The newspaper of the physics community

July 2005

interactions

Institute *of* **Physics**

Dancing to the tune of physics

Ayala Ochert reports on an exuberant celebration of Einstein's theories through dance.

The première of Rambert Dance Company's *Constant Speed* on 24 May at Sadler's Wells was hailed a success by critics and scientists alike. The dance, commissioned by the Institute of Physics, was a colourful and exuberant celebration of the centenary of Einstein's groundbreaking 1905 works.

This unusual collaboration between physics and dance was the brainchild of Jerry Cowhig, the managing director of Institute of Physics Publishing, who came up with the idea almost three years ago.

"At Institute of Physics Publishing we've a strong tradition of supporting the arts. We were looking for a way to make a contribution to Einstein Year, and I thought that dance would be ideal because it's abstract and expressive, it can convey ideas and themes, and it would get audiences. It would also be something different," he says.

When he first came up with the idea, Cowhig didn't dream that it would be picked up by Rambert, the country's oldest dance company and one of the most respected – nor that the company's new artistic director, Mark Baldwin, would choose to choreograph the dance himself.

Tristram Kenton

Two of the energetic "pollen grains" in Rambert Dance Company's interpretation of Brownian motion.

Early on, Baldwin was briefed on Einstein's ideas by lighting designer Samantha McNern, who has a background in physics (*Interactions* June p5). Later on the Institute introduced him to Ray Rivers, professor of theoretical physics at Imperial College, London. With his help, Baldwin got to grips with Einstein's three seminal works on Brownian motion, the photoelectric effect and special relativity.

"Prior to starting this project my knowledge of physics was basic. As well as enlightening me about ideas I never knew existed, it has given me a new awareness of how far physics reaches into our daily lives," says Baldwin. "During this process I also discovered just how compatible dance and physics are. Both have the ability to fire the imagination and question the world around us."

Of the three works, Brownian motion lent itself most easily to expression through dance. In the final performance the dancers move about the stage like pollen grains on the surface of a pond "as if jostled by unseen forces". But everyone involved with *Constant Speed* is clear that it is not a literal representation of Einstein's physics. "You're not getting a physics lesson," says Cowhig.

The photoelectric effect is represented in *Constant Speed* by the colours of the dancers' costumes and through McNern's stage lighting. The idea that blue photons have more energy than red ones is conveyed by the powerful entrance of a female dancer dressed in blue. Against a black backdrop the entire stage is bathed first in red light, then in blue light. In the finale, a large mirror ball appears on stage, scattering light across the theatre in discrete packets to represent photons. At the very end, all 19 dancers (almost the entire Rambert troupe) appear on stage in a full spectrum of colours.

Einstein's most famous theory, special relativity, was harder to convey through dance, although the title of the piece refers clearly to it. Baldwin tried to capture the idea of time moving at different rates for different observers, with groups of dancers moving quicker or slower across the stage simultaneously.

The costumes, created by the acclaimed set designer Michael Howells, were meant to evoke the late 19th century, when Einstein was formulating his ideas. The music, by composer Franz Lehar, was also chosen from the period and provides an energetic and, at times, comic setting for the dance. At the première the audience laughed out loud at some of the circus-like antics of the dancers.

The new dance performance was received enthusiastically by the arts community. The *Sunday Telegraph* called it a "hugely imaginative commission from the Institute of Physics", while the *Observer* said that "Baldwin succeeded in making everyone marvel at the wit and beauty of Einstein's theories".

Scientists were also impressed with the final product. "In a word, the performance was stunning. The idea of using colour to illustrate the energy of photons was inspired," said Sir John Enderby, president of the Institute. Cowhig said he was thrilled with the performance: "I loved the movement, the colour, the use of music – the whole experience. I am astonished that the project went so well from start to finish, and the ultimate accomplishment was so much more than I could have dared hope."

Constant Speed goes on tour around the UK from September and in spring 2006. Wherever it goes, Rambert will also be running workshops for secondary-school students, who are the main target audience for Einstein Year. The company has a well established education programme that aims to enthuse young people about modern dance. With *Constant Speed* it is joining forces with the Institute to help them to appreciate the physics behind the dance, too.

"This unique collaboration is bringing ideas from physics to people whom we might not normally reach. We hope that it will inspire at least some to wonder about how the world works," says Cowhig.

www.rambert.org.uk

CONSTANT SPEED

AUTUMN 2005

- **The Lowry, Salford**
  21–24 September
- **Wycombe Swan, High Wycombe**
  28 September – 1 October
- **Bristol Hippodrome**
  5–8 October
- **Norwich Theatre Royal**
  12–14 October
- **Milton Keynes Theatre**
  2–5 November
- **Sadler's Wells, London**
  15–19 November
- **Edinburgh Festival Theatre**
  23–25 November
- **Theatre Royal, Plymouth**
  30 November – 3 December

SPRING 2006

Dates to be confirmed

- **His Majesty's Theatre, Aberdeen**
- **Theatre Royal, Newcastle**
- **Hall for Cornwall, Truro**
- **The Marlowe Theatre, Canterbury**
- **Clwyd Theatr, Cymru Mold**
- **Theatre Royal, Brighton**
- **Birmingham Hippodrome**

einstein year

www.einsteinyear.org

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Sandra Chapman, p5

"I have to admit I enjoyed the film. In fact I found it rather funny."
Jim Al-Khalili, p8

HIGHLIGHTS

Holograms detect digital fraud

Is that photo in the headlines real or has it been doctored just to sell more newspapers? With the advent of digital imaging technology, that's a question that's increasingly being asked. Now, physicists at the University of Roma Tre say they have a way of answering it. Writing in the *Journal of Optics A*, which is published by the Institute of Physics, Giuseppe Spagnolo and his colleagues describe a digital "watermark" that shows whether – and how – a photograph has been tampered with. The watermark is a computer-generated hologram that is embedded in the photo, but which is invisible to the human eye, appearing simply as random "noise" in the image. Any changes to the photograph damage the watermark, proving that the photo has been modified.

"We hope that this technique can be used to improve the reliability of photographs in the media," says Lorenzo Cozella, co-author of the paper. "Digital cameras could be developed so that an invisible watermark is added when a picture is taken. A newspaper buying a photo from a freelancer could then check for a watermark to confirm that it hasn't been tampered with to make it more newsworthy." The system could also protect images used as evidence in court.

Sheffield students discover art of physics

On 18 May the physics department of the University of Sheffield opened its doors to the public for an exhibition of works by local artist Chris Crossley, who has been inspired by physics and astronomy and particularly by Einstein. The event, which was part of Einstein Year, included a series of short talks for the adults and hands-on "physics in a box" demonstrations for the 50 schoolchildren who attended.

