OCTOBER 2002

POSTGRADUATE PAGE

Stand out with a skills portfolio

NICHOLAS CALLAN

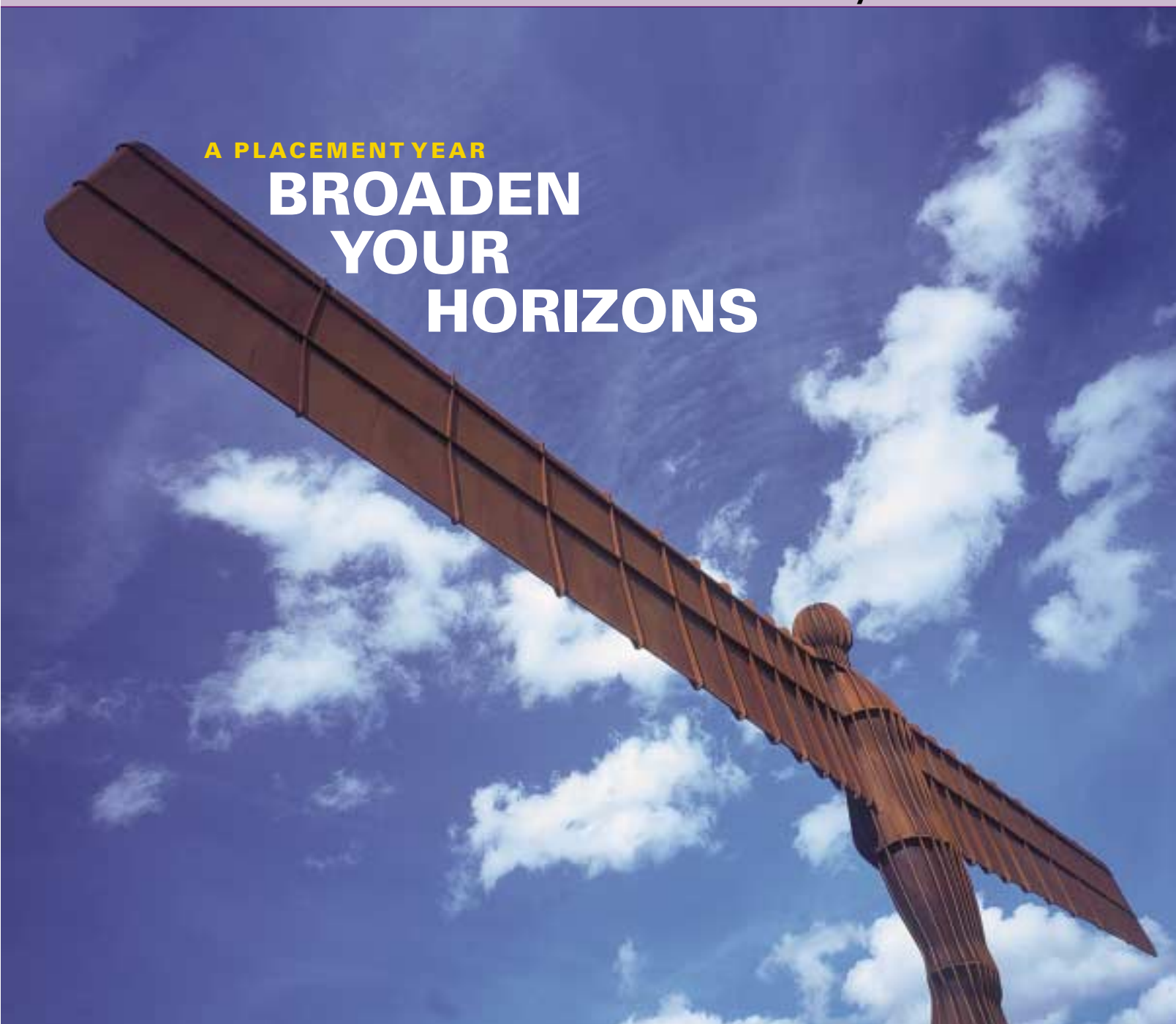
A physicist in monk's clothing

CONFESSIONS

The road to PhD success

# nexus news

The Student Newsletter of the Institute of Physics



nexus news

Institute of Physics, 76 Portland Place,
London W1B 1NT, UK.
Tel. +44 20 7470 4800
Fax +44 20 7470 4848

**Sam Rae**
Student liaison officer
and editor of *Nexus News*
sam.rae@iop.org

**Joseph Hines**
Graduate liaison officer
joseph.hines@iop.org

**Alex Byrne**
Professional
development officer
alex.byrne@iop.org

Email membership@iop.org if you have any queries about your subscription, need to register a change of address or have missed a copy of *Physics World*.



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**Art director** Andrew Giaquinto
**Senior production editor** Teresa Ryan
**Circulation** Laura Serratrice



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# Letter from the editor

Welcome to the new-look *Nexus News*, where you're certain to find something of interest. Let me give you a taste of what's inside.

In our news pages, find out about the activities that you can get involved with through Nexus and the Institute of Physics, and read about the recent Nexus trip to CERN.

If you're considering taking a year out to give working life a try, be sure to read "Lab life" (p11). Two students in Bath tell us about their placement year at the Rutherford Appleton Laboratory. Or perhaps you're planning to do a PhD. Well you're in luck, we have part two of Calum Byrom's tale of postgraduate life (p8).

As some of you may already know, 2002 is the 10th anniversary of Nexus. So why not join in the celebrations by attending the anniversary dinner. (For more details, see the news story on p5.) Then flip to the interview with Jonathan Fost, the founder of Nexus, to get the low-down on how it all started (p6).

The professional development workshop (p4) will interest postgraduates and budding magicians alike, as will Alex Byrne's article giving advice on how to get noticed by potential employers by making the most of your skills.

As usual we have book reviews and a crossword competition, along with the all-new rubbish-physics-joke section (p16).

We welcome your contributions to the magazine and in return we offer a small financial reward. And If you'd like to become more involved in Nexus, by becoming a student representative for your university, or by joining the Nexus committee, please get in touch.

Sam Rae, *editor/student liaison officer*

## Contents

**Cover image: *Angel of the North* by Antony Gormley. Image courtesy of Gateshead Council. See cover story on p3.**

# Paul Dirac gets spin treatment

The Institute of Physics has designed six posters to celebrate the centenary of Paul Dirac, born in Bristol in 1902. The posters tell the story of how Dirac's prediction of antimatter revolutionized modern life, and what we can expect from his discovery in the future. When Dirac died he was widely hailed as one of the most important scientists of the 20th century, yet, as one of the shyest figures of modern physics, he remains almost completely unknown.

