IOP | Institute of Physics
Education *Supporting Teachers*

Classroomphysics

The newsletter for affiliated schools

December 2007 Issue 3

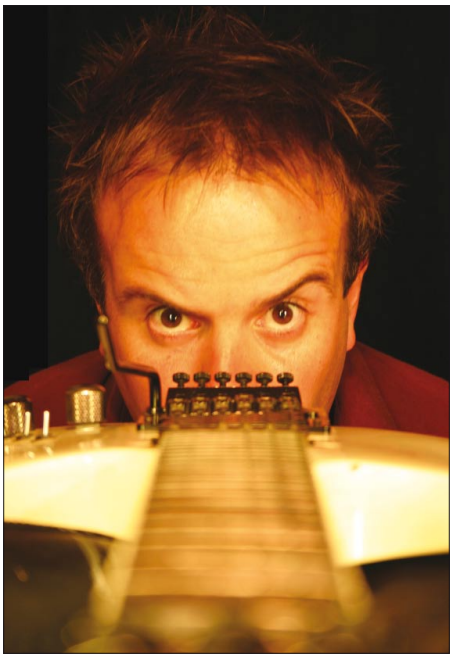
Physics rock tour hits the UK in '08

"The Rock Doctor – a cross between Einstein and Jimi Hendrix."
Comment from Children's BBC

Next year the biggest experiment ever built will allow us to see what the universe was like in its first hundred-trillionth of a second. The Large Hadron Collider (LHC) should tell us where the mass of the universe came from and where most of it mysteriously disappeared to, and it might even let us peek into "extra dimensions" in an attempt to explain what kind of universe we live in.

String theory
In his mind-expanding and ear-stimulating lecture, acoustics expert Dr Mark Lewney explains the distinctive sound of the rock guitar and shows how string vibrations might lie at the heart of the answers to some of the fundamental questions about the Big Bang and the dimensions of the universe. He will share the challenges of the LHC international research project based at CERN in Geneva, Switzerland. This is the most ambitious science endeavour of the decade and it is hoped that the LHC will bring new understanding about the origin of our universe, and will answer many of the questions that remain in physics.

Rock in 11 dimensions
The lecture will involve hands-on demonstrations, movie clips, expert rock guitar playing, plus mind-bending stories and animations to try to get the audience to think in 4, 5 or even 11 dimensions, and it will share the wonder and excitement of such grand-scale, cutting-edge physics. The free lecture lasts an hour and is suitable for ages 14 and above. It will be touring all over the UK throughout 2008.



Dr Lewney looks forward to the Institute of Physics Schools and Colleges Lecture tour in the new year.

Dr Mark Lewney is a science presenter who works at the UK Intellectual Property Office in Newport, Wales. After years of research into guitar physics at Cardiff University, he won the FameLab competition (an "*X Factor* for scientists") in 2005 at the Cheltenham Science Festival. He has since presented *The Physics of Rock Guitar* on Channel 4 and appeared on BBC Radio 4 as a guitar expert, on BBC *Newsnight* as a "physics evangelist" and on Children's BBC as "the Rock Doctor – a cross between Einstein and Jimi Hendrix".

For more information: www.iop.org. For further details about lecture bookings and venues, click on "Schools and Colleges" and go to "Events".

In this issue

Editorial

Welcome to the third edition of *Classroom Physics*. Many of you will be reading this as you come to the end of the autumn term and will be looking forward to winding down for Christmas. I hope that you won't feel that this issue is yet another reminder of all the things that you haven't managed to achieve or organise this term, but rather a timely reminder of all the support and resources that are out there. We have had lots of positive comments about the restyled newsletter and hope that you will continue to respond with your views and comments on what you would like to see in future issues.

Our front-page story launches the Institute of Physics Schools and Colleges Lecture tour 2008. Given by Dr Mark Lewney, the lecture combines rock guitar and string theory, and it promises to be a very entertaining take on physics.

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Editorial (continued)

There are several competitions that might catch the eye of both teachers and students. SciCast Physics will be closing its entries for this year on 4 January 2008, so there's still time for an end-of-term burst of creativity (p2). Catch a Star is the international astronomy competition run by ESO and EAAE (p4), and the online mathematics magazine *Plus* has launched an award to find the science writers of the future (p2).

New resources that you may find useful are also included in this edition. Lab in a Lorry, launched during Einstein Year, is still going strong. Details of where the lorries will be over the next few months are on p2. Ashfield Music Festival is a new resource, developed for the Stimulating Physics project, which combines physics and enterprise (p3). There are details of the brand-new *Particle Detectives* site, launched by the STFC to celebrate the opening of the LHC (p3). It includes resources to use with both pre- and post-16 students. *Catalyst* magazine has recently been bought by Gatsby Science Enhancement Programme and there are details of how to buy it for your students and to access past issues (p4).