Tim Searle, a physicist at Sheffield, said: "It was a great opportunity to introduce some of Einstein's ideas to young people and to show them that science and art needn't be kept apart." The event, which was co-sponsored by the Institute, will be repeated across the region.

Seeing with neutrons

The power of neutron-beam scattering to explore the structure of all kinds of materials is the subject of the latest paper in the Institute's "Visions" series. There are now 15 Visions papers, on subjects ranging from quantum information and superconductivity to flat-screen displays and physics in finance. The series is aimed at raising awareness among opinion formers and policymakers about dynamic areas of research in physics and their theoretical and technological implications. "Seeing with neutrons" explains the basics of neutron scattering and describes the current facilities in the UK and Europe for producing them. It also highlights the need for a more powerful facility to be built in the coming decades.
http://policy.iop.org/v_production

Galactic Gig tours the north

In June the Lancashire & Cumbria Branch of the Institute toured the region with their Galactic Gig – a musical for primary schoolchildren that aims to teach them about physics. Written and performed by members of the branch, the musical stars an extraterrestrial called Zubi who arrives on Earth from the planet Zuben-el-Genubi. His world has no air, so Zubi is unable to hear sounds, but he meets two Earth girls who teach him about it as the three travel around the solar system.

Albert Einstein narrates the show, which is followed by physics demonstrations and experiments. "The children were enthralled, both with the drama and the hands-on experience," said Chris Bowdery, chair of the branch. "The hope is to create a spark of interest in science, and particularly physics, at an early age."

Time Lords open up their doors

Physics student Alice Perrett has won the opportunity to undertake work experience with a Time Lord in a competition that will mark the 50th anniversary of the invention of the atomic clock.

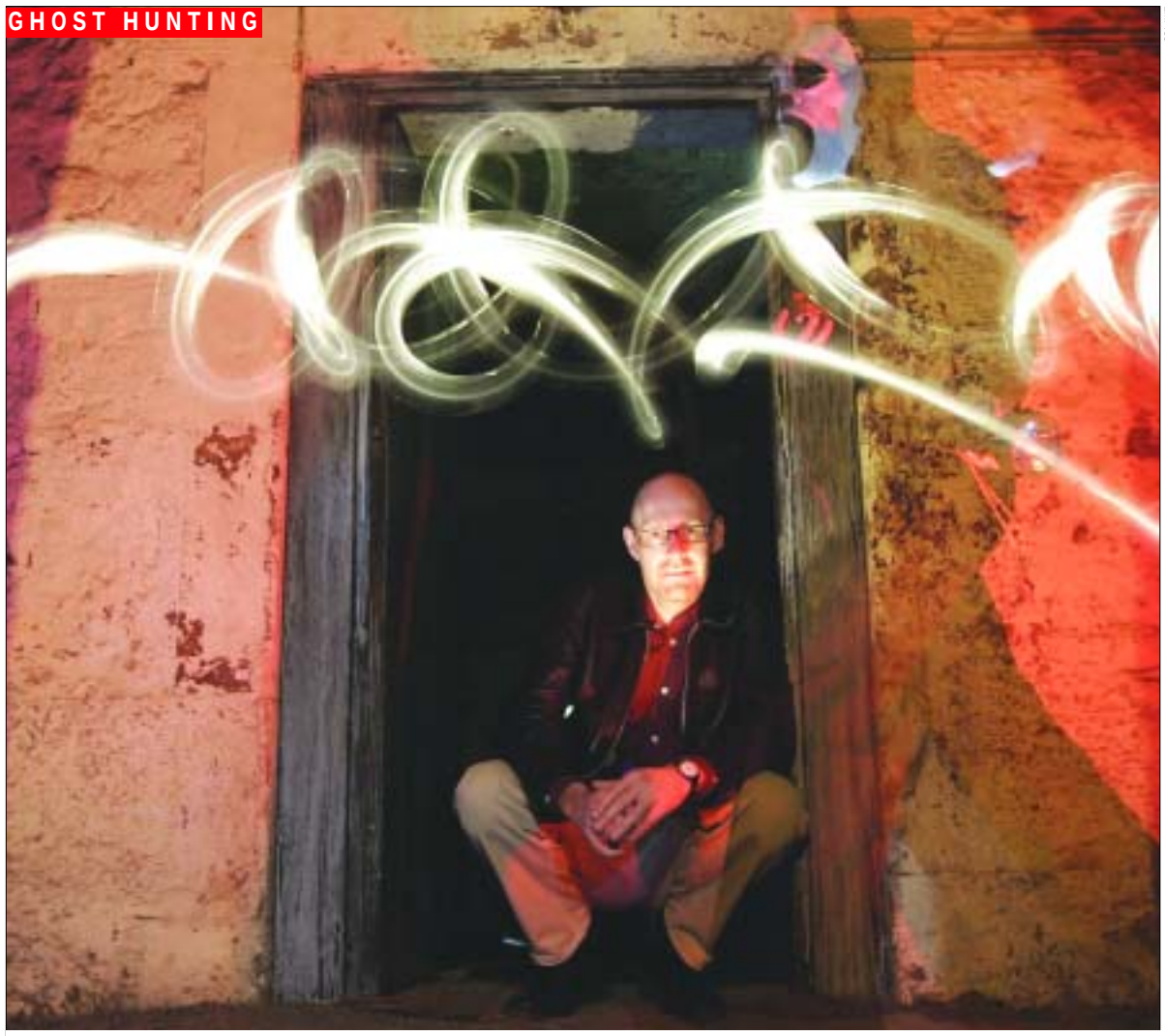
The Einstein Year competition was organised by the Institute and the National Physical Laboratory (NPL) in Teddington, where Perrett will spend the summer with the scientists responsible for maintaining the UK's atomic timescale and contributing data to support international time standards.

To compete for the prize, entrants had to complete the sentence: "If I could freeze time for 10 minutes, I would..." To encourage imaginative entries to last month's competition, television presenter Adam Hart-Davis was asked to describe his ideal time-freezing scenario. He said: "I would arrange to be in the most beautiful place I could imagine – perhaps a corner of Sri Lanka, or Kashmir, or the Big Island of Hawaii. I would round up a beautiful bunch of people and eat a delicious meal, then throw the switch."

Perrett wrote: "If I could freeze time, I would confirm once and for all whether it is arrow-shaped or not." The judges liked the way her answer played on the "arrow of time" metaphor, first coined by the ancient Greeks, but also contained a serious question about whether time has a direction. The runner-up prize of a binary watch went to Lynda Nwicke, who said she would go diving with endangered species on the Great Barrier Reef.

NPL developed the first accurate caesium atomic clock in 1955, which led to the internationally agreed definition of the second being based on atomic time.