Shuk Kwan Liu, public relations officer at the Institute said: "Dirac was a recluse and therefore his genius has gone mostly unnoticed by the public. These posters are aimed at making people as familiar with Dirac as they are with Newton and Faraday."

"Rather than go for traditional posters with photos of physicists and equipment, we thought that a modern cartoon style would be better at attracting the attention of children. The Manga style has given Dirac a bold, modern image, which he probably would not have agreed with if he were still alive," added Liu.


**Tank Girl gets to grips with spin physics.**

The six posters about Dirac cover atomic theory, the Dirac equation, his life's work, spin, antimatter and colour. The posters can be downloaded from the Institute's website (education.iop.org/schools/supteach/dirac.html).

# Strategies for selling science

An internationally acclaimed science writer and broadcaster, Peter Spinks, plans to run an open-house science-writing and media-skills workshop at the Institute of Physics in London in early December. The two-day course will teach scientists, technologists and project leaders the basic skills and strategies needed to convey their work to the media, government, research-funding bodies and the public.

The workshop will cover fundamental science-writing principles and the "rules of the journalism game", thus equipping scientists and managers with the confidence and media savvy required to project messages clearly and simply.

The course will provide hands-on training in preparing articles, features, media releases and illustrative material for various outlets, including in-house publications, British and international media and the Internet.

● For details on course content, class size, coaching methods, cost and copies of testimonials, email pspinks@hotmail.com.

## Cover story

The *Angel of the North* is the UK's largest sculpture. Commissioned by Gateshead Council and created by internationally renowned sculptor Antony Gormley, the figure measures 20 metres in height and has a 54 metre wingspan. It is situated on the site of a former mine on the edge of the Great North Forest, marking the southern entry to Tyneside. The sculpture is one of the most viewed pieces of art in the world, seen by more than 90 000 drivers a day on the A1 and by train travellers using the London–Edinburgh east-coast main line.

The construction of the 200 tonne statue was undertaken by Hartlepool Steel in collaboration with Ove Arup and Partners. The angel is made from a special weather-resistant steel that contains copper, the surface of which oxidizes to form a patina that ages to a rich red-brown colour. Thomas Armstrong Ltd won the contract to install the angel's foundations. Some 50 tonnes of concrete were poured to form piles to root the sculpture into the solid rock that lies 20 metres below.

**Feat of engineering: the structural design of Antony Gormley's *Angel of the North* means that the sculpture can withstand wind speeds that are in excess of 100 mph.**

Owing to the angel's exposed position, the effect of wind must be considered in the structural design of the statue. Where a person would lean to adjust to the load imposed by a gust of wind, the angel must withstand these forces in a static state. Where the wings join the body and where the ankles connect to the ground are critical points in the design of the statue.

An understanding of the ground conditions and the requirements of the foundations were essential – especially where a wind load is imposed on one wing only, thereby twisting the structure. Wind loads on the wings are transmitted along the angel's ribs, down its body and into its foundations, enabling the sculpture to withstand wind speeds of 100 mph and greater.

# PD workshop employs magic

**Stress management: don't lose your head.**

At last year's professional development workshop, attendees trekked for days across the Arctic Circle to dig for meteors rich in precious metals. They braved the snow and ice, communicating with base-camp via walkie-talkie, traversing metres of green carpet and using coded messages to keep other teams ignorant of their plans. This year's workshop entitled "Expertise in management, communication and control" is going to be a little different. There will still be the same gathering of students and young professionals. There will still be two seminars, this year on "Managing your manager or supervisor" and "Stress management". There will still be excellent food and, of course, the green carpet. The difference will be that, instead of a business game involving bobble hats and compasses, there will be magic.

On 21 October, team work and presentation skills will be learned through the medium of magic. Rabbits will appear from hats while attendees work together to solve mind bending tricks and learn how to perform them in front of an audience. The grand finale, complete with plastic sheeting and an insurance get-out clause, will be sawing a person in half.

Two seminar topics have been drawn from those suggested in the feedback from the 2001 event and these will be led by Ashok Gupta, from the Harley Street Stress Management Clinic, and Steve O'Smotherly, from Campaign for Leadership. All of this for a mere £60.

- If you would like to register for the event, and possibly volunteer be sawn in half, visit careers.iop.org/Pdev/PD2002.html. A limited number of travel bursaries are available to *Nexus News* readers on a first-come-first-served basis.

# Communicate your message

Discover how to communicate physics effectively to all sorts of audiences at a physics communication day organized by the south-west branch of the Institute and the Institute's public-relations team. Journalists and professional science communicators will help you to learn the tricks of their trade.

Pick up useful tips on how you can best raise awareness of physics and deliver accurate information to the media; get involved in discussions about physics and the media; and meet other people involved in physics communication. The communications day will be held in Bristol on 16 November (to be confirmed).

- For further information, email Shuk Kwan Liu on shuk_kwan.liu@iop.org.

# Do you know a great teacher?

Every year, with the teachers' awards, the Institute of Physics seeks to celebrate the success of teachers who have raised the status of physics in schools by their outstanding practice in the classroom.

Such people have continued to teach year in year out, and through continued hard work have uplifted pupils, staff and the science-teaching profession in general. This year, seven awards have been made: three for primary science, three for teaching physics at secondary schools and colleges, and one for science teaching.

In the teaching physics at secondary schools and colleges category, the award recipients for 2002 are: **Vida Given**, head of physics at Omagh Academy, Northern Ireland; **Susan Holt**, head of physics at Lymm High School, Cheshire; and **BernardTaylor**, head of physics at St John's School, Marlborough.

The Institute is currently seeking nominations for the 2003 awards and needs your help. It is calling for you, undergraduate and postgraduate students, to make recommendations on the basis of the quality of physics teaching that you received at school. It is looking for teachers who inspire a love of physics in their pupils. If you know of someone who fits this description then the Institute wants to hear from you. The closing date for entries is 30 November. Forms can be obtained from Ian Cuthbert, teachers' awards 2003, Education Department, Institute of Physics, 76 Portland Place, London W1B 1NT, UK. Tel. +44 020 7470 4800; fax +44 020 7470 4848; email ian.cuthbert@iop.org.

# Manchester to host YPC 2002

This year the Young Physicists' Conference is being held in Manchester on 22–24 November. Those who came to the conference in Oxford last year will know how worthwhile it is. Well this year's event is going to be even better.

The activities on offer include a trip to the Daresbury Laboratory to see the Synchrotron Radiation Source; a visit to the Manchester Museum of Science and Industry; a careers fair; and the undergraduate and postgraduate lecture and poster competitions. There will also be plenty of guest lecturers. On the evening of Saturday 23 November the Institute has hired out the VIP room of a nearby bar to help get your evening off to a good start.

