Innovations

This issue: 1 CLASP Energy Call Information and Networking Day 3 STFC announces seven new projects aimed at solving environmental challenges 4 Engineering Solutions from STFC to Improve Efficiency in Agrifood Sector 5 Identifying alzheimer’s using space software 7 Nuclear Physics Technology Showcase Event 8 From Mars, to volcanoes, ash clouds and chimneys stacks – UK spin-out brings space technology to Earth 10 CCD4-2013: The 4th Cryogenic Cluster Day 11 New fluorescent fingerprint tag aims to increase IDs from ‘hidden’ fingerprints on bullets and knives 13 Scientists unlock structure of elusive ‘stress’ protein 14 Ten more years of neutron science! 15 Australian physicists cast new light on spin-bowling 17 External Innovations Team and Innovations Club contacts

CLASP Energy Call

Information and Networking Day – 2 July 2013
Science Museum, London

The Innovations Club held an Information and Networking Day to launch the new energy funding call of the Challenge Led Applied Systems Programme (CLASP). The scheme supports the application and commercialisation of STFC research in the four key global research challenge areas of healthcare, security, environment and energy and is now offering £1.5M to fund a range of projects from short feasibility studies to large developmental projects that will use STFC funded research to solve key challenges in the energy sector.

CLASP reduces industry risk in the R&D process through the development of technology demonstrators and industry-ready prototype systems. The scheme is inviting proposals that draw on technology and expertise from the STFC research community. It is expected these will provide a solution to one of the many challenges associated with the energy sector and for which there would be a demonstrable potential market.

Innovations Club
The event was held in the grand surroundings of the old library at the Science Museum and hosted 80 delegates representing the energy industry, academia and knowledge exchange professionals. STFC showcased the technologies, capabilities and expertise available in its facilities. Chris Bagley, Director of the Energy Generation and Supply (EGS) KTN, represented the STFC Energy Focus Group, which brought together energy sector experts to define the key technical energy challenge areas that form the priorities for the CLASP energy call:

- energy storage
- nuclear energy
- future energy grids
- energy materials
- sensing and monitoring

Further details are available on the CLASP webpage.

Chris also presented the work of the EGS KTN in accelerating innovation in the energy sector.

The second part of the event featured case studies of STFC technology applied to the energy sector. Steve Bennington, CEO of STFC spin-out Cella Energy, Ian Macafee, CEO of STFC spin-out Oxsensis and Peter Lee of the STFC Global Challenge Network in Batteries Science each presented the story of their venture, the challenges they faced and gave their tips for successful industry-academic collaborations.

The final session included funding and application information on the CLASP call and a lively Q&A session. There was also a great deal of networking as delegates exchanged ideas and briefed one another on their technologies, expertise and plans.

A copy of the agenda, presentations and energy challenge areas are available on our website.
STFC announces seven new projects aimed at solving environmental challenges

STFC is pleased to announce the awarding of £1.5M to fund seven exciting multidisciplinary projects under the challenge led CLASP Programme to meet specific challenges in the environment sector. These projects plan to produce tangible results in a 3-5 year period and bring STFC researchers together with other academic disciplines and industry through new collaborations to solve real environmental challenges.

1. ST/K006614/1 Dr G. Ferrier (Hull) & Dr H. Mortimer (STFC Labs)
   **Project title:** Development of a low cost, field portable, imaging fourier transform interferometer for gas leak detection in the petrochemical industry
   
   *Gas leak detection in petrochemical industry - utilising micro-FTS developed for space applications (compact Fourier-transform spectrometer (FTS)) based on a unique static optical configuration, which has no moving parts and is inherently stable and robust, providing a compact and inexpensive solution to chemical identification for industrial applications and use in harsh environments.*

2. ST/K006509/1 Dr R. Thomson (Heriot-Watt), Dr T. Binks (Bath) & Dr R. Henderson (Edinburgh)
   **Project title:** Development of an instrument for rapidly detecting cryptosporidium in drinking water
   
   *Instrument development to treat cryptosporidium in drinking water – building upon research undertaken to develop multicore fibres and 3D fan out devices for astronomy applications.*

3. ST/K006614/1 Dr G. Ferrier (Hull) & Dr H. Mortimer (STFC Labs)
   **Project title:** Development of a low cost, field portable, imaging fourier transform interferometer for gas leak detection in the petrochemical industry
   
   *Using new hand held spectroscopy device to detect pollution in water - utilising micro-FTS developed for space applications (compact Fourier-transform spectrometer (FTS)) based on a unique static optical configuration, which has no moving parts and is inherently stable and robust, providing a compact and inexpensive solution to chemical identification for industrial applications and use in harsh environments.*

4. ST/K006568/1 Prof I. Thompson (Oxford), Mr P. McIntosh (STFC Labs) & Dr T. Scott (Bristol)
   **Project title:** Development of a hybrid technology for treating recalcitrant water contaminants: assessing e-beam potential.
   
