The newspaper of the physics community

June 2005

interactions

Institute of Physics

Mobile science labs hit the road

David Reid reports from the launch of Lab in a Lorry at the Annual Representatives Meeting.

On 18 May two 44 ft lorries pulled up outside the Institute of Physics headquarters in Portland Place to showcase Lab in a Lorry – a new initiative that is designed to inspire the next generation of scientists and engineers. Three mobile science labs will tour the UK and Ireland, visiting schools, youth organisations and community events throughout 2005 and beyond. During its first year, Lab in a Lorry hopes to reach more than 50 000 children, making it one of the UK's biggest science outreach projects.

The stop outside headquarters was timed to coincide with the Institute's Annual Representatives Meeting (ARM), giving members a chance to look inside the lorries and try out some of its interactive science experiments.

Vince Smith, chair of the South West Branch, said: "It was wonderful to see the Lab in a Lorry project begin its life 'on the road', bringing real experiments to young people all over the country. I am really looking forward to hosting one of the lorries in our region and bringing the excitement to our own youngsters."

Jonathan Lodge

Outside the Institute, children from Quintin Kynaston School in St John's Wood learn about drilling for oil.

Lab in a Lorry is a partnership between the Institute of Physics and the Schlumberger Foundation – a non-profit organisation created by the oil and gas technology services company, which employs scientists and engineers in more than 80 countries. The foundation supports educational opportunities for young people around the world, particularly in developing countries. "We have a long-term interest in supporting a global society that values and invests in science – needed now more than ever," said Johana Dunlop, director of the Schlumberger Foundation.

Each lorry is fitted with three distinct lab areas, where groups of up to six 11- to 14-year-olds can take part in fun and informative experiments, guided by a volunteer scientist. The experiments are designed to be different from school practical lessons by allowing students to engage in the process of discovery in a more organic way, unbounded by expectation or rules.

The original concept was devised in 2001 by Charles Jenkins, a scientist at Schlumberger Cambridge Research. He wanted to give children an opportunity to experience what it is like to be a real experimentalist. "Scientists do experiments because they want to be surprised and design them carefully so they can understand those surprises. This needs space and time – time for things to happen that you didn't expect and that you can learn from," commented Jenkins.

"Lab in a Lorry is about showing young people how science is part of everyday life."

Four experiments have been designed so far for the lorries, and more are planned for the future. In one experiment, students use vibrations to try to get a wine glass to wobble and, if possible, shatter. Using a strobe light, they are able to view the rapid oscillations of the glass, which looks like a clay pot on a potter's wheel. Students are encouraged to adjust the variables in the experiment to get the glass to resonate and to explore and try out ideas for themselves. For example, they can change the frequency of the sound being emitted by two large speakers, alter the position of the wine glass, or change the type of wave being emitted or the speed of the strobe light.

The idea is not only to introduce students to new concepts, such as resonance and surface tension, but also to highlight their everyday applications. One experiment, which looks at stress and strain, helps to explain how engineers came up with the shape of windows on aeroplanes and how medical physicists are able to create models to predict where there might be weaknesses in bones.

"Science is perceived by a lot of people as not being relevant. Lab in a Lorry is about showing them how science is part of everyday life," said Wendy Sadler, one of the project scientists for Lab in a Lorry.

The programme is delivered by volunteers – mainly practising scientists and engineers – many of whom are members of the Institute. Each lorry has three volunteer mentors – one for each section of the lab – with each mentor looking after groups of around six children.

"Once we've decided on a location, the first stage is to find volunteers," said Sadler, who has been briefing the volunteers. "We approach all sorts of organisations, mainly science-based companies. There are loads of people out there willing to share their passion for open-ended experimentation."

Ian Cuthbert, project manager for Lab in a Lorry, sees it as an excellent opportunity to get across the importance of physics. "The things that we work on in physics are absolutely central to people's lives, but the complexity can put them off. It's up to us scientists to make these subjects accessible," he said.

The lorries are already proving popular with children. "Science is really fun but our lessons are short and so we don't always get time to do experiments. I'm looking forward to Lab in a Lorry coming to our school," said a girl from Quintin Kynaston School in St John's Wood, which had been invited to visit the lorries on the morning of the ARM. Another child said: "It's changed my mind about what scientists are like because I didn't think they got to do fun stuff like that. It makes science more interesting – it makes me want to do more."

www.labinalorry.org.uk

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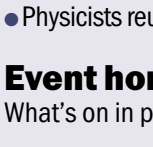
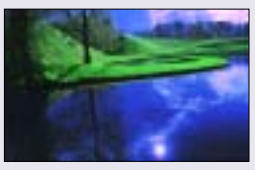




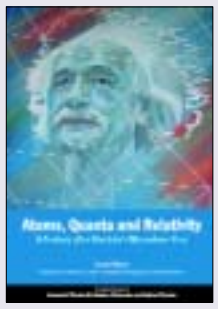
"Our recommendations must be excellent and inspire public confidence."
Gordon MacKerron of CoRWM, p4

"You've got to have the right idea at the right time. It's no good having it too early."
Gareth Edwards, p5

HIGHLIGHTS

Einstein's legacy reviewed in anniversary year

A commemorative issue of *Journal of Physics B: Atomic, Molecular and Optical Physics* has been produced by Institute of Physics Publishing. *Atoms, Quanta and Relativity: a Century after Einstein's Miraculous Year* includes 27 invited review papers in the fields of atomic physics, quantum optics and synchrotron radiation. Highlights include "1905: a miraculous year" by Jürgen Renn and Dieter Hoffmann, which discusses Einstein's famous papers of 1905 and the connections between them, and articles on recent developments and cutting-edge research in cold atom clocks, attosecond physics and quantum computing.



www.iop.org/journals/jphysb

Levitation experiment is on the money

In an experiment that would have made Archimedes proud, physicists at the University of Nottingham have managed to levitate diamonds and heavy metals, such as gold, silver, lead and platinum. Writing in the *New Journal of Physics*, Laurence Eaves and Peter King explain how they used mixtures of liquid and gaseous oxygen and nitrogen to provide enough buoyancy to levitate a number of dense objects, including a £1 coin. They exploited the magneto-Archimedes effect, in which a magnetic field applied to diamagnetic materials provides enough force to balance the weight of an object. This has a number of applications, particularly in the mining industry. "You can use this technology to accurately sort minerals into bands according to their density. The method can discriminate between components with very small differences in density, enabling you to extract the precious parts you require," explains King. The gas mixture is also safer and lower-power magnets can be used.

If you could teach the world just one thing…

Last month *spiked*, the online current affairs magazine, asked 250 scientists, science communicators and educators (including 11 Nobel laureates): "If you could teach the world just one thing, what would it be and why?" The answers provide a fascinating insight into how scientists view the scientific enterprise. The most common response was that we should not just communicate the findings of science — the most important thing to teach is the scientific method. Lynne Frostick, professor of physical geography at the University of Hull, chose "the concept of climate change and the role of every human being in causing it", while Chris Isham, professor of theoretical physics at Imperial College, London, chose "the view of reality that is suggested by quantum theory". Nobel prizewinner Wolfgang Ketterle said that "science is a network of knowledge, and it is impossible to single out one thing". The idea came from science communicator and filmmaker Alom Shaha and the project was funded by the National Endowment for Science, Technology and the Arts as part of Einstein Year.

www.spiked-online.com/einstein

Exploring the evolution of physics

A new interactive resource exploring how scientific ideas are born and the historical links between them went live on the Institute's knowledge-based website, *physics.org*, in May. Physics Evolution presents users with a geographical map of the most influential ideas and thinkers in physics, access to several levels of information and "wormholes" to jump between historical eras. It is aimed particularly at older school students and their teachers. Nicola Hannam, editor of *physics.org*, said: "I wanted to create a piece that was more than a traditional timeline. The map illustrates how concepts spread, adds intriguing details about the people involved and shows that physics is not just about the right answers – that the science community develops and agrees on ideas through debate and discussion."

