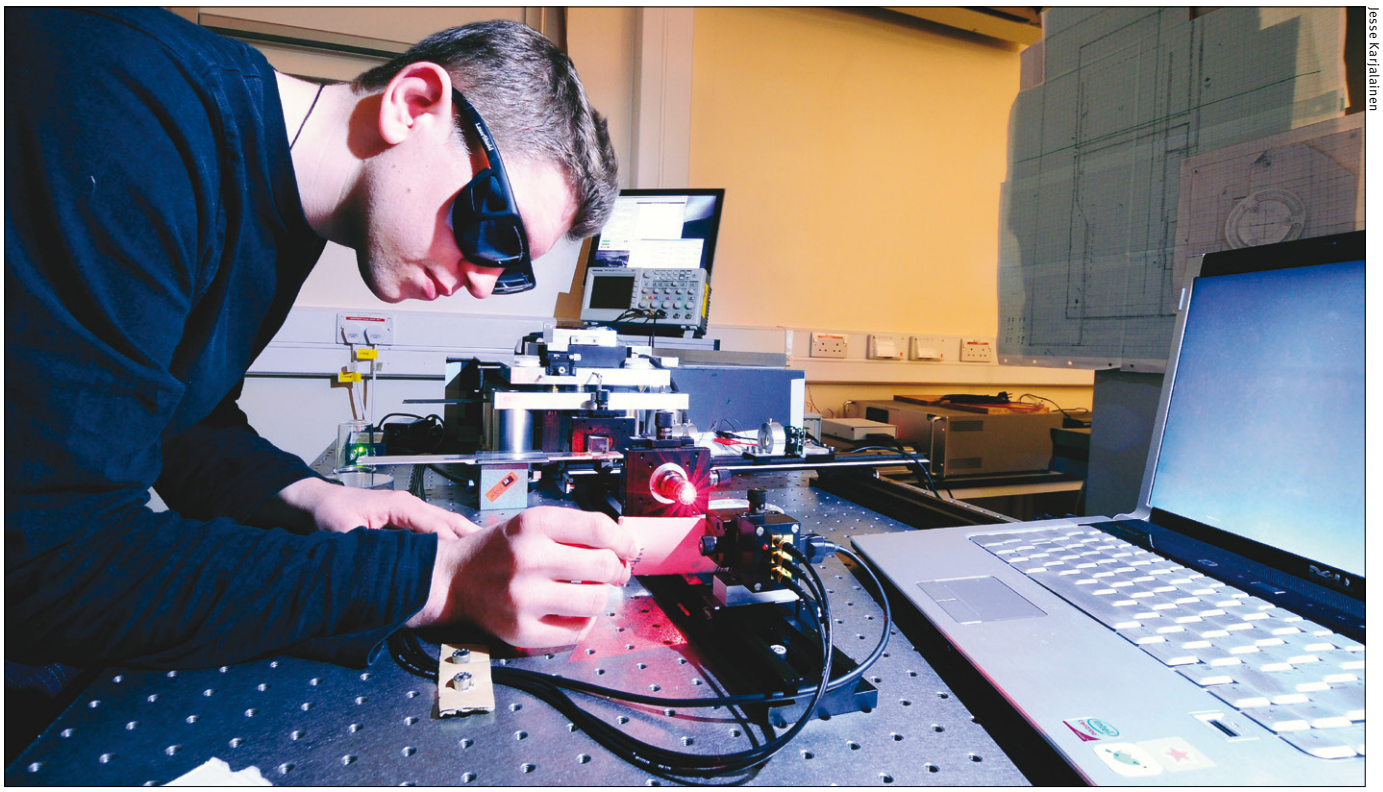
IOP | Institute of Physics
Education *Supporting Teachers*

Classroomphysics

The newsletter for affiliated schools

September 2010 Issue 14



Jesse Karjalainen

Working with lasers at the Centre for Nanoscience and Quantum Information, University of Bristol.

Celebrating 50 years of the laser

Lasers provide the archetypal example of how a discovery in basic physics led to an invention, several decades later, that was unpredictably world-changing.

When Theodore H Maiman constructed the first working laser in 1960 he could never have imagined the impact that his invention would have. Today, lasers are found in every home, used for applications as diverse as medicine and manufacturing, and they are the backbone of the internet.

The principle behind the laser goes back to Einstein, who proposed a theory of stimulated light emission in 1917. However, it took more than 40 years before this idea was converted into practice, and even after Maiman's demonstration of the first working laser the idea did not really catch on for another decade. It was the development of the first room-temperature semiconductor lasers in the 1970s that turned the laser from a research tool into a practical, everyday device.