   *Developing a hybrid technology to treat water contaminants using electron beams used in the development of particle accelerator technology.*

5. ST/K006746/1 Prof A. Lawrence (Edinburgh) & Dr A. Grainger (Leeds)
   **Project title:** Utilizing Virtual Observatory Technology to Improve the Frequency and Coverage of Tropical Forest Monitoring (ASTROTROP)
   
   *Using a ‘virtual observatory’ to improve the monitoring of tropical forests building upon AstroGrid software for large scale modelling techniques.*

6. ST/K006673/1 Dr A. Cross (Strathclyde) & Dr G. Smith (St Andrews)
   **Project title:** Novel Gyro-TWA Amplifier for High Power mm-wave Radar Remote Sensing
   
   *Improving weather forecasting through the use of high power mm wave radar remote sensing to predict cloud formation.*

7. ST/L001810/1 Prof J. Moncrieff (Edinburgh), Mr D. Henry (UK ATC) & Dr J. Thompson (NERC Centre for Ecology & Hydrology)
   **Project title:** A Differential Absorption LiDAR for Measurement of Greenhouse Gases
   
   *Measurement of greenhouse gases using LiDAR and building on STFC funded systems integration expertise developed for satellite & astronomy research.*

CLASP project calls

STFC runs an annual Challenge Led Applied Systems Programme (CLASP) call for proposals with each call focussing on a Grand Challenge area where new technology emerging from STFC’s research base can be applied through collaborative work with other researchers and industry to meet challenges aligned to the Futures programme; Energy, Environment, Healthcare and Security.
Engineering Solutions from STFC to Improve Efficiency in Agrifood Sector

The Technology Strategy Board, together with the Department for Environment, Food and Rural Affairs (Defra), the Biotechnology and Biological Sciences Research Council (BBSRC), and Scottish Government, has launched a competition, offering up to £13m for businesses to develop engineering solutions across the agri-food supply chain.

This competition will draw on all facets of engineering science to advance the sustainable intensification of primary agriculture, and raise product quality and process efficiency in food manufacturing. They are particularly keen to encourage engagement with sectors such as space, ICT and electronics sensors & photonics, which may not have fully recognised opportunities that exist for applying technologies throughout the agri-food supply chain. Full details can be found at: https://www.innovateuk.org/competition-display-page/-/asset_publisher/RqEt2AKmEBhi/content/engineering-solutions-to-enhance-agri-food-production

The ESP KTN, in conjunction with STFC are hosting a small workshop on the 19th September to discuss the current challenges in food production and how STFC-funded technologies may be applicable. The workshop will seek to incorporate STFC capabilities into applications to the current funding call. We invite participation from STFC scientists involved in:

- Robotics/autonomous systems
- Satellite/Earth Observation
- Image recognition/Machine vision
- Data analysis/comms

Venue: Hilton London Euston Hotel
Address: Hilton Hotel London Euston, 17-18 Upper Woburn Place

Register Here
Identifying alzheimer’s using space software

Software for processing satellite pictures taken from space is now helping medical researchers to establish a simple method for wide-scale screening for Alzheimer’s disease.

Used in analysing magnetic resonance images (MRIs), the AlzTools 3D Slicer tool was produced by computer scientists at Spain’s Elecnor Deimos, who drew on years of experience developing software for ESA’s Envisat satellite to create a program that adapted the space routines to analyse human brain scans. “If you have a space image and you have to select part of an image – a field or crops – you need special routines to extract the information,” explained Carlos Fernández de la Peña of Deimos. “Is this pixel a field, or a road?”

