The newspaper of the physics community

# interactions

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IOP Institute of Physics

# Climate science stirs up a storm

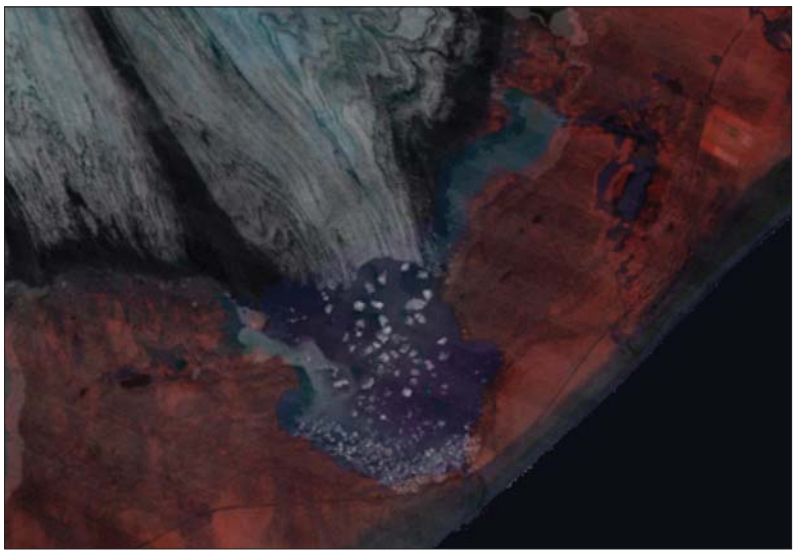
*Heather Pinnell* reports on a heated debate about global warming, hosted by the Institute.

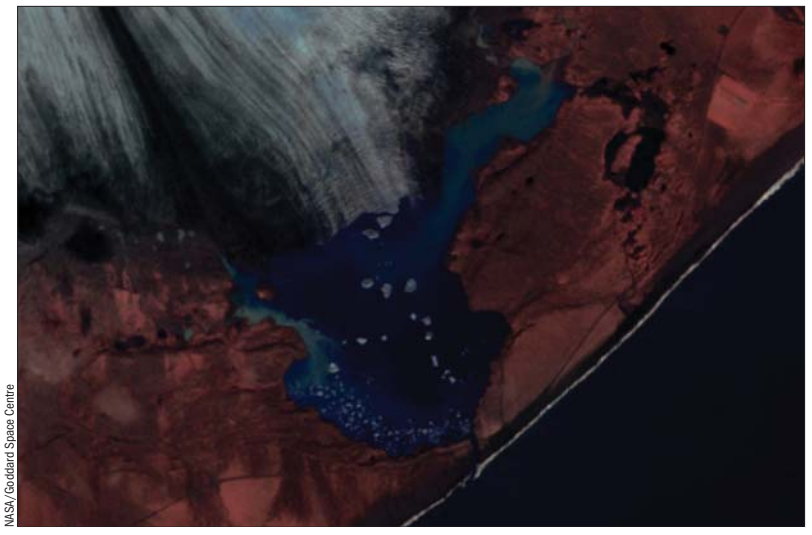
In the same week that the G8 leaders were discussing climate change and agreeing to talk about cutting $CO_2$ emissions, a large audience packed into the Institute's London centre to hear expert opinion and discussion on the models used to understand climate change. On 7 June, MP and former environment minister Michael Meacher chaired a seminar with prominent speakers from both sides of the climate change debate, while a week later there was standing-room only when Prof. Jonathan Gregory, one of the lead authors of the Intergovernmental Panel on Climate Change (IPCC) report, presented evidence on global warming.

Opening the first seminar, Meacher said that 10 years ago the issue was hardly on the radar screen; now there were almost daily reports about climate change, including runaway melting of the arctic sea ice, massive methane releases in Siberia and Alaska and dramatic hurricanes. It had been suggested that global warming could create 50 million environmental refugees, while the Pentagon considers climate change to be a greater risk than global terrorism, he said. "The argument is that increasing $CO_2$ levels are responsible for rising global temperatures. The question is whether that is correct."

Though there is an almost universal consensus that the world is warming up, some scientists still question whether $CO_2$ emissions are causing the change. Prof. Richard Lindzen, an atmospheric scientist from the Massachusetts Institute of Technology, is one of them. Addressing the seminar, he discussed the main areas of controversy, which concern the uncertainties in the data, the effect of both negative and positive feedbacks and the sensitivity of the climate to rising $CO_2$ levels. He went further, however, arguing that the models are fundamentally wrong and do not take sufficient account of the warming in the tropical troposphere rather than at the surface. Based on this, he said, no more than about a third of the Earth's surface warming could be due to the greenhouse effect.

It was claimed, he said, that doubling $CO_2$ should lead to about 1.5 C to 4.5 C warming. However, we were already 86% of the way to a doubling of $CO_2$ levels but have seen only 0.6–0.8 C warming at the surface, he argued. He did not believe that aerosols, such as sulphate pollutants in the atmosphere, had counteracted much of the warming and said that suggestions that there was a long time delay as the effect of warming in the oceans had not yet been felt globally were exaggerated.





NASA/Goddard Space Centre

**Iceland's Breidamerkurjokull glacier in 1997 (top) and 2000 (bottom).**

**"Ten years ago the issue was hardly on the radar screen; now there are daily reports about climate change."**

Lindzen said that each chain in the argument for human-induced global warming was tenuous, leading to an infinitesimally small chance that it was the correct model. Like believers in intelligent design, he said, those who believed in it did so because they could discover no alternative explanation. "When politics enters the picture, science takes a back seat, even among scientists," he said.

Prof. Alan Thorpe, a distinguished meteorologist and chief executive of the Natural Environment Research Council, presented substantial evidence to support the opposing view. He agreed that there were significant uncertainties in certain aspects of the models, particularly the effects of clouds, but there was no reason to suppose that the models had a systematic bias towards human-induced global warming, he said.

He described the close correlation between rising $CO_2$ levels and global temperatures over the last 100 years. Scientists had created "hindcasts" to represent the climate during the 20th century as it should have been according to the models, and compared these with actual observations. These showed that the models simulated reality very well, he said. Similarly, predictions had been made since 1990 using the models and these had predicted the state of the climate during the last 17 years very well, but if anything had underestimated the degree of warming.

A panel discussion followed, with Lindzen and Thorpe joined on the panel by astrophysicist Piers Corbyn and Prof. Chris Rapley, director of the British Antarctic Survey. Lindzen was challenged on his statement that the effects of aerosols were "virtually unknown". Keith Shine, from Reading University's meteorology department, said: "To claim this now in 2007 virtually beggars belief. There have been dozens of field campaigns as well as collection of satellite data. There's a very large body of evidence that aerosols reflect heat back to space and contribute to cooling." Lindzen maintained, however, that their global impact was unknown.

In a meeting organised jointly by the Institute's Environmental Physics Group and its London and South-East Branch, an audience of more than 170 people again packed into the Institute on 13 June. They had come to hear Prof. Gregory lecture on the considerable evidence for human-induced global warming, for which the IPCC had said there was a 90% probability. The IPCC did not conduct new research but assessed the existing literature, he explained.