The conference fee is £40, which includes two nights in shared accommodation in Manchester's youth hostel in Castlefield, with full board (including packed lunch). There are only 100 places, so book early. Booking is available online at iop.org/cgi-bin/Confs/confreg/YPC/, or go to nexus.iop.org and follow the links.

**Young physicists get their thinking caps on.**

● If you have a general enquiry about the Young Physicists' Conference, please contact Joseph Hines, the Institute's graduate liaison officer on joseph.hines@iop.org, tel. +44 020 7470 4845.

# Awareness of physics awards

The Institute's Public Awareness of Physics awards were set up to recognize individuals for their innovation and commitment in promoting physics to the public. This year individuals were nominated for their science writing, science–art exhibitions, physics demonstrations and talks, physics game shows and roadshows.

The five winners for 2002 are: **Dominic Dickson**, Science Communication Unit, Liverpool University for promoting physics through drama, demonstrations and the Liverpool Physics Olympiad; **John Brown**, University of Physics and Astronomy, Glasgow University, for his leadership in promoting mobile planetarium shows across Scotland and for his use of magic to explain physics, in particular the "Black holes and white rabbits" lecture; **Jonathan Hare**, Creative Science Centre, University of Sussex, for establishing the Creative Science Centre and the numerous activities that he carries out to promote physics; **John O'Connor**, **Terrence Burns** and **Robert Nelson**, University of Newcastle, Australia, for creating the Science, Maths and Real Technology (SMART) programme and for their work in coordinating the Australia Science communicators (Hunter Chapter) and the Science and Engineering Challenge; and **Chris Budd**, **Peter Ford** and **Bob Draper**, University of Bath, for establishing and participating in the successful Bath Taps into Science, an annual science festival.

● For more information on the Public Awareness of Physics awards, visit physics.iop.org/IOP/puawards.html or contact Shuk Kwan Liu on shuk_kwan.liu@iop.org.

# Nexus marks its first decade

To celebrate the 10th anniversary of Nexus, the Institute of Physics is holding a formal dinner at its headquarters in London on Saturday 14 December. Tickets cost £20. Speakers include Dr Julia King, chief executive of the Institute; Prof. Andrew Wallard, vice-president of the Institute; and Sir Arnold Wolfendale FRS, emeritus professor of Durham University. The evening will include the Nexus Student Society awards. For help in finding accommodation and to order tickets, contact Sam Rae, student liaison officer on sam.rae@iop.org, tel. +44 020 7470 4890.

nexus 10
1992 – 2002 10th Anniversary

## Report – Nexus visits CERN

CERN – the European organization for nuclear research – is the world's largest particle-physics centre. Founded in 1954, the laboratory has become a shining example of international collaboration.

Situated on the Swiss–French border near Geneva, CERN's largest particle accelerator has a diameter of 27 km. Scientists from all over the world come to CERN to carry out world-class research, and a group of 40 lucky Nexus members got the chance to have a look around on a trip organized by Barry Cottrell.

The people on the trip were from all walks of life – students from as far afield as Oxford and Dublin, and a large contingent from the Open University.

Having gotten to know each other over a drink or two on the Thursday evening, we spent Friday looking around Geneva.

**Nexus members relax in the sun.**

Taking a boat trip on Lake Geneva and climbing to the top of the cathedral proved to be popular attractions. I also had a guided tour of the UN building, with its conference rooms, and many exhibits donated by member countries. That evening I was challenged to a game of oversized chess. I'm not sure who won, but by the end of it teams of physics students had moved in on both sides to discuss every move.

On Saturday we left our hostel early, eager to see as much of CERN as possible. On arrival we were given an introductory talk before being driven out to the opposite side of the accelerator ring located just a few miles away in France.

CERN is in the process of transforming its electron–positron collider into a proton–proton collider, so we weren't able to see anything in action. Instead, we visited one of the new detectors under construction. The octagonally shaped detector (designed to record hundreds of millions of particle collisions every second) rose high into the roof of the hanger-like building. Our guide explained how each of the parts of the detector fitted together and what they did. Outside, a shaft was being excavated into which the detector would be lowered.

**Sightseeing is thirsty work.**

The visitors' centre was of particular interest. On show was an early bubble chamber and some of the first coils that were used to generate the high voltages that are required by a particle accelerator.

With the afternoon free we took advantage of the weather and visited Mount Saleve, which towers above Geneva giving a fantastic view of the the surrounding area. A last visit to the pub in the evening saw the end of the trip, but not before a couple of five litre towers of beer were emptied.

And so ended a visit to one of the most famous research establishments in the world. I look forward to 2005 when we can see it in action again.

*James Cannon, Surrey University.*

# THE FOST REPORT

Some 10 years ago Jonathan Fost – a physics student at Portsmouth University – somehow found the time between lectures to found Nexus, a national network of physics societies, which forms the student wing of the Institute of Physics. One decade on from this momentous event I travelled down to Portsmouth to catch up with Jonathan to ask him how it all began.

### How did you first become involved with the Institute of Physics?

From the experience of setting up Portsmouth University's physics society I could see that students in other disciplines were getting a great deal more support from their respective professional bodies. Our university society had vague approval from the physics department, but there was no governing body saying "we're supporting physics students". So it seemed logical to me when we were being asked to join the Institute of Physics to enquire about what we would get back from the Institute.

I wrote a letter to the chief executive asking why the Institute did not have a division for students. I received a reply from the Institute's professional services directorate, offering to sponsor a physics event at Portsmouth. This was a positive first step. A few months later I read an article in *Physics World* that said that there was going to be a representatives' meeting to discuss how the Institute could improve student membership, so I suggested that students be invited.

### What gave you the idea of starting Nexus?

I attended a meeting at the Royal Institution with staff from the Institute, namely Helen Fitzpatrick, professional services manager, and John Harwood, professional membership director. I hid at the back listening to fairly typical suggestions on how to improve student membership, such as giving out pencil cases and book tokens. Eventually I put up my hand and said what I thought the Institute should be doing. Students are worried about the image of physics, their careers, their courses and the pressure that they are under. That's what students want to discuss. When I'd finished there was silence. I think my lecturers were embarrassed because I'd used Portsmouth University, and all of the problems that existed there, as an example. On my way out, Helen stopped me and asked if I would like to come and sit on the professional services committee.

**Fost: "Students are worried about the image of physics, their careers, their courses and the pressure they are under."**

A few months later at an Institute meeting in London I mentioned that I'd like to do a student survey. I was surprised by the positive response I got. That's when I organized the first student representatives' meeting. I wrote to physics societies and managed to get a representative from every region in the UK and

Nexus is celebrating its 10th anniversary this year, but who was behind its conception? **Sam Rae** tracks down Nexus founder Jonathan Fost to find out what moved him to set up the network and what he thinks about his legacy now.