GHOST HUNTING



EMPICS

Psychologist Richard Wiseman at one of the allegedly haunted locations in Mary King's Close, Edinburgh, where he has been conducting a scientific investigation into ghostly apparitions. Wiseman suspected that people who report ghostly sensations have been affected by infrasound, magnetic fields and changes in humidity and lighting, as well as their own expectations. This was partly borne out by the results of the experiment – an Einstein Year activity conducted during the Mary King's Close Ghost Fest in May. Around 70% of those visiting the "haunted" locations reported unusual phenomena, compared with 48% in control locations. However, 70% of those with high expectations of experiencing such phenomena did so, compared with 50% of those with low expectations. Environmental factors also played a part. Full results are at www.ghostexperiment.co.uk.

Patent physicist is a science star

by Ayala Ochert

Mark Lewney, a physicist from Cardiff, is the winner of FameLab – the science world's answer to *Pop Idol*. Lewney beat 11 other finalists in the competition, which was launched to find the next generation of science communicators, on 11 June at the Cheltenham Festival of Science.

Altogether 334 contestants across the UK vied for the title and the prize of £2000 as well as the chance to appear as a science presenter on Channel 4.

Appropriately enough for a competition taking place in Einstein Year, Lewney works in the UK Patent Office. His PhD from the University of Cardiff was on the acoustics of the guitar, and he used this as the basis of his audition – a demonstration of the physics of music, including sections from Vivaldi and Deep Purple played on his electric guitar.

Writer Simon Singh, one of the judges, called his performance "gob-smackingly amazing". Hamish Mykura of Channel 4, also on the judging panel, said: "The reaction of the audience in the final spoke volumes. They loved Mark – he left the opposition behind. This is exactly the kind of talent that works on TV."

As with *Pop Idol*, the audience helped to choose the winner by eliminating two out of the last six finalists. The runners-up, chosen by the judges, were David Booth, an evolutionary biologist, and Matt Wilkinson, a zoologist.

Physicist Kathy Sykes, director of the Cheltenham Festival of Science and a well known TV science presenter, said: "I have been overwhelmed by the level of interest in FameLab. Hundreds of people entered, revealing a thriving community of talented scientists in the UK committed to communicating."
www.famelab.org

Making physics appeal to girls

Ayala Ochert looks at research that examines the factors that attract girls into the subject.

Two forthcoming reports commissioned by the Institute are tackling head on the question of why so few girls continue with physics after age 16. Together they will form an authoritative set of recommendations for how best to encourage girls to stick with the subject.

The first report is a comprehensive review of the last 30 years of research into girls and physics. Written by Patricia Murphy and Elizabeth Whitelegg of the Open University, it looks at studies done in the UK and abroad. The second report, entitled "Yes, she can!", is a more qualitative survey of best practice in physics teaching and is drawn from schools that have been particularly successful. It was written by former schools inspector Bob Ponchaud.

The reports agree that there is no single answer but that "girl-friendly" teaching styles combined with a "can do" culture make a significant difference. "Schools that were successful were those that engendered self-belief rather than stereotypical views that imply that girls struggle with physics," says Ponchaud. Students need to feel confident that they can succeed in the subject, but this appears to be especially important for girls. Those who carry on with physics after 16 generally have higher grades than the boys who do so.

Girls tend to find physics less relevant to their lives than boys do, and this can lead to a decline in their interest. Girls are also more interested in the social applications of the subject and respond well to approaches that set physics in its social context. These alternative approaches have led to improved performance for both girls and boys, and have increased the proportion of girls doing well.

Hamington Photography

The reports looked at single-sex groupings, which are used by some mixed schools, particularly for practical work.

The question of single-sex teaching remains a thorny one. While Ponchaud found that the best single-sex schools are much more successful with girls than mixed schools, the authors of the Open University study concluded that these differences are because more single-sex schools are selective. There was some evidence that single-sex groupings – for example for practical work – can make a difference, but more research is needed in this area, say Murray and Whitelegg.

Another common finding was a lack of awareness among teachers of the gender issues in their classrooms. Although teachers give significantly more attention to boys than to girls, they are rarely aware of this. Teachers also tend to have lower expectations of girls than of boys.

"What surprised me most was just how 'male' the teaching is in physics," says Ponchaud. He adds that the teacher's style of questioning is important. Girls tend to respond better to discussions than to closed questions requiring brief, factual answers. They also appreciate being put in groups rather than being put on the spot, he says. Both studies recommend that teachers are trained to make them more aware of how they relate to each sex.

Over the summer the Institute will compile a list of recommendations and a set of tools to send to teachers. "We know that girls can succeed at physics. What we haven't known is why so few choose to continue with the subject," says Daniel Sanford-Smith, the Institute's education manager. "These reports start to answer this question and suggest strategies for teachers to make physics more appealing to girls."

Women physicists meet in Brazil

By Julie Corbett

Rio de Janeiro welcomed 145 female (and a few male) physicists on 23 May for the 2nd IUPAP International Conference on Women in Physics. The meeting followed the highly successful 2002 conference in Paris, which prompted the UK to tackle the issue in a more coordinated and determined manner and to start dedicating significant resources to it.

The Rio conference reviewed progress in the last three years and focused on a number of themes, including how to attract girls into physics and how to get more women into leadership positions in physics. Aihua Xie of the American Physical Society also gave an uplifting review of progress in the US. The recommendations will be presented to the International Union of Pure and Applied Physics (IUPAP) general assembly in South Africa in October.

Institute sells off books division

By Heather Pinnell

The publishing arm of the Institute of Physics has sold its books division to the Taylor & Francis Group. Transfer of the list of 600 titles, including responsibility for their sales, marketing and ordering, took place on 1 July. The sale is part of the strategy of Institute of Physics Publishing to concentrate on its core activities – journal and magazine publishing.

Managing director Jerry Cowhig explained that there has been a trend away from book publishing by learned societies. The British Medical Association and the Institution of Mechanical Engineers, for example, have recently sold their own book-publishing divisions because it has become difficult for small publishers to offer the level of service that authors, distributors and booksellers now expect.

"I would like to assure the Institute's members that their publishing company is strong and growing, and will continue to serve them and to serve physics," said Cowhig. "This decision reflects the refocusing of our energies into the areas where we feel we are best equipped to fulfil the mission of the Institute.

"At the same time we feel that the kind of physics books we were previously publishing will flourish at their new home in Taylor & Francis."

Book publishing has always been a relatively small part of the Institute of Physics Publishing's activities, with approximately 50 book titles being produced per year.

The company's journal-publishing business, meanwhile, has roughly doubled in output in the last five years, and it has recently opened offices in Japan, Russia, China and Germany. "We want to expand the range and quality of the journals that we publish to expand our influence around the world and do more work in the areas where we are strong," Cowhig added.