Despite some limitations, the climate models were reliable, he said. There was thermal inertia in the system because it took a long time for the oceans to heat up, so there was a predicted temperature rise that would lag decades behind the corresponding rise in $CO_2$ levels. Ice core evidence showed that the atmosphere had been little changed for the last 10 000 years, then since about 1750 the levels of $CO_2$ shot up and we could be confident that this came from fossil fuel burning and deforestation.

He also presented evidence of sea-level rise, more severe and longer droughts in the last 30 years and rapid thinning of the arctic ice sheet, as well as glacial retreat. Asked by *Interactions* to comment on Lindzen's arguments, Gregory said that his views stood out as exceptional within the scientific community. "The scientific literature is overwhelmingly saying that $CO_2$ is causing climactic warming," he said.

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"I found a section on black holes, which I decided to read because it looked scary."
**Haley Gomez, p5**

"A scientist appears, to congratulate them or to tell them where they went wrong."
**Heather Pinnell, p8**

## HIGHLIGHTS

### Physics buskers take experiments far afield

A team of physics "buskers" from the Institute performed tricks to engage visitors at the East of England County Show on 15–17 June. Their demonstrations included making balloon kebabs and launching Alka Seltzer rockets during the event in Peterborough. The aim was to take physics to people who would not actively seek it out, according to the Institute's physics in society manager, Caitlin Watson. The activity attracted a lot of attention at the show from both adults and children, and people were shown how they could perform the same tricks in front of family and friends. The event was the first in a number of Physics in the Field demonstrations – the team is set to perform at the Bradford Mela (7–8 July), the Highland Games in Inverness (21–22 July) and the Green Man Festival in the Brecon Beacons, Wales (17–19 August) .

### Physicists focus on climate change in Scotland

Climate change and pollution were key topics in a day of talks about environmental science held at Discovery Point, Dundee, on 2 June. The day, which was organised by the Institute of Physics in Scotland, also included an exhibition about Antarctica and the opportunity to visit Captain Scott's ship *Discovery*. Physicists who attended were especially interested in the experiments of *Discovery's* physicist, Louis Bernacchi, whose work included magnetic measurements, auroral observations and seismic recordings. Among the talks was one on "Fossil fuels, global warming and the threat to our way of life". Mhairi Coyle of the Centre for Ecology and Hydrology, spoke on "Tropospheric ozone – pollutant and greenhouse gas", and Alex Cunningham of Strathclyde University outlined his work in monitoring and modelling algal blooms. Paul Williams of the Institute's Environmental Physics Group discussed the possible effects of the Gulf Stream slowing down.

### Blue plaque commemorates renowned pioneer

IET Archives

The outstanding physicist Hertha Ayrton, who was a pioneering figure among women in physics, has been commemorated with an English Heritage blue plaque. The plaque will mark her home at 41 Norfolk Square in London W2, where she lived for 20 years and worked in a laboratory on the first floor. Ayrton (1854–1923) read mathematics at Cambridge but later became interested in electricity. While working at her laboratory in Norfolk Square she invented the Ayrton fan, a hand-operated device for dispersing poisonous gases which was said to have saved more than 100 000 lives during the First World War. The fan was based on her earlier research into the effects of currents and vortices in water on the formation of sand ripples. Ayrton, who has a room named after her at the Institute's conference centre in London, was a supporter of women's rights and cared for some of the suffragette hunger-strikers at her Norfolk Square home.

### Superconductors could power electric aircraft

Aircraft could be propelled by electric motors using superconducting magnets that would consume no fossil fuels during flight, according to a paper just published in the Institute's journal *Superconductor Science and Technology*. Philippe Mason and Cesar Luongo of Florida State University, collaborating with Gerald Brown of NASA and Danielle Soban of Georgia Institute of Technology, are now looking for an industrial partner to build a prototype of their superconducting "turbofan". An electric motor using conventional magnets can weigh up to five times as much as a jet engine and is less fuel-efficient. Because superconductors lose no energy through electrical resistance, a superconducting motor can generate three times the torque of a conventional electric motor for the same energy input and weight, the authors explain. The team believes that they can cool the magnets enough for them to become superconducting by using liquid nitrogen to run an electric fuel cell, which produces no carbon emissions. Liquid hydrogen has four times as much energy weight for weight as aviation fuel and could be produced from a solar or wind-powered plant.

# Nanoscience looks to the future

Nanoscience could provide huge benefits to society but further research is needed into any problems that could arise from the use of nanoparticles, according to a report published jointly by the Institute and the Royal Society of Chemistry, *The Future for Nanoscience and Nanotechnology*. It explains some of the ways in which nanoscience is leading to new materials and technologies and its potential applications.

The booklet says that nanotechnology is likely to affect every industry eventually and it is predicted that products made using nanotechnological processes will account for 15% of global manufacturing output by 2014. Currently they account for just 0.1%.

The report explains that matter made from nano-sized particles or films can behave very differently from the same constituents in a bulk material because of their much larger surface-area-to-volume ratio. This leads to increased chemical reactivity which means nanoparticles can make good catalysts. The emergence of quantum effects at the nanoscale means nanomaterials can be used as the basis for quantum dots, with applications in data-reading devices and potentially as the elements of quantum computers.

It is inevitable that developments in technology will tend towards increasing miniaturisation, the report says. This will probably involve integration of chemical and biologically-based processes at the quantum level. Looking into the future, it says sections of DNA could be used as the building blocks of nanomachines to diagnose and treat disease, or as the read-out elements of a DNA computer. Researchers are already integrating enzymes with metal and organic nanostructures to build devices to act as biomedical motors.

The booklet says that governments around the world should work with industry and the research communities to establish global protocols for testing the safety of nanotechnological products. Nanoparticles are highly reactive and may be able to traverse cell membranes, it notes, although no clinical toxicity has been reported in humans. There is a need for further research into these possible effects and into how nanoparticles could spread in the atmosphere and accumulate in the environment, it concludes.

For additional information, e-mail heandresearch@iop.org.

## APPEALING TO GIRLS

**A DVD on engaging girls in physics, commissioned by the Institute, was short-listed for a prize in the Royal Television Society (RTS) awards this year. *Saving Nellie, a* drama featuring actors including Helen Baxendale and James Fleet (pictured) was produced for physics teachers and has been sent out to all secondary schools in the UK where there are female students. It has also been shown on Teachers TV . The DVD was one of just three short-listed in the teaching category of the RTS awards, in which the winning entry was also about physics. Winners of the RTS education awards, presented at the Savoy Hotel in London on 11 June, included mainstream television documentaries. The Institute's education manager (schools and colleges) Daniel Sandford Smith said: "We believe that producing the video has helped to contribute to an environment in which more people are taking the issue of the under-representation of girls in studying physics seriously."**

# MODEL project is inspirational

A new resource to help teachers to provide stimulating physics experiments for 14–16-year-olds has had a favourable reception from teaching staff who have given feedback on it. *The MODEL Project: Practical Physics at Work* was produced by the Institute and sent out free to all its affiliated schools throughout the UK and Ireland in May.

MODEL provides ideas for practical physics activities, student instructions and worksheets, and guidance for teachers and technicians. The practical activities are supported by video sequences showing how some people use physics in their jobs.

The package sent out to schools included an evaluation sheet for teachers to give their comments about the resource. Currently, all responses received have been positive, with 26 rating MODEL as "excellent" and 12 rating it as "good". One teacher commented: "Very good experiments, novel ideas. Particularly looking forward to trying SMART wire and thermosheet experiments.