Physics is key to biotech success

By David Reid

The latest in a series of special events to improve the commercialisation of research took place at the Institute on 19 April. The meeting focused on the commercialisation of biotechnology – a market worth $600bn worldwide and one in which physicists have an important role. In the UK, biotechnology employs 22,400 people.

Julian Burke, chief scientific officer at Genetix – a small biotech firm – spoke about the secrets of his company's success. Based in Southampton, Genetix makes a range of machines for "picking" cells, some of which are being used to search for new antibiotics. Its small team of R&D staff includes several physicists specialising in optics.

"You have to understand what is going on and how your technology will be used. Sometimes the fastest machine isn't always needed and isn't always the most profitable product to make – despite what engineers might tell you," said Burke. Understanding the need to be flexible and adapt to a changing market is vital, he added. "The only difference between a successful biotech company and an unsuccessful one is that the successful one isn't doing now what it started out doing."

Frank Rinaldi from Evolution Life Sciences highlighted the growing field of healthcare diagnostics, where one of the key technologies is microarrays. Glass slides printed with thousands of spots of DNA, microarrays can be used to test for the presence of a particular sequence of DNA in a sample, making them very powerful diagnostic tools.

Edwin Southern, managing director of Oxamer Gene Technology, first conceived the idea of a microarray in 1987, but it was 2000 by the time an operating company could be established to exploit the research properly.

He explained that physics is vital to healthcare diagnostics, especially in device fabrication (making more efficient microarrays), sample handling (looking at how liquids interact with glass), detection (developing more sensitive detection methods, preferably with electronic read-outs) and data handling (where biologists can learn a lot from the way physicists model large volumes of data). "I haven't got a good physicist on my team at the moment," said Southern, "but I'm looking."

● At the event, the Institute launched a new biotechnology forum, which will focus on the physical sciences side of biotechnology. It aims to improve communication between those involved in interdisciplinary research in areas such as biophysics, biochemistry and physical biology.

http://industry.iop.org

PHYSICS CAREERS

Mark Harrison

On 30 April, *The Times* magazine featured a five-page spread on careers based on physics. The line-up included Jessica James (far left), a theoretical physicist turned financial strategist; Helen Nesbitt (second row, second left), who studied physics and now creates the special effects for the Harry Potter movies; and Simon Whittaker (bottom right), who uses physics to program Playstation computer games. The article also featured non-physicists who have been inspired by physics, including Cameron McMillan (bottom left), a dancer in the Rambert production *Constant Speed*, which is based on Einstein's 1905 works, and Jack Liebeck (second row, second right), a violinist who has been performing at Einstein Year celebrations.

ARM focuses on next generation

The younger generation – from schoolchildren to graduate students – was the main subject for discussion at the Annual Representatives Meeting, which was held at the Institute on 18 May. The meeting is a chance for honorary officers from the groups and branches to give their input into the Institute's strategy.

It was announced that the magazines publishing division has sold its children's science and maths titles because they had not been commercially viable. Some members were worried that this would undermine the Institute's efforts to reach young people. Communications director Paul Danielsen explained that Einstein Year and other programmes were more effective ways of enthusing young people about physics. He also announced that the small grants scheme for outreach activities would continue after Einstein Year.

Another issue was the perception that many university lecturers are unaware of recent changes in the school curriculum, and that undergraduate physics education is suffering as a result. Education and science director Peter Main said that the Institute is supporting teacher fellowships, in which A-level teachers spend a year at a local university, to help address this issue.

The question of how to get more graduate students to join subject groups also arose. It was suggested that supervisors can play a key role. The Institute is also introducing six months' free associate membership for new graduates to help keep in touch with them after graduation.

The ozone layer could recover, but it's still under threat

Heather Pinnell looks at a report on the current state of the ozone layer.

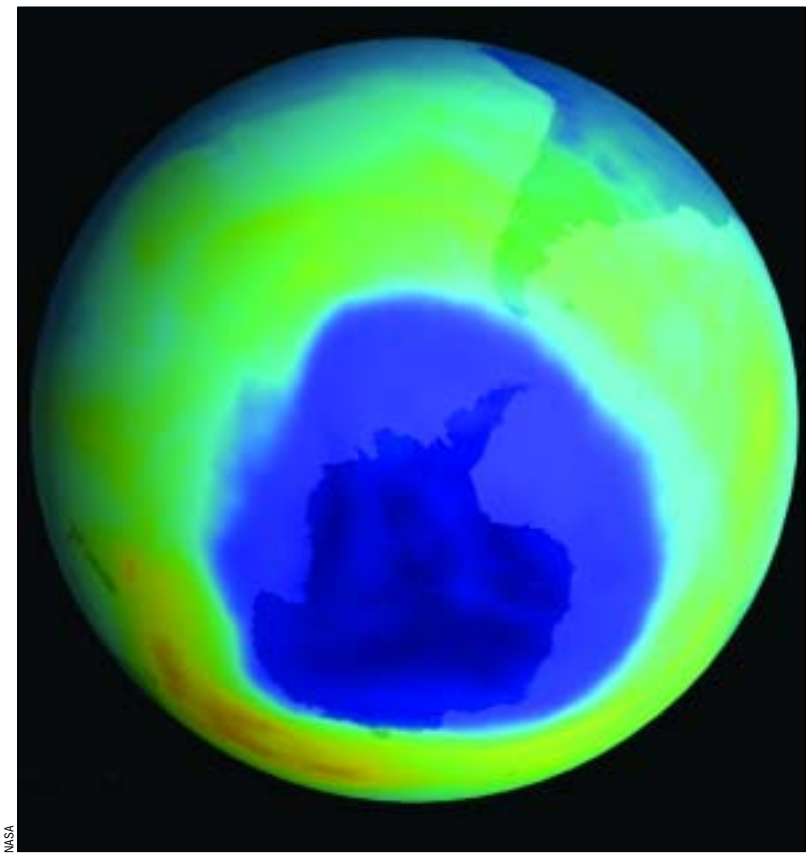
There are indications that the hole in the ozone layer is being repaired, but the process of recovery will take decades and the ozone layer is still under threat. These were the conclusions of "The rise of ozone research", a report commissioned by the Institute from Peter Hodgson of the independent consultancy Sci-Fact.

The report says that international action on ozone should serve as a model for how scientists can drive political change. In 1987 they helped to secure the Montreal Protocol, which sought to restrict the production and use of ozone-depleting chemicals such as chlorofluorocarbons (CFCs). However, Hodgson warns against complacency and calls for further international efforts to strengthen and extend the protocol.

The report states that the total ozone in the stratosphere is declining but at a slower rate than previously. Hodgson writes: "Despite the progress in limiting the emissions of ozone-destroying pollutants, the timescales of the atmospheric processes involved in ozone destruction mean that it will be decades before it can be judged whether the Montreal Protocol has been completely successful and the ozone layer restored." He adds that changing patterns of behaviour, such as people spending more time outdoors in the UK as the climate warms, may be more significant than the thinning of the ozone layer in exposing people to harmful ultraviolet radiation.