Some of the support and training that we are offering to non-specialist physics teachers is outlined on p5, including an interview with a current participant on the Physics Enhancement Project's pre-PGCE course at Loughborough University. If you know of anyone who might benefit from one of these courses, please pass the information on to them.

We are continuing to look for dedicated teachers who would like to be involved in the development of the education department's work and have some input at policy level. Daniel Sandford Smith writes more about this on p4.

Finally, there are some top tips for teachers, including a wonderful demonstration or class activity to produce a giant image on the wall of your lab (p7), and a photocopiable worksheet, "Question loop for the electromagnetic spectrum", to use as a group revision activity (p8).

If you have any comments or requests for future issues, do get in touch.

Clare Thomson, editor (tel 020 7470 4981, e-mail clare.thomson@iop.org).

SciCast announces final call for scientific short film entries

SciCast Physics, the short film-making competition for scientists, is well under way, but there is still time before the 4 January 2008 deadline to enter your masterpiece. We are looking for films that are less than two-and-a-half minutes long and that explain a principle of physics in an entertaining and innovative way to non-scientists.

The competition is open to teams of all ages, and you don't need to have the latest technology because films can be submitted in any format, including mobile phone files and VHS. If you're a debut director, there are online hints to help you to capture the best shots and make your scientific explanation a cinematic creation worthy of Spielberg.

If you need some inspiration then take a look at the films already uploaded on the site. Entries so far include the explanatory powers of a tennis ball, an unusual use for a leaf blower and an intriguing explanation of Newton's laws of motion.

Guidelines, rules, tips and entry details are all online. SciCast Physics is part of Planet SciCast, which is a partnership between NESTA, the Institute of Physics and the Engineering and Technology Board.

For more information: http://www.planet-scicast.com/scicast_physics.cfm.

Lab in a Lorry takes to the road in the Midlands

On 15 October 2007, Lab in a Lorry (LIAL) made its first visit as part of a new partnership between the Institute of Physics, the East Midlands Development Agency (emda) and STEMNET. The lorry's appearance at the Derbyshire Skills Festival marked the start of three years' funding for the initiative in the East Midlands by emda.

LIAL is an interactive mobile physics laboratory that gives 11–14-year-olds the opportunity to do hands-on physics experiments, while being guided by volunteers who are practising scientists and engineers from industry and academia. Originally developed as a partnership between the Institute and the Schlumberger Foundation, LIAL was launched in March 2005 and has since received nearly 70 000 visitors from more than 600 schools. The lorry, now based in the East Midlands, joins a lorry in Scotland, which is supported by the Offshore Training Foundation and the Scottish Executive. A third lorry is due to take to the road in the North-West in early 2008.

Teachers in the East Midlands, Scotland and the North-West who are interested in hosting one of the lorries can find out more and register their interest online.

For more information: www.labinalorry.org.uk.

New award seeks the science writers of tomorrow

Plus magazine is trying to find the science writers of the future, who can make mathematics lively and interesting for a general audience. Published online and free of charge, *Plus* has articles by top mathematicians and science writers, providing a window into the world of mathematics with all its beauty and applications in fields as diverse as art, medicine, cosmology and sport. The *Plus* New Writers Award gives readers a chance to join an acclaimed list of authors, including physicist Stephen Hawking and NASA astronaut Michael Foale.

Secondary-school students are invited to write a piece of up to 900 words about the life and/or work of any mathematician, living or dead. The winning entries will be read by an international audience of more than 200 000 subscribers in the June 2008 issue of *Plus*. The closing date is 31 March 2008.

Besides the prestige of having an article published in *Plus*, there are also prizes for the best submissions, including signed copies of popular science books and an Apple iPod.

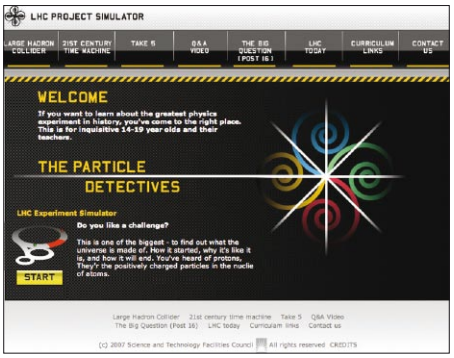
For more information: http://www.plus.maths.org/competition.

