded by a group of geologists and engineers as a spin-off from the ‘Sapienza’ University of Rome. After monitoring the ground beneath the basilica for a few weeks, project manager Alfredo Rocca delivered the good news: “We found the situation was not so bad and no particular problems affected the structure during the observation period.”

Landslide area
Of course, when it comes to land stability, the news is not always good. Landslides, quarrying and oil extraction, for example, can affect terrain, with subtle shifts rendering structures like dams, houses and highways vulnerable. Until now, though, geologists and engineers had limited sources to draw on when shifting ground was suspected. That all changed, said company CEO Prof. Paolo Mazzanti, when their geologists – then working with the University of Rome – discovered ESA’s treasure trove of satellite radar images.

Envisat
Collected over decades during Earth observation missions like ERS and Envisat, these images hold a wealth of information about changes in our planet’s surface. “It was like a time machine,” said Alfredo. “These ESA satellite data archives over years are very rich.”

This new ability to look back in time was a huge leap forward for geologists, Professor Mazzanti noted: “In the past, if you suspected a problem you began to measure any small movements. Usually, you had to wait for many months or at least one year in order to get the answer.” With the help of the satellite images, however, the geologists could tell very quickly if a particular hillside had slid a little over the years, or if the ground under a house had sunk a bit.
On solid ground

**Satellite scanning**

Inspired by the ESA satellite techniques they learned about as they worked with the images, the company also developed a second method. In addition to tapping the ESA archives of radar images from space, they moved to ground-based radar imaging technology, which works in much the same way as satellites scan surfaces on Earth.

Alfredo compares their approach to the way a bat ‘sees’. By correlating outgoing pulses with the echoes, geologists and bats can produce detailed, 3D images.

**Cliff inspection**

Over time – minutes or months – the company’s ground radar scans can be compared to determine if any movement has occurred.

There were two reasons for creating a ground-based system, said the scientists. First, vertical structures like the gorgeous coastal cliffs of southern Italy – which the company monitored and found to be stable – are hard to track from the sky. Second, in acute cases, it can be necessary to monitor an area more frequently. “Sometimes you need to check daily or hourly,” said Alfredo, citing a recent project for the Italian Highway Company. They provided realtime monitoring to ensure workers’ safety as a slipping road embankment was stabilised. “This is something a satellite can’t do, but we can from the ground.”

**Dam displacement**

As they developed their technologies, the company turned to ESA’s Business Incubation Centre in Lazio, Italy. Here, they received support that was crucial to refining their ideas and turning them into a viable business.

**ESA Business Incubation Centres**

ESA’s role in hosting the company at its incubator was key to their development, said Professor Mazzanti: “We had a very strong cooperation with ESA during our first years. Without ESA and its satellites, we would not have been able to do any of this.”

“Through hosting them in our centre, we could support the company to develop their system and methodologies quickly,” explained the incubator’s Roberto Giuliani. “Coming with a university research background we also helped them to build their entrepreneurial skills, a key to succeeding as a company.”

**Portable ground-based radar**

Today, three years after the end of the incubation programme, the company is internationally recognised. In the last year alone, they have worked in Italy, France and in Asia, investigating and monitoring everything from landslides to road embankments, dams, bridges and buildings. In the future, they plan to expand to new business sectors, including oil and gas.
External Innovations and Innovations Club

The External Innovations team manages the activities that aim to realise the impacts and benefits that flow from STFC’s investments in science and technology towards commercialisation through one to one brokering, events and a range of funding schemes.

If you wish to contact the teams for more information please see the following contacts and email addresses.

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The Innovations Club newsletter contains a selection of articles drawn from our partner organisations that we think you will find interesting. We welcome your comments innovationsclub@stfc.ac.uk