Evidence suggests that while the level of ozone-depleting chlorine is at or close to its peak, levels of other ozone-depleting substances, such as bromine, are continuing to rise. There is also uncertainty about the effect of certain compounds that are designed to replace CFCs. For some damaging compounds, such as methyl bromide, there is still no suitable alternative.

At the same time, global warming – which paradoxically is believed to lead to cooling in the stratosphere in the polar regions – is thought by many to contribute to cloud formation of a kind that stimulates ozone depletion. The subtle interactions between global warming, ozone depletion and exposure to ultraviolet radiation are poorly understood and need further research, says Hodgson.



NASA

The hole in the ozone layer situated over the Antarctic, September 2003.

"The ozone 'holes' that appear annually at the polar regions are still large and long-lived," he writes, "and the possibility that climate change may bring conditions likely to cause even greater ozone loss is a contemporary danger." In April, researchers from Cambridge University reported that in winter 2004/5 the ozone layer over the Arctic was at its thinnest on record.

Hodgson says that while 180 countries have signed up to the Montreal Protocol, only a couple of dozen have ratified it, and pressure must be applied to those countries that haven't. Other ozone-depleting substances also need to be brought under the umbrella of the protocol, he adds.

"I wouldn't want to give the impression that the problem with the ozone layer has got worse," says Hodgson. "Some elements of the Montreal Protocol are working – it's clearly had an effect, and as long as nations are encouraged both to sign up to and ratify it, and to put controls in place, we should start to put things back to pre-1970s levels. But we can't forget about it and say that it's a done deal."

For a copy of the report, e-mail: tajinder.panesor@iop.org.

Physics research in the UK is to be evaluated

A panel of eminent international scientists is to review the state of physics and astronomy research in the UK. It will report on the quality, distribution of effort and future potential, and it also aims to indicate areas of strength, weakness, improvement, decline and growth since the last review in April 2000.

From 31 October the 14-strong panel will spend a week visiting physics and astronomy departments and the Rutherford Appleton Laboratory. It will also take evidence from individuals in research, higher education and science policy before making its report, which is expected by year end.

The Institute is a joint sponsor of the review, together with the Engineering and Physical Sciences Research Council, the Particle Physics and Astronomy Research Council and the Royal Astronomical Society.

The panel is chaired by Jürgen Mlynek, president of Humboldt University, Germany. The other panel members are:

- David Gross, Kavil Institute for Theoretical Physics, USA
- Stephen Forrest, Princeton University, USA
- Rick Casten, Yale University, USA
- Roger Blandford, Stanford University, USA
- Govind Swarup, National Centre for Radio Astronomy, India
- Mildred Dresselhaus, Massachusetts Institute of Technology, USA
- Tuija Pulkkinen, Finnish Meteorological Institute, Finland
- Massimo Inguscio, University of Florence, Italy
- Sir Anthony Leggett, University of Illinois, USA
- Albert Wagner, German Synchrotron Research Centre, Germany
- Anton Zeilinger, University of Vienna, Austria
- Daan Frenkel, University of Amsterdam, the Netherlands
- Herman Gaub, Munich University, Germany.

http://policy.iop.org/International_review

Physics heads meet

Universities have been underfunded in both teaching and research for a quarter of a century, and without tuition-fee income the decline in funding per student would have been much worse, president of Universities UK, Ivor Crewe, told a meeting of physics department heads at the Institute on 13 May.

Crewe was also critical of the government's decision to drastically cut funding for departments rated 4 in the Research Assessment Exercise, which he said had contributed to the closure of some departments. He said that Universities UK had called on the government to restore funding to those departments, arguing that they were often nurseries of talent.

But Crewe dismissed the Institute's concerns about emerging "physics deserts" – regions in which it is impossible to study physics locally. Students are not bound by the artificial regions defined by government, he said, nor is central planning the solution.

Keith O'Nions, director-general of the Research Councils, outlined the Office of Science and Technology's 10 year programme aimed at sustaining and exploiting a world-class science base. The Research Councils' agreement to fund 80% of the full economic costs of research by September 2005 and 100% by the beginning of the next decade was the most important decision that they had made that year, he said.

There would be a continued £500 m investment per year in capital infrastructure for the next three years, and the Research Councils would receive £2385 m in 2005–6 and £2793 m in 2007–8, he added.

The increased expenditure on science was generally welcomed by the physics heads but they argued that there was no guarantee that the money would actually find its way into physics departments and suggested that it should be ring-fenced.

O'Nions said that he was opposed to ring-fencing and preferred to trust universities to run themselves.

IN BRIEF

● As some universities are closing their physics departments, **the University of Salford has just built five new undergraduate physics laboratories.** The Joule Physics Laboratories, which were opened on 11 May by Institute president Sir John Enderby, are purpose-built facilities that will house high-tech equipment such as laser optics, multimedia units and electron microscopes. They are designed to accommodate 150 undergraduate physics students in a modern facility that uses space more efficiently.

Keith Ross, associate head of research in the physics and materials department at Salford, said that recruitment of undergraduates into the department has been buoyant. He put the success down to its policy of developing the potential of students who lack traditional qualifications. Such students can usually be brought up to the required level quite quickly and often go on to get first-class degrees, he says.

"We specialise in reinvigorating people who have probably not been taught by physics specialists at school but who nevertheless decide that they want to do physics at university and are naturally intrigued by the subject," he added.

At the opening of the new labs, Sir John Enderby said: "The government's commitment to science can only succeed if there is strong local support for new and exciting facilities such as these. The new laboratories will strengthen the science and engineering base in Salford, so maintaining a great tradition of which Joule is but one of many exemplars."

NEWSMAKERS

The Fenia Berz Award was presented in April at the Physics 2005 conference to **Emese Forgács-Dajka** of Eötvös University, Budapest. The award is presented annually by the Institute to a young theoretical physicist from continental Europe to support them in attending a major conference in the UK.

The Engineering Leadership Award, which provides an accelerated personal development programme to undergraduates with leadership potential, has been awarded this year to **James Martin**, a student of theoretical physics at University College London. The award was established in 2004 and is given jointly by the Institute and the Royal Academy of Engineering.

Jonathan Flint has been appointed as the new chief executive of Oxford Instruments. He was previously managing director of Vislink and has spent a major part of his career with BAE Systems.

Nuclear waste is in all of our backyards


Gordon MacKerron

"A recent survey found that the average Briton lives just 26 miles away from a radioactive waste site."

In 1955, Britain launched its civil nuclear programme. Now, 50 years on, the British public are being asked to help deal with the nuclear legacy – what to do with the radioactive waste.

There is currently no long-term management strategy to deal with the UK's 470,000 m^3 of radioactive waste – enough to fill the Royal Albert Hall five times over. And some of that material may be closer to your home than you might think. A recent survey found that the average Briton lives just 26 miles away from a radioactive waste site.

In September 2001 the UK government launched the public consultation entitled "Managing radioactive waste safely" and from that the Committee on Radioactive Waste Management (CoRWM), which I chair, was formed in November 2003. We have until July 2006 to recommend a long-term strategy for managing high-level, intermediate-level and some low-level radioactive waste in the UK.

The government asked us to start without preconceptions about what the "best" option or options might be and to engage extensively with the public and stakeholders throughout the process. To be workable, the recommendations that we make for a long-term management strategy for radioactive waste will have to both be scientifically excellent and inspire public confidence.