Today, the largest application of lasers is in optical-storage devices, such as CDs, DVDs and Blu-ray discs, as well as barcode readers and laser printers. The second largest is in fibre-optic communications – which carry broadband internet across the globe.

The applications of lasers are, of course, not limited to information technology and telecommunications. In medicine, lasers are used routinely to perform micro-surgery. In manufacturing, lasers are used for welding and cutting metal. In measurement, lasers have long been used by the military for range-finding, but now, even estate agents use laser tape measures. Lasers can also be used to analyse chemical and physical structure and are therefore used in factory quality control and to monitor environmental pollutants remotely. The laser industry worldwide is worth many billions of pounds.

Virtually every university science department in the UK relies on lasers for some aspect of its research programme. Lasers interact with matter at the quantum level in specific ways and so are important probes in research. Without lasers, many recent discoveries would never have been made. Increasingly, life scientists are employing lasers in new types of microscopy designed to highlight cellular structures.

To celebrate 50 years of this truly revolutionary invention, the Science and Technology Facilities Council and the Engineering and Physical Sciences Research Council have produced a booklet illustrating the last 50 years of the laser and its impact, which is included with this issue of *Classroom Physics*, along with a poster showing a timeline of laser development.

For more information about the science and impact of lasers, see the IOP case study at www.iop.org/cs/lasers, or see *Physics World* **23** 5 (May 2010 issue, currently available as a free PDF download from physicsworld.com).

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Editorial

Welcome to the first edition of *Classroom Physics* for the new school year. I hope that you have returned from a well deserved break feeling relaxed and refreshed! In this edition we celebrate the 50th anniversary of the first working laser (p1). Lasers are one of the outstanding success stories in physics and are so much a part of our everyday lives that we scarcely notice them. Our teaching tips (pp7–8) look at ways of exploring their use with your students.

We have news of our Supporting Physics Teaching (SPT) project (p3), with the launch of the first section of the 14–16 materials. SPT is a set of resources to help teachers develop a greater confidence in their teaching of physics.

We continue to focus on promoting more effective practical work. With that in mind, there is news of the Getting Practical project (p2) and the Gatsby Science Enhancement Project (p3). In addition, if you are supported by a wonderful technician, you might want to nominate them for a Salters' Technician Award (p2).

SciCast Physics challenges young people to explain a principle of physics in an entertaining way to non-scientists. The number of entries continues to grow and we have news of this year's winners (p5).

There is exciting news of the STEM challenges developed by STEMNET in preparation for the London 2012 Games (p4). The Science Museum is also offering support for STEM clubs and teaching How Science Works (p3).

The National Schools Observatory is launching its new website (p4), which has a huge range of resources to enrich your teaching. For the future UK-ESERO, the UK space-education office, has recently been established (p5).

If you are an affiliated school, you will receive a copy of the SEP resource *Voicebox: The Physics and Evolution of Speech*, a collaboration between University College London and the IOP. This is a set of practical activities and interactive software that encourage students to understand human speech at a basic level, as well as its evolution. I hope you find it interesting and useful.

Your comments are always welcome.

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

Salters' Awards 2011: call for nominations

In 2011 the Salters' Institute will enter the eighth year of the Salters' National Awards for Science Technicians, which are now presented annually in collaboration with the Institute, among others. The awards are open to science technicians in schools and colleges catering for students up to age 18, and who have a total of five or more years' experience (either full time or part time).

The aim of the awards is to acknowledge publicly the immense contribution that science technicians make to the well-being and success of schools and colleges and, in particular, to science departments. We hope very much that the awards will heighten the awareness of the importance of science technicians to education. The closing date for nominations is 1 March 2011. If you know of a technician who fits our criteria then please nominate them for an award.

For more information and a nomination form, visit www.saltersinstitute.co.uk or contact the publicity co-ordinator (tel 020 7628 5962 ext. 260; e-mail publicity@salters.co.uk).

You've heard of Getting Practical, now get involved

"Outstanding course. I will definitely be using ideas and strategies delivered and shared in this session – particularly modelling scientific theory." (A secondary teacher, after attending Getting Practical.)

Following on from the success of the first year of the Getting Practical – Improving Practical Work in Science professional-development programme, trainers are being prepared in the early autumn for the 2010/11 courses. These courses will be run all over England for teachers, technicians and HLTAs and are free to attend. Last year many teachers were able to take the training and materials back to their schools and have worked with their colleagues on improving the effectiveness of the practical science that they teach. This year, we invite more schools to take part in and enjoy the benefits of this reflective CPD course.