Robert Kirby-Harris, chief executive of the Institute, said: "The Institute is dedicated to the advancement and dissemination of knowledge and education in pure and applied physics. Taylor & Francis has a distinguished tradition of publishing excellence in physics that dates back to its founding in 1798. We believe that it will take forward and develop this extensive list of titles for the benefit of the physics community."

Taylor & Francis will offer a 25% discount on physics titles to Institute members who order via the Internet. All new titles will carry the Taylor & Francis imprint but returns will be handled by Institute of Physics Publishing until 31 October. Books currently in print will continue to be published under the Institute's imprint.

IN BRIEF

A scheme to encourage UK universities to demonstrate their commitment to **advancing the careers of women in science** and increasing the number of women in top posts was launched in June. Universities that sign up to the Athena SWAN Charter – an initiative of the Athena Project at the Royal Society – pledge themselves to take action to address gender inequalities in science at a departmental and an institutional level, and to monitor and report on their progress in doing so. Signatories to the charter can go on to apply for bronze, silver or gold SWAN awards, which recognise different levels of progress in meeting their pledges. The charter won the Institute of Physics prize in the 2003 Royal Society Athena Awards and the Institute also hosted last month's launch.

NEWSMAKERS

The 2005 Royal Society Rosalind Franklin Award has been given to Christine Davies, professor of physics at the University of Glasgow. She was the first woman in the UK to become a professor in theoretical particle physics and the award was given for her proposal to develop a public lecture to highlight the role of female scientists and inspire a younger generation of women.

Among 44 new fellows of the Royal Society elected in May was Douglas Ross (left), professor of physics at the University of Southampton. Other physicists elected fellows were Robert Evans, professor of physics at the University of Bristol; Philip Russell, professor of physics at the University of Bath; Michael Morgan, professor of visual psychophysics at the City University, London; and Paul Cokum of the National Research Council of Canada.

Peter Knight, head of physics at Imperial College London, received a knighthood in the Queen's Birthday Honours last month in recognition of his services to quantum optics.

Other Institute members honoured were David Pettifor, director of the Materials Modelling Laboratory at Oxford University, and Adrian Mears, former technical and research director at QinetiQ, who both received the CBE. Receiving the OBE were Gillian Gehring, professor of physics at the University of Sheffield's department of physics and astronomy, and David Saxon, Kelvin Professor of Physics at the University of Glasgow.

John Morton has been appointed chief executive of the Engineering Technology Board. He was previously strategy director of the future systems technology division at QinetiQ.

Carbon trading is just the first step


Tom Burke

"Much has been made of the supposed 'omission' of the developing countries as a major flaw in the Kyoto Protocol."

Like all good theories the theory of emissions trading is an elegant one. Governments establish an overall limit of the amount of a pollutant that can be emitted. Enterprises are then allocated permits to emit the pollutant up to that limit – the "cap" – and companies cannot emit the pollutant unless they have a permit to do so. Those that reduce their pollution below the amount that they have been allocated may sell the unused portion of their permit – called a "credit" – to anyone who has been unable to keep their pollution within the limits of their own permit. In theory, this is a cheap and efficient way of reducing the pollution to the desired level.

Since 16 February 2005 this rather arcane mechanism for pollution control has become the focus of growing debate. On that date the Kyoto Protocol came into force, and at its heart is a global "cap-and-trade system" for controlling the emissions of greenhouse gases – in particular, carbon dioxide.

A bargain was struck in which the richest countries would act first by limiting their emissions – because they are largely responsible for the carbon dioxide increases until now – and, later, developing countries would join in. Much has been made of the supposed "omission" of the developing countries as a major flaw in the Kyoto Protocol. Actually, all of the industrialised nations, including Australia and the US, agreed to this approach from the beginning.

To encourage everyone to join in, the initial cap was set within relatively easy reach and countries agreed to proceed in a series of stages. This allows for the cap to be tightened as experience drives down the cost of compliance and as the science becomes more certain. To lower the cost of compliance and pave the way for future participation by the developing countries, three so-called flexibility mechanisms were agreed – emissions trading, the Clean Development Mechanism and Joint Implementation.

Modest targets may not be met

Under the protocol the industrialised countries as a whole have agreed to reduce their greenhouse gas emissions to 5.2% below 1990 levels by the end of 2012, with each country negotiating a specific target to achieve this overall goal. Those countries that have ratified the protocol are entitled to join the international emissions trading system to buy carbon credits to fill any anticipated shortfall in meeting their target. The theory is that the overall reduction will then be increased step by step until greenhouse gas emissions have been reduced to a level that avoids dangerous anthropogenic climate change.

So much for the theory. In practice there are two major flaws with this apparently elegant approach. First, it was extremely difficult to get agreement even to this relatively small reduction in emissions. Nevertheless, there are still considerable doubts about whether the industrialised countries will in fact meet their commitments. And there is no political appetite for starting negotiations on the next stage, which would put even stricter limits on emissions. Worse still, two major emitters – Australia and the US – have jumped ship and refused to ratify the protocol.

The second flaw is even more serious. We don't have enough time for the protocol to work. The future of the climate is determined by two ticking clocks. The first is the rate at which carbon dioxide is accumulating in the atmosphere – currently about 1.8 ppm per year. The second is the rate at which the world is building conventional coal-fired power stations – currently about 5 GW a month. At this rate it will be just 12 years before we reach a carbon dioxide concentration in the atmosphere of 400 ppm. At this concentration a dangerous increase in global temperature of 2 °C by 2100 will become very likely.

This makes it vital that the G8 leaders meeting in Gleneagles this month add considerable political momentum to our current response to climate change. Emissions trading may well be a necessary measure for tackling climate change, but it is a long way from being sufficient. In particular, we must change the technology trajectory of current planned investment in 1400 new coal-fired power stations over the next 25 years. If these are built with conventional technology there is no hope of the world maintaining a safe climate. If they are built using advanced coal technologies, with carbon capture and storage, then we still have some prospect of stabilising carbon dioxide concentrations at safe levels. But it will require a willingness to spend public money to change that trajectory.

Some 600 of the planned power stations will be built in China. At Gleneagles the EU must give a clear signal that it is willing to work with China to deploy advanced coal technologies rapidly. Carbon trading will not be enough to avert dangerous climate change. We must also invest – and soon.

Tom Burke is a visiting professor at Imperial College and University College London and a co-founder of E3G, Third Generation Environmentalism.

focal point: mentoring

How to find a more rewarding relationship

The Institute currently has more members actively involved in developing their careers than ever before. To meet this increase in interest we have been busy adding to our career-development resources, starting with mentoring.

The physics community seems to be firmly divided into two groups – those who know about mentoring and are actively engaged, either as mentors or mentees, and those who are not yet clear why they should get involved.