Physics students get to grips with the Big Bang

In summer 2008 the world's biggest physics experiment will begin a 10-year programme of research. The Large Hadron Collider (LHC), based at CERN in Geneva, will use cutting-edge science and engineering to allow particle physicists to test their latest theories. State-of-the-art technologies, which are already finding widespread applications outside physics, will produce collisions between subatomic particles at energies that last existed billionths of a second after the universe came into existence.

The Science and Technology Facilities Council (formerly PPARC) has developed several new classroom resources to engage students in the excitement of this hugely important project. These are not just for A-level but allow discussion of "How Science Works", from how theories are formed and tested, through data acquisition and analysis, to the management of "big" science involving multidisciplinary (and often international) teams.

The interactive *Particle Detectives* site



www.particledetectives.net targets the 14–16 age range and post-16 students. Users can "drive" an LHC simulator to learn how scientists will look for new discoveries. There are downloadable presentations that can be used by students or teachers, which cover the main questions that the LHC will explore. There are video clips of students asking, and scientists answering, questions about the LHC, and a "curriculum map" that identifies where the resources map onto the awarding bodies' schemes of work.

In Search of Giants is a series of three 15-minute films on particles, forces and the quantum world. A lively mixture of archive footage, interviews with present-day physicists and demonstrations of basic physics, the films focus on the physics questions that remain unanswered and how the LHC might help to answer them. This is a rich source of materials for particle physics teaching, but it also includes many sequences of use in other areas of the physics curriculum. The films are being broadcast by Teachers TV and are available for download from www.teachers.tv.

"Tunnelling to the beginning of time" and "Big questions: big experiment" are large posters on the LHC and LHC-related science, while *The Little Book of the Big Bang* is a cartoon book that takes a light-hearted and accessible look at the LHC project and the questions that it might answer.

All of the above resources are available at http://www.so.stfc.ac.uk/publications/#PSP.

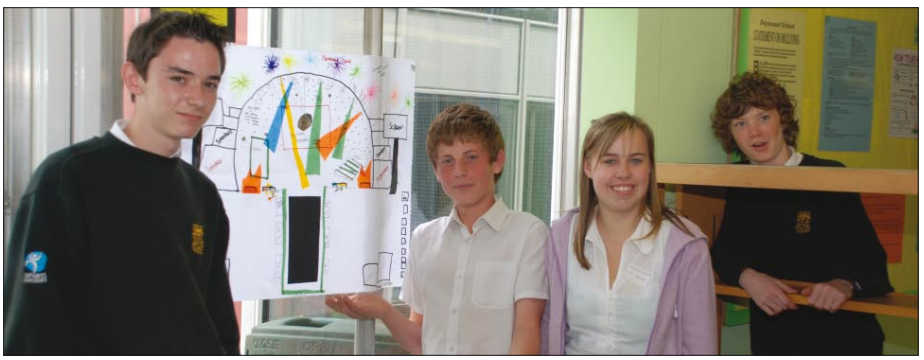
Enterprise activity stimulates young physicists

Does your school have an enterprise day in which students are taken off timetable to take part in a team activity? Have you ever wished this activity was based on something more useful, like physics? If either answer is yes, we can help.

Key Stage 4 students have an entitlement to five days' activity focused on enterprise capability. Since 2005 there has been funding available for schools to provide work-based learning and in-school activities. The aim is to help the students to become more innovative, creative and aware of risks while developing a "can-do attitude and a drive to make ideas happen" (*TeacherNet*, National Guidance on Enterprise Education). Typically, the in-school activities are commercial in nature and often revolve around developing a marketing campaign. Often they satisfy only a very narrow view of enterprise.

As part of the Stimulating Physics programme, we have been working with the Careers Advisory Research Centre to develop an enterprise activity with real challenges and a physics context. The aims are to provide students with a challenging experience that allows them to work in an enterprising way and to show them that the skills, knowledge and understanding that they have from physics help them succeed.

The students work in teams of six to



Students from Dayncourt School present their stage design proposal for the Ashfield Music Festival.

develop a proposal for the stage at **Ashfield Music Festival**. Each takes on a role in their team. These include a sound engineer, a lighting designer and a project manager. During the activity the students can consult adults who, with the aid of a briefing sheet, take on the role of an expert adviser. This is an ideal opportunity to bring in parents, undergraduates or local business people to work with your students.

We hope that, as well as appealing to students who are already interested in physics, the activity will draw a wider diversity of students to the subject. These will be youngsters who hadn't previously considered physics as an option but see that there is more to the subject than trolleys, meters and nuclear power. In particular, it might bring physics to the notice of students who are interested in enterprise by showing them that they will gain an advantage if they continue with their education in the subject.