One issue that emerged was that not all teachers had found the Word versions of the worksheets that are available on the DVD. Several commented that they found the resource excellent but lacked the time to evaluate it fully as there was so much material.

Asked what the barriers were to carrying out practical work in their school, several mentioned lack of time, finances and equipment, and some lacked technician support.

The Institute's education manager (schools and colleges), Daniel Sandford Smith, commented: "The Institute believes that practical work plays a very significant role in enthusing students about physics and so is very pleased by the positive response to MODEL. We did the evaluation partly to check that the resources met teachers' needs but also to collect some ideas about what further resources we might produce and what more we could do to support teachers in carrying out practical work, so we will be lobbying the government to provide more support for practical work."

The Institute is planning to produce further resources to support the teaching of radioactivity and material on the role of phyics in the environment, working with the environmental physics group.

There is still time to respond to the evaluation by returning the printed sheet or e-mailing education@iop.org.

# Project Juno to tackle gender inequality in universities

*Heather Pinnell* reports on the launch of an initiative to support women in physics.

Photoshot Assignment

**Dame Jocelyn Bell Burnell helps to launch the new code of practice.**

An initiative to make university physics departments a better environment for women to advance their careers was launched in June by the Institute. Called Project Juno, it aims to sign up university departments to commit to a code of practice and to implement policies that will make them more welcoming, open and inclusive places.

Speaking at the launch event, Dame Jocelyn Bell Burnell, who has long been active on behalf of women in physics, said women in university departments were "the canaries in the coal mine". She said: "If women are not surviving and thriving, it may mean that there's an issue about the health of your department and if you address it, it will benefit the whole department, both men and women."

Project Juno was born in response to an international review of UK physics and astronomy research that expressed concerns about the shortage of female academics, she said. The code was based on good practice identified during the Institute's site visits to universities in 2003–2005, which Bell had helped to set up. While 20% of physics graduates are women, less than 5% of physics professors are female, and the figures are changing only very slowly, she said.

"There remain issues around work-life balance. There's still some harassment, I regret to say, and it's not always well dealt with. I think there is very little malicious discrimination but rather a lot of naïve discrimination and diminution of women. A lot of departments operate with a male ethos and women have tried to fit in, while those who don't like it have departed and even those who fit in progress more slowly."

The code of practice includes a commitment to monitor the gender balance in admissions, recruitment and promotion of staff. It will be necessary for universities to collect such data to fulfil their duty to promote gender equality under legislation which came into force in April, she said. "We're going to have to do it, so we might as well get on with it."

Prof. Christine Davies, a theoretical physicist who leads the Particle Physics Theory Team at Glasgow University, described how the department was trying to become more welcoming to women and had seen an improvement in female representation. It was resisting a long-hours culture, encouraging a reflective approach to research and had transparent procedures for allocating work and giving recognition for all work carried out on behalf of the departmnet, including outreach activities.

Prof. Davies said she would certainly encourage her department to sign up to be a Project Juno Supporter, which involves endorsing the five principles of the code, and to aim to be a Project Juno Champion, which means being judged to have met the five principles.

The code includes a commitment to having a structure in place to deliver equality of opportunity, which encourages men and women to apply for posts; and promotes career progression for all staff. Those who sign up to it will also be committed to flexible working arrangements and an inclusive, transparent and open structure. The Institute's director of education and science, Peter Main, said it was hoped that the project would spread to the other sciences and the Institute was having informal talks with the Science Council about how the experience gained in Project Juno could be shared.

The event attracted a large audience from the universities, the learned societies and others, who exchanged experiences and raised issues about diversity during a question and answer session. Some were concerned that Project Juno would cover the same ground as the Athena Swan Charter, which accredits university departments that promote gender equality in all the sciences. It was explained, however, that the two schemes will be dovetailed and one can be a stepping stone to the other.

The Institute's current president, Peter Saraga, described how Phillips Research Laboratories, where he had been director, had been a male-dominated environment. "It had been difficult to attract women to work there and to be honest, I don't think we understood why," he said.

Its culture was then transformed by a "critical mass" of women, bringing changes such as more flexible working hours. "There's a school of thought that says if fewer women than men seem to want to do physics we should just accept this. For me there are fundamental reasons why we should care," he said.

## *Kaye and Laby* goes online

The publication *Kaye and Laby*, which has been an essential table of physical and chemical constants for scientists since it was first published in 1911, has been made available online with help from the Institute.

The National Physical Laboratory (NPL) is providing free access to the entire contents of the 16th edition, which was published in 1995, including data, formulae, charts and graphs.

The NPL intends to regularly review and update the contents to reflect developments in physics and chemistry. GWC Kaye was superintendent of the NPL's physics department in the 1930s.

# Honours given to physicists

A number of members of the Institute have received awards in the Queen's Birthday Honours announced in June. Jocelyn Bell Burnell, visiting professor of astrophysics at Oxford University, has been made a dame. She was awarded the honour for services to science.

Bell Burnell discovered the first radio pulsars with her thesis adviser Anthony Hewish, at Cambridge.

She later became professor of physics at the Open University, a visiting professor at Princeton University in the USA and dean of science at the University of Bath. Bell Burnell has won several prestigious medals and prizes and is a fellow of the Royal Society. She has also been president of the Royal Astronomical Society.

Prof. David Melville, vice-chancellor of Kent University and a former physicist, has been knighted for services to further and higher education Heather Couper, a prominent broadcaster and astronomer and a Millennium Commissioner, has been awarded the CBE for services to science. The CBE was also given to former physicist Geoffrey Copland, who is vice-chancellor of the University of Westminster, for services to higher education.

The OBE was awarded to Nigel Mason, professor of physics at the Open University, for services to science, and to Prof. Rodney Kimber, director of science and engineering at the Transport Research Foundation, for services to road transport.

The MBE was awarded to Ann Marks, a physics education consultant and former chair of the Institute's Women in Physics Group, for services to physics. An MBE also went to Prof. Mark Bailey, director of the Armagh Observatory in Northern Ireland, for services to astronomy, and to Thomas Balanowski, teacher and winner of a Teaching Award from the Institute, for services to education in West Lothian.

## NEWSMAKERS

**Mark Lewney** has been chosen to give the Schools Lecture for the Institute in 2008. The lecture for secondary school students will be delivered at various schools and colleges around the country during the year. Mark's previous lectures, which have been on rock guitar and strings in 11 dimensions, have already been popular with Institute members, and it is expected that string theory will also feature in his Schools Lecture. More details about the forthcoming lectures will appear in a future issue of *Interactions*.

**Prof. Jim Al-Khalili**, a leading expert in nuclear reaction theory at the University of Surrey, has been awarded the Royal Society's prestigious Michael Faraday Prize for his outstanding achievements in science communication. Al-Khalili, who is an enthusiastic writer and broadcaster on science, was profiled in March *Interactions*.

**Prof. David Delpy** has been appointed chief executive and deputy chair of the Engineering and Physical Sciences Research Council, succeeding Prof. John O'Reilly on 1 September. He is currently vice-provost for research at University College London.

**Sir Martin Rees**, the astronomer royal and president of the Royal Society, has been appointed by the Queen to the Order of Merit. The award is a distinguished honour and is in the personal gift of the Queen. Sir Tim Berners-Lee, inventor of the World Wide Web, has also been appointed to the Order of Merit.