Details of courses available in your area, as well as access to good quality practical science resources, can be found on the website www.gettingpractical.org. It is updated regularly with new events.

For more information and to register your interest in the programme, contact Kirstie Hampson (e-mail kirstiehampson@ase.org.uk, tel 01707 283000).

Royal Astronomical Society re-launches website

The Royal Astronomical Society (RAS), founded in 1820, encourages and promotes the study of astronomy, solar-system science, geophysics and closely related branches of science. The RAS supports education through grants and outreach activities. Its recently re-launched website is an invaluable source of advice and information on all matters astronomical, including careers advice for young people and an annual newspaper competition. There is now a searchable database of kitemarked free resources for teachers at both primary and secondary level.

For more information: go to www.ras.org.uk or, for the full searchable database, www.ras.org.uk/education-and-careers/educational-resources.

Museum ‘gets’ science education

Respected all over the world for its innovative and interactive galleries, the Science Museum is sharing its expertise in creating engaging learning experiences through two unique schemes for secondary schools – STEM Clubs and the new How Science Works.

The How Science Works scheme helps KS3 and KS4 teachers to engage students with the key concepts of this core curriculum area. Teachers can attend the popular and effective discussions of the Talk Science course, which is packed with ingenious techniques for running classroom discussions on contemporary science topics, such as climate change. These give students the confidence to find their voice and have a say in how science impacts and shapes their lives.

Participating schools also receive two of the museum’s innovative classroom resources. Mystery Boxes are intriguing “lesson in a box” kits that help students understand the processes though which scientists explore theories. News + Views asks students to work as science journalists, considering different ideas and opinions while creating displays about a topical subject area in science.

Students can visit the museum for an exclusive discussion event and the chance to enjoy the amazing new contemporary science galleries Who Am I?, Antenna and Atmosphere: Exploring Climate Science.

Students work as journalists using the Science Museum’s News + Views classroom resource.

How Science Works is based on the museum’s successful STEM Clubs idea, which has already supported more than 40 schools in making their KS3 STEM clubs more inspiring and exciting. Teachers who have been involved rate the scheme highly: “If you’re running or want to start a KS3 STEM club, this scheme is just the thing.”

For more information: Places are still available on both of these schemes for the 2010/11 academic year. For dates and costs, visit the “What’s on for teachers” area at www.sciencemuseum.org.uk/educators. Thanks to generous support from BP, the Talk Science course component is provided free of charge.

Institute’s 16–19 membership goes from strength to strength

As the new term starts, don’t forget to remind your new students that they can join the Institute for free if they are over 16 and studying physics. The Institute now has more than 2000 16–19 members, a number that grows daily. As well as being a great way for your students to enhance their CVs, 16–19 membership gives them the opportunity to speak directly to other students and physicists about careers in physics and what studying at university is like. There are also regular competitions, online access to the member magazine *Physics World* and lots of other opportunities, such as the chance to ask IOP president Jocelyn Bell Burnell about what it was like to discover the first neutron stars and being a woman in science, then and now.

For more information: Students can sign up at www.iop.org/16-19.

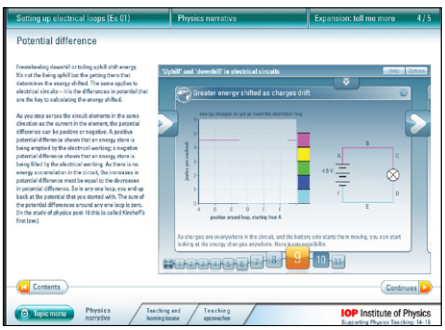
SPT14–16 starts with electricity and energy

The first SPT14–16 topic, Electricity and Energy, is now available to download from the *talkphysics* website. It consists of 14 hyperlinked rich PDF files (Acrobat 9). A year in the making, it is a large download, so allow plenty of time. The topic builds on models used in the 11–14 resources, so analysing circuits using remote working by loops plays a big part, as does a development of the energy model, keeping power and energy separate.

SPT14–16 has the same episodic structure as the 11–14 resources, encapsulating pedagogical content knowledge in the physics narrative, the teaching and learning issues and the teaching approaches. However, the interactive elements, embedded in the PDFs, have been revised to reflect the more complex, often multistep, structure of the arguments developed with 14–16 year olds. These now show visual and graphical overviews of the argument, while still allowing you to zoom in for the careful and coherent exploitation of the strengths of graphical and interactive communication.

There are two groups on *talkphysics*: one for teachers and one for their support. In the autumn there will be a *talkphysics*-based online CPD event, focused on the materials.