For those who haven't yet had the chance to find out for themselves, mentoring is a relationship that benefits the mentor as much as the mentee. Mentors help to develop the mentee's skills by sharing their experience and knowledge with them during one-to-one meetings. In fact, many people have mentors without even realising it. Anyone whose advice you trust and whom you seek out to discuss new ideas could be considered a mentor. Mentees not only gain new knowledge but also learn new approaches to problem solving, while mentors develop their own communication skills and enlarge their network.

Many Institute members are already benefiting from mentoring – often as part of Institute-accredited trainee schemes at their workplace. James Phillips of Devonport Management is one such member. "My mentor really supports my career. He has often jogged me to identify training needs and areas for personal development," says Phillips. "Most recently he helped me to think about my next steps and as a result I feel much more focused about the future."

For now we're concentrating on producing materials to help those already aware of mentoring to form a partnership and ensure their meetings are as productive as possible. We've produced a "how to" guide to mentoring with templates to help to record meetings. Copies are free to members (£10 to non-members) or can be downloaded at **http://careers.iop.org/mentoring**.

Apart from publishing the guides, we're also running training sessions for groups and branches to explain more about how members can benefit from mentoring. We'll be in Bristol and Plymouth in October and may be coming to a branch near you. As awareness of mentoring grows among members, we hope to set up a database to match potential mentors with mentees. This should be of particular use to members in remoter areas or those working as the only physicist within their company, by helping them to access support and guidance from people who understand their background.

If you're interested in your own professional development then you can learn more at our annual conference, PD2005, which will be held on 24–25 October 2005 in London. We'll be discussing communication skills and how to avoid stress – subjects that often come up in mentoring meetings. For more details go to **http://careers.iop.org/pd2005**.

Alex Byrne is the Institute's professional standards manager.

profile: Sandra Chapman

Thinking in pictures

Ayala Ochert meets an astrophysicist realising her dreams in paint.

Sandra Chapman surrounded by some of the pictures that she has created to capture her vision of Antarctica.

From the age of eight Sandra Chapman knew that she wanted to be an astrophysicist. While she watched the moon landing on television, then and there she decided on her future career. Deep down she wanted to be an astronaut but, realising even then that "women didn't really get to go", she thought that it would be wonderful to be involved somehow in the whole enterprise.

It was a decision that served her well. At just 39, Chapman became a professor of physics at the University of Warwick, where she also heads its Space and Astrophysics Group. She is one of fewer than 30 women professors of physics in the country.

When she first arrived at Imperial College, London as a physics undergraduate she hoped to become an astronomer, but along the way she fell in love with electromagnetism. "I'm a spatial thinker; I think in pictures. And the particular kind of mathematics in electromagnetism – vector fields, vector operations – is very spatial, so it suits my way of thinking," she says.

Chapman doesn't just think in pictures; in her spare time she also creates them. Alongside physics she has always practised art and over the years she has brought her two passions closer together. Nowadays she explicitly tries to capture how she visualises physics. "I used to paint landscapes. Now it's very much landscapes of the mind," she says.

According to Chapman, art and science are more similar than one might think. "Both are in pursuit of some sort of absoluteness, and in their practice I don't think they are so different," she says. "Physicists choose problems according to taste as much as anything – we make an aesthetic choice."

The process of coming up with an idea – in physics and in art – is the same, she says. "You load into your head all of the ideas and information, then go off and do something else, and the idea just comes out of the blue. You don't know where it comes from – it's just there. With painting, you get the same experience when you figure out how to realise the thing on paper. For me it's so fast, it feels as if it's not my own idea."

Last year, Chapman got the opportunity to explore the connections between science and art when she spent several months in the Antarctic as a Dream Time fellow for NESTA (National Endowment for Science, Technology and the Arts). She was attracted to Antarctica because of its remoteness and because it represented the idea of exploration, the last frontier. "For me it's the next best thing to space," says Chapman.

After all this time she still dreams of going into space. "I'd probably try to go as an artist now rather than a scientist because my work is too theoretical," says Chapman. "Part of the reason I went to Antarctica as an artist was because I wouldn't get to go as a scientist. I'm a theoretician, so I'm absolutely useless to them out there. As an artist I'm useful."

Chapman is a plasma physicist whose expertise is in complex systems. She's studied everything from comets to black holes and is currently working on solar-wind turbulence. "These are very different systems but the same kind of ideas apply," she explains. "Plasmas are messy and there's a lot of different physics going on, yet they show some very generic behaviour. The theory of complex systems is a very powerful set of ideas because in principle it describes population dynamics, flocking behaviour, how people vote." Her thoughts about turbulence are reflected in the art she is currently producing. "My paintings now are a kind of controlled randomness."

"I want people to see that physics is beautiful."

Her perspective as a scientist makes her art very different from traditional "sci-art", which is usually produced by artists looking at science from the outside in, says Chapman. "For me the beauty of maths is very visual, and I want people to see that physics is beautiful. It's a different way of sharing with people what physics is rather than just standing up and giving a science talk. It's another dimension that people can experience."

Emphasising the beauty and creativity in physics might have other benefits – it might attract more women into the field, says Chapman, who thinks that physics is often portrayed as very "mechanistic". Although she's experienced success as a woman physicist, she is keen to improve the situation for others and is on the committee of the Institute's Women in Physics Group. In 2002 she went to Paris for the first IUPAP Women in Physics conference, which she says was an eye-opening experience. "It was all women physicists and there was a different atmosphere. The culture in physics is definitely a macho one, and debates can be very confrontational. If there were more women, I think it would be less adversarial."

OBSERVATIONS

Graeme Langlands describes his experience of working on Lab in a Lorry – a project that aims to inspire young people with hands-on science experiments.

For me it was Johnny Ball, Heinz Wolff and a science teacher called Taj Kowalczyc. These were the people who first fired in me that spark of interest in science. And that was why I wanted to get involved with Lab in a Lorry. In this world of MP3 players and mobile phones, young people think there's nothing left to invent or discover. So we need to help the next generation of scientists to find that spark. The lorry is the brainchild of one of my colleagues at Schlumberger Cambridge Research. When I heard that they were looking for volunteers, I jumped at the chance.

6 April

The training session at the Cavendish was unusual as we had film crew hanging around. We were put onto the experiments cold and left to work them out for ourselves, which is ideally how you'd like the kids to do it. We managed to get fractals using glycerol, a spiral rainbow and interesting birefringence patterns in Perspex. We didn't get to see a wine glass break as there were software problems, but this reinforced the principle that experiments in science don't always work.

18 April

The dry run was at Netherhall School in Cambridge. When I turned the corner and saw a huge, brightly painted lorry for the first time, it brought a big, stupid grin to my face. Inside was even more impressive.