Working for ESA, the team gained experience in processing raw satellite image data by using sophisticated software routines, then homing in on and identifying specific elements. “Looking at and analysing satellite images can be compared to what medical doctors have to do to understand scans like MRIs,” explained Mr Fernández de la Peña. “They also need to identify features indicating malfunctions according to specific characteristics.”

Adapting the techniques for analysing complicated space images to an application for medical scientists researching into the Alzheimer disease required close collaboration between Deimos and specialists from the Technical University of Madrid. The tool is now used for Alzheimer’s research at the Medicine Faculty at the University of Castilla La Mancha in Albacete in Spain.

Space helping medical research

“We work closely with Spanish industry and also with Elecnor Deimos through ProEspacio, the Spanish Association of Space Sector Companies, to support the spin-off of space technologies like this one,” said Richard Seddon from Tecnalia, the technology broker for Spain for ESA’s Technology Transfer Programme. “Even if being developed for specific applications, we often see that space technologies turn out to provide innovative and intelligent solutions to problems in non-space sectors, such as this one.”

“It is incredible to see that the experience and technologies gained from analysing satellite images can help doctors to understand Alzheimer’s disease.” Using AlzTools, Deimos scientists work with raw data from a brain scan rather than satellite images. Instead of a field or a road in a satellite image, they look at brain areas like the hippocampus, where atrophy is associated with Alzheimer’s.

In both cases, notes Mr Fernández de la Peña, “You have a tonne of data you have to make sense of.”
Identifying alzheimer’s using space software

Ricardo Insausti Serrano, a medical doctor and researcher, worked with the computer scientists to help guide them through the workings of the brain: “I looked at images, and told them which part has which function.”

With his expertise, he could identify which information might be useful for a doctor looking for signs of Alzheimer’s disease. “For example, profound atrophy in the temporal lobe can be quantified. As long as you know where to look, you can make an approximation about how much volume has been lost.”

Right now, doctors analyse images of brains the old-fashioned way, with the naked eye. But only medical experts can do this, and it takes a long time.

The goal is to find easier and reliable means of screening for Alzheimer’s. “It’s like breast cancer and mammographies,” said Dr Insausti. “For the general population, this has been an enormous advance.”

Developing something like the AlzTools can lead to a cheaper, easier and more reliable means of screening for dementia in the population at large. “We want something that doesn’t require the latest equipment to give prognoses and early treatment,” noted Dr Insausti. “With ESA, you have all these technologies that let you look at Earth thanks to image analysis. You can look at the brain with the same kinds of analysis.”
The STFC Innovations Club, IOP Nuclear Physics Group, IOP Nuclear Industry Group and National Nuclear Laboratory are jointly hosting a knowledge exchange event with industry on current developments and potential applications of nuclear physics in the key areas of healthcare, security, energy and the environment.

This event is intended for:

• Industry interested in knowing more about current knowledge exchange and commercialisation opportunities from UK nuclear physics community
• Industry looking for academic partners for specific development projects
• STFC-funded researchers in nuclear physics wanting to get more involved in knowledge exchange and learn about good practice in this area, and the funding available
• STFC researchers from allied fields looking for partners in these areas.

UK nuclear physicists work at the forefront of detector technologies of high interest to UK industry including advanced gamma-ray tracking detectors, next generation scintillator detectors, ultra-fast photomultiplier tubes, highly-pixelated silicon and diamond detectors.

These technologies are already being deployed in a wide range of industrial and societal applications, including:

• Environment monitoring – oil and gas exploration
• Mobile X-ray and Gamma-ray cameras for analytical, medical and space applications
• Medical imaging including (SPECT)/ (PET) imaging
• Nuclear data for reactor cycles, decommissioning and the future fusion programme
• Homeland security.

The development and exploitation of these new technologies for the benefit of UK industry can only happen through close interaction between academics and industrial partners, leading to greater impact for the academic research.

This workshop will bring together academia and industry to increase knowledge exchange (KE) with a view to exploiting advances in nuclear physics.

The workshop will highlight funding opportunities to support KE relationships around nuclear physics R&D and industrial/societal applications as well as providing an opportunity to hear an update on the latest research. In addition there will be a poster session detailing industry-relevant work carried out by university research groups.

For more information contact:
Dr Vlad Skarda, STFC (vlad.skarda@stfc.ac.uk) or Dr David Jenkins (david.jenkins@york.ac.uk).

