**Your News Wanted**

The news section gives updates on what has been happening in physics education worldwide. Items included show how events in one country could be relevant to good practice elsewhere in the world. Contributions are welcome from all of our readers. They should be about 200–300 words long and can include pictures. Please e-mail your news items for the March issue of Physics Education to ped@iop.org before 31 January 2008.

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**Conference**

**Big money at teacher conference**

On 8 October 2007, 75 enthusiastic teachers and exhibitors gathered at Christ College, Brecon, Wales (www.schools-christ-wales.com) to participate in the sixth Welsh Physics Teachers Conference.

Gareth Kelly from the WJEC (www.wjec.co.uk) discussed the new A-level syllabus that will come into effect in September 2008, while some teachers were ‘Shocked and stunned’ in a workshop about the van de Graaff generator, run by Gary Williams. This was followed by Dr Eleri Pryse from the Institute of Mathematics and Physical Sciences, Aberystwyth (www.aber.ac.uk/maps/en/sep.php), delivering a stimulating talk about her research work in Svalbard in the high Arctic. It is one of the most exotic locations on Earth and the ideal place to study atmospheric, ionospheric and space physics.

During lunch there was the opportunity for teachers to share ideas that would be useful in the classroom, as well as to visit the commercial stands that were exhibiting. David Grace (IOP Teacher Network co-ordinator) gave an outdoor demonstration using a fantastic solar telescope.

During the afternoon, teachers could choose from a range of workshops, including data logging, run by Iain Davison; material science, run by Dr Martin Carr from Oxford University (www.materials.ox.ac.uk/home.html); ‘Shocked and stunned’; and the Virtual Physics Laboratory, run by John Nunn from the National Physical Laboratory (www.npl.co.uk). There was also plenty of free software, equipment and ideas available for teachers to take back to school.

A competition entitled ‘What’s in the box?’ gave teachers an opportunity to guess what the stuff in the box was and how the material could be used (£20000 of recycled bank notes—available from MUTR—www.mutr.co.uk). The winner, Stephen Jones, was awarded a prize and the money on display. Not many teachers walk away from a conference £20000 better off, although piecing together the minute fragments of notes would probably take a year and then he may find that they are incomplete.

To end the day, Keith Gibbs (www.schoolphysics.co.uk) gave a short presentation of five of his favourite teaching ideas. This really helped to get everyone enthusiastic again before they left, should they have started to flag towards the end.

Teachers commented that the day was extremely enjoyable and rewarding (‘Excellent! Excellent! Excellent!’ was the response of one), and it is hoped that more physics teachers will take the opportunity to attend next year.

*Cerian Angharad* IOP Teacher Network co-ordinator, Wales
The International Conference of Physics Education for 2007 (ICPE2007) [1] was held in Marrakech in November. These are just a few highlights and reflections from an inspiring event.

For most salespeople in the souks in the medina quarter of Marrakech on a Sunday morning, a group of four female physicists from Sweden, Japan and South Africa would be confusing, but this shop owner needed only a second to catch the spirit—‘we are international!’ Physics education is even more international than physics research. The conference gathered nearly 300 physicists, teachers and researchers in physics education from 39 countries to share teaching ideas, evaluations, research ideas and results, as well as large-scale teacher development projects.

The question of physics education in developing countries is a focus for IUPAP [2] committee C14, or the International Committee on Physics Education (ICPE) [3], and it was also an important theme for the conference. Creative experiments with low-cost or no-cost materials were presented alongside advances in learning made with high-tech equipment.

The days started at 5.30 a.m. with a call to prayer from the mosque. Indeed, one could only be impressed by the work ethic of the Moroccans, reflected in an intensive conference programme, which was planned to create many possibilities for interaction among participants, both in sessions and during the conference excursion. The hospitality was overwhelming, with an incredible variety (and quantity) of excellent food. The coffee breaks included an outstanding display of drinks and miniature cookies. The personal touch was reflected in an abstract book with the list of contributors sorted by first name.