Ireland. At that meeting we found that students from all over the country seemed to be worried about the same things. We knew that to be productive we would need to meet again, but we could not pay for everyone's travel expenses. That's when we formed the Student Working Party, the idea being that we would gather opinion and create an agenda to be put before the professional services committee. Things quickly snowballed until the topics for discussion were not only relevant to professional services but also began to cover all of the workings of the Institute.

As more people got on board, the party grew in stature and started to get Council recognition. I chose the name Nexus because it meant the central point of a network. I thought that's the whole point of what we're trying to do: have a central core that talks to all of the societies, and the societies talk to the individual members. We branded the idea and sent information out to all university physics societies and heads of department.

**Where did you expect Nexus to be now and where would you like to see it going in the future?**

When I attended the student representatives' day last year, I heard students talk about the problems that they had either with their society or setting up a society. The problems were the same as those I had experienced 10 years' ago – student apathy, problems with courses, the image of physics – so the aims of Nexus are the same now as they were back then. In the future I hope Nexus will just get a lot bigger and better.

I'd also like to see students going into schools. I've talked to teachers about physics and they've said that they want people like me to talk to students because I would inspire enthusiasm for the subject better than they could. I'd love to do that.

**Do you think that physics undergraduate courses are poorly taught?**

No, but I think that the maths content is a problem. One of the things that I found was that physics courses are too dominated by maths. My work with computers and the Internet is about problem solving. I attribute my problem-solving ability to being a physicist. I find that I can get in there and reach a solution more efficiently than people from other disciplines because of the way I think and have been taught. In academia and industry you might use your knowledge as it was intended, but in business you aren't going to be using your ability to use perturbation theory. I wish that could be acknowledged more. Things might have changed in the last 10 years, but perhaps exams should be set up to test your knowledge and skills as a physicist as well as your memory of this or that derivation.

**What career moves have you made since you graduated in physics?**

I reached the point that I think most students get to: "I've got this degree in physics, what the hell am I going to do now?" I thought of all of the subjects that I was interested in. I could have gone into forensic science, but I had a horrible feeling that I would end up in a laboratory and I didn't want that. The thing that I had enjoyed most at university was the promotion of science and physics, and organizing groups of people. I had especially liked the marketing aspect of it all: coming up with a brand and then selling that idea and attempting to get everybody on board. I knew that I wouldn't be able to walk straight into any marketing job, but I found a technical-marketing position advertised that asked for the skills that I had acquired.

A company called Lloyd Instruments, which builds material-testing devices, needed someone who could market its products. The marketing people that it had weren't scientific, so I became a bridge between the technical people and the creative marketing people. After that I got into database marketing, followed by telemarketing and PR. I then took over corporate marketing for the firm. With the good background I then had in all areas of marketing, I got a job in a management-consultancy group, working on the company's website. Eventually I decided to start my own e-marketing business and I've now teamed up with an advertising firm that was interested in expanding.

**What are your plans for the future?**

There's a big issue of accessibility on the Internet. Under civil law all websites now have to be accessible to everyone. Therefore, anyone who wants to read a website should be able to, including those with visual disabilities. That's going to be a big project over the next few years. Also, I've kept up my interest in science and I would like to resume my involvement with the Institute, perhaps through the south-central branch. ■

*Sam Rae, student liaison officer.*

Portrait of a PhD

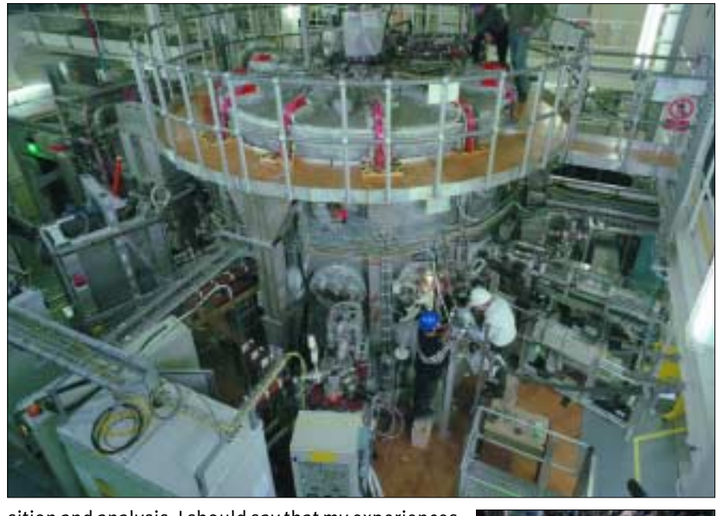
# POSTGRADUATE CONFESSIONS II

In part two of an account of his experiences as a PhD student, **Calum Byrom** discusses the necessary evil of the first-year upgrade report and shows us the path to finished-thesis heaven.

Okay, for those of you who weren't paying attention, last time round I discussed the initial stages of PhD life, concentrating on the decision to undertake this mammoth task, finding (and being offered) suitable positions and finally settling into the research project. This time I discuss the more meaty topics – namely deciding on a suitable study plan, obtaining appropriate results, then exploiting these to the full and assembling them into something approximating a doctoral thesis.

So, picking up where I left off, my first year of study was mostly spent getting up to speed with the research undertaken at my lab, which involved familiarizing myself with the background theory (i.e. learning lots of acronyms) and the various resources available – both hardware and software. As I mentioned last time, a technical hitch with the project that I was supposed to be working on (the Mega Amp Spherical Tokamak – MAST), meant that operations were delayed for roughly a year.

While this did not seem ideal at the time, it did at least give me the chance to practise using the equipment relevant to my PhD on an older experiment – the COMPASS tokamak. Although this did not result in any work that was directly featured in my thesis, it was a great training opportunity. It also probably saved the government thousands of pounds that would otherwise have been lost in equipment breakages. In this first year I was also able to identify and exploit my core role in the research group – effectively that of IT geek. This allowed me to develop important software resources that would prove vital for later data acquisition and analysis. I should say that my experiences are probably more relevant to PhDs undertaken in large experimental projects. Most students, however, do adopt a position in a large research group and I think that the first year of study is generally concerned with building relationships within this group and establishing a suitable role to follow.