For more information and to download the materials, go to www.talkphysics.org and log in or register. You then need to click on the link on the left-hand side of the page to join the Planning for Electricity and Energy group. To have the choice of how to download the materials, go to the group blog by clicking the link on the left-hand side of the group page.



Physics muscles in on Olympics enthusiasm

The 2012 Olympics and Paralympics are fast approaching and will soon take centre stage as athletes represent their countries in the quest for gold.

Why not bring the fun and excitement of the event into your classroom? Schools have the opportunity to play their part in the London 2012 Games and help inspire the next generation of British scientists and engineers in the process.

Teams of 11–14 year olds are invited to tackle 10 STEM challenges focusing on different aspects of preparations for the events. Each challenge has been designed to enable young people to use skills they have learned in science, design and technology, and maths lessons to create something interesting, useful and potentially spectacular. The challenges are co-ordinated by STEMNET (the Science, Technology, Engineering and Mathematics Network) in association with the London Organising Committee of the Olympic and Paralympic Games (LOCOG) and are funded by the Department for Education.

The next challenge is being launched in September on the theme of sustainability and transport, in which schools will be asked to look at the logistics of how athletes get from the village to the venues.

Double Olympic gold medallist James Cracknell with students from Burnham Upper School at the launch of the second STEM challenge.

The first STEM challenge asked students to consider some of the steps involved in designing and siting a National Handball Centre for the 2012 London Olympics. The second invited teams to design gloves for rowing, canoeing or sailing to protect against painful calluses and blisters. The last challenge was on the theme of anti-doping, focusing on laboratory techniques.

Each challenge can take place either in the classroom or at after-school STEM clubs. They are each designed to be addressed over a school term and therefore run for six to eight weeks.

For more information and to register for challenges, go to www.stemchallenges.net.

SEP expands professional-development team

The flexible, bespoke professional-development support offered by the Gatsby Science Enhancement Programme (SEP) now has even more physics and chemistry expertise in the shape of Richard Ager and Dorothy Warren. Richard and Dorothy join the team of SEP professional-development leads (PDLs) who are working with science departments all over the UK, supporting the development of subject knowledge and the practical expertise of teachers and technicians in secondary schools and colleges.

Like the rest of the team, Richard and Dorothy have both been teachers in UK secondary schools and colleges. In addition to physics expertise, Richard also has extensive knowledge and experience of producing and using ICT in the classroom, as well as having written a number of books and spoken at international conferences in this area. Dorothy is one of SEP's resident chemists and has led a number of curriculum-development projects, including cross-phase with KS2 teachers to support the transition to KS3 and, most recently, writing a module for the Twenty First Century Science GCSE course.

Professional development support from the PDLs is tailor-made for each school, designed together with the teachers in the science department. Training sessions are completely flexible, arranged to work around busy timetables, during the day and evening. The team often works with science departments on an on-going basis, supporting them over several terms where appropriate. This subsidised professional-development support programme is available thanks to the generosity of the Gatsby Charitable Foundation.

For more information, visit www.sep.org.uk/cpdsupportfromsep.asp or contact the team directly (e-mail cpd@sep.org.uk).

National Schools' Observatory website gets a major upgrade

September will see a major change to the National Schools' Observatory (NSO) website, when the team at Liverpool John Moores University "switches on" the latest incarnation of its web presence.

The update keeps all of the popular features and activities from the previous version, but also includes many new options to show content that is relevant to the type of user viewing the pages. In addition, there are new classroom activities and specific sections that are dedicated to topics such as GCSE astronomy. Other sections include ideas for setting up an extra-curricular astronomy club, and a quick and easy way to find resources that are relevant to almost any topic in the science curriculum, as well as other school subjects.

Following this launch the school interface to the Liverpool Telescope will undergo a series of upgrades, and a range of new observation programmes will be available.

The website switch is due mid-September, so look out for all of the new features.