In the first stage of CoRWM's Public and Stakeholder Engagement (PSE) programme the committee held plenary meetings, working groups and many consultation events throughout the length and breadth of the country. Early on we learned lessons from overseas – from countries like Canada, Germany, Sweden and Finland. Their experiences showed that we cannot succeed without openness and transparency at every stage of our process and that we must encourage the widest range of public participation. To that end, CoRWM holds all of its plenary meetings in public.

On 4 April this year we moved forward into the second round of Public and Stakeholder Engagement (PSE 2). Having whittled the initial list of 15 options down to four, we are now consulting with the public on this more concise list. We are also asking people what criteria they think we should use to judge the various options. The provisional shortlist is:

- **deep geological disposal** – burying waste between 300 m and 2 km underground, where future access is not envisaged;
- **phased deep geological disposal** – same as deep disposal, but waste would be monitored and be retrievable;
- **shallow disposal of short-lived waste** – waste with a short half-life buried less than 100 m below ground;
- **interim (not permanent) storage** – waste would be stored long term above the ground or just below the surface, but out of the biosphere.

Getting the best information

We are also in the process of subjecting this shortlist to rigorous specialist scrutiny, with the help of learned societies, such as the Royal Society, and from external scientific members of CoRWM's Quality Assurance Working Group, as well as a panel of distinguished scientists appointed by Prof. Howard Dalton, chief scientific adviser to the Department for the Environment, Food and Rural Affairs. Although CoRWM was not formed as a scientific committee, we are fortunate to have considerable scientific expertise: more than half of our members are scientists and many have substantial experience and knowledge of the nuclear industry. We are therefore confident that we can properly assess the quality of all the evidence put before us.

This specialist input is complementary to our public and stakeholder engagement plans – we value the continuing involvement of citizens in helping us to assess options once we have acquired the best specialist information about their performance.

In September, during PSE 2, Glasgow will host the 10th International Conference on Environmental Radiation and Radioactive Waste Management, in which CoRWM members will play a key part. The third stage of our consultation will run from then until December 2005 and will involve both specialist and citizens panels in assessing the shortlisted waste-disposal options against the publicly selected criteria for technical, ethical and social suitability. After this we will pull together our conclusions before reporting back to the government with our findings and recommendations in July 2006.

This process demands both the best available science and technology and the best possible engagement with citizens and stakeholders, so that our recommendations will be technically robust, inspire the greatest possible public confidence and – ultimately – help to ensure that the UK's legacy of nuclear waste will be safely handled for generations to come.

Gordon MacKerron of the University of Sussex is chair of the Committee on Radioactive Waste Management, which invites your participation (www.corwm.org).

focal point: council news

Undergraduate Bursary Scheme moves forward

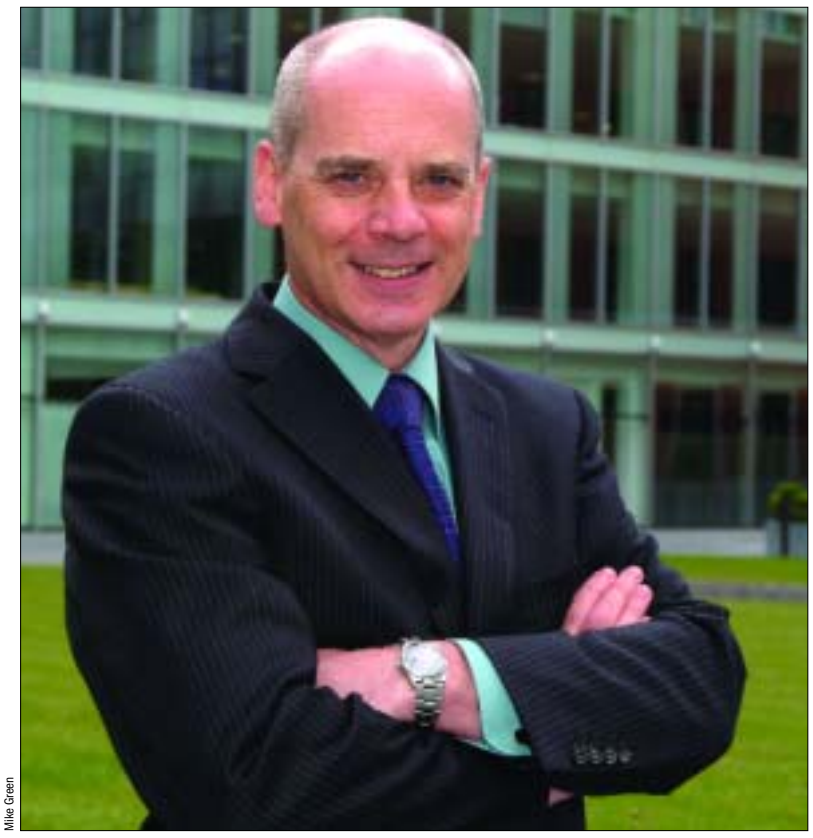
The Council of the Institute of Physics met at 76 Portland Place on 21 April 2005 and discussed the following:

- Since January 2004 the steering group for the Undergraduate Bursary Scheme has been looking at ways to administer the scheme. It will offer bursaries of £1000 per annum to students studying for accredited degrees in the UK and Ireland from 2006. The group's chair, honorary secretary John Beeby, explained that it was not possible to use means-tested information from prospective students (as originally planned) because of problems accessing the data. Instead the group proposed a quota-based model in which each university department offering accredited physics degrees would be allocated a fixed number of bursaries to distribute. Departments would be obliged to use the bursaries "to encourage students to study physics who would not otherwise do so, with an emphasis on disadvantaged students". Quotas would be biased towards smaller departments, with a likely range of between three and 15 bursaries per department. This removes much of the financial risk because only a fixed number of bursaries can be awarded each year. Council endorsed the proposal. It would also work well across the regions, including Scotland and Ireland.
- The Boards and Committees Working Party made several proposals designed to streamline the Institute's governance. All were fully endorsed by Council. The principal recommendations were:
  – the creation of a new Communication and External Affairs Board;
  – the replacement of the International Affairs Board by a less formal International Affairs Forum, to encourage more effective communication between international societies;
  – greater responsibility for the Chairs of Branches Committee for the delivery of greater "localisation" of the Institute's activities;
  – a common form of Terms of Reference for all Boards, clarifying the extent of their delegated powers and responsibilities.
- Council supported a proposal by director of education and science Peter Main to establish a working group to review the portfolio of awards given by the Institute and the process by which they are awarded, which would take advice from the Awards Committee and the Boards of Council before making recommendations to Council later this year.
- Andrew Wallard presented the recommendations of the Membership and Qualifications Board for a new policy for membership subscriptions for 2006–2009. Council resolved to recommend the proposals to members at the AGM in July.
- A close-to-final draft of the proposed Charter and Bylaws was presented to Council by membership director John Brindley. This together with the minutes of Council meetings are available for members to review at http://members.iop.org/governance.html. The final document will be taken to the AGM for approval by the membership.

profile: Gareth Edwards

Inventing his own future

Ayala Ochert meets a physicist turned entrepreneur.



Mike Green

Gareth Edwards has developed dozens of innovative products.