The activity has been piloted and is now ready to go into field trials. It is available in electronic form (as a compressed folder of files) ready to deliver in schools, although you may want to use some of your school's enterprise budget to get a SETPOINT or Education Business Partnership to arrange and deliver it for you.

If you would like to try it out for yourself, visit the *Stimulating Physics* site at www.stimulatingphysics.org or contact Charles Tracy (e-mail charles.tracy@iop.org).

International competition looks for new stars

The exciting international Catch a Star competition for school students is returning for its sixth year. It is run by the European Association for Astronomy Education and the European Organisation for Astronomical Research in the Southern Hemisphere (ESO). Students can win a trip to visit the ESO Very Large Telescope on Cerro Paranal in Chile, as well as many other fantastic prizes. The deadline for entries is 29 February 2008.

There are three competition categories to choose from:

- **Catch a Star researchers**

Teams of up to three students write a project about a chosen topic in astronomy, by choosing an astronomical object, such as a nebula, star, planet or moon, or a more general theme, such as black holes or star formation. They research this topic and discuss how large telescopes can play a part in studying it. They may also include practical activities, such as observations or experiments. The most important goal is to develop an interest in science and astronomy through investigation and teamwork. The winning entries are chosen by an international jury. For teams from Europe there are major travel prizes, including the trip to the Paranal Observatory set on a mountain-top in the Atacama desert in northern Chile.

- **Catch a Star adventurers**

There is another section in which the prizes are awarded by lottery. Again, students should write a project about a chosen astronomical topic. This part of the competition is aimed at, but not limited to, larger groups, such as whole classes working on joint projects, younger students, or students who do not wish to write their entries in English.

- **Catch a Star artists**

Individuals can enter the artwork category of the competition by making a drawing or painting, with prizes awarded with the help of a public web-based vote.

Star prize: students can win a trip to visit ESO's Very Large Telescope facility on Cerro Paranal in Chile.

For more information:
http://www.eso.org/catchastar/cas2008.

Institute focuses on expanding its network of policy advisers

Policy work is probably the least visible thing that we do in the Institute's education department, but in many ways I think it may be the most valuable. In recent years we have successfully lobbied in a number of areas, including A-level subject criteria; girls in physics; the recognition of the importance of specialist science teachers (e.g. physicists); and careers support.

The Institute attempts to base its policy work on evidence. In some cases this evidence comes from research that we have commissioned; at other times we will seek the views of physics teachers by using Physics Education Policy Advisors (PEPAs). These also provide a steer for the department in its education work.

We are currently trying to extend the network of PEPAs by setting up an e-mail list of teachers and others with an interest in school and college physics education. We will use the e-mail list to elicit responses to consultations or opinions on resources that we are developing. For example, recently PEPAs have been asked to:

- provide information about assessment for a parliamentary select committee;
- trial a questionnaire on website usage;
- review physics textbooks;
- comment on the criteria for the chartered physicist designation;
- help with a study into the effect of ethnicity on progression in physics;
- volunteer to sit on a review of physics standards panel;
- give feedback on a proposal for a physics club resource.

There will be times when it is more useful to organise a group of PEPAs to meet and discuss issues in greater detail. For example, PEPAs provided detailed feedback on the GCSE specifications in 2006. There will also be occasions when the Institute is asked to supply a teacher representative for a meeting, and normally this would be a PEPA.

Anyone with an interest in physics education in schools and colleges, who is prepared to make a commitment to responding to requests from the Institute, can be a PEPA. Although there will be no payment for PEPAs, we hope that it will be useful professional development as well as something to include on your CV.

If you are interested in becoming a PEPA, contact **Daniel Sandford Smith** (e-mail daniel.sandfordsmith@iop.org).

SEP offers free resource

Catalyst: Secondary Science Review has been providing secondary-science students with engaging, informative and challenging articles for more than eight years. By exploring science in real-world applications, headline issues and cutting-edge research, all linked to curriculum topics, *Catalyst* aims to help students to take their exploration of science beyond the classroom.

The latest issue focuses on wave power, TB in badgers, QTC (quantum tunnelling composite), and science in the media.

In September, Gatsby Science Enhancement Programme (SEP) took over the publication and distribution of *Catalyst* as a natural addition to the range of resources that it offers to support science teachers and to engage and inspire students exploring science. Through the Gatsby SEP Associates scheme, teachers can request a free copy of the latest issue of *Catalyst*. You can become a SEP Teacher Associate free of charge. Join online at www.sep.org.uk.