**Sir David King**, the government's chief scientific adviser, is to be the president of the British Association for the Advancement of Science for 2008. He will be taking up the presidency after he steps down as chief scientific adviser at the end of 2007 and will succeed Lord Browne of Madingley in the role.

**Stefan Hell** has been awarded this year's Julius Springer Prize for Applied Physics. The Göttingen-based researcher has been given the prize for his discovery that resolutions far below the diffraction limit can be achieved in a fluorescence microscope using conventionally focused light. He has been a researcher at the Max Planck Institute for Biophysical Chemistry in Göttingen since 1997.

**John Hemmingway**, a retired physicist who chairs the Institute's Yorkshire Branch, has been named UK Graduate Volunteer of the Year by Manchester University.

# ARM looks at need for university places

The number and spread of university physics departments, and recruitment and retention of Institute members, were high on the agenda at the Institute's annual representatives' meeting (ARM) in May. Branch, group and division officers who attended took part in small group discussions to consider the questions "what physics departments do we need?" and "how can the Institute recruit and retain more members?"

Among the views expressed in the discussion were that the Institute has an important role in preventing any future closures of UK and Eire physics departments. Members believed that irrespective of the size and nature of departments, regional spread is important for the diversity of the subject, and to ensure that schools and business have access to physics departments in their regions, as more students are living at home and will not travel too far to study.

In discussion, members emphasised that the quality of education is important, regardless of how it is delivered. However, it is imperative that undergraduates are taught by academics who are active in research, so that they are exposed to the latest developments and are best prepared for a career in research or industry, it was argued.

The Scottish Universities Physics Alliance (SUPA) was cited as an excellent model of pooling research expertise that could be applied to regions in England. However, members noted that SUPA was a bottom-up proposal which is thriving because Scottish university physics departments want to make it succeed.

In the discussion on membership the focus was on promoting existing services better, particularly *Physics World* and the status conferred by membership and the designation of chartered physicist. Ideas for new services included more accessible articles in *Physics World*, with more on physics applications; more collaboration to provide shared services with other bodies; extending chartered physicist status to include applicants in general management; and providing courses relevant to general managers such as corporate governance.

The Institute's president, Peter Saraga, highlighted significant success across all areas of activity over the past year. The treasurer, Tony Scott, gave a review of the Institute's finances. This showed that the Institute was generating more income and spending more on physics and on members than ever before.

Members raised points about the format of the ARM and the process for publicising vacancies on Council and nominations which will be considered by Council at its July meeting.

# Condensed matter illuminated

Groundbreaking research being carried out in condensed matter physics is highlighted in a new booklet soon to be published jointly by the Institute and the Engineering and Physical Sciences Research Council. *Physics for Future Technology: Condensed Matter* focuses on reserach which can be exploited commercially.

The booklet describes the areas covered by condensed matter physics and explains its importance in applications ranging from medical devices to computers and DVDs. It looks at six examples of cutting-edge research in the UK, detailing the work of particular research teams in universities, national research laboratories and industry.

A section on soft matter explains how theorists and experimentalists are investigating the behaviour of polymer chains during flow, the formation of glasses from colloids and how new types of glassy colloids could be exploited commercially.

Another section, on nanoparticles in medicine, describes how David Russell at the University of East Anglia has been exploiting the change in colour of gold nanoparticles when they cluster to develop a test for the presence of bacterial toxins. It also looks at biomedical sensors based on Raman scattering from silver nanoparticles, which can be used to detect DNA sequences.

The booklet explains the fundamental science behind the development of quantum dots and describes how they could provide more robust, less temperature-sensitive and cheaper alternatives to quantum-well lasers, with huge potential advantages in optical communications.

The report also describes how a team led by Andrew Shields at Toshiba Research Europe Ltd, collaborating with Cambridge University and Imperial College London, have demonstrated single-photon quantum cryptography.

The new possibilities opened up by the discovery of graphene and carbon nanotubes are explored in the report, including spintronics, ultra-fast transistors and gas sensors. It describes how Mark Ellerby, Tom Weller and Neal Skipper at University College London made two new compounds of graphite .

The report explains why there may be fundamental limits to what can be achieved in computer power using conventional semiconductors and examines some of the alternatives, such as computers based on spintronics, carbon nanotubes, or quantum dots.

For further information, e-mail heandresearch@iop.org.

# Scottish economy gains from physics

**By Heather Pinnell**

Around 102 000 jobs in Scotland are in physics-based sectors, according to a report commissioned by the Institute from the Centre for Economics and Business Research (Cebr).

The report, *Physics in the Scottish Economy*, also showed that the gross value added by Scotland's physics-based sectors accounted for 9.5% of national output – a much greater percentage share than that for UK physics-based sectors in the UK economy as a whole.

The Cebr report defined physics-based sectors as those where the work could not be carried out without the use of technologies based on physics.

The definition used by Cebr encompassed the use of modern technologies such as lasers, but not, for example, the most basic mechanics. Staff who worked in the sectors but did not use physics-based technologies were included in the figures, but these were adjusted to exclude the distorting effects of huge numbers of employees in some sectors, such as soldiers who relied on the products of the defence industry, or teachers not teaching physics in the education sector.

The physics-based sectors accounted for 4.3% of all jobs in Scotland in 2005. The largest share of these (47%) were in manufacturing; 15% in telecommunications; and 9% in oil and gas. About 10% of all UK jobs in physics-based sectors were in Scotland. There has been a slight decline in the number of jobs in physics-based sectors in Scotland since 2001, mirroring a similar UK trend.

In 2005, physics-based sectors in Scotland contributed £8 bn in gross value-added to the economy. This is a measure of the difference between the value of goods and services produced and the cost of inputs.

Gross value-added rose rapidly in the four years to 2005, due to the fall in raw materials costs, technological advances driving down the price of machinery and equipment, and lower wage costs resulting from a more capital-intensive approach.

Productivity levels in physics-based sectors in Scotland and the UK were similar in 2005, but the levels in Scotland were much more variable than the UK as a whole during the period 2001–2005 .

# Physicist takes Famelab prize

A physicist has won NESTA Famelab, a national competition to find the best science communicators among people working in science in the UK. Famelab, now in its third year, is sponsored by the National Endowment for Science, Technology and the Arts (NESTA), Pfizer, and Research Councils UK. The winner was Nicholas Harrigan (pictured), a 25-year-old postgraduate student in quantum information at Imperial College, London, who impressed the judges with his presentation on the science of microwaves.

The judging took place after a live final in front of an audience at the Cheltenham Science Festival on 9 June. Each finalist had to give a five-minute performance on stage to explain a scientific concept in a way that would engage a broad audience. The seven finalists had all won their regional heats to gain their opportunity at Cheltenham.

Harrigan wore a chef's outfit on stage to explain how microwaves make the water molecules in food move around, generating heat. As part of his brief show, he made a bulb light up in a microwave oven, which went down well with the audience, who voted him the best performer in a paper ballot of more than 250 people held in addition to the main competition.

The judges were Kathy Sykes and Mark Lythgoe, both co-directors of the Cheltenham Science Festival; Roger Highfield, science editor of the *Daily Telegraph*; and Louisa Bolch, commissioning editor for science at Channel 4. Sykes, who is also a NESTA trustee, said the judges thought Harrigan had been brave to use props and demonstrations, which can easily go wrong. He had huge potential and was prepared to take risks, she said.