Towards the end of the year, a thing known as the "first-year upgrade report" reared its ugly head. At the time, the prospect of scraping something useful together from my year's work was somewhat daunting. Even more so was the prospect of having to defend this work in a *viva* to continue my studies for a further two years. Suffice to say, the whole thing didn't turn out to be as nasty as I'd imagined. In fact, looking back through sufficiently rose-tinted glasses, the report turned out to be pretty useful; not only did it help to consolidate the knowledge that I had acquired over the year, but it also forced me to put together something of a plan for the following years. This plan turned out to be massively optimistic (good research being dictated primarily by sod's law). However, coming up with a framework of research at that early stage was probably the most useful thing I did in the course of the PhD. Without it I'm sure I'd still be slaving away on the thesis now. The other good thing about this report is that it gives an early opportunity to practise your oral skills in preparation for the final *viva*.

**Above: a discharge of plasma from the Mega Amp Spherical Tokamak (MAST) experiment. Left: the MAST experiment in action. Bottom: Calum Byrom winds down after a hard day.**

On to the second year (via an extended break in Morocco – hey, I was still a student, you know) which brought with it the feeling that I should be getting some sort of results that would prove useful to my thesis. Not an uncommon feeling, from what I've seen, but results are dominated somewhat by luck and circumstances. I've come across people who obtained all of the results that they needed in the first four weeks of starting and others who didn't find anything useful until their final six months. Thankfully, in my case, things were aided by the MAST project finally going online and achieving better-than-expected initial results. This meant that I got to spend much of what was a glorious summer stuck in a lab – I guess it added to the PhD experience – though once data started to arrive, the course of my work began to take shape.

I had undertaken an open-ended project that was merely defined by the equipment that was available to use. If a strong objective had been set from the outset of my PhD then I suppose that that would have remained the focus of my experiments. I think the former style affords the student the opportunity to investigate a wider range of phenomena and then cherry pick results to produce a thesis. The latter, however, holds the advantage of having a clearly defined goal.

Possibly the biggest waste of time for a PhD is either researching "dead-ends" or repeating work previously completed. In my case, by obtaining results early on I was able to identify the strengths and weaknesses of my equipment and thus adjust my research plans accordingly. By looking at how my equipment had been exploited in previous experiments I was able to repeat this work to shape my data into something that was worthy of either a thesis or a conference presentation. →

# Putting together abstracts, posters, talks and conference papers helps consolidate your work.

And that's a nice link to conferences and other activities associated with PhDs. I think that I am correct in assuming that most fields of physics research have a fairly well-developed network of conferences and summer schools. While these are often mentioned by supervisors, it is definitely worthwhile identifying all of the possibilities. This gives you the option of picking the most useful events – in the nicest parts of the world. A summer school in the early stages of a PhD is a good way of getting to grips with the background theory of your field of research, as well as providing the opportunity to meet like-minded souls and seeing a new part of the world. I managed a pleasant two-week course in sunny Maastricht. Usually, these schools also provide the opportunity to prepare your first poster presentation in a friendly atmosphere, which acts as good practice for later conferences.

**Men at work: Calum Byrom (centre) with colleagues from the Culham Science Centre.**

Conferences depend somewhat on the subject area and the quality of your results – i.e. if it is an active field and you've got great results then you should be able to visit several. Personally, I would recommend attending at least one conference a year, if possible, and start with presenting a poster before moving onto giving talks. Like the first-year report, the act of putting together abstracts, posters, talks and conference papers helps to consolidate work undertaken, effectively "compartmentalizing" your research. Obviously, writing papers is the best way of doing this, although with large projects, such as mine, this can be difficult owing to the large number of contributors involved in the work (well, that's my excuse anyway). Writing papers can also be detrimental to achieving the golden dream of finishing your research before the money stops. If publishing is an issue, but time is tight, consider concentrating on the thesis and then extracting papers from it following submission.

I should probably say a little about conferences. I guess they live up to expectations – i.e. a meeting of hundreds of the top physicists in your field is either going to appeal or not, depending on your own tastes. However, they do give you an opportunity to defend and discuss your work with experts and this can prove invaluable in identifying new channels to explore or tidying up "mysteries". Personally, I think it is better to be selective with conference lectures and only attend those directly relevant to your work, otherwise they can turn into great sleepathons and the most vital talks can be missed completely. This provides the student with the added bonus of a little free time in which to explore their chosen destination.

Extracurricular activities are also worth a mention. As with undergraduate physics, many opportunities exist for students who are keen to grab them. In my case, I was able to land a fully paid "holiday" in the US by offering to install some analysis software – which I'd written – in a lab over there. Also, in my final year, I attended a week long CRAC management course, which is offered to all EPSRC-funded students. I would highly recommend doing this course. Not only does it help with the whole job-hunting fiasco, but it also provides a break from thesis writing and time to socialize with people who are in the same situation (although, uniting "writing-up" PhD students does tend to provide ample opportunity for bitching about things).

So my story finishes with writing up the thesis. My main advice here is to start as soon as possible. I started mid-way through my second year and, while this was perhaps a little premature, it did make things much easier in the long run. Starting early can massively help the research as holes in your work are identified early on, allowing time – you hope – to patch them up. By putting everything down on paper you should be left with an excess of work, which then makes for a much tighter thesis once it is trimmed down and all the "iffy" stuff removed. All of your previous reports and papers will be extremely useful at this stage, allowing a cut-and-paste approach to thesis writing. It is also beneficial to buy yourself a cheap PC so that you can write up at home, unless, of course, the prospect of spending hours in the lab appeals. Roping in a few fellow students or supervisors to help proof-read the document can be helpful. Although, beware, you may be called on to do likewise. Finally, if time is an issue, it is vital to arrange an external examiner and *viva* date prior to submission, otherwise the process can drag on for months.

Well, that's it. I'd have liked to discuss the *viva* but I haven't had mine yet. From what I hear though, your supervisor shouldn't let you submit unless he/she thinks that you'll pass. I hope this has provided some insights to the life and times of a (typical) physics PhD student – any questions? ■

A student-placement year is a great opportunity to put "real life" to the test, say **Andy Bodey** and **Jodie Smith**.

# Lab life

**Andy Bodey** Nearly 14 months ago I abandoned my lecture notes, donned a pair of dayglo rubber gloves and headed for the Rutherford Appleton Laboratory (RAL) in Oxford to begin my year in industry at the Central Laser Facility.

I started my three-year degree course in natural sciences at Bath University with the clear intention of staying away from the real world for as long as possible. But with my final year looming, the real world was beginning to catch up with me and I realized that I was going to have to make some important decisions. In a rare moment of wisdom I decided that the best way to make any informed career choice was to get some work experience.

**Andy Bodey makes adjustments to a spatial filter that is used to improve the beam quality of the laser-plasma X-ray laboratory's high-power, ultraviolet excimer laser.**

On my first day in the laser-plasma X-ray laboratory I was overwhelmed by everything I saw. Every spare bit of the lab was packed full of equipment and I wondered if I would ever manage to get to grips with it all. I did, and it was a fantastic experience.