Teachers and students can also explore articles from the last five years of *Catalyst* through the free online archive, which is available at www.sep.org.uk/catalyst.

Annual magazine subscriptions cost £16.95. Class sets of the latest issue are available for £20 (10 copies) through Middlesex Teaching Resources at http://www.mutr.co.uk/catalog/.

Incentive sweetens SASP pilot

The Science Additional Specialism Programme (SASP) offers support for non-specialist physics teachers. Pilot courses were launched this autumn in Brighton, Keele and Ormskirk, and they have recruited well. Aimed at teachers whose first degree or teaching qualification is not physics, the courses (available in both physics and chemistry) aim to improve knowledge and skills, and there is some flexibility to target a particular age group. The work includes research in the classroom as well as tuition to improve subject knowledge. Significantly, in October the government announced that an incentive of £5000 would also be paid to those completing the course successfully. It was also stated that supply cover would be available for the first year, although this is not guaranteed for future years.

The course's key features include:

- a maximum of 40 days in total, including study at home;
- opportunities for in-school development;
- accredited at Master's degree level, not in terms of subject knowledge, but in educational research terms;
- improving subject knowledge and teaching skills.

Attendees must:

- have some experience of teaching physics or chemistry already;
- be recommended by their head teacher;
- have the opportunity to put their

experience into practice in the following year.

The Institute and the Royal Society of Chemistry, with support from the Gatsby Foundation, are also providing a follow-up programme of light-touch mentoring. Similar but not identical to that provided for PEP participants, it will include visits to the Association for Science Education annual conference, Saturday workshops and a summer conference. In the case of the SASP course, there will be a greater component of school-based visits from mentors, providing help for devising and implementing new schemes of work.

Chris Shepherd,
e-mail chris.shepherd@iop.org

For more information:
visit http://www.tda.gov.uk/teachers/continuingprofessionaldevelopment/ and click on "Science".

PEP up your knowledge

Robert Slater talks about his experience on the Physics Enhancement Project's (PEP's) pre-PGCE course at Loughborough University.

What did you do before you enrolled on the PEP?
I am an ex-Rolls-Royce engineer with a degree in engineering and a masters' in business.

So what made you decide to enroll on the PEP?
I've taught before as an instructor in the RAF. Also, I have two young children aged 7 and 10, and I recognise that children of this age need a lot of support.

What have you enjoyed most about the PEP?
My tutor has the ability to look at what we actually need, as opposed to sticking to a rigid, structured course. With his in-depth knowledge and passion for the subject, he recognises what we need, where the shortfalls are and how best to fill any gaps.

Are there any aspects of the course that you haven't enjoyed or found particularly difficult?
One weakness is that it has been split into elements, which include topics like electromagnetism and particle physics, taught by the physics department. We've had problems with communications between the two departments. Also, this element hasn't been taught in the way that we need it to be.

What would you say to someone thinking of enrolling on the course?
I would say don't hesitate and, whether you have a strong physics background or not, I think the course is the right way to go pre-PGCE. Having spoken to people who have done a PGCE without this sort of opportunity, they found that they struggled with some course elements due to having to go back and relearn their physics. I'm in the position where I've studied some physics already, so I can concentrate on learning how to teach.

SPT plans global support

Supporting Physics Teaching (SPT) 11–14 is already a worldwide success. The gestation period was a little protracted, but for the past two or three years the great majority of trainee student teachers in higher-education institutions have had the materials to develop their subject knowledge. This year we're working to give everyone access. If you find yourself at a physics support meeting in Christchurch, New Zealand, you'll also find it comes highly recommended (or so my man down under informs me).

The publication comprises a set of five CD-ROMs (to purchase, e-mail joanne.page@iop.org), but this is only the start. They were designed to be used as a part of in-service training; relearning without support is hard. The resouce is challenging, particularly in areas that you might expect, such as the teaching of energy. Each topic area (light and sound, electricity and magnetism, Earth in space, forces, and energy) is divided into carefully sequenced episodes, developed in three strands. These elements spell out an engaging and coherent physics narrative, developed alongside the teaching and learning challenges to be faced, which form another strand. The final element consists of a selection of activities, reflecting the major facets of the other pair. The resource is a professional kit set, designed to underpin the development of subject knowledge for the 11–14 curriculum (and most of the current 14–16 curriculum as well).