In his acceptance speech, Harrigan said: "I like sharing things that make me go 'wow, that's cool'. There are so many everyday things that you can find in the house that are awesome."

He wins £2000, a master-class in science communication, a tour of international events and a two-week internship with Channel 4. The runners-up were Jan Schnupp, a researcher in neurobiology at Oxford University, and Marieke Navin, a 28-year-old physics PhD student at Sheffield University who gave a presentation on atoms and the large hadron collider.

Navin also won a prize for her podcast which was on Channel 4's Famelab website. Visitors to the site at www.channel4.co.uk/famelab were invited to vote for the best 99-second podcast and Navin topped the poll.

# profile: Haley Gomez

# How stars are made

*Sharon Ann Holgate* talks to a fledgling astrophysicist who's truly down to earth.

Nick Trehame

**Haley Gomez enjoys both research into and teaching about the cosmos.**

It's not often that a bit of dust sparks off an international debate but, when astrophysics lecturer Haley Gomez published her PhD research, that's what happened. "A lot of people believe that cosmic dust is formed in supernovae but no one had actually seen it, apart from a small amount with a temperature of 100 K. I was part of a team that found, using a submillimetre camera sensitive to dust of about 30 K, the first observational proof that a supernova can form as much as a solar mass of cosmic dust.

"Because submillimetre astronomy is relatively new, this result caused a lot of controversy," says Gomez, who won the Royal Astronomical Society Michael Penston Astronomy Prize for best doctoral thesis in 2005. Her PhD work, conducted in 2001–2004 at Cardiff University, also won her the departmental Bessie Jones Prize for Outstanding Postgraduate of the Year in 2004 and led to a shortlisting for the 2005 Times Higher Young Researcher of the Year Award. She continues to work in this field and is trying to determine if the dust observed in the Cassiopeia A supernova remnant comes entirely from the remnant or from something between it and the Earth.

Her fascination with the universe began when she was nine. "My parents had a *Reader's Digest Encyclopaedia* and I found a section on black holes, which I decided to read because it looked scary. The idea that there's something in space incredibly strange that scientists didn't understand really got me hooked," she recalls.

Despite an increasing desire to understand the universe, partly fuelled by reading Stephen Hawking's *A Brief History of Time* and opting for physics, chemistry and maths at A-level, Gomez found herself wondering whether university was the right choice. "No one in my family had been to university so they couldn't really advise me, but my A-level maths teacher Mr Griffiths was really supportive and told me I could do anything if I was interested in it enough. He lent me a book about time travel, *Masters of Time*, which featured the first female astronomer I'd ever read about, and I started thinking: 'actually maybe I could do that'."

Having decided to apply for astrophysics at Cardiff, Gomez had to deal with disappointing A-level results. "I'd been predicted to get three As but I got a C and two Ds. Luckily, Cardiff accepted me on the strength of my interview. Many of the lecturers were so supportive academically and I ended up with a first, but only because I'd been given a chance." She snapped up a PhD place at Cardiff and has stayed there, first as a research fellow, then from 2005 as a fixed-term lecturer.

"Having a history like mine means that I find it really important now I'm lecturing to get to know my students as individuals. They respond to that and work harder for it," she says. Gomez is equally keen for her students to feel comfortable approaching her with questions, so starts her lecture courses by making it clear that she doesn't know everything about astronomy. "As lecturers we have a responsibility to bring out the best in every student, and students who are not high-flyers deserve to be given the confidence to ask for more help."

As part of the EU Hands-On Universe network she's helping to train specialist astronomy teachers who can pass this training on to colleagues "Astronomy is becoming more important at A-level and GCSE, but a lot of physics teachers haven't studied it," Gomez explains. She became involved through her work with the Faulkes Telescope project.

Schools can book time on either of the two research-sized telescopes run by the Faulkes project, and control the telescopes' movements via web-based software. Gomez helps teachers to use the software and has written support material for the children. "The Faulkes project is an amazing way to get astronomy into the classroom. Children can use the telescopes to see things like the moons of Jupiter and get pictures of galaxies. Learning how to make astronomical images look good involves art and IT as well as astronomy."

**"I ended up getting a first, but only because I'd been given a chance."**

Gomez regularly visits schools to talk about being an astronomer. "It's so important to show children that science isn't elitist or stuffy or arrogant. I grew up in a council house and never dreamed I would end up presenting my research to Prince Philip at Buckingham Palace and to MPs in the Houses of Parliament," she says.

Gomez often works 24 hour shifts and weekends, and she admits that, like many temporary lecturers, she feels under pressure to ignore her holiday entitlement. Even the small amount of leave that she does take is often filled with science outreach work. This has included promoting science to girls as a Women Into Science and Engineering in Wales role model, running an after-hours astronomy club at a school and helping the charity Sense about Science to prepare a guide to dealing with the media for early-career researchers.

Despite her hectic schedule, Gomez is incredibly enthusiastic about the future. "I enjoy being around astrophysicists who are passionate about what they do and have great ideas, but equally realise that they don't know all the answers. The only friend I have that works as many hours is a lawyer who earns five times as much as me, but the rewards of making a research breakthrough and seeing my students understand difficult concepts are worth any struggles that I have. This really is my dream job."

## OBSERVATIONS

**Mary Matthews, seconded to work in parliament on an Institute fellowship, is finding sparks can fly over the radio spectrum.**

I'm privileged to have a three-month fellowship, funded by the Institute, to work at the Parliamentary Office of Science and Technology (POST). Each year the Institute's POST fellow is tasked with writing a briefing paper for MPs and peers about a science or technology issue, contributing to a longer report or helping with a select committee enquiry.

POST is all about science and all about parliament, but it suffers from mistaken identity. People think that it represents the government, but this is most definitely not the case. POST serves the House of Lords and the House of Commons. People may also imagine that it's a think tank, but it's not about policies or agendas. It really is all about the science, which makes POST quite unique in politics as an enclave of truly independent research. A scientist is often the person who doesn't have an axe to grind but simply wants to know what's going on. The topics that parliamentarians deal with are inreasingly science related, from global warming through health to telecommunications. Technology has changed our world but our understanding of this is still limited. POST aims to provide accessible and independent briefings on such topics.

My task is to write a briefing paper on "management of the radio frequency (RF) spectrum". Now if, like I did, you think that RF management sounds a little dry, let me correct you. I rapidly discovered that this topic can cause sparks to fly. About 3% of the UK's gross domestic product comes from the use of the RF spectrum, so there's significant interest in it.

I've interviewed people at Sky, ITV, the BBC, Motorola, Vodafone and the Ministry of Defence, and I'm about to interview staff at Orange, the Department for Trade and Industry, the Civil Aviation Authority, $O_2$ and many other organisations. The RF spectrum is a huge resource that many of us rely on every day, in applications from television and telephones to aircraft safety. It's great to see a piece of physics that's so wide and relevant, even though many of the users don't even realise it.

I'm currently looking at the regulation of RF and the changes that are happening in this area. "Spectrum liberalisation" and "spectrum trading" are all hot topics, as is the "digital dividend", which will arise from the auctioning off of the UHF spectrum when the switchover to digital happens.