To register go to: https://eventbooking.stfc.ac.uk/news-events/nuclear-physics-technology-showcase
Technology designed to measure water vapour on Mars is poised for use in a whole host of everyday applications here on Earth from monitoring food production or industrial gas emissions, to surveying volcanic ash clouds and even giving a farmer a health check on their crops.

KEIT Ltd is a new spin out company from the Science and Technology Facilities Council (STFC) which grew from the need for an extremely compact but highly accurate spectrometer to measure gases in planetary atmospheres, that was also robust enough to withstand the harsh conditions in space.

Dr Hugh Mortimer, a research scientist at STFC’s RAL Space, and inventor of the technology said: “Mass is a real commodity on board space satellites, so we developed a very high performance spectrometer which was also extremely stable and compact. We quickly realised that there were also some very real non-space application opportunities for this, ranging from R&D, to food production, environmental monitoring and agriculture, just to name a few. It’s the unique simplicity and stability of the spectrometer that we’ve developed here at STFC that makes it so versatile and powerful. This technology could transform how spectrometers are used, where they can be used and who uses them.”

Unlike conventional spectrometers that are bulky and rely on a complex system of moving mirrors, this new generation of spectrometer is compact, lightweight, and has no moving parts, making it not only unique, but also extremely stable.

The versatility, stability and simplicity of a KEIT spectrometer means that it could sit on any food or pharmaceutical production line to check, for example, the fat content of milk, or the origin and quality of whisky.

Environmentally, the spectrometers could play a key role in monitoring gaseous emissions from industrial chimney stacks, helping industries adhere to environmental regulations. A KEIT spectrometer could also provide an invaluable analytical tool for any industrial or academic laboratory-based R&D facility.
KEIT spectrometers are so lightweight and compact they are especially suited for use on Unmanned Aerial Vehicles (UAVs), that can image and map the geology of the ground below and monitor the atmospheric gases surrounding large areas that might be inaccessible to man, such as ash clouds, volcanic eruptions or chemical spills. In agriculture, the KEIT spectrometer can monitor the colour variation within a farmer’s crop, to assess the health of the crop and so enable a more targeted and cost-effective use of resources such as pesticides and fertilisers.

Kate Ronayne, Head of Innovation at STFC said: “KEIT is a perfect example of how innovation derived from our most cutting edge technology programmes in Space can create growth and economic benefit through enterprise. I’m really excited about working with KEIT, as it grows its product portfolio to transform the way we measure and monitor materials across multiple industry sectors, ultimately improving our lives by increasing the yield of our land or by allowing us to affordably monitor environmental emissions.”

Longwall Ventures and the Rainbow Seed Fund have invested in the spin-out which will now take its patented technology forward towards full commercialisation. KEIT has also been awarded a prestigious place within the European Space Agency’s Business Incubation centre (ESA BIC Harwell). The incubation centre provides the ideal environment for such innovative, fledgling companies to translate space technologies and applications into viable businesses in non-space industries.

As a tenant at the ESA BIC, KEIT will benefit from an impressive support package, which includes more than £40,000 towards further technology development; easy access to both STFC and ESA technical expertise, and a dedicated business champion from STFC to help with business planning and guidance.
As we draw nearer to September 25th, we look forward to welcoming the Cryogenic Community to congregating once again at STFC Rutherford Appleton Laboratory for a mix of seminar and trade show with the option of lab visits.

Rutherford Appleton, on the Harwell Oxford campus, is at the heart of the extraordinary British Cryogenic Cluster. It is home to some exceptional heritage in cryogenic and superconducting magnet development and indeed, so much science involves low temperatures that cryogenic activity is embedded throughout the campus.

Cluster Day has been growing and gaining attention year on year, and this year’s programme is no exception, with talks from Cluster Members, from Scientists at the Lab, talks touching on Helium (whose supply is a matter of serious concern for those engaged in cryogenics).

We have always had attendees from overseas, and this year we may have new visitors from the USA. Keep a look out in the B Cryo newsletter or on this website for updated information on the programme - and do register to attend as early as you can to help us plan.

You can find out more about CCD3 and prior years’ events here.

CCD4 is free to attend for delegates. Prior registration is necessary for access and for us to plan the catering. A modest fee payable to STFC is charged for participation in the Trade Show.