I worked as part of a three-person team, running a facility that provided high-intensity X-rays for university researchers. I got involved in work that spanned the sciences, from lithography to microscopy and cell communication.

Then there was the project work. I designed a self-drilling spatial filter (which improved the quality of our laser beam), carried out some work in target preparation and dabbled in some chemistry on the side. The attitude in our lab was fairly relaxed, so I could organize my own workload, which I did enthusiastically.

As part of my placement I went to schools one day a month to teach young, budding scientists about the wonderful world of research. We ran egg races, made bubble-powered rockets and oozed slime (this was my speciality). Not being the keenest of public speakers, the grandly titled Ambassadors for Science Scheme allowed me to gain confidence in front of an audience.

I also enjoyed a good social life at RAL. I was a little concerned that research would be all socks and sandals, so I was relieved when I found 20 other students working there. With our new-found wealth we frequented the pubs of Oxford and became well known at a number of curry houses.

So, has any of this helped me to form any career ideas? Well, yes. I've worked in research for a year now. I've experienced a range of sciences and have become particularly interested in the crossover between physics and biology (something I would not have been able to combine at university). I've learned that working in detail on a project can be really interesting and I had a great time with the other students. Now that wasn't a bad year, was it.

**Jodie Smith** At the time I joined RAL, Vulcan – a high-power neodymium glass laser – was capable of delivering 100 TW laser pulses (that's $10^{14}$ W) that were sent to two target areas for use by teams of experimental physicists. Each target area was used by a different team, and was changed every six weeks. The targets were often used in very different fields, and each one had a unique set of requirements from the laser.

My brief was to help develop a third target area that would enable Vulcan to deliver petawatt ($10^{15}$ W) shots. When I first

I was a little concerned that research would be all socks and sandals, so I was relieved when I found 20 other students working there.

arrived the new area was just a building site. Contractors were installing concrete radiation shielding suitable for the new types of experiments that would be possible with the increase in laser power. My project was to work on the laser diagnostics for the new target area. With a little help from my supervisor, Cristina Hernandez-Gomez, I built diagnostics to measure the bandwidth and duration of the laser pulse. I also helped to set up the new laser beam line where the light is amplified and transported into the target area. The experiments using the 100 TW laser had to continue while the petawatt upgrade was in progress. This meant that each member of the Vulcan team was also assigned three or four shifts each week to fire the laser to the existing target areas.

**Jodie Smith uses an infrared viewer to examine a sample of the Vulcan petawatt laser beam as it travels through a custom diagnostic system.**

My year-long placement at RAL was an extremely valuable and enjoyable experience. I learned a lot about lasers and optics but I also developed transferable skills. I became a better communicator and learned about time management. I became more tolerant of people and learned how important it is to be able to work both alone and as part of a team. I strengthened my problem-solving abilities and learned that determination is an essential part of any major achievement. The skills I acquired there will help me in whichever career path I choose later in life.

To sum up, an industrial-placement year is a fantastic idea. It lets you test out the type of thing that you think you might want to do once you've finished university, it's a year's trial period and the best bit – you get paid. ■

*For more information about the Central Laser Facility visit clf.rl.ac.uk. If you're interested in working for the Council for the Central Laboratory of the Research Councils then visit clrc.ac.uk/Activity/ACTIVITY=Jobs. The Institute of Physics publishes a booklet entitled* Sponsorship and Placement Opportunities for Physics Students. *To request a copy, email education@iop.org, quoting your membership number. The Royal Academy of Engineering operates a Year in Industry Scheme. To apply, go to yini.org.uk.*


## Contribute to *Nexus News*

***Nexus News*** needs your contributions. Why not send in those cartoons that you've doodled during lectures, or write up a Physics Society event?

If your work gets published in the magazine, you'll be paid and receive extra copies of ***Nexus News*** for your friends.

Contact Sam Rae (student liaison officer) at the Institute. Email sam.rae@iop.org. Tel.+44 020 7470 4890.

Nicholas Callan 1799–1864

# Shock tactics

**Diarmaid Mac Mathúna** gives us the low-down on the hair-raising classroom antics of Nicholas Callan.

Lecturers don't normally get away with electrocuting their students, especially if the students are rendered unconscious. However, Nicholas Callan, an Irish physics professor and priest, used a number of stunts to teach his students about electricity. Unfortunately, some of these students subsequently required medical attention.

Nicholas Callan was born near Dundalk in 1799. He studied to become a priest at St Patrick's College, Maynooth. After he was ordained he went to Rome to study divinity, but he also learned about the work of physicists such as Galvani and Volta on the side. In 1826, at the age of 27, he returned to Ireland and was appointed professor of natural philosophy at St Patrick's College. It was there that the Reverend Prof. Nicholas Callan (as he was by then called) began to study electricity intensively and to experiment on his unsuspecting students.

In one of his most infamous jests he got a group of students to attempt to pull an iron bar out of a large electromagnet. When the students weren't looking he switched off the magnet and they all fell to the floor. After a few other incidents, which included the hospitalization of one student, the university authorities decided that it would be best if Callan only electrocuted turkeys.

Callan is not known only for his sense of humour. He also invented the induction coil, which is widely used in electrical transformers. It was years before he received the credit for his invention, despite sending a replica to the Electrical Society in London. At the time, the device was attributed to a man called Ruhmkorff, while Callan merely got into trouble for electrocuting students instead of training them to be good priests.

Mobile-phone users should thank Callan for developing inexpensive battery technologies. Thanks to his research, batteries could be made from cheap cast-iron instead of platinum. He also found a way to make a battery that used only one chemical solution rather than two. While he was tinkering with new battery designs he also found a way to prevent iron from rusting. He quickly realized how valuable his technique of "galvanizing" was and patented it.

## Unconventional

But Callan wasn't all about physics – he enjoyed a good laugh too. He'd once been refused permission to see one of the world's largest telescopes in Birr, Offaly. When its owner, the 3rd Earl of Rosse, came to have a look at the induction coil, Callan told him to go home and take a look at it through his telescope.

Callan was an unconventional man with a range of interests. He showed us that remarkable scientific achievements can be made with few resources and little support from colleagues. He loved his work and believed that physics could be taught in a fun way – quite a combination for a 19th-century Irish priest. ■

# GET NOTICED

How can you make sure you land the job you want? **Alex Byrne** discusses the resources available to help you beat the competition.