Everyone has an opinion and everyone wants to tell you about it. However, there are occasions when I think: "I'm only a PhD student. Why do they think that anyone will listen to little old me?" In fact that, bizarrely, is why they do listen. Parliamentarians need good information to understand the decisions that they take. More often than not, they're not scientists and they really do need help, even from a little old physics postgraduate.

As I have delved deeper into the subject, my focus has become more policy based and less scientific. It can be quite difficult to maintain an objective view, because your own opinions start to make themselves heard. I try to step back and pretend that this is just the same as probing a GaAs heterostructure. Even so, I'm finding that there are limits to objectivity and to what I can discover. Spectrum users come in all shapes and sizes, while practicalities get in the way of discovering hard facts, just as noise gets in the way of an experiment.

I'm really enjoying gathering people's different perspectives into one report, but a part of me really wishes that they could be translated onto a graph – all nice and neat, with error bars. Surely that would be easier to interpret. If parliament and government could do that, wouldn't the world be a better place?

If you would like to contribute to **OBSERVATIONS**, e-mail your idea to interactions@iop.org.

interactions

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LETTER FROM

## ...the Printing and Graphics Science Group

Exciting developments are happening in graphic arts technology and printing. The digital revolution initiated new ways of reproducing and displaying images and information, in which the UK has a leading role. Inkjet and other printing and deposition processes are in use in applications such as VDUs, flexible electronics, smart packaging, and photovoltaics based on organic and polymer electro-optic materials.

Physics and physicists are involved in forming and measuring an image and how it is perceived, developing the processes and the new materials, and designing and characterising the products. The Institute's Printing and Graphics Science Group promotes the application of physics in these fields. It is a relaunch and renaming of the Printing, Packaging and Papermaking Group, formed in 1985; we maintain an interest in the manufacture and properties of paper and the physics of packaging.

Research in our areas is multidisciplinary, often conducted in departments not called "physics", by scientists whose original discipline is not physics. Our activities include this wider community, wherever physics is brought to bear. We'll bring together scientists in industry, academia and elsewhere, and develop links with other professional societies. We are affiliated to the Institute's Applied Physics and Technology Division, ensuring strong links with related subjects.

Our objectives are to promote the application of physics in graphic arts technology, printing, packaging and papermaking, and the development of innovative printing in new markets such as displays, lighting and printed electronics. We aim to promote physics in these industries as a career choice and to act as a forum for communication between scientists working in them.

As well as running meetings, visits, a newsletter and a website, we organise the triennial Institute conference "Preservation and Conservation Issues in Digital Printing and Photography". We award an annual prize for the best application of physics in the subject area. To support postgraduate researchers we run an annual student conference and award an annual grant.

To find out more, visit "Groups and Divisions" on the Institute's website. We're seeking views on the group's direction and activities; you can help by completing a questionnaire at www.iop.org/activity/groups/subject/pgs/index.html.

**Dilwyn Jones** chairs the Institute's Printing and Graphic Science Group.

## Prepared to teach

I am writing regarding A R Matthews' letter on teacher shortages (May issue). One current programme to address shortages provides prospective teachers with a six-month course in physics. This enhancement course leads into the PGCE and upon completion all individuals should be capable of teaching physics to GCSE and, in some cases, A-level. The writer suggests that this course is not suitable for training physics teachers and that those completing it may not be entirely fit for the teaching the subject, writing "the proposal that non-physicists be given a six-month crash course in the teaching of physics fills me with horror".

I'm currently close to completing my Physics Enhancement Course (PEC). I'm one of 18 people at Loughborough University who have spent the last five months studying to gain a wide breadth of physics knowledge in order to commence their PGCE as physics specialists. If the opportunity had not arisen to take the PEC, I would not have been able to train as a physics specialist and biology would have been my back-up. I've gained 9 GCSEs, 5 AS levels, 4 A-levels and a BSc (Hons) in sport and exercise science. After years of education, I find the suggestion that I'm not capable of teaching physics in secondary schools insulting.

Each person on my course has years of experience in industry, most of which is entirely applicable to physics. We've not only learned the crucial skills needed to teach physics, we've also had the opportunity to discuss and investigate relevant uses of the subject. Surely this range of practical experiences is ideal for teaching physics in schools? We're now capable of teaching physics and doing so in a practical and exciting way.

A R Matthews wrote: "I chose to read physics and maths in the sixth … I cannot believe that I would have been motivated to do so had I been taught by teachers who did not have a thorough physics or maths graduate training and a deep interest in their subjects and their students". This suggests that A R Matthews believes that anyone without a degree in physics cannot be interested in the subject. However, modern courses can enable people to study elements of the core sciences while allowing interest in alternative subjects to develop. Someone truly interested in a subject will inevitably return to it later in life, hence our enthusiasm for our current study on the PEC.

PEC students have first-hand experience of the difficulties that can be encountered when studying the subject. We're likely to be more capable of teaching physics to GCSE and A-level than the majority of highly educated physicists because we can lower the complexity of topics to a level that pupils can relate to.

I'm more than happy for my progress throughout my training and my early years of teaching to be monitored if that is what's needed to convince people that the PEC is the way forward. I have every confidence that all 17 of my peers at Loughborough will not only be good quality teachers, but good quality physics teachers. When I discussed the letter in May *Interactions* with them, we unanimously decided that we would each sign our names to this letter to demonstrate our strong feelings on the matter. I hope that A R Matthews will rethink his or her opinion of the "six-month crash course in physics" now that they have perhaps had an opportunity to entertain the other side of the story.

**Vikki Horner and 17 others**

## Scandalous schools

Like many of your respondents, I left industry to try and give something back to the younger generation by teaching physics. My first rude shock was that my PGCE college could not accept me to teach only physics; I'd be expected to teach "science" including biology. For someone who has left biology behind by several decades this was too much to ask. It did not take much time to rethink and opt to teach maths with IT.

My next shock at a real school after 30 years was the standard of discipline. In previous times, a teacher had a right (and some would argue a professional duty) to change bad behaviour to good by using physical coercion or punishment if necessary. Now, teachers are expressly forbidden to even touch a pupil except *in extremis*. One quickly learnt from other staff that generally, it was not about teaching subjects, but about "riot control". Even headteachers now seem bound by a wealth of regulations. A new teacher would feel totally unsupported in this situation where indiscipline is endemic.

Surely teaching maths and physics demands a disciplined class with disciplined minds ready to learn? How on earth can this be done if one has to concentrate on "riot control" which saps so much morale and energy? Why should any teacher be forced to spend a considerable percentage of time trying to get a class to listen? Even doubling salaries would not remove the pain of mentally exhausted teachers with all the hours of paperwork thrown in.

The next big shock was to find out how much standards have fallen. Nearly all my peers in my class of top-year infants (7–8-years-old) knew their multiplication tables to 12 x 12, with the following year at junior school making sure all in the class really did. However, about half the 14–15-year-olds at the school where I taught had great difficulty with their tables. I had to give out printed tables as aides-mémoire. This was necessary to even move slowly when teaching the Pythagorean right angle triangle relation. Without pupils knowing the squares of simple integers, teaching this topic is a dead duck.

Adding fractions without a calculator is well beyond most senior pupils under 16, though this is needed to do calculations for resistors in parallel, and light rays with mirrors and lenses. I was taught addition of fractions in my second year at junior school. Fundamental questions must be asked not just about physics, but also about the standard of maths and a pupil's ability to think, to analyse and to describe a topic in maths and clear English.