"Until I was 28 I was a nerd," admits Gareth Edwards. As a student of theoretical physics at Cambridge in the 1970s, he was very shy, but several years working on the world's first body scanners brought him out of his shell. At 32 he started his own company – Cat Systems – a product consultancy that turned out dozens of innovative products inspired by the microprocessor revolution of the 1980s.

Having amassed nearly three decades of experience in electronics R&D, Edwards is now a consultant at Deloitte, advising companies large and small on how much they can claim in R&D tax credits. As a result he now has a more intimate knowledge of telecoms R&D in the UK than anyone else in the country.

Edwards had imagined that he would become an academic physicist but, as graduation approached, he changed his mind. "I wanted to understand things, but I also wanted to see that I'd made a big difference somehow." He felt that he could make a more immediate impact in the world by applying his knowledge of physics to making really useful products. "I was attracted to the body scanner because I immediately saw that this was something that was going to be incredibly important to people across the world," he recalls.

The scanners had just been developed at EMI Medical, and he travelled the world troubleshooting them until he was poached by a start-up selling low-cost versions of the machines. It seemed like a great idea – except that the machines didn't sell. "It was my first big lesson in business," says Edwards. "Know your market." Every hospital wanted the very best machine that money could buy and via local appeals they were able to raise as much money as they needed.

In 1984 he left to start Cat Systems. Drawing on its creative talents, the consultancy developed products for other companies, including a brain mapper to decode EEG signals – which appeared on *Tomorrow's World* – and a "total sleep study laboratory", which revolutionised the diagnosis of sleep disorders. But while the intellectual challenge was satisfying, the business side was stressful. The consultancy saw none of the profits from its successful products – Edwards' second lesson in business. "The biggest mistake was that we put a huge amount of creative effort in but we didn't get much credit for it because we were being paid on a consultancy basis. We should have tried to get a share of those products we created," he reflects. "When I started out, I was half thinking that I only have to develop these ideas and I will automatically get lots of money. But that's not what happens. You have to put in place the levers to make sure the money comes to you."

During the recession of the early 1990s, Edwards wound the business down and decided to try something different. He worked for a few years on eddy-current technologies at Emerson Electric, and in 1996 he moved to Motorola. There he was in charge of a large team of engineers developing the world's first picocells – tiny mobile phone base stations that enable coverage in areas of high use, such as outside theatres and cinemas.

At the time, everyone at Motorola was talking about 3G, but Edwards was sceptical about its possibilities. "It comes down to simple physics, which says that to get the biggest bandwidth you've got to go the shortest distance and then get into something like optical fibre. You can't send these signals through the air, which is a horrible environment," he explains. This was the basis of the "blue phone", which he invented in 1997. Most mobile-phone calls are made within a few feet of a broadband connection. Using a short-range medium like Bluetooth, a blue phone can hook into these high-speed networks. BT is now developing a blue phone but, back then, says Edwards, no-one wanted to know. This was his next lesson in business. "You've got to produce the right idea at the right time. It's no good having it too early because you'll just bang your head against a brick wall."

"I wanted to understand things, but I also wanted to see that I'd made a big difference."

In 1999 he became head of European R&D at Mitel Networks and was there during the Internet boom, which he calls "one of the most energising experiences of my life". But when boom turned to bust a few years later, Mitel closed down its European R&D section. He had patented his blue phone but, unfortunately, Mitel let the patent drop.

Although he now advises on tax, Edwards is still an entrepreneur at heart and still comes up with new ideas for products. When the next killer idea comes along, Edwards says that he would like to start his own business again to profit from it (next time he will take out the patent himself and protect it fiercely). He now has the knowledge and experience to make it a success, but this isn't everything, he says. "As you get older, you develop caution. But being aware of all the obstacles in your way can be an obstacle in itself."

OBSERVATIONS

Samantha McNern, lighting designer for the Rambert Dance Company's new production *Constant Speed*, explains how she has been inspired by physics.

While I was at school, physics seemed to me a rather dull part of science compared with the messy and smelly experiments of biology and chemistry. It was only years later, when I decided to enrol on a science foundation course at the Open University (OU), that I discovered the real beauty and fascination of physics.

My growing interest in physics was also related to my interest in lighting. I find light fascinating on many levels – light as a creative medium on stage, the engineering challenges of light in architecture, the psychology of light and how it's perceived by the human mind, the relationship between light and colour and, of course, the physics of light. I was intrigued by the wave–particle duality of photons, which made me appreciate how light is fundamental in understanding how the whole universe works.

I decided to continue with my studies at the OU and began a degree in physics, where I discovered other wonders – like Einstein's theory of special relativity. Among my friends I soon became well known for my propensity (after a few drinks) to explain it to anyone showing the mildest curiosity, shakily scrawling sausage-shaped spaceships and stick men with stopwatches on the nearest beer mat. This was no doubt how Mark Baldwin, Rambert's artistic director, came to hear of me. He was looking for a lighting designer for his new production *Constant Speed*, which had been commissioned by the Institute of Physics for Einstein Year.

We talked generally about how Einstein's theories might be related to dance, and I gave Mark my bar-room explanation of relativity. We concluded that physics and dance are not so very remote – both are intimately concerned with space and time, and also light. I felt very lucky to be included so early in this project and to inject lighting ideas from the start. As the lighting isn't usually realised physically until a few days before the first night, lighting designers are often the last members of the design team to be taken on.

Later on, Mark got some more detailed insight from physicist Ray Rivers, and the piece began to take shape. Of Einstein's three 1905 theories, Brownian motion lent itself most directly to interpretation through dance. Relativity would be suggested by the juxtaposition of music and movement, with the speed of the dancers contrasting with the speed of the music to suggest independent reference frames.

In conveying the photoelectric effect, light and colour became more important. We decided to use two basic colours – red and blue – and to try to show that red carries less energy than blue. This presented a challenge because red is a much stronger colour on stage than blue. In the end we combined the blue light with some white light, which increased its impact.

This theme continued with the dancers' costumes. The female dancers first appear in white, then the male dancers appear in red, before a solitary dancer in blue appears centre stage. The "weak" reds are scattered to the floor by the "strong" blue.

For the final sequence, the dancers change into costumes covering a full spectrum of colours. In this finale, a large mirror ball is used to suggest the scattering of photons in the photoelectric effect – beams of coloured light are reflected off the spinning ball, creating random pockets of colour around the stage and auditorium.

All in all, working on *Constant Speed* has been a great experience for me. It has renewed my resolve to complete my physics degree (having taken time out to complete two postgraduate qualifications in lighting design) and it has also inspired me to delve further into the parallels between lighting as an art form and the deeper scientific principles of light.

For more information, visit www.rambert.org.uk. If you would like to contribute to OBSERVATIONS, please send an e-mail with your idea to interactions@iop.org.

Institute *of* **Physics**

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interactions

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Physicists reunited

I have been enjoying a pleasant retirement for the past quarter-century, following 40 years at the GEC Hirst Research Centre engaged in the research and development of cathode-ray tubes. We worked closely with the phosphor manufacturer Levy West Laboratories Ltd, which was operated by Guy Hill.

Imagine my surprise, then, when, after 25 years without contact, I see not one but two separate references to a certain Guy Hill of Faversham in the April issue of *Interactions*. Was this the same Guy Hill I had known years ago when he lived in Hertfordshire? Through the good help of the Institute I was able to make contact and discovered that he was indeed the colleague and friend I had known so long ago. It gave us both pleasure and satisfaction to meet again and discuss both technical and personal happenings during the intervening years.