A trip into the medina provided a vivid illustration of the often-forgotten fact that we see not only with our eyes. In one of the souks, our little group had been invited to visit a carpet dealer who told us about the natural dyes—indigo, saffron and poppy—and the different techniques—woven, embroidered and knotted, as well as combinations of them, depending on area. While we sipped our mint tea, he told us how the women create and keep the patterns in their minds, making every carpet unique. On coming back to the hotel, I suddenly discovered that my room, and indeed all of the open spaces, had beautiful handmade carpets that I had not noticed before.

**Physics for all?**

ICPE2007 presented several science caravans and other outreach activities to bring physics experiments to rural areas. Quarks ([www.grupoquark.com](http://www.grupoquark.com)) from Mexico is one of these groups. In addition to this multitude of national projects, the confer-
ence also presented coordinated, large-scale projects in collaboration between Unesco [4] and ICPE, aiming to make physics and science education available to everyone. These are described below.

**Active learning in optics and photonics**

Optics and photonics have been identified as areas that can help students to learn about experimental physics and engineering. They can be seen as enabling science, forming the basis of many modern advances in high technology. This project began in 2003 and involves collaboration with the International Centre for Theoretical Physics (ICTP), SPIE, the Optical Society of America and the Asian Physics Educational Network.

Students are introduced to basic optics concepts and systems, including the eye, communications, the atmosphere, and the role of interference and diffraction in spectroscopy and photonics. Workshops have been held in Ghana, Tunisia, Mexico, Brazil and India, with the aim of training and better equipping teachers for them to teach the optics part of the introductory physics course by using active learning with hands-on activities, and by drawing examples from local research activities. (Contact Unesco for more information, e-mail m.alarcon@unesco.org.)

**Physware**

In collaboration with ICTP, ICPE is preparing a Physware workshop for 27 October – 7 November 2008 called ‘A collaborative workshop on low-cost equipment and appropriate technologies that promote undergraduate-level, hands-on physics education throughout the developing world’. This workshop was discussed in the talk by ICPE medallist Priscilla Laws and ICPE chair Prathiba Jolly.

**Microscience**

The concept of small-scale, low-cost science kits can be one way to achieve hands-on practical science for all. Microscience addresses the lack of practical experiences in educational institutions. These facilitate enjoyment and understanding, and they attract more students to the sciences.

The Radmaste microscience system [5] was developed in South Africa, at the University of the Witwatersrand in Johannesburg. It was first conceptualized in the early 1990s and began with the introduction of microchemistry kits and workbooks. Soon after, it was endorsed by Unesco and the International Union for Pure and Applied Chemistry in a global programme for microscience. It has been brought to the attention of more than 40 countries and has led to pilot projects and wider implementation in many of these countries.

Today the system has been diversified to enable practical work in other disciplines, notably biology and physics (current electricity, electromagnetism and electronics). The physics variant was presented at the conference, though it has already been tested in South Africa, where it has been received with enthusiasm.

Teacher training in the use of microscience is essential; not primarily for the purpose of learning how to use the equipment, but to help teachers to gain confidence in performing and managing practical work in the classroom and to relate practical work to theory.

**Women in physics**

The IUPAP working group on women in physics (www.iupap.org/wg/wip) was formed in 1999. Since then, international conferences have been held in 2002 (Paris) and 2005 (Rio de Janeiro), with the next conference scheduled for Korea in 2008.

One of the tasks for the working group is to survey the current situation for women in physics, and its conferences have emphasized the need for more data. During dedicated sessions at ICPE2007,
data from several countries were presented. In some cases, data from earlier years were impossible to trace, since student gender had not been recorded.

Azita Seiedfadaei showed how female students dominate Iranian undergraduate physics, but the fraction drastically decreases at higher stages. Imrana Ashraf Zahid from Pakistan described the difficulties faced by many young female physicists. Still, the discussions were not only about difficulties. During breaks and mealtimes we all shared the challenges and joys of juggling careers and children.

The issues are complex. They cannot be attributed to a single cause and