I was assigned to the Reluctant Oil Well experiment, which introduces the problem of getting crude oil out of the ground. The crude is represented by a lovely sticky mixture of glycerol and green poster paint. The kids use syringes to suck up the "green goo" – a good demonstration of how difficult it is to get viscous liquids moving. We then asked the kids the best way of emptying the "well". Suggestions ranged from sucking the goo out with a syringe (the same way they pumped it in) to breaking open the container. Eventually they worked out that they needed to pump air in to displace the goo, which is exactly how we do it in the field. They also found that if they pumped very fast they could create wonderful oak-leaf fractal shapes. The experiment is a real favourite with the volunteers and the kids. It's fun, interesting and you get to make a mess.

The kids were great – keen and curious. The teachers seemed genuinely impressed with the whole set-up. Even the art teacher breezed in, looked round, said "marvellous" and breezed out again.

18 May

The lorries were parked outside the lovely old sandstone façades of W1, in front of the Institute of Physics. In the morning would be the press launch of Lab in a Lorry; in the afternoon members attending the Annual Representative Meeting would get their first look at the lorries. The kids – this time from a school in London – were great again, and the teachers couldn't have been happier. There's enough to do in the lab to keep people entertained for at least an hour and a half.

The afternoon was also fun and gave me the chance to explain the experiments to a whole new audience. After the members left, I spent the rest of the afternoon accosting members of the public with John T Barnum calls of "Science! Roll up, roll up!". Everyone who came aboard seemed impressed and all left with a better opinion of science.

I hope this wasn't my last turn on the lorry. It would be great to tour the country like Mick Jagger in a lab coat. Getting covered in green goo – and enthusing the next generation of scientists while you're at it – is a great way to spend an afternoon.

To become a volunteer for Lab in a Lorry, visit www.labinalorry.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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LETTER FROM

...the Einstein Year coordinator

I'll try to refrain from making any relativity jokes, but time really is flying by. We're half-way through Einstein Year already, yet it seems like only five minutes ago that I was standing in the Science Museum feeling the breeze of a BMX bike whizzing over my head and wondering what I'd let myself in for.

January's Einstein Flip set the tone for Einstein Year, and activities over the past six months have continued to feed into the interests of young people. There's been the Move Over Einstein exhibition, which is touring the UK; the Ghost Experiment, investigating alleged hauntings in Edinburgh (p2); the Ipswich Town Sports Day, where 400 kids explored the physics of sport; the Universe poetry competition; and much more.

Physicists across the country really have risen to the challenge laid down by Sir John Enderby in *Interactions* last September to get involved and organise their own activities. In the first quarter of 2005 more than 60 000 people took part in more than 350 Einstein Year activities.

These figures include many of the local activities funded through the Einstein Year grant scheme – which has supported 48 superb projects – or via the Institute's branches, delivered by physicists like you. The Merseyside Branch has been helping local students to search for asteroids; Averil Macdonald in Wokingham used puppets to explain relativity to children as young as six; and Allen Rowe of SETPoint Cambridgeshire got young people across the county building radios.

Einstein Year is going well, but it could be even better – it's not too late to get involved and share your passion for physics with your local community. The website www.einsteinyear.org contains ideas and resources to spark your imagination. The Physics To Go pack gives you all of the information you need to run an event at a supermarket, pub, summer fête or motorway service station. And once you've got your activity arranged, don't forget to enter the details on the website's events database.

At midnight on 31 December 2005, Einstein Year will be over but the challenge of inspiring young people about physics won't come to an end. Ultimately we can only judge Einstein Year a success if there is a sustainable increase in engagement between physicists and the public. So now's the time to start thinking about how you can make a difference in the perception of physics – not just this year, but for the future.

Caitlin Watson is the programme manager for Einstein Year **www.einsteinyear.org**.

Military right or wrong

I have just read "The real cost of military research" (May p4) and would like to commend you for including such an informative piece, which raises issues that are not normally discussed in mainstream publications.

As an undergraduate member of the Institute thinking about future careers, I am concerned at the influence of military interests in physics research. I would hope that scientists consider the full implications of their research and try to ensure that it is destined to improve the lives of all people. I think that there needs to be much more discussion on the purpose and funding of physics research and a more stringent ethics policy.

Gareth Haslam
Durham

As director of research and technology at Rolls-Royce plc, I must correct some damaging inaccuracies in Stuart Parkinson's article. He insinuates that the Rolls-Royce University Technology Centres (UTCs) are used exclusively for military research and are somehow under the control or influence of the Ministry of Defence. Rolls-Royce is a major global power systems company operating in civil aerospace, military aerospace, marine and energy. Only one-third of its products and activities are focused on defence.

There are now 25 UTCs worldwide, which service all aspects of Rolls-Royce technology. Far from being dominated by military research, the majority of their work today is focused on environmental protection through programmes aimed at CO_2 reduction, reducing NO_x emissions and cutting aircraft noise. Their success has been noted in the DTI Innovation Report and by the Lambert report on business and university interaction.

Richard Parker
Derby

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.

INTERACTIONS READER SURVEY

Your views on *Interactions*

It's exactly a year since the first *Interactions* was published. In that time we've kept you informed about the many activities of the Institute of Physics – from the Paperclip Physics Competition to our survey of members' salaries and including the groundbreaking Physics 2005 conference in April. Of course, this year there have also been the many exciting events of Einstein Year to report on.

We've also tried to keep you up to date with issues that matter to the physics community, from nuclear waste to nanotechnology. In each issue we've also profiled interesting members of the community, including engineer-turned-physics teacher Terry Winterton and science communicator Wendy Sadler. We hope we've entertained a little, too, with our back-page section "Antimatters" and its reviews, puzzles and fun experiments for children.

Some of you have written to let us know what you think about what we're doing, but we'd like to hear from more of you. So keep sending the letters, but please also take a moment to fill in our reader survey at http://surveys.iop.org/interactions. It will help us to know if we're on the right track and how we can improve *Interactions* for all of our members. There's also the chance to win one of five 256 MB data sticks. We look forward to hearing from you.

interactions IS ON HOLIDAY IN AUGUST BUT BACK IN SEPTEMBER

notices

NEW MEMBERS

Mercedes Alcon-Camas, Thomas Babbedge, Christopher Bates, Ian Blenkinsop, Mark Bowden, Iain Brown, Paul Burnham, Matt Chessher, Rory Clarke, Gianfranco Claudio, Paul Cooper, Robin Dickson, Stuart Finan, David Gillingham, Haley Gomez, Mark Hadley, Robyn Halford, David Hall, James Harries, Tim Hely, Buddhika Hewakandamby, Anne Hoath, Lara Howlett, Andrew Jaffe, Dewi Johns, David Jones, Lin Ke, Robert Lamb, James Libby, John MacPhail, James McIntyre, Cristinel Mares, Koshy Matthews, Peter Moran, Lynn Mulelly, Patricia Nunn, Habib Pathan, Carlos Perez Aparicio, Aleksandr Ryasnyansky, Mohammed Sanduk, Pradeep Sharma, Michael Skegg, Andrew Stewart, Martin Symons, Andrew Turner, Jitesh Vadhia, Malini Vieyra, Karl Virden, Darren Wallace, Neil Warfield, Grant Watson, Stephen Weatherley, Jonathan Whybrow, David Wilkinson, Richard Willis, Tomasz Zarebski, Shanju Zhang, Qiang Zhao.