A recent conference entitled Profiting from Postgraduate Talent highlighted the need for postgraduate students to develop transferable skills. One of the speakers, Sir Gareth Roberts – past president of the Institute and head of a recent inquiry into the supply of science, engineering and technology people – spoke about recommendations that he had made concerning funding for PhD students.

There is concern in industry and business that postgraduate students have lost sight of the objectives of their continued study. The ultimate goal of a PhD student should be to complete the research that they have been contracted to do and increase the knowledge base of the scientific community. However, most students will not continue in academia after completion of their PhD and will instead enter one of a variety of employment sectors. In these cases the result and subject of the research are of low importance and it is the interpersonal and research skills that the company is most interested in.

Despite efforts by different agencies, there is still a common misconception that physics students will be poor communicators, unused to interaction, and, in extreme cases, daylight, and therefore will be poor team members. For this reason it has become clear that physics students need to work even harder than other scientists and engineers to compile evidence of their competence in these and other areas.

One opportunity that exists for postgraduate students is the Graduate Schools Programme, which is funded by the Research Councils (gradschools.ac.uk). These schools last for five days and run throughout the summer months all over the UK. Tutors from academia and industry share their expertise, but attendees are also encouraged to explore topics by themselves through a series of case-studies. The courses are fast-paced and occasionally stressful, but they are also extremely rewarding.

Although Roberts's recommendations are unlikely to come into full effect for several years, now is a good time for current and prospective PhD students to start examining their skills. The Institute provides several resources that can help. A booklet called *Compiling a Portfolio of Evidence* gives a good introduction to beginning a record of your competencies. Another resource is the Institute's Professional Formation and Development Scheme (PFDS), which allows you to assess yourself against a framework, while also working towards Chartered Physicist status. Alternatively, just keeping a simple log of the skills that you have demonstrated and giving an example of each could serve as a useful aid when preparing for that all-important first interview.

## Sell yourself

With the economic downturn affecting telecoms and other big physics employers, it is more important than ever that graduates are able to sell themselves as effectively as possible. With more and more people completing PhDs it seems that it will no longer be enough simply to have the title "Dr"; instead it will be a case of proving that you are more useful than the next candidate. Keeping a record of your achievements as you go along will make this a great deal easier. ■

*If you would like further information on career resources and PFDS, visit careers.iop.org.*

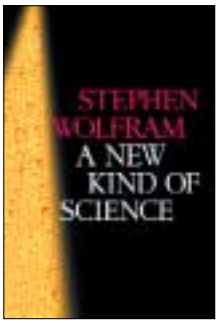
## A New Kind of Science

### Stephen Wolfram

May 2002, Wolfram Media, 1280pp, £36.00, ISBN 1 5795 5008 8.

If thousands of scientists worked on huge experiments for years, would they discover as much as Stephen Wolfram does by sitting at his desk and programming all day? Apparently not, according to the physics and computer-science guru who wrote *A New Kind of Science*, a 1280 page tome that was more than a decade in the making.

The creator of Mathematica software is widely regarded as one of the world's most original scientists and innovators in scientific and technical computing today.




Born in London in 1959, Wolfram was educated at Eton and Oxford and received his PhD in theoretical physics from Caltech, US, at the age of 20. Having started to use computers in 1973, Wolfram developed Mathematica, the primary software system that every student knows. He is now the CEO of Wolfram Research in the US.

Starting from a collection of computer experiments, this long-awaited book presents a series of discoveries and shows a fundamental new way of modelling complex systems. It's amazing to read about what simple computer programs can do, but you don't need to know Mathematica to understand the book. You can just skip over the 500 pages of the *addendum* and a lot of code-related text.

"It has been a great challenge for me to capture the things that I have discovered over the past 20 years in a book of manageable size," Wolfram writes. Manageable size? Wolfram must have a fine sense of humour. Running to some 1280 pages, the book is huge.

While it is a worthwhile read, particularly for those who are just starting out in their careers, don't hurry out to buy it if you're on a tight student budget. There will be a lot of used copies available in the near future, as it has, surprisingly, reached the top 10 at amazon.com.

● *A New Kind of Science*, wolframscience.com; Stephen Wolfram, stephenwolfram.com; Wolfram Research company, wolfram.com.

*Renato Losio, renato@arsenio.it.*

## The Strange Story of the Quantum

### Banesh Hoffmann

1959, Dover Publications, paperback £8.95, ISBN 0 4862 0518 5.

First published in 1947, *The Strange Story of the Quantum* is a tale of the emergence of quantum theory. It plunges the reader straight into the excitement and confusion of theoretical physics in the early 20th century and emphasizes the daring and audacity of each new idea.

The book begins with the competition between the wave and particle theories of light, and the problems with classical atomic theory. It goes on to describe the various solutions proposed and their vast and unsettling implications for the entire structure of physics. A postscript, written in 1959, outlines many of the developments that have occurred in quantum theory since the book was first published.

The book's style is unique. Hoffmann manages to convey the essence of highly mathematical theories with ingenious analogies, and the narrative is energetic and packed with bizarre detours. Shakespearian quotes, mad millionaires, odes, precocious children and ocean monsters are just some of the elements that are woven into the text. Who else would include a two-page *intermezzo* entitled "Warning to the reader", informing us that we have "climbed to the highest peak of the rollercoaster" and so have "no dignified way of escape" from the downward journey?


Hoffmann assumes no previous knowledge and steers clear of any technical language. I would have liked a few more mathematical terms, but this might have spoiled the character of the book for a non-specialist reader.

*The Strange Story of the Quantum* will not only make you laugh out loud, but it will also remind you of just how radical a development quantum physics really is.

*Karina Williams.*

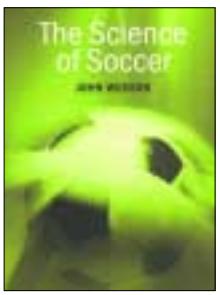
## The Science of Soccer

### John Wesson

2002, Institute of Physics Publishing, 206pp, £14.99, ISBN 0 7503 0813 3.

Now that the excitement of the World Cup is over, the publication of John Wesson's popular-science book is a pleasant surprise. This retired theoretical physicist describes the mechanical details of the motion of a football (from a solid and fluid point of view), and funny probabilistic considerations associated with the game.

All of the topics presented are explained with simple physical and mathematical principles, the mathematical details being provided at the end. All aspects of the beautiful game are dealt with here. Aerodynamics and mechanics are covered in detail, but that's just the start.