The Institute must draw education ministers' attention to the fact that changes or even extra money do not necessarily equate to improved standards. Many "initiatives" and "targets" have proved to have dubious foundations, and changes in school curricula can be very disruptive and time-consuming.

The present shortfall of 10 000 physics teachers with only 200 new physics graduates entering the teaching profession every year is a national disgrace, and will certainly not be helped by more universities closing their physics departments. Besides attracting young physicists into teaching, the profession – or rather government – must retain them if their aspirations are to be realised. Pay must enable people to undertake a mortgage in addition to buying a loaf of bread. Disciplinary procedures and riot control must not leave the teacher exhausted at the end of the week, and bureaucracy must not demand 70 hours per week.

Neither government nor headteachers will openly discuss the taboo subject of indiscipline because it is feared that is an admission of failure. A radical rethink is necessary. Unless and until indiscipline, pay and bureaucracy are addressed I fear qualified physics teachers will become an even rarer species, much like teachers of Latin and Greek today.

**P Edwards**
Barnwood, Gloucester

Write to interactions@iop.org or the address above. Letters may be edited for length.

## HAVE YOUR SAY ON NUCLEAR POWER

The government is suggesting that the private sector should be allowed to build new nuclear power stations but it wants to find out what the public thinks about the proposal. It is inviting individuals as well as organisations to comment on its consultation document on nuclear power, *The Future of Nuclear Power: the Role of Nuclear Power in a Low Carbon UK Economy*.

Anyone can take part in the Department of Trade and Industry's consultation by visiting http://nuclearpower2007.direct.gov.uk and giving their views online as to whether the government has considered the relevant arguments; whether it has considered the arguments reasonably; and whether there are important arguments that it has overlooked. The closing date is 10 October.

The Institute will also be submitting a response.

# notices

### NEW BUSINESS AFFILIATES

Franks & Co, Plasma Clean.

### NEW MEMBERS

Alistair Bell, Jose Castrejon-Pita, Patrick Collins, Bryan Davison, Stephanie De La Bedoyere, David Eccles, Joesph Herbert, Sarah Kendrew, Jaime Reed, Hugh Reynolds, Paul Ruffle, Michael Shaw, Mark Stroud, Philip Thomas, Benjamin Tordoff, Keith Warburton, Xiulai Xu.

### IN MEMORIAM

Mahendranath Chady, Christopher Escreet, David Ottewell, Cestmir Radon, Michael Seaton, Harry Standing, Victor Suchar.

### MEMBER NEWS

Fraser Hatfield, a lecturer in medical physics at the University of Liverpool, has been awarded a Fellowship for Excellence in Teaching by the Higher Education Academy.

### MEMBER OFFER

**• Online subscription prize draw**
Sheena Haytack from Littleover, Derby, is May's prize-draw winner. She wins a 2 GB data stick. For your chance to win a data stick, pay your membership online at http://members.iop.org when you receive your subscription notice.

# Visit whatson.iop.org for full details of all Institute of Physics events.

## JULY 2007

**Schools Lectures 2007: Light Fantastic – the Science of Colour**
Lecture by Pete Vukusic of Exeter University.
Education Department
*University of Sheffield, Hull Collegiate School*
4 & 5 July
www.iop.org/activity/education/index.html

**Music to Your Ears**
Presentation by Wendy Sadler of the University of Cardiff.
Midland Branch
*St Peter's School, Wolverhampton*
12 July
http://midland.iop.org

**Low-Energy Quantum Gravity**
Informal meeting for PhD students and researchers.
Mathematical and Theoretical Physics Group/Gravitational Physics Group
*University of York*
19–20 July
www.iop.org/activity/groups/subject/index.html

**Recent Advances in Mixed and Active Membranes**
Meeting with invited speakers and poster session.
Biological Physics Group/Liquids and Complex Fluids Group
76 Portland Place, London W1
23–24 July
www.iop.org/Conferences
**Registration required**

### SYMPOSIUM

**Dynamic Nuclear Polarisation Symposium**
Meeting to discuss progress in nuclear magnetic resonance research involving dynamic nuclear polarisation.
BRSG Group
University of Nottingham
29–31 August
**www.iop.org/Conferences**
**Call for papers and registration open**

## AUGUST 2007

**ICPS 2007**
International conference for physics students.
Nexus
*University College London*
10–16 August
www.icps2007.info
**Registration required**

## SEPTEMBER 2007

**Physics by the Lake Summer School 2007**
School on condensed matter theory.
Theory of Condensed Matter Group
*University College of St Martin, Ambleside, Cumbria*
2–14 September
www.physicsbythelake.org
**Registration required**

**Clusters 07**
Conference on the clustering of nucleons in the nucleus.
Nuclear and Particle Physics Division
*The Holiday Inn, Stratford-upon-Avon*
3–7 September
www.iop.org/Conferences
**Registration required**

**Electron Microscopy and Analysis Group Conference (EMAG 2007)**
Conference with speakers, technical workshops, exhibition and posters.
Electron Microscopy and Analysis Group
*Glasgow Caledonian University/University of Glasgow, Glasgow*
3–7 September
www.iop.org/Conferences
**Registration required**

**Current Research in Combustion**
Forum for research students and early-career researchers.
Combustion Physics Group
*Faculty of Engineering, Loughborough University*
4 September
www.iop.org/activity/groups/subject/comb/index.html

### ONE-DAY CONFERENCE

**Non-Adiabatic Molecular Dynamics: a Discussion**
Talks by experts in different methodologies.
Computational Physics Group
76 Portland Place, London W1
10 September
**www.iop.org/Conferences**

**Schools Lectures 2007: Light Fantastic – the Science of Colour**
Lecture by Pete Vukusic of Exeter University.
Education Department
*Glasgow University, St Andrews University, Heriot-Watt University, Edinburgh*
6, 10 & 11 September
www.iop.org/activity/education/index.html

**Polymer Physics Group Biennial Conference**
Conference on physical aspects of polymer science.
Polymer Physics Group
*Grey College, Durham University*
10–12 September
www.iop.org/activity/groups/subject/pol/index.html
**Registration required**

**QuAMP 2007**
Conference on ideas and results at the forefront of research.
*University College London*
Atomic, Molecular, Optical and Plasma Physics Division
10–13 September
www.iop.org/Conferences
**Registration required**

**Sensors and their Applications XIV**
Conference on sensors, instrumentation and measurement.
Instrument Science and Technology Group
*Liverpool John Moores University*
11–13 September
www.iop.org/Conferences
**Registration required**

**Physical Acoustics Tutorial Day and AGM**
One-day tutorial meeting.
Physical Acoustics Group
*76 Portland Place, London W1*
13 September
www.iop.org/Conferences

**Schools Lectures 2007: Light Fantastic – the Science of Colour**
Lecture by Pete Vukusic of Exeter University.
Institute of Physics in Scotland
*St Andrews University, Heriot-Watt University, Glasgow University*
17, 19 & 20 September
www.iop.org/activity/branches/Scotland

**Electro-active Materials**
Conference on field-induced effects in materials.
Dielectrics Group
*Cranfield Management Development Centre, Cranfield*
20 September
www.iop.org/Conferences