Laurie Allard
Pinner, Middlesex

Editor writes: We were pleased to be able to reunite these two old friends. Members are invited to make use of our "Notices" section to send in news about their movements or to make contact with former colleagues.

Tension causes stress

It was good to see an article devoted to the too-long-neglected achievements of Robert Hooke in the April issue, but a bit of a shock to see his succinct *ut tensio sic vis* turned into the tautology "the tension is equal to the force" – bad Latin and bad physics! *Tensio* means stretching or extension, whereas, in modern physics usage, tension refers to the force causing it. And *ut...sic* is literally "as...so", implying proportionality rather than equality – an essential aspect of a law connecting two quite different physical quantities. "As the extension, so the force", please!

Michael Craddock
Vancouver, British Columbia

Correction

In John Beeby's letter about the new Institute charter (p6, May), "Former Fellows of the Physical Society" should have read "Fellows of the Former Physical Society".

We'd like to hear from you. Please send your letters to interactions@iop.org or the address above. Letters may be edited for length.

EINSTEIN YEAR COMPETITION

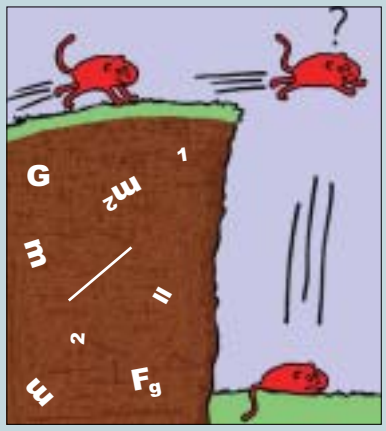
The best of the worst physics

A rocket is fired and finds it target – a spaceship – which instantly blows up, creating a huge fireball and a deafening boom…Cops and robbers fight it out on the city streets, and bullets fly back and forth, sparking bright flashes as they ricochet off a parked car…A villain takes a long drag on his cigarette, then flicks it callously into a puddle of petrol, which immediately ignites.

Until now, all of these examples of "fallacious physics" – phenomena that wouldn't occur in the real world but frequently appear in movies and on television – would just have driven you mad. But now you can be rewarded for spotting them. As part of our Einstein Year celebrations, *Interactions* is looking for the very best of the bad physics out there. Perhaps your real bugbear is not on the screen but the product that claims to magnetise a glass of water using little more than a fridge magnet.

Just send in your example, along with details of where you saw it and what's wrong with the physics, and you could win some spending money at the Science Museum shop, or some book tokens that you can use to read up on some real physics.

Of course, science fiction and fantasy will sometimes distort the laws of physics for dramatic effect – Harry Potter's flying car is powered by magical forces and, when the Star Trek crew teleport onto the nearest planet, we're not asked to believe that this could really happen. What we're after for this competition are those phenomena that pass themselves off as real physics.



The first prize – for the best example – is a £50 gift voucher for the Science Museum shop (www.sciencemuseumstore.com), where you can buy science-based toys for all ages and innovative products for your home. In addition, two runners-up will each receive a £25 gift voucher or book token.

E-mail your entries to interactions@iop.org with the subject line "Fallacious Physics" by **1 August 2005**. *Interactions* is on holiday in August but we'll return in September with full details of the lucky winners.

notices

NEW FELLOWS

Supriyo Bandyopadhyay, Stephen Barrett, Andrew Clarke, Helen Dowker, David Drabold, Adrian Kiermasz, Peter Lynch, Klaus-Ulrich Neumann, Andrew Randewich, Chang Sun.

NEW MEMBERS

Tunde Adeosun, Kenton Arkill, Itziar Balboa, Nigel Bish, Jennifer Bryant, Michael Cass, Lee Cooper, Derek Cousins, David Cullen, Anita Dawes, John Deadman, Andrea Donarini, Christopher Firth, David Gabriel, Inmaculada Gomez-Morilla, Robert Habberley, Rosalind Hamblin, Robin Hradsky, Tariq Hussain, Jasper Ikpesu, Zahur Ilahi, Cait MacPhee, Steven Massie, Joshua Milstein, Andrew Pearce, Fabio Pulizzi, David Rimmer, Stephen Roberts, Yoshihiro Sugawara, Leonard Traub, Roderick Vann, Garry Vernon, John Watt, Colin Wilson.

IN MEMORIAM

Roy Birch, Philip Ciddor, Michael Collins Jack Darbyshire, Hubert Gauss, Edgar George, Ronald Halmshaw, M R Hawkesworth, Franz Heymann, Uno Opik, Alan Segar, Nigel Trott.

MEMBER NEWS

● Congratulations to Sir John Richardson, who will be 100 years old on 30 June.

MEMBER OFFER

Online subscriptions prize draw

Aurelian Botman of Belgium is March's prize draw winner and Samantha Jenkins of Sweden is April's winner. They each received a 512 MB datastick. For your chance to win a datastick, pay your membership subscription online at http://members.iop.org when you receive your subscription notice.

The Engineering and Technology Board (etb)

The etb has a broad remit - from encouraging children to study science, technology, engineering and maths (STEM) subjects at school and promoting the value of professionally registered engineers to engaging with industry and society. With such diverse audiences the etb is undertaking a wide range of projects in 2005.

Image courtesy of SETNET

Promoting Professional Registration

The first round of applications to the Registration Fund of £1 million resulted in two grants given to the Energy Institute and the IEE. The total projected number of net incremental new registrants over a two year period from the organisations is 2,750 - over 50% of the joint etb/EC^{UK} two-year target of 5,000. The second round of applications closed 5 May and the new grant beneficiaries will be announced shortly.

The etb has, under the umbrella of the Engineering Education Alliance, reformed its technicians working group to look at ways of encouraging more people to register as Engineering Technicians (EngTech). The etb will be producing an analysis of existing promotional activities, training opportunities and careers advice available to technicians and those considering registering. In addition, the group believes that research should be undertaken into developing the EngTech to ensure it is aligned with industry qualifications including the Advanced Apprenticeship scheme.

Challenging perceptions

Building on the Department of Trade and Industry's (DTI) *Science in Society* research examining adult attitudes towards science and engineering, the etb has commissioned a qualitative study to examine the importance of perceptions in influencing a young person's career choices. The project builds upon the contribution of the perceptions steering group including the IOP, BA, EEF and Royal Academy of Engineering. The final report is due early summer.

Inspiring young people

The etb is pleased to be working with the IOP on the 2005 schools lecture tour entitled 'Our Planet -Our Future' which aims to show 11 to 16-year old students how the physics they learn in the classroom fits into a wider scientific and social context. The free hour-long interactive talk will increase their awareness of the central role science and engineering will play in building a sustainable future. Ending 3 November the lecture will have been seen by more than 10,000 students, with others having the opportunity to watch it online and on a specially produced CD-Rom available from the etb. **For more information visit www.scenta.co.uk/schoolslecture**

SETNET co-ordinates nationally, through the SETPOINTs, the Science and Engineering Ambassadors (SEAs) Programme which the etb part funds along with the DTI. Some 9,000 volunteers from diverse STEM backgrounds work with young people in the classroom to stimulate their interest in the sector.

Careers have always been an important focus for the etb. Work is underway on a new project looking at how year 9 students (13 to 14) can be better supported with science, engineering and technology (SET) career advice. The etb aims to provide statistically significant findings relating to the subject choices of year 9 students with a focus on their attitude towards science and arts courses, examining the effect of career choices on their future career flexibility and reviewing how they actively seek career information.