SPT is being used by heads of departments with their non-specialists, and by strategy teams and ASTs to support schools. All have found that the challenge needs handling with care, but that feedback has been very positive (not uniformly, but actually overwhelmingly). Training has been run for the trainers (twice at the National Science Learning Centre), and courses offered in regional science learning centres.

So what are the resource's key ideas? Coherence and consistency for one – physicists make simple (but not necessarily simply accessible) models and these play a central role. Second, usable and principled classroom approaches, leading to the ability to reason things out with children, rather than working with knowledge delivered and appropriated in bits and pieces.

Developing with SPT is not altogether uniform, however – a little cultivation is now planned. If you or your colleagues are not as confident and competent as you'd like to be, then look out for supporting developments over the next 24 months (visit www.iop.org).

Ian Lawrence, e-mail ian.lawrence@iop.org

Events

UK National Science and Engineering Week

7–16 March 2008

Details: visit www.the-ba.net for more information about running activities and what might be happening in your area. To contact a member of the organising team, e-mail nsew@the-ba.net or tel 020 7019 4963. To apply for an IOP/STFC grant of up to £500 to help with running your event, visit www.iop.org and click on "Schools and Colleges".

EVENTS FOR TEACHERS

ASE Annual Conference

University of Liverpool

3–5 January 2008

A varied programme of lectures and workshops, as well as a large exhibition showcasing the latest science resources of all types.

Details: to book for the whole conference or any single day, visit www.ase.org.uk

ASE Scotland Annual Conference

Crieff Hydro Hotel, Crieff, Perthshire

7–8 March 2008

"Climates for change" – an opportunity to develop a deeper understanding of some of the issues and possible solutions facing our communities in the future. The programme includes lectures, talks and workshops.

Details: www.asescotland.org.uk

Nanotechnology and New Materials – Lecture and Demonstrations

Burghley House, Stamford, Lincolnshire

11 March 2008, 4.00–5.30 p.m.

Nanoscience team (University of Cambridge) followed by quantum tunnelling composites and smart materials – samples of both to test and take away. The event, which is most appropriate for A-level/IB teachers or those wishing to teach at this level, will be followed by a meal.

Booking: e-mail slc2@oakham.rutland.sch.uk

Physics Update

School of Physics and Astronomy, University of Leeds

4–6 April 2008

A three-day residential course for teachers of physics. Accommodation at Westwood Hall, Conference Centre and Hotel, Leeds. The flier and application form will be sent out in early January.

Details and booking: contact Leila Solomon, e-mail leila.solomon@iop.org, tel 020 7470 4821

Salters Horners Advanced Physics Residential Courses

University of York

7–9 April: AS preparation, teachers' course

9–10 April: AS and A2 preparation, technicians' course

9–11 April: A2 preparation, teachers' course (focusing on the current course and its assessment)

2–4 July: AS preparation, teachers' course (a repeat of the April course)

These courses will be particularly valuable for teachers and technicians preparing to teach the new Edexcel GCE physics from September 2008 and who are intending to adopt a context-led approach for all or part of their teaching. The courses will be based on the Salters Horners course materials and activities, and will show how these can be used to support the new Edexcel specification.

Details and booking: www.york.ac.uk/org/seg/salters/physics

Advancing Physics Teachers and Technicians Courses

Department of Physics and Astronomy, University of Birmingham

1 July: Introduction to AS

2 July: Introduction to A2

3 July: Technicians' course

Are you new to Advancing Physics, or do you feel the need to do a bit of catching up? These courses, run jointly with OCR, will cover all aspects of teaching and learning, including a session on coursework and an introductory CD session, reflecting the revisions made to the specification for September 2008. Special rates are available for early bookers and affiliated schools.

Details and booking: advancingphysics.iop.org/teacher/index.html

EVENTS FOR STUDENTS

Institute of Physics 2008 Schools and Colleges Lecture: Rock in 11 Dimensions: where Physics and Guitars Collide!

This free lecture, given by Dr Mark Lewney for 14–16-year-olds, starts its UK tour of schools and colleges (p1).

Details and booking: visit www.iop.org and click on "Schools and Colleges" for further information regarding dates and venues, or contact Joanne Page, e-mail joanne.page@iop.org

Physics in Perspective

University College London and the Institute of Education

17–19 February 2008

A three-day course for sixth-formers and college students, with the aim of bringing to participants some of the excitement, relevance and fun of physics. Consisting of six lectures or lecture-demonstrations, there will be free time scheduled in to allow participants to explore other aspects of London. Discounted accommodation is available through Minerva Travel.