**Extreme Physics at National Science Learning Centre, York**
Talks, workshops and participation.
Education Group
*National Learning Centre, York*
22–23 September
www.pegresources.net/Home.html

### CONFERENCE/COURSE

**Emergent Themes in Biophysics**
Day one: a research meeting on emerging technologies in biophysics. Day two: a course for students and postdoctoral research assistants considering a career in biological physics.
Biological Physics Group
Manchester Institute of Biotechnology, University of Manchester
17–18 September
**www.iop.org/Conferences**

### CONFERENCE

**Novel Applications of Surface Modifications**
Event on surfaces, materials and systems for the 21st century.
Applied Physics and Technology Division
University of Southampton
18–20 September
**www.iop.org/Conferences**
**Registration required**

## OCTOBER 2007

**Light for the Firm but Gentle Control of Disease**
Talk by Prof. Stephen Brown of the Royal Free and University College London Medical School.
Institute of Physics in Scotland
*Glasgow Science Centre, Pacific Quay, Glasgow*
2 October
www.iop.org/activity/branches/Scotland

**Schools Lectures 2007: Light Fantastic: the Science of Colour**
Lecture by Pete Vukusic of Exeter University.
Education Department
*Prior Pursglove College, Guisborough, Northumbria University, Newcastle upon Tyne, Hartlepool College of Further Education*
16 & 17 October
www.iop.org/activity/education/index.html

**Energy Management Group**
Lecture on electricity supply by Lord F. Tombs.
Energy Management Group
*76 Portland Place, London W1*
17 October
www.iop.org/activity/groups/professional/emg/index.html

## NOVEMBER 2007

**Schools Lectures 2007: Light Fantastic – the Science of Colour**
Lecture by Pete Vukusic of Exeter University.
Education Department
*Highcliffe School, Christchurch, Clayesmore School, Dorset, Ralph Allen School, Bath*
5, 6 & 7 November
www.iop.org/activity/education/index.html

**Pie in the Sky: Scotland's Space Satellites**
Talk by Craig Clark of Clyde Space Ltd.
Institute of Physics in Scotland
*Glasgow Science Centre, Pacific Quay, Glasgow*
6 November
www.iop.org/activity/branches/Scotland

**Utopia Theory: the Search for the Physics of Society**
Talk by science journalist Philip Ball.
London & South East Branch
*Rutherford College Lecture Theatre 1, University of Kent*
7 November
www.iop.org/activity/branches/London_and_South-East

**Applications of Plasmas: Micro to Nano Scale**
Meeting with invited and contributed speakers.
Ion and Plasma Surface Interactions Group
*76 Portland Place, London W1*
7 November
www.iop.org/activity/groups/subject/ipsi/index.html

**Experimental Techniques in Semiconductor Research**
One-day course aimed primarily at new researchers.
Semi-conductor Physics Group
*East Midlands Conference Centre, Nottingham*
13 November
www.iop.org/Conferences

# 'Time and Space' well worth the wait

*Heather Pinnell* explored the new astronomy galleries and planetarium at the Royal Observatory Greenwich.

Courtesy of the National Maritime Museum

For most of its 330 year existence the Royal Observatory Greenwich (ROG) has tried to keep a foot in two camps, rather like the tourists who are eager to straddle both sides of the meridian line that passes through its site. It has been the keeper of a historic tradition of astronomy in the UK while keeping up with the cutting edge of scientific research and, until the work moved to Herstmonceux in the 1950s and 1960s, being an active player in astrophysics.

The ROG's new planetarium and astronomy galleries reflect this dual identity. Opened by the Queen in May, the new facilities are the final phase in its Time and Space Project, which has taken five years to complete. The earlier phases included the much anticipated Time Galleries, which opened in February 2006.

From the outside the South Building, which houses the new Weller Galleries dedicated to astronomy, is all of a piece with the architecture in the royal park. Constructed in 1899, its decorated redbrick exterior retains a late-Victorian appearance. Inside, however, it has been completely transformed into a 21st-century facility, with a broad spiral staircase and lift giving access to the modern galleries, Lloyd's Register Educational Trust Learning Centre and the Peter Harrison Planetarium, as well as a café, toilets and a shop.

The blending of old and new continues inside the galleries, where historic objects and charts used in astronomy since the 18th century rub shoulders with interactive installations highlighting modern research in astronomy and cosmology.

So in the "Astronomy explores" gallery a thermometer used by Herschel to measure the heat produced by different colours of the spectrum sits next to an interactive game on modern spectroscopy. Nearby a 19th-century hand-held spectroscope is close to a demonstration of how diminution in a star's light can be used to detect an extrasolar planet. This consists of passing a ball on a stick in front of a light-filled globe and watching the resulting change on an LED display.

More sophisticated interactive games include "Gravity modelling", in which the player arranges solid three-dimensional dice on a stand, allowing a computer to pick up their positions and turn the configuration into a computer simulation of astronomical objects. It projects their future positions when the player alters parameters such as mass and velocity, so that sometimes they crash and coalesce or bounce, and sometimes a smaller object begins to orbit a larger one.

One of the most popular activities in this gallery appeared to be a space mission simulation, in which players, acting singly or with two or three others, help to design and launch a spacecraft. They can decide on such factors as the weight of the spacecraft and, depending on the outcome at each stage of the mission, a scientist appears in a video to congratulate them on their success or to tell them where they went wrong.

The "Astronomy inspires" gallery has a continuous video projected onto a curved wall, which explains the history of the universe from the Big Bang to the present, and outlines some of the unanswered questions in cosmology. There is only one historical artefact in this room, but it is an impressive one – an orrery dating from about 1750 (pictured). This is still in working order and shows the position of the planets in relation to the Earth, although Uranus and Pluto are missing because they had not then been discovered. A guide explained that the planets move so slowly in the orrery that their motion cannot be detected by someone standing by and watching. However, a person looking at it and returning a week later will notice that the planets have moved, he said rather disconcertingly.

The last astronomy gallery is called "Astronomy questions". Here there is a Moroccan astrolabe dating from 1721 and a Persian one from around 1850; the eyepieces used by Herschel to discover Uranus; an armillary sphere from 1730, which models the solar system and was used for teaching and calculation; and a planisphere from Philadelphia made in 1856. Coming closer to the present day, there is a mirror used on the *Hipparcos* satellite, which ended its mission in 1993.

**"The planets move so slowly in the orrery that their motion cannot be detected by someone standing by and watching."**

The most colourful part of this gallery is a screen and bench covered with a mosaic of changing coloured patterns. Visitors can move solid dumb-bell shapes onto one of three numbered circles that appear on the bench. Depending on their choice, part of the screen pattern dissolves into one of several video clips of a real researcher talking about their area of work, from star formation to asteroids. While many young children were attracted to the coloured lights, this installation is likely to have the most interest for teenagers or adults wanting more substantial content.

Every hour there is a 25 minute show in the 120-seat Peter Harrison Planetarium. Since the recent closure of the planetarium next to Madame Tussaud's, this is now the only live public planetarium in London. Children under seven are not admitted to the show in case the loud noises and dark frighten them. Certainly the show has a stunning impact – watching a supernova unfold gave the illusion of being showered by cosmic gas and dust, and the clarity of the images was startling. The old London Planetarium has truly been eclipsed.

**Heather Pinnell** is acting editor of *Interactions*. For more information, see www.nmm.ac.uk/astronomy/index.html.

## particles