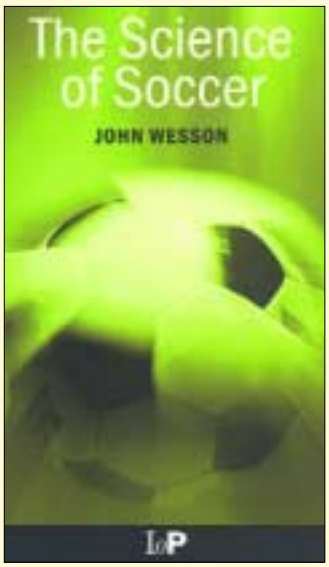

Chapters five, six and seven emphasize simple numeric problems to do with football, with interesting analogies to statistical thermodynamics. For instance, Wesson describes why, given the field size, and 10 players (excluding the goalkeeper) a player has an average of three seconds to receive a ball, control it and then act.

An interesting question is posed regarding the relevance of seasonal championship results. In a thought experiment where all of the teams are of equal strength and have an equal probability of winning and losing, there is still a champion with 67 points, and a ranking ranging down to 31 points. In another model, where one club is better than the others, it finishes second, four points behind the champion. Chapter nine is devoted to soccer economics. Useful data are given on the exponential growth of money interests in football, which allows readers to make up their own minds on whether big money is good for the game.

Wesson shows great skill in mathematics and physics, as well as a perfect knowledge of soccer and its rules, but can he explain the offside rule to a non football fan?

● Win a copy of *The Science of Soccer* (p16). For more information on new releases from Institute of Physics Publishing, visit bookmarkphysics.iop.org.

## Book competition




This issue we have five copies of *The Science of Soccer* by John Wesson to give away (see the review on p15). To be in with a chance of winning, answer the following question: **Which country will host the 2006 World Cup?** Send your entry to: Science of soccer competition, Sam Rae, Institute of Physics, 76 Portland Place, London W1B 1NT, UK.

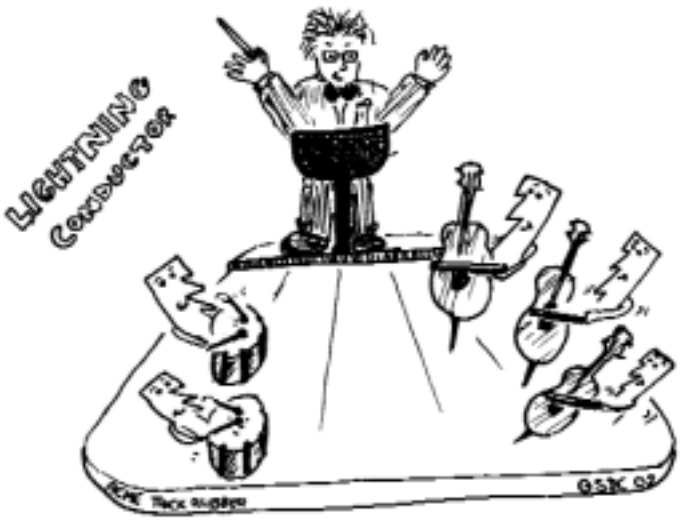
Last issue we had five copies of Sir Martin Rees's new book, *A Cosmic Habitat*, to give away. The lucky winners are Michelle Lanyon, Marisa Cristina March, Catherine Scott, Adam Sykes and Abdulla Shareef.

## Rubbish-joke corner

Two hydrogen atoms walk into a bar.
**Hydrogen 1**: (*Checking himself all over*) I think I've lost an electron somewhere.
**Hydrogen 2**: Are you sure?
**Hydrogen 1**: Yes, I'm positive.

A little while later, a neutron and a proton walk into the bar.
**Proton**: Two pints of your best bitter please.
**Barman**: (*Putting the pints on the bar*) There you go sir, that'll be £2 for you, but for the neutron there's no charge.

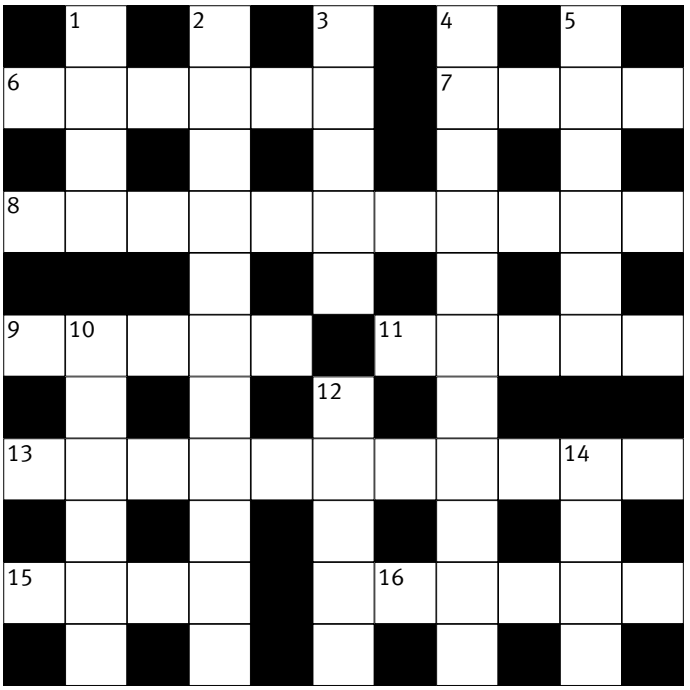
**Q**: Why was Heisenberg rubbish in bed?
**A**: Because when he had the time he didn't have the energy and when he had the energy he didn't have the time.




**Greg Coltman**

## Nexus prize crossword Set by BoyAlex

Send your crossword solutions by fax to +44 20 7470 4848 or by post to Sam Rae, Institute of Physics, 76 Portland Place, London W1B 1NT, UK, to arrive no later than 3 November 2002. All correct answers will be entered into a draw. The lucky winner will receive £25 and the two runners-up will each receive £10.



**Across**
**6.** A scientific picture (6)
**7.** Physics _____ that which the social sciences suffer from (Medawar) (4)
**8.** Usually about 100 millibar at sea level (3, 8)
**9.** The best kind of gas (5)
**11.** The italian navigator, father of the weak forces (5)
**13.** A less direct current (11)
**15.** A system with a single audio channel (4)
**16.** Resonant bit of a laser (6)

**Down**
**1.** Very faithful stereo system (4)
**2.** One sulphur, four oxygens, too many electrons (8, 3)
**3.** SI unit of magnetic flux (5)
**4.** It depends on where you are standing (11)
**5.** Digital versatile disc read only...etc (3-3)
**10.** John _____, pioneer of atomic theory of matter (6)
**12.** Where the champagne remains (2, 3)
**14.** Sponsors of advanced study institutes (4)

## Last issue's solution

All of the correct answers that were sent in were entered into a draw. Martyn Lawrence from the Open University wins the first prize of £25. Alexander Adamou of Cambridge University and Steven Mills of Reading University each win £10.

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