Details: contact Leila Solomon, e-mail leila.solomon@iop.org, tel 020 7470 4821

Advancing Physics Revision Roadshow for 2008

All venues will feature sessions for both AS and A2 students

20 March: Science Learning Centre, York

27 March: University College London

28 March: University of Bristol

31 March: University of Birmingham

17 April: University College London

The cost is £20 per student, which includes revision sessions, revision handouts, lunch and refreshments. Accompanying teachers are free. Please book early to avoid disappointment.

Details: booking forms are available on the Advancing Physics website at advancingphysics.iop.org/teacher/roadshow.html, or contact Anastasia Ireland, e-mail anastasia.ireland@iop.org

Particle Physics Masterclasses

These events will be held in a variety of locations around the country in March/April 2008, including Rutherford Appleton Laboratory, Didcot, Oxfordshire

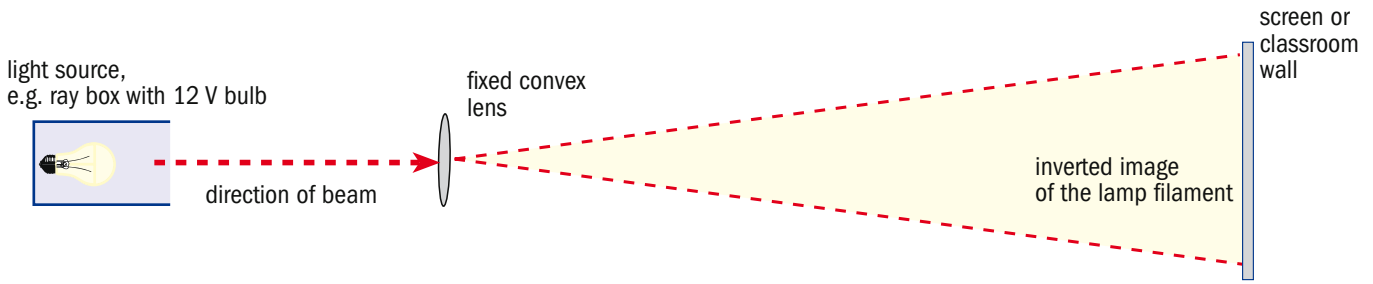
12, 13 and 14 March 2008

The masterclasses are primarily intended for those students taking modules that include particle physics at A- or AS-level, but are also open to any physics students or teachers interested in studying or teaching the subject. The classes will consist of a mixture of talks (given by researchers in the particle physics department), hands-on practical sessions and visits to experimental facilities.

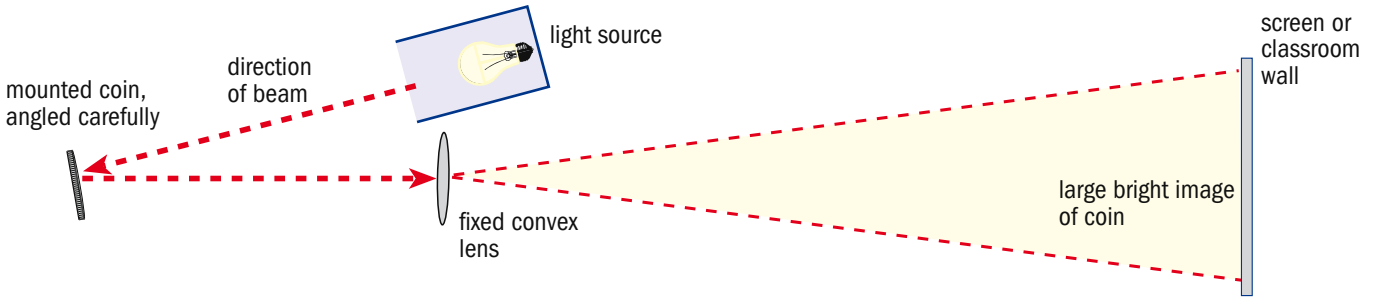
Details: contact Elizabeth Clarke, e-mail e.m.clarke@rl.ac.uk, tel 01235 445 950, or visit http://hepwww.rl.ac.uk/pust/masterclass.htm

The world's largest coin

Projecting an enlarged image of an object onto a classroom wall can be a magical experience for pupils. Typically a 12 V filament bulb, ideally in a suitable holder that cuts the light down to a broad beam, is placed at a distance of about two focal lengths away from a fixed convex lens (say 7D or about 140 mm focal length), and the inverted image of the lamp filament is captured on a piece of card. The lamp is gradually brought closer to the lens, and pupils move the card back to capture larger and larger images of the filament. With suitable positioning, a very large image can be projected onto a clear section of laboratory wall.