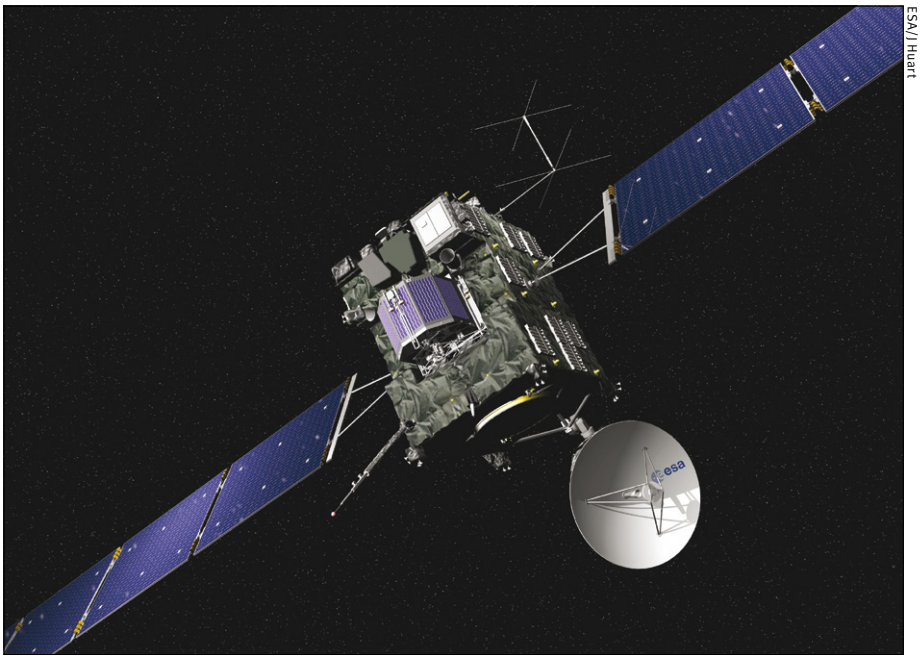
For more information, go to www.schoolsobservatory.org.uk.

New space-education office for the UK aims to inspire and engage young people

UK-ESERO, the UK space-education office, has been set up by the European Space Education Resource Office (ESERO) to promote the use of space to enhance and support the teaching and learning of Science, Technology, Engineering and Mathematics (STEM) in schools and colleges throughout the UK. Funded by the European Space Agency (ESA) and the Department for Education, the office has been established at the National STEM Centre at the University of York.

UK-ESERO aims to become the first point of contact for teachers and lecturers seeking information about space education and careers. It also intends to share good practice and become the place to go for teaching and learning resources for space education. With this in mind, a group of space-education ambassadors is being established throughout the UK, to build and maintain education networks.

The resources are available online via the National STEM Centre's eLibrary, which can be found at www.nationalstemcentre.org.uk. Click on "eLibrary" and then look for ESERO under "Publisher". The list of resources will gradually increase as more are added. Schools interested in space and producers of space-related resources are invited to sign up for more information on the UK-ESERO website, www.esero.org.uk.



ESA/J Huart

Rosetta is the first ever mission designed to orbit and land on a comet. It gets its name from the famous Rosetta stone that led to the deciphering of Egyptian hieroglyphics almost 200 years ago. Similarly, scientists hope that Rosetta will unlock the mysteries of how the solar system evolved.

A formal launch of UK-ESERO will take place at the IOP on the 13 October, where schools already using space as a context will display their work. If you are interested in attending, contact Dr Clements (see below).

For more information, contact Dr Allan Clements, manager of UK-ESERO (e-mail a.clements@nationalstemcentre.org.uk).

Physics sweeps the board – again!

Once again physics films dominated the annual Planet SciCast Awards, winning 10 of the 16 prizes on offer, including the coveted Best Film 2010, at a glittering ceremony held at the Royal Institution on 16 July.

Planet SciCast invites budding film-makers to produce short and entertaining films that explore science. This year more than 270 teams took up the challenge and the awards ceremony is a chance to recognise the hard work and ingenuity of some of these teams.

The Institute-sponsored SciCast Physics category attracted so many entries this year that the films were split into three age groups. The Best SciCast Physics Film (primary) award went to *The Last Straw*, a hugely entertaining look at straws and atmospheric pressure, by four 11 year olds from St Mary's Primary School in Richmond, London. The Best SciCast Physics Film (secondary) award went to *The Doppler Effect*, a deceptively simple looking film by two 14 year olds from south-west London.

Prof. Jim Al-Khalili and Marty Jopson from The One Show *with the creators of the best SciCast Physics film (secondary),* The Doppler Effect.

The Best SciCast Physics Film (16+) award went to *The Leidenfrost Effect*, a film that captured not only the beauty of standing waves in a drop of water but also the excitement of discovery, by 16 students from St Joseph's College in Lucan, Ireland.

Physics ruled in other award categories as well. *Gravity, Mass and Weight*, an inspired parody of the Apollo Moon landings in Lego won the Award for Technical and Artistic Achievement and went on to win Best Film 2010. Remarkably, the film was the work of just one person: 18-year-old Oliver Madgwick from St Albans.

For more information: All of this year's entries (including the winners) can be seen at www.planet-scicast.com/films.cfm.