The day starts with registration and coffee from 9.30 with the first speakers at 10.00. Lunch is provided, courtesy of the exhibitors, and the day finishes around 4.30. Parking is outside the laboratory*, with a 5 minute walk to reception-so attendees need to come prepared for weather on the day. Here are directions to the lab.

*Special parking arrangements are available for blue badge holders by prior arrangement.
New fluorescent fingerprint tag aims to increase IDs from ‘hidden’ fingerprints on bullets and knives

A new way of detecting and visualizing fingerprints from crime scenes using colour-changing fluorescent films could lead to higher confidence identifications from latent (hidden) fingerprints on knives, guns, bullet casings and other metal surfaces.

The technique is the result of a collaboration between the University of Leicester, the Institut Laue-Langevin and the STFC’s ISIS pulsed neutron and muon source, and will be presented today at the Royal Society of Chemistry’s Faraday Discussion in Durham.

Dr Max Skoda, Instrument Scientist at ISIS said: “The newest neutron reflection instruments, built at both ISIS and the ILL, provide high intensity beams that enable the real time study of changes in such complex systems for the first time. In order to unravel the intricate behaviour of these chemical reactions it was necessary to employ the specialist skills and facilities provided by all the institutes involved. This is a clear example of where investment in new world class scientific capability continues to provide tools for the UK academic community to perform world leading science.”

When your finger touches a surface, it leaves behind deposits of sweat and natural oils in a pattern that mirrors the ridges and troughs found on your fingertips. The odds of two individuals having identical fingerprints are 64 billion to 1, making them an ideal tool for identification in criminal investigations.

The greatest source of fingerprint forensic evidence comes from latent fingerprints, i.e. those not immediately visible to the eye, because they are less likely to be ‘wiped’. However, visualizing these prints with sufficient clarity for positive identification often proves difficult.

Despite the availability of several enhancement techniques, only 10% of fingerprints taken from crime scenes are of sufficient quality to be used in court.
New fluorescent fingerprint tag aims to increase IDs from ‘hidden’ fingerprints on bullets and knives

films, we can dramatically improve the accuracy of crime scene fingerprint forensics. From the images we have produced so far, we are achieving identification with high confidence using commonly accepted standards. This combination of optical absorption analysis with observation based on fluorescence is also opening up fingerprint analysis to a far wider set of samples, particularly those eroded by ageing or aggressive environments. The use of neutrons alongside spectroscopic techniques has been fundamental to understanding how this technique might work in practice and is evidence for what has been a truly collaborative partnership between these three institutions.”

The technique is highly sensitive as even tiny amounts of insulating residue, just a few nanometres thick, can prevent polymer deposition on the metal below. As a result, much less fingerprint residue is required than is typical for other techniques. Also, because it focuses on the gaps between the fingerprint deposits, it can be used in combination with existing (e.g. powder-based) approaches.

In their latest paper in Faraday Discussions the team, led by Professor Robert Hillman, have developed this technique further by incorporating within the film fluorophore molecules that re-emit light of a third colour when exposed to light or any other form of electromagnetic radiation such as ultra-violet rays. Their success in combining the electrochromic and fluorescence approaches provides a significantly wider palette to ‘colour’ their films and two sets of ‘levers’ in the form of electricity and light to control and tune this colouration in order to achieve the best possible contrast with the underlying metal surface.

The addition of these large fluorescent tagging molecules required a conducting film that could undergo post-deposition chemical changes. Neutron reflectivity measurements were used to follow and quantify the deposition and functionalisation of the film with the fluorophores. These measurements were performed on FIGARO and D17 at the Institut Laue-Langevin (Grenoble, France) and on INTER at ISIS (STFC Rutherford Appleton Laboratory in the UK).

Dr Rob Barker, Instrument Scientist at the Institut Laue-Langevin, said: “Neutrons are an ideal tool for understanding what is going on inside these complex systems. Whilst the mix of polymer and fluorescent molecules might look similar to x-rays and other surface-sensitive techniques, neutrons can easily distinguish between them. This allowed us to non-invasively probe on a nanometre scale deep into the sample from the top surface of the polymer to the metal below and follow the marker molecules as they entered the polymer film.”