Our careers portal **scenta.co.uk** continues to attract high visitor numbers (average of 650,000 per month) and receives content from more than 100 partners including the IOP. We will continue to expand its reach and content with an ambitious project to grow scenta into a robust SET careers information site.

To find out more about the etb's work subscribe to our electronic newsletter *Catalyst* by visiting: www.etechb.co.uk/catalyst

etb
Progress through partnerships

Visit **whatson.iop.org** for the Institute's full online calendar for the physics community or **www.einsteinyear.org** for Einstein Year public outreach events (indicated in **blue**).

JUNE 05

● Your Brain and How to Use It!
INTECH, Winchester, UK
1 June – 30 August
www.intech-uk.com

● Physics in Our Everyday Lives
St Colman's Primary School, Annaclone, Ireland
1 June – 1 October
Kevin Donaghy 028 4067 1363

● Audience Engagement Activity for the Centre of the Universe
Artpoint Trust, Oxford, UK
3–17 June
Louise O'Reilly 01865 248822

Einstein Symposium 2005
Bibliotheca Alexandrina, Alexandria, Egypt
4–6 June
www.bibalex.org/Einstein2005

8th International Conference on Web Handling
Oklahoma State University, Oklahoma, USA
5–8 June
www.engext.okstate.edu/2005call.pdf

CANCUN 2005: Scanning Probe Microscopy, Sensors and Nanostructures
Cancun, Mexico
5–8 June
http://spm.phy.bris.ac.uk/cancun2005

Laser-Driven Plasma Accelerators
The Royal Society, London, UK
6–7 June
www.royalsoc.ac.uk

Central European Workshop on Quantum Optics
Bilkent University, Ankara, Turkey
6–9 June
www.fen.bilkent.edu.tr/~cewqo2005

● 1905: The Annus Mirabilis of Albert Einstein
INTECH, University of Derby, UK
9 June
www.intech-uk.com

ONE-DAY WORKSHOP

Drug Delivery and Diffusion through Polymers
76 Portland Place, London, UK
21 June
Four one-hour talks on the modelling of biological systems, aimed at physicists who have little or no knowledge of the subject. Organised by the Computational Physics Group of the Institute of Physics.
http://conferences.iop.org/DDD

Short Course on Laser Doppler Anemometry
Italian Association of Laser Velocimetry and Non-invasive Diagnostics, Ancona, Italy
9 June
www.aivela.org

● Automatic Person Recognition: Biometrics is the Key of the Future
INTECH, Winchester, UK
9 June
www.intech-uk.com

Biodetection Technologies 2005
The Knowledge Foundation, Baltimore, USA
9–10 June
www.knowledgefoundation.com

Short Course on Particle Image Velocimetry
Italian Association of Laser Velocimetry and Non-invasive Diagnostics, Ancona, Italy
10 June
www.aivela.org

ONE-DAY MEETING

Polymer Tribology
University of Birmingham, UK
23 June
Review of the science and engineering of polymer tribology. Organised by the Tribology Group and the Polymer Physics Group of the Institute of Physics.
http://conferences.iop.org/PTG

Institute of Physics in Scotland AGM
IOP in Scotland, Glasgow, UK
10 June
http://scotland.iop.org

Plasmas, Surfaces and Thin Films
IOP Ion and Plasma Surface Interactions Group, London, UK
15 June
http://conferences.iop.org/PLS

EMRS DTC Annual Technical Conference
Electro Magnetic Remote Sensing Defence Technology Centre, Edinburgh, UK
16–17 June
www.emrsdtc.com/conferences/2005/conferences.htm

European Association of Managers and Research Administrators (EARMA) Annual Conference
National Institute for the Physics of Matter, Genova, Italy
16–18 June
www.earma.infm.it

Biological Surfaces and Interfaces: EuroConference on Biomaterials, Biosensors and Analytical Techniques
ESF Research Conferences, Sant Feliu de Guixols, Costa Brava, Spain
18–23 June
www.esf.org/conferences/pc05187

● Move Over Einstein Exhibition
IOP, The Royal Museum, Edinburgh, UK
19 June – 20 August
www.moveovereinstein.org

First International Symposium on Electromagnetism, Satellites and Cryptography (ISESC 05)
LET Laboratory/LAMEL Laboratory, Jijel, Algeria
19–21 June
www.univ-jijel.dz/Seminaire/ISESC'05/Home.htm

University of Oxford High-Speed Digital Engineering Week 2005
Oxford, UK
20–24 June
www.conted.ox.ac.uk/cpd/electronics

5th International Conference on Non-Accelerator New Physics
Joint Institute for Nuclear Research, Dubna, Russian Federation
20–25 June
www.nanp.ru

Drug Delivery and Diffusion through Polymers
IOP Polymer Physics Group, London, UK
21 June
http://conferences.iop.org/DDD

Surveys of Dark Energy
Institute of Cosmology and Gravitation, University of Portsmouth, UK
21 June
www.sdss2005.info/darkenergy

WFOPC2005: 4th IEEE/LEOS Workshop on Fibres and Optical Passive Components
IEEE/LEOS Mondello, Sicily, Italy
22–24 June
http://leos.cres.it/wfopc

MMD Meeting: Matter, Materials and Devices
INFM, Genova, Italy
22–25 June
www.mmd.infm.it

● Robotic Challenge
Chelmsley Wood Library, Solihull, UK
25 June
Natalie Goulding 0121 788 4370

● Fun with Physics
Shropshire SETPOINT, Shrewsbury, UK
25–26 June
n.moore.epb@connexionsstw.org.uk

Summer School: Instrumental Methods in Electrochemistry
Southampton Electrochemistry Group, Southampton, UK
26 June – 1 July
www.soton.ac.uk/~gd/summerschool.html

einstein year

For full details of Einstein Year events (indicated in **blue**) and to find out what's happening in your area, visit **www.einsteinyear.org/events**.

15th Interdisciplinary Surface Science Conference
Cardiff University, UK
27–30 June
daviespr@cf.ac.uk

Summer School for Physics Teachers
IOP in Scotland/SSERC/universities of Edinburgh and Glasgow, Glasgow, UK
27 June – 1 July
http://scotland.iop.org

High Speed Digital Packet Access (HSDPA 2005)
Vision Gain, London, UK
29–30 June
www.b2b-conferences.com

First ECHEMS Meeting: Electrochemistry in Nanosciences
Venice, Italy
30 June – 31 July
www.chfi.unipd.it/%7Eechems/index.html

JULY 05

● Cosmos and Creation
Winchester Cathedral, Winchester, UK
1–31 July
www.winchester-cathedral.org.uk

● Science Meets Music
University of Edinburgh, UK
1 July – 1 November
Murray Campbell 0131 650 5262

Ultrasound and Other Minimally Invasive Therapies
Mayneord-Phillips Trust, Oxford, UK
3–8 July
http://mpss.iop.org/trust.html

Decommissioning and Radioactive Waste Management
IBC Global Conferences, Cambridge, UK
4–8 July
www.nuclearevents.com

● IOP Schools Lecture: Our Planet, Our Future
INTECH, Winchester, UK
5 July
www.intech-uk.com

MC7: Functional Materials for the 21st Century
Royal Society of Chemistry, Edinburgh, UK
5–8 July
www.rsc.org/MC7

Recent Challenges in Novel Quantum Systems
University of Camerino, Le Marche, Italy
6–8 July
http://fisica.unicam.it/nqs2005