Events

EVENTS FOR TEACHERS

Rocket workshop for PGDE students

Jordanhill Campus, Strathclyde University
9 September, 4.30 p.m.
All physics teachers are welcome to join this event. Teachers should register to secure their rocket launcher. Contact Ronna Montgomery (e-mail ronnamontgomery@yahoo.co.uk).

East Midlands Physics Network Day

Leicester Grammar School, London Road, Great Glen, Leicester, LE8 9FL
18 September, 10.00 a.m. – 3.00 p.m.
For anyone teaching or supporting physics; a mixture of lectures and workshops. To register, contact Alison Gupta (e-mail alisongupta@rocketmail.com).

South West Physics Network Event – Virtual Physical Laboratory

Stroud High School, Beards Lane, Stroud, Glos, GL5 4HF
23 September, 4.30 – 6.00 p.m.
Virtual Physical Laboratory is software developed by John Nunn at NPL and provided free by licence through the Institute. This workshop is at KS4 and 5 physics level. Book through Deborah Reed (e-mail deborah.reed@gloucestershire.gov.uk).

The Scottish Physics Teacher Network Autumn Tour

25 September – full day event, Edinburgh
27 September, Dundee
28 September, Glasgow – see below
29 September, Dumfries
30 September, Inverness
2 October – full day event, Aberdeen
The IOP Physics Teacher Network, working with ASE Scotland, has arranged a week of CPD events, spread widely across Scotland. John Wayne and Andy Spoone from PASCO in the US will run a series of workshops for physics teachers. There will also be other workshops, exhibitions and opportunities for science teachers to share ideas and network. The two Saturday events are full ASE day-long conferences, including workshops from IOP Teacher Network co-ordinators. For further details of the tour, contact Stuart Farmer (e-mail stuart.farmer@yahoo.co.uk).

Irish Teachers of Physics Annual Conference: Frontiers of Physics 2010

Department of Experimental Physics, NUI Maynooth
25 September
A day of lectures, demonstrations and workshops for teachers. There will also be a tour of the National Science Museum. For further details, go to http://physics.nuim.ie/Frontiers2010.shtml or contact Paul Nugent (e-mail paulnugent@eircom.net).

Physics Teacher Network Autumn Event

Glasgow Science Centre
28 September, 4.30 p.m.
This will follow the usual format and will include practical work for the new Higher in physics. Refreshments will be provided. Details will appear on SPUTNIK and in mailings to all schools. For further information, or to join SPUTNIK, contact Ronna Montgomery (e-mail ronnamontgomery@yahoo.co.uk).

Welsh Physics Teachers Conference

Christ College, Brecon
6 October
This free conference is open to anyone who teaches physics, including non-specialists, and technicians. Presentations include the Bloodhound SSC Car and examination officers speaking about changes in specifications and examinations. There is a choice of workshops in the afternoon, an opportunity to try out new apparatus and demonstrations that will be useful in the teaching of physics at all levels. There will also be an exhibition. Booking is essential. For more information, go to www.iopwales.org/Calendar or contact Cerian Angharad (e-mail cerian@angharad.fslife.co.uk).

Autumn Physics Update

University of Oxford
17–19 December
This three-day residential course will feature an exciting programme of talks and workshops, including a visit to the world's largest fusion experimental facility at Culham Science Centre and a lecture from Prof. Jim Al-Khalili on "The secret of chaos". For details and booking, visit www.iop.org/update or contact Manchi Chung (e-mail manchi.chung@iop.org).

Spring Physics Update

University of York
15–17 April 2011
This three-day residential course will feature an exciting programme of lectures and workshops, including a visit to the brand-new National STEM Resource Centre and a practical medical-physics workshop – "Seeing inside the body" – from Dr Michael Drinnan. For details and booking, visit www.iop.org/update or contact Manchi Chung (e-mail manchi.chung@iop.org).

Summer Physics Update

University of Bristol
8–10 July 2011
This three-day residential course will feature an exciting programme of lectures and workshops, and an evening wine-tasting session. For details and booking, visit www.iop.org/update or contact Manchi Chung (e-mail manchi.chung@iop.org).

EVENTS FOR STUDENTS

Institute of Physics 2010 Schools and Colleges' Lecture – Powering the future: the physics of fusion

This free lecture for 14–16 year olds, given by Dr Melanie Windridge, continues its UK tour. For details and booking, visit www.iop.org/education and click on "Events" or contact Clare Mills (e-mail clare.mills@iop.org).

Free GCSE Physics Taster – What is physics?