IN MEMORIAM

John Carver, Peter Davies, Andrzej Jonscher, Robert Kell, John Lowry, Richard Sillitto, Humphry Smith, Eric Thornton.

MEMBER NEWS

- **Eddie O'Brien** became president of the US Society for Experimental Mechanics in June.
- **Bill Gelletly**, professor of physics at the University of Surrey, has been awarded an honorary doctorate from the University of Bordeaux 1 for his contributions to nuclear physics.
- **Sir John Meurig Thomas** has been awarded the Sir George Stokes Medal of the Royal Society of Chemistry for his pioneering electron-based nanochemical analyses.

MEMBER SERVICES

- **Wireless access**

The John Barton Centre at 76 Portland Place now offers a wireless network for members' use, in addition to its three wired PCs and two laptop connections.

- **Biotechnology Forum**

The Biotechnology Forum, launched by the Institute in April, is an e-mail based information exchange and discussion forum for representatives of industrial companies and academics working in biotechnology. It aims to forge new collaborations and to promote the commercialisation of leading-edge research. It will also disseminate information about workshops, conferences and events, funding, awards and government initiatives, and discuss issues related to biotechnology businesses. To join, e-mail: dipali.chauhan@iop.org.

MEMBER OFFER

- **Online subscriptions prize draw**

Marcus Benna of Germany is May's prize-draw winner. He receives a 512 MB data stick. For your chance to win a data stick, pay your membership subscription online at http://members.iop.org when you receive your subscription notice.

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**).

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

Commercialising Nanotechnology
IOP Industry & Business, Edinburgh, UK
5 July
http://industry.iop.org/induni/nano/index.html

CONFERENCE

EMAG-NANO 2005 Imaging, Analysis and Fabrication on the Nanoscale
University of Leeds, UK
31 August – 2 September
Online registration now available at **http://conferences.iop.org/EMNA**

● 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

● Understanding Einstein
Museum of the History of Science, Oxford, UK
6 July
www.mhs.ox.ac.uk

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
University of Aveiro, Portugal
6–8 July
http://event.ua.pt/dsl2005

Theory and Experiment in Quantum Gravity
IOP Mathematical and Theoretical Physics Group and Gravitational Physics Group, Durham, UK
7–8 July
www.ippp.dur.ac.uk/QGrav

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

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

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

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

Let's Get Physical
Institute of Acoustics, Buxton, UK
13 July
www.ioa.org.uk

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

Contact, Collaboration and Co-ordination
IOP Consultancy Group, London, UK
13 July
http://conferences.iop.org/CCC

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 & 6 August
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, London, UK
17 July
Emma Ghafur 07811 255 290

● How Solar Electricity Works
St Helens Council, Cheshire, UK
17 July & 29–31 July
Bryan Lipscombe 01244 381 580

CONFERENCE

Sensors & their Applications XIII
University of Greenwich at Medway, UK
6–8 September
Join academic researchers and industrial engineers to review new developments in sensor technology. The programme and online registration are now available at **http://conferences.iop.org/sensors**

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

● Albert's Boy
Icarus Theatre Collective, Finborough Theatre, London, UK
19 July – 31 August
www.finboroughtheatre.co.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

● World View Exhibition
The National Trust, Woolsthorpe Manor, North Yorkshire, UK
26 July – 25 September
Susan Haimes 01476 860 338

● Obscura Physics Poem
Clifton Observatory/Camera Obscura, Bristol, UK
30 July – 6 August
Bec Gee 0117 378 9915

AUGUST 05

● Crazy Golf
INTECH, Winchester, UK
1–5 & 15–19 August
www.intech-uk.com

● Physics Under Your Feet!
The Council for Scottish Archaeology, Caithness and Upper Clydesdale, UK
1–30 August
Thomas Knowles 0131 247 4119

Theoretical and Experimental Magnetism Meeting
CLRC/IOP Magnetism Group, Abingdon, UK
2–3 August
d.t.adroja@rl.ac.uk

37th Conference of the European Group for Atomic Systems
EGAS, Dublin City University, Ireland
3–6 August
www.egas37.org

63rd World Science Fiction Convention
Worldcon, Glasgow, UK
4–8 August
www.interaction.worldcon.org.uk

International Conference on Muon Spin Rotation, Relaxation and Resonance
ISIS and Oxford University Muon Groups, Oxford, UK
8–12 August
http://musr05.physics.ox.ac.uk

● 'Make It' Aeroplanes
INTECH, Winchester, UK
8–12 August
www.intech-uk.com

International Conference on Science and Technology for Sustainable Development
St Berchmans College, Kerala, India
10–13 August
www.conferencesbc.org

NEXT-SigmaPhi: News, Expectations and Trends in Statistical Physics
Politecnico di Torino, Kolymbari, Greece
13–18 August
www.polito.it/NEXT-SigmaPhi

● Physics in Medicine Roadshow
University of Paisley, Hospitals in Renfrewshire, UK
15 August – 15 September
Judith Steven-Setchell 0141 848 3630

12th Canadian Semiconductor Technology Conference
National Research Council Canada, Ottawa, Canada
16–19 August
www.canadiansemiconductor.org

● Fun with Physics! From Einstein to Ice Cream
Open University, Milton Keynes Main Shopping Centre, UK
20–21 August
Nigel Mason 01908 655 132

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**.