The exact position and distribution of the fluorophores within the film is key. Professor Hillman and colleagues needed the molecules to penetrate the deposited polymer layer without reaching the underlying metal surface, where their fluorescence is diminished. Using isotopic methods, the team were able to use neutrons at ILL and ISIS to label the different parts of the system and observe the behaviour of each to find the ideal conditions (temperature, polymer concentrations, reaction time) for the introduction of the fluorophores.

Using the new technique on laboratory-sourced fingerprints, the team of researchers have already demonstrated an improved ability to make positive identifications due to better sample resolution. However the team are keen to stress these prints were taken under laboratory conditions. The next step is to apply it to fingerprints that have been exposed to more realistic scenarios, such as water, heat from a fire or cleaning agents.

Access to both the ILL and ISIS is provided to UK researchers by funding from the Science and Technology Facilities Council, STFC, which also operates the ISIS neutron source.
Scientists working to design advanced medicines that are perfectly targeted to control the body’s natural receptors have made a major discovery.

For the first time, they have been able to visualise and study the structure of CRF1, the protein receptor in the brain which controls our response to stress.

The level of detail required for this work could only be achieved using the intense synchrotron light produced at the STFC funded Diamond Light Source, the UK’s synchrotron science facility in Oxfordshire.

Heptares Therapeutics, an MRC spin out company, was responsible for identifying the 3D structure of the ‘stress’ receptor. This discovery will help scientists to develop improved treatments for depression and anxiety.

Furthermore, having identified the architecture of CRF1, scientists now have a template that can be used to accelerate research into other protein receptors that are known to be in the same ‘family’, including those that can be targeted to treat Type 2 diabetes and osteoporosis.

Read more about this story.

Left to right Kaspar Hollenstein (Heptares), Gwyndaf Evans (Diamond), Andy Dore (Heptares) and Fiona Marshall (Heptares) on life science beamline (I24) at Diamond where the structure of the ‘stress’ protein was solved. Copyright Diamond Light Source
The United Kingdom, Germany and France have (1st July 2013) signed an agreement extending the convention governing the Institut Laue-Langevin (ILL) neutron source for a further decade to 2023. This assures UK researchers continued access to the world’s most powerful neutron source, enabling both academics and industrialists to benefit from the advances it yields in materials science.

UK Minister for Universities and Science David Willetts said: “At the G8 science ministers meeting we discussed the importance of international research collaboration as a means of driving growth and innovation. The ILL neutron source is an excellent example of working with European partners and thanks to this agreement it will continue to support cutting edge research well into the future.”

The United Kingdom has been a member of the ILL since 1974. UK scientists from a broad range of disciplines have used its facilities since then, from health and medicine, to electronics, geology and nuclear physics. The ILL instruments complement those at the UK’s national neutron source, ISIS in Oxfordshire and the two facilities collaborate frequently.

Signing the convention for the UK, Hermione Gough, Counsellor at the British Embassy, Paris said “The ILL neutron source in Grenoble has proved to be a long and very successful scientific collaboration between France, Germany and the UK. The importance of the world class scientific facility and of the wider collaboration in cutting edge research is reflected in the UK’s decision to extend its commitment for a further 10 years.”

Professor John Womersley, CEO of the STFC which manages the UK membership of the ILL said “Neutron science enables scientific breakthroughs in areas like healthcare, where it helps us understand how ozone gas can damage human lungs, and in physics, where it’s helped us design new superconductors; it is also essential for industrial R&D, for example in stress testing engineering components, and designing chemical catalysts to reduce energy use and limit waste products. The ILL is an essential facility for UK scientists to have access to and there’s great demand for its capabilities, so I am delighted that we will be continuing our partnership. Big science facilities like ILL also offer a great training ground for scientists and technicians, so we will be offering five apprenticeships at ILL during the next year.”

The original ILL Convention was signed between France and Germany in 1967. The Convention details how the facility shall be funded governed and decommissioned. The UK joined in 1974. The Science and Technology Facilities Council is the shareholder in ILL on behalf of the UK. The Convention has been extended by a series of protocols and the current 4th protocol runs until 31 December 2013. This 5th protocol extends the ILL Convention until 31 December 2023.

1st July, Ministry of Research, Paris. From left to right Prof. Andrew Harrison, ILL Director, Hermione Gough, a Ministerial Counsellor at the British Embassy in France, Mrs Geneviève Fioraso, the French Minister for Higher Education and Research and Peter Reuss, Director of Economic Affairs at the German Embassy in France. Credit: ILL/M. Walter
As the Ashes series gets underway, a pair of brothers from Australia have been exploring the physics behind the spin of a cricket ball.