15/16 September, a.m. or p.m. – University of Southampton
23/24 September, a.m. or p.m. – Royal Holloway, University of London
You are invited to bring a group of year-10 students to one of these half-day events at a SEPnet partner university campus. The event covers energy and energy resources, as detailed in the GCSE specification. For more information and to book places, go to www.sepnet.ac.uk or e-mail gcse@sepnet.ac.uk .

The Irish Times Higher Options Conference

RDS Exhibition Centre, Merrion Road, Ballsbridge, Dublin 4
15–17 September, 9.00 a.m. to 3.00 p.m. each day.
This conference has become the definitive and centralised forum for third-level choices for Irish students. It also has the official sanction of the Irish Department of Education and Science. For more information, go to www.higheroptions.ie.

The Central London School Physics Society SPN networking event for sixth formers and their teachers

Holland Park School, London
6 October, 5.00–7.00 p.m.
This event is to launch a new networking group for students considering studying physics at university. It will include university stands and a physics/careers specialist speaker. For more information and to register your interest, contact Niloufar Wijetunge (e-mail niloufar@wijetunge.com).

IOP/WES Girls into Physics and Engineering Event

George Watsons' College, Edinburgh
27 October
A much enhanced repeat of the successful free event from last session, featuring a whole host of new workshops suitable for girls from S3 to S6 (a few S2 girls may accompany their older colleagues). Each girl will have the opportunity to participate in up to six workshops and lunch will be provided. For more information, contact Gail Miller (e-mail g.millar@fc.gwc.org.uk).

A revolution in your lifetime: CD to Blu-ray

For ages 16–19

You should do your own risk assessment before using this classroom activity. Ensure that the set-up you use avoids students accidentally looking directly at the laser source. The power of a class 2 laser is less than 1 mW. This is not harmful even if it is seen directly because the blink response gives adequate protection. **Warning:** cheap laser pointers cannot be relied on to be class 2.

Ask your students to investigate the difference in the track spacing between a CD and DVD using a laser. They can estimate the spacing of the (preferably blank) CD by determining the angle θ of the first-order diffraction maximum using (for example) the set-up in figure 1.