1st International Conference on Diffusion in Solids and Liquids
Aveiro, Portugal
6–8 July
http://event.ua.pt/dsl2005

● Astronomical Inspiration
Institute of Astronomy, Cambridge University, UK
8 July
ljw@ast.cam.ac.uk

Ultrasound and Microsystems: Sensing, Streaming and Resonator Design
Ultrasonic Standing Wave Network, Southampton, UK
8 July
www.ucl.ac.uk/medicine/hepatology-rf/research/usw-net

IVNC 2005: 18th International Vacuum Nanoelectronics Conference
CCLRC, Oxford, UK
10–14 July
www.ivnc2005.org

● Inside Out: the Physics of Medical Imaging
Various venues in Glasgow and Edinburgh, UK
10 July – 10 December
Andrew Reilly 0131 537 1161

ONE-DAY MEETING

Contact, Collaboration and Co-ordination
76 Portland Place, London, UK
13 July
The Consultancy Group of the Institute of Physics hopes to repeat the success of last year's seminar, which attracted more than 80 attendees from a variety of consultancy backgrounds. See www.consultantsjcf.org.uk to view last year's presentations.
http://conferences.iop.org/CCC

Wind Power Summer School
CREST, Loughborough, UK
11–13 July
www.lboro.ac.uk/departments/el/research/crest/education-shortcourses.html

5th International Conference on Inverse Problems in Engineering: Theory and Practice
Engineering Conferences International, Cambridge, UK
11–15 July
www.engconfintl.org/5ai.html

13th General Meeting of the European Physical Society: Beyond Einstein – Physics for the 21st Century
European Physical Society, Bern University, Switzerland
11–15 July
www.eps13.org

Symposium of Surface Physics
Institute of Physics of the Czech Republic/Academy of Sciences of the Czech Republic, Prague, Czech Republic
11–15 July
www.fzu.cz/activities/conferences/ssp10

5th International Conference on Inverse Problems in Engineering: Theory and Practice
Engineering Conferences International, Cambridge, UK
11–15 July
www.engconfintl.org/5ai.html

Wind Farm Connection Issues
CREST, Loughborough, UK
14–15 July
www.lboro.ac.uk/departments/el/research/crest/education-shortcourses.html

● Robotic Challenge
Chelmsley Wood Library, Solihull, UK
16 July
Natalie Goulding 0121 788 4370

● Cambridge Hands-on Science Summer Tour
Kent County Show, Kent, UK
16–31 July
Philip Tuddenham 07816 327 109

● Rocket Science Day
Millfield Arts Centre, Edmonton, London, UK
17 July
Emma Ghafur 07811 255 290

● How Solar Electricity Works
Grosvenor Park, Cheshire, UK
17 July
Bryan Lipscombe 01244 381 580

Workshop on Metamaterials for Microwave and Optical Technologies
University of the Basque Country/Donostia International Physics Center, San Sebastián, Spain
18–20 July
http://dipc.ehu.es/meta2005

SUSY 2005
IPPP, University of Durham, UK
18–23 July
http://SUSY-2005.dur.ac.uk

● 'Make It' Aeroplanes
INTECH, Winchester, UK
25–29 July
www.intech-uk.com

● Summer Holiday Science Trails
INTECH, Winchester, UK
25 July – 26 August
www.intech-uk.com

● Physics in the Community
Visiting Lancashire, Bakewell, Anglesey, Buckinghamshire, UK
26 July – 1 September
Suzanne Phillips 0292 081 3551

Exploring the Garden of Cosmic Speculation

Sam Rae describes an unusual garden in Scotland inspired by physics and cosmology.


Charles Jencks

Combining landscape design with the science of the cosmos may seem a little unusual but, as acclaimed architect Charles Jencks points out, the two have been interlinked for millennia. "If you look at prehistoric works like Silbury Hill and stone circles, those are speculations on cosmic reality. So what I'm doing, in a sense, is the traditional thing," he says.

Jencks spent 15 years creating the Garden of Cosmic Speculation, which he started with his late wife, the landscape architect and author Maggie Keswick, in the grounds of her family home, Portrack House in Dumfries, Scotland. The result is a unique 30 acres where plants and sculpture are used to explore the nature of reality through a series of metaphors.

Every aspect of the design draws on a scientific concept. Mounds and lakes take the shape of chaotic attractors, while giant DNA double-helices sit among the shrubs and herbs of a kitchen garden. In the centre of the garden a set of banana-shaped mounds surrounding a lake represent the multiverse – the idea that there is more than one possible universe. The smallest mound is a failed universe, which suffers gravitational collapse before life has the chance to evolve. Our universe rises from the lake as a magnificent water cascade, tracing evolution from the Big Bang, through the formation of the first stars and planets, to the emergence of life and consciousness.

Jencks is also fascinated by fundamental particles and the traces that they make in cloud chambers. In an area of the garden called the Quark Walk, these elegant swirls are recreated as steel-cable sculptures while carved stone tablets portray the Standard Model of particle physics – with a vacant space awaiting the Higgs Boson.

In celebration of the new sciences of chaos and complexity, Jencks has replaced the linear forms of traditional garden design with fractal shapes. According to him, all of the best art is fractal. "Why are you attracted to a symphony that's always changing the themes? Why is a good novel always fractal in its organisation and why do we like it? Because it's closer to how our perceptions really work than a predictable novel. I think we can learn something deep about the nervous system, about our personalities, when we look at fractals. We live in a fractal universe," he says.

"Every aspect of the design draws on a scientific concept."

The private garden is open to the public for only one day of the year but, fortunately, Jencks's account of his project, newly published in paperback, contains more than 375 colour illustrations and photographs. These include landscape shots, close-ups of details – including a series of well known physics equations that line the top of the greenhouse – and original plans and drawings from the construction of the garden. The stunning pictures make it the ultimate coffee-table book, but it's also a serious read. Jencks's commentary ranges from personal anecdotes to postmodernism, science and philosophy, uncovering the many layers of meaning of this strange and beautiful place.

Sam Rae is part of the Einstein Year team at the Institute of Physics. *The Garden of Cosmic Speculation* by Charles Jencks is published by Frances Lincoln.

particles

Lifting the lid on freezers

We were overwhelmed by the number of responses to **David Taylor's** chest freezer problem in May's *Interactions*. Thanks to all of those who wrote in to explain why the lid is so difficult to lift when he shuts it quickly, but not when he shuts it slowly.

As many of you realised, when the lid is shut quickly, cold air is expelled and replaced by warmer air from the room. As it cools, a pressure difference develops across the door. Chest freezer lids are often quite large, so the force needed to open the lid can be significant. As the seal won't be perfect, the pressure eventually equalises, making the lid easy to open once again.

This can have some amusing results, says Mike Cruise of Birmingham. On one hot day in Spain, he watched customers trying to get at the ice-creams in a chest freezer. "The first person finds it easy to open. Others approach the door, fail, and go back to their seats only to see someone else open it easily a few minutes later. They approach the door again, and the same thing happens. At this point they start looking for the hidden cameras."

But the winner, for producing the most helpful answer, is **Theo Tulley of Hull**, who provided not only the explanation but also a practical solution to the problem. He suggests inserting some fine tubing – about 2 mm wide – in the corner of the lid to relieve the pressure difference more quickly. He wins his choice of a bottle of champagne or £30 worth of Institute of Physics merchandise.

If you have a similarly weighty problem, send it to interactions@iop.org.