While physicists are much more accustomed to measuring the spin of electrons, protons and neutrons, Garry and Ian Robinson, Honorary Visiting Fellows at the University of New South Wales and the University of Melbourne respectively, have presented equations that govern the trajectory of a spinning ball as it moves through the air in the presence of a wind.

Their paper was published on 5 July, in *Physica Scripta* - a journal published by IOP Publishing on behalf of the Royal Swedish Academy of Sciences for the Science Academies and the Physical Societies of the Nordic Countries.

If the English and Australian cricketers are looking to take advantage of their results then they will be hoping that the unpredictable British weather brings plenty of wind throughout the five-game series, as the researchers have calculated that it can have a profound effect on the movement through the air of a spin-bowler’s delivery.

According to the research, the presence of a cross-wind from either side of the cricket pitch can cause the spinning ball to either slightly ‘hold up’ or ‘dip’, depending on which direction the wind comes from and which way the ball is spinning. This therefore changes the point at which the ball pitches on the wicket.

Garry Robinson said: “Our results show that the effects on a spinning ball are not purely due to the wind holding the ball up, since a reversal of wind direction can cause the ball to dip instead. These trajectory changes are due to the combination of the wind and the spin of the ball. The effects of spin in the presence of a cross-wind, and how to fully exploit it, may or may not be completely appreciated by spin bowlers. Either way, we have provided a mathematical model for the situation, although the model of course awaits detailed comparison with observations.”
As an example, the researchers show that when a 14 km/h cross-wind interacts with the spinning ball, the point at which it hits the ground can change by around 14 cm, which they believe may be enough to deceive a batsman.

The equations take into account the speed of the ball, gravity, the drag force caused by air resistance, and the Magnus or ‘lift’ force, while at the same time incorporating the important effect of wind.

The Magnus force is a commonly observed effect, particularly in ball sports, when the spin of a ball causes it to curve away from its set path. This is observed in football when players purposely put spin on the ball to make it bend around a defensive wall.

Once the equations were constructed, they were numerically solved using a computer software program called MATLAB; the solutions were then used to create illustrative examples for cricket.

The researchers also show that a spinning cricket ball tends to ‘drift’ in the latter stages of its flight as it descends, moving further to the off-side for an off-spinning delivery and moving further towards the leg-side for a leg-spinning delivery, effects which are well-known and regularly utilised by spin-bowlers.

“We hope that this work can be used to cast new light on the motion of a spinning spherical object, particularly as applied to cricket, whilst also stirring the interests of students studying differential equations,” Garry continued.

This paper can be downloaded from http://iopscience.iop.org/1402-4896/88/1/018101
External Innovations Team 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.

Innovations club: innovationsclub@stfc.ac.uk
IPS: ipsfunding@stfc.ac.uk
For Tender Opportunities: tenderopportunities@stfc.ac.uk

External Innovations and International Tender Opportunities

Penny Woodman Head of External Innovations
Tel: + 44 (0)1793 442 014 Email: penny.woodman@stfc.ac.uk

Phillip Tait External Innovations Programme Manager
Tel: + 44 (0)1793 442 111 Email: phillip.tait@stfc.ac.uk

Julie Bellingham Head of Business Opportunities for International Facilities
Tel: +44 (0)1793 442 060 Email: julie.bellingham@stfc.ac.uk

Allanah Bayliss International Business Opportunities Intern
Tel: +44 (0)1793 442 056 Email: allanah.bayliss@stfc.ac.uk

Vlad Skarda Knowledge Exchange Manager
Tel: + 44 (0)1793 442 051 Email: vlad.skarda@stfc.ac.uk

Administration

Andi Kidd Office Manager
Tel: +44 (0)1793 442 059 Email: andi.kidd@stfc.ac.uk

Julie Gilbert Administrative Officer
Tel: +44 (0)1793 444 532 Email: julie.gilbert@stfc.ac.uk

Kim Mugford Administrative Officer
Tel: +44 (0)1793 442 650 Email: kim.mugford@stfc.ac.uk

Rachel Atkins Administrative Officer (from 1st October 2013)
Tel: +44 (0)1793 442 650 Email: rachel.atkins@stfc.ac.uk

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