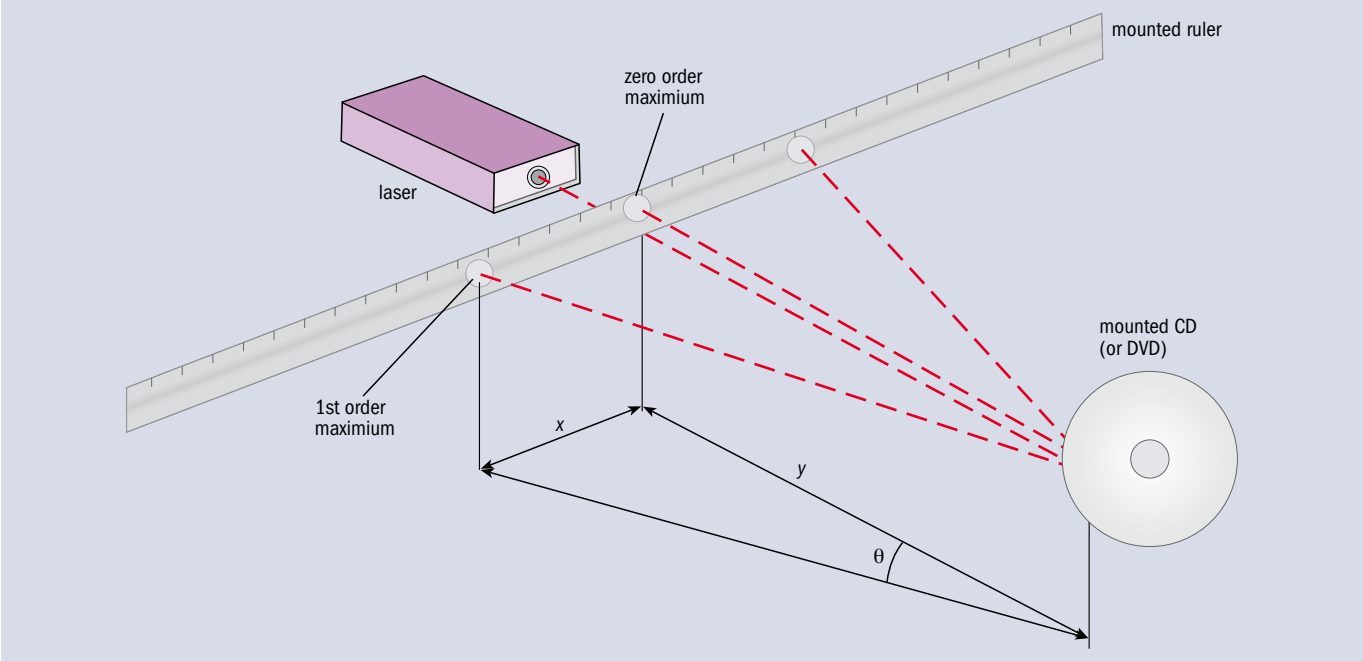


Figure 1. *A suggested experimental set-up.*

The CD acts as a reflection diffraction grating, and so the track spacing can be determined using $n\lambda = d \sin\theta$. For the first-order maximum ($n = 1$) the slit-spacing d between the tracks is given by $d = \lambda/\sin\theta_1$, where λ is the laser wavelength and θ_1 can be determined using $\theta_1 = \tan^{-1}[x/y]$. The experiment can then be repeated using the DVD. If you use a helium-neon laser ($\lambda = 633$ nm). The angle θ_1 should be around 20° for the CD and around 60° for a DVD. Ask the students to calculate d for both the CD and DVD. Use this to start a discussion on the difference in data capacity of CDs and DVDs and how this depends on the wavelength of the laser light used to read them. The shorter the wavelength, the smaller the spot size a laser can be focused on to read the disc, which means a smaller spacing between the tracks can be accommodated and more data can be fitted into a given space (figure 2). Typical data for optical-storage discs are shown in the table below.

The above experiment is difficult to do with Blu-ray discs because d is smaller than the wavelength of the (red) lasers that are typically found in school science departments. The advances in semiconductor technology required to read these modern optical discs have only been made recently – it was not until the late 1990s that the first practical (i.e. small) blue laser was demonstrated – and so Blu-ray technology offers a rare opportunity to discuss how research carried out during the lifetime of your students has led to an invention that they will be familiar with.

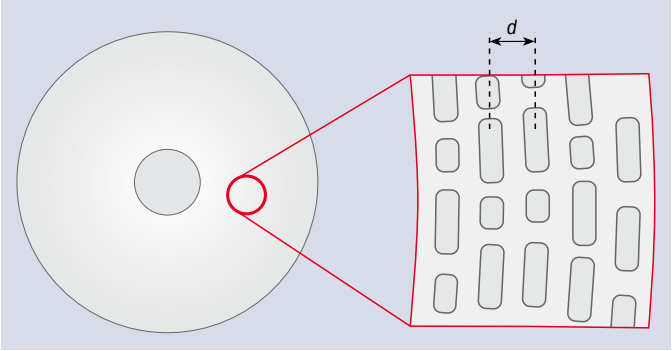


Figure 2. *The spacing between the tracks,* d.

OPTICAL-STORAGE DISCS

optical disc	capacity (Gb)	*d* (μm)	laser wavelength (nm)
CD	0.7	1.6	780
DVD	4.7	0.74	650
Blu-ray disc	25	0.32	405

Some ideas for celebrating 50 years of the laser in the classroom

Age 11–14: Hidden lasers
Ask your students to look around their homes and find as many lasers as they can, then list and count them (e.g. in CD players, DVD players and computer disc drives).

Age 14–16: How lasers are used
Information and ideas are available in the booklet *Lasers in our Lives: 50 Years of Impact*, included with this issue of *Classroom Physics*. It is also downloadable as a PDF from www.stfc.ac.uk/Resources/PDF/Lasers50_final1.pdf. Photocopy the list of applications (below), cut them out and put them into a hat or bag. Organise students into teams, asking each team to pick one application and work together to research and prepare a short presentation or poster about how lasers are used for that particular application.

Classroom Physics issue 5 (June 2008) included a couple of classroom demonstrations that used a laser. This copy is available to download as a PDF from the *talkphysics* website (you will need to log-in or register): www.talkphysics.org/pg/groups/forum/14671.

Lasers for measurement
Find out more about how lasers are used to measure distances (e.g. to the Moon).

Lasers for defence and security
Find out more about how lasers are used in defence and security (e.g. spying on people).

Lasers for medicine
Find out more about how lasers are used in medicine (e.g. in eye surgery).

Lasers for energy
Find out more about how lasers are being used in generating energy (e.g. in building a nuclear fusion reactor).

Lasers for communications
Find out more about how lasers are being used in communications (e.g. optical fibre communication).

Lasers for the environment
Find more about how lasers are used in monitoring the environment (e.g. monitoring the weather).

Lasers for manufacturing
Find more about how lasers are used in manufacturing (e.g. for cutting or welding).

Lasers for entertainment
Find more about how lasers are used in the entertainment industry (e.g. DVDs).