The next stage is to repeat the process but with an illuminated coin substituted for the filament bulb. A coin, mounted on a block with Blu-Tack, is placed where the filament bulb was, and it is illuminated with the beam from the filament lamp. The lamp typically has to be alongside the lens, the beam directed at the coin. The coin is twisted slightly to perfect the angle of reflection until a large bright image is projected by the lens onto the card or the wall. The key is to get enough light onto the object to start with, and to have a dark enough background to project onto. Any reflective object can be used, to powerful effect.



If a ray box is used, care has to be taken because the metal parts get very hot. For more experiments and helpful advice regarding safety and risk assessments, see the optics section of the *Practical Physics* site (www.practicalphysics.org).

Chris Shepherd

Classroom activities – introducing moments

Moments and turning forces are sometimes difficult to put into an engaging context. Here is an entertaining suggestion. Introduce the lesson with a clip from the film *Pirates of the Caribbean*, where Jack Sparrow and Will Turner are fighting onboard a ship. At one point they end up on a plank and have to balance themselves.

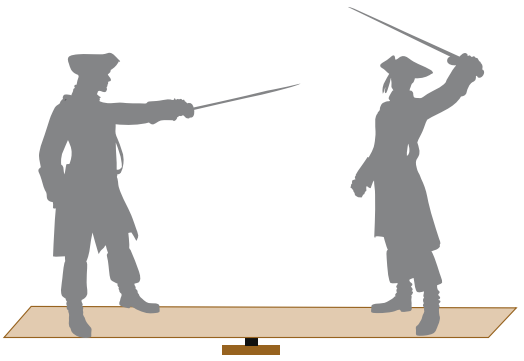
Discussion point

If Captain Jack Sparrow is heavier than Will Turner, do you think Will needs to move closer to the pivot than Jack or farther away than Jack to make the plank balance? Explain your answer using your knowledge of moments. A diagram of the scenario might help.

Plenary

A plank was balanced on a beam at a building site. A builder placed a bucket of water on one end of the beam. He claimed that, to his surprise, the plank fell off the beam and hit a surveyor below. The surveyor received a severe head injury and now wants to sue the builder for negligence. He believes that the builder should have known that the plank would fall in that situation.

Write a newspaper article or a lawyer's argument for court that either defends the builder or attacks him. Make sure you explain the science relevant to the case, especially in relation to balanced and unbalanced seesaws.



Many thanks to **Antonia Rowlinson**, whose ideas these are.

Question loop for the electromagnetic spectrum

Teachers' notes: photocopy the worksheet onto A3 paper and cut out each answer and question pair. Divide them up among ~~the~~ groups, making sure that you use all of them. Anyone can start reading out their question and the group with the correct answer should respond. They then read out their question and so on, until all the questions have been read and answered and the loop returns to the start. This can be repeated in a number of different ways to assist with memorising the properties of the electromagnetic spectrum.

A. To protect themselves from exposure to too much damaging radiation.
Q. How fast do radio waves travel in space?

A. 300 million metres per second.
Q. What electromagnetic radiation is used in TV remote controls?

A. Infrared.
Q. What radiation is used to irradiate food to prolong its shelf life?

A. Gamma rays.
Q. What radiation is used to identify forged bank notes?

A. Ultraviolet.
Q. What radiation does a dentist use to make an image of your teeth?

A. X-rays.
Q. What does prolonged exposure to ultraviolet light do to the skin?

A. It damages the skin cells, which can lead to excessive wrinkles and skin cancer.
Q. Why are the short wavelength radiations potentially more dangerous than visible light?

A. They carry more energy and can penetrate deeper into the body to damage cells.
Q. Why are living things visible with night vision cameras?

A. Because they are warm and give off infrared radiation.
Q. What waves have the longest wavelength in the electromagnetic spectrum?

A. Long wave radio.
Q. Why do some washing powders have chemical brighteners in them?

A. These absorb ultraviolet light and re-emit it as visible light, which makes white clothes look especially white.
Q. The energy of an electromagnetic wave increases with increasing ...

A. frequency.
Q. X-rays are useful for detecting bone fractures because they ...

A. are absorbed by bone but pass through flesh.
Q. What colour of light has the highest frequency?

A. Violet.
Q. If you lie in the Sun, the electromagnetic radiation that falls on your skin includes ...

A. infrared, visible and ultraviolet light.
Q. How do microwave ovens cook food?

A. They emit particular wavelengths that excite water molecules to vibrate more. This causes heating.
Q. Why do medical professionals leave the room or go behind a screen when they give you an X-ray?