Euro Summer School on Exotic Beams
GSI-Darmstadt, Mainz, Germany
25 August – 2 September
www.linux.gsi.de/~scheid/eurohome.html

● Voyage into Space
University of York, UK
27 August
David Jenkins 01904 432 248

● The Greek, the Apple and the Time Machine
Unaccustomed as I am...Ltd, The Beehive Inn, Edinburgh
27 August
www.brucefummey.demon.co.uk

World Biophysics Congress 2005
IUPAB/EBSA, Montpellier, France
27 August – 1 September
http://worldbiophysics2005.sfbiophys.org

● Storm the Fort!
The Royal Armouries, Fareham, UK
28–29 August
www.armouries.org.uk

6th International Conference on Nitride Semiconductors
University of Bremen, Germany
28 August – 2 September
www.icns6.org

Trends in Nanotechnology 2005
Phantoms Foundation, Oviedo, Spain
29 August – 2 September
www.tnt2005.org

6th International Conference Renormalization Group 2005
University of Helsinki, Finland
30 August – 3 September
http://theory.physics.helsinki.fi/~rg2005

Faraday Discussion 131: Molecular Wires and Nanoscale Conductors
Royal Society of Chemistry, University of Manchester, UK
31 August – 2 September
www.rsc.org/conferences

NanoteC'05: Nanotechnology in Carbon and Related Materials
The British Carbon Group, University of Brighton, UK
31 August – 3 September
www.hpc.susx.ac.uk/nanotec

SEPTEMBER 05

● Practically Astronomical!
Scottish Mining Museum, Edinburgh, UK
1 September
Dan Hillier 0131 668 8406

● Fun Physics Roadshow!
University of Manchester, Manchester Museum, UK
1 September – 30 December
Barbara Grundy 0161 275 4926

CONFERENCE

PD 2005
76 Portland Place,London, UK
24–25 October
Annual two-day career-development conference for all career-minded members. Mix with physicists and engineers and enjoy expert training. Registration from £105, including conference dinner.
http://careers.iop.org/pd2005

CFN Summer School 2005 on Nano-Electronics
DFG-Center for Functional Nano-structures, Bad Herrenalb, Germany
1–4 September
www.cfn.uni-karlsruhe.de/summerschool05

Diffractive Optics 2005
Institute of Applied Optics and Warsaw University, Warsaw, Poland
3–7 September
www.do2005.org

Fundamental Problems of Mesoscopic Physics: Entanglement and Coherence in Nanoelectronics
ESF Research Conferences, Acquafredda di Maratea, Italy
3–8 September
www.esf.org/conferences/pc05188

Neutrons in Biology
Institut Laue Langevin, Grenoble, France
4–7 September
www.ill.fr/neutbio2005

Mathematics for Biomedical Engineering: Summer School
University of Warwick, Coventry, UK
4–9 September
www.warwick.ac.uk/go/ssimbe

What the *Bleep* do we do about this nonsense?

Jim Al-Khalili has a surprising take on a documentary about quantum physics that's got the scientific community talking.

Revolver Entertainment

Anyone who has seen the film *What the Bleep Do We Know!?* will have an opinion on it and, if you're a physicist, I am guessing it won't be a favourable one. So I suspect that many readers will not agree with what I'm about to say here.

Let me begin by saying that I am unapologetic about my views on the disturbing rise in belief in New Age mumbo-jumbo and such things as ESP, reiki, homeopathy, crystals and the healing properties of copper bands. I do not buy the view that there is "no harm" in people resorting to reflexology, say, to get rid of their "negative energy" so long as they believe it helps. I am not prepared to sit idly by while such antiscientific thinking takes hold.

And so I come to *What the Bleep Do We Know!?* (By the way, the "bleep" in the title stands for "heck", in case you were wondering.) This is now the third-highest grossing documentary film in history and was a huge hit in the US and Canada last year. The week before its release in the UK, I was invited, along with several other physicists, to watch a preview of it at the Science Media Centre at the Royal Institution. The film is essentially about quantum mechanics (hurrah!) and explains some of the ideas very well. But about halfway through it starts to stray over into pseudoscience, claiming that, since it has been shown that the role of the observer is central in quantum mechanics, then "clearly" the power of the conscious mind does indeed affect the nature of reality itself. It ends with the central character (there is a drama running through the film, interwoven with more traditional documentary-style interviews with both scientists and less reputable characters) throwing away her medication because, through quantum mechanics, she can now heal herself with the power of her mind. Argh!

Perhaps unsurprisingly, then, the other physicists at the screening all panned the film. And other scientists, including geneticist Steve Jones and psychiatrist Raj Persaud, wrote articles strongly arguing that the film was dangerous and should be avoided at all costs. But despite all of this, I was accurately quoted in *The Times* as saying that I welcome the release of the film. Why? Because it's the first-ever example of quantum mechanics for the masses and, while there was certainly a lot of nonsense in the film, it gives us the hook to engage with the public and correct some of these more outlandish beliefs.

Since then I have concluded that there are three camps in the science community. The first is the ambivalent camp, which doesn't care what muddled thinking and pseudoscientific notions plague the general population – they are beyond help and it is futile trying to rescue them. (According to a recent survey, more than half of the UK population believe that ESP is real.) The second camp feels that it is our responsibility as scientists to point out that this film is complete hogwash and recommend that it be boycotted by everyone.

Then there is the third camp – me. I have to admit I enjoyed the film. In fact I found it rather funny, although it wasn't meant to be. Despite the playful title, it takes itself very seriously, and I am sure that many watching it are looking for answers to deep scientific, philosophical, even religious questions. It mixes fantastic ideas from modern physics with crackpot New Age notions, and to the non-expert they sound equally plausible (or implausible). In this sense the film is dangerous and has to be confronted. The question is how. On the one hand, there is so much bad science "out there" already. Shouldn't we be just as concerned with astrology pages or the endless adverts for psychics in tabloid newspapers? Does this film really make things any worse?

My view is that, somehow or other, we need to engage with the public – not just those who attend our public lectures, read popular science books or attend science festivals, but the much tougher cookies who distrust science, see scientists as arrogant and aloof, and who think that with a film like *What the Bleep!?* they are finally being allowed access to some closely guarded scientific secrets. For these people – and they are the main audience for such a film – it is counterproductive to tell them not to watch it. We must instead tread carefully if we want them to listen.

Fantastic ideas from modern physics are mixed with crackpot New Age notions.

Scientists have a responsibility to discuss publicly those scientific issues of importance to us all, especially where the public's trust in scientists is vital, whether it be climate change, genetically modified foods, nuclear power or nanotechnology. We must try to engage in meaningful dialogue with the public without coming across as dogmatic or close-minded.

So should we, as physicists, go to see this film? Heck, yes! The next time you are at a dinner party and the conversation turns to how scientists have proved that with the power of conscious thought one can alter the molecular structure of water (yes, the film claims this) you need to know what they are talking about. Know thine enemy.

Jim Al-Khalili is a theoretical nuclear physicist at the University of Surrey and author of the popular science book *Quantum: a Guide for the Perplexed*. The documentary *What the Bleep Do We Know!?* is on general release in the UK. For dates and venues visit www.thebleep.co.uk.

Fallacious physics

– a competition to find the best of the worst physics

Be rewarded for spotting bad physics. As part of our Einstein Year celebrations, *Interactions* is looking for the very best of the worst physics – in movies, on television, in books, on the radio, in adverts – or anywhere else you come across it. Just send in your examples to **interactions@iop.org** with the subject line **"Fallacious Physics"**, along with details of where you saw it and what's wrong with the physics. 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.

First prize: £50 gift voucher for the Science Museum shop.
Two runners-up prizes: £25 gift voucher or book token.
Closing date: 1 August 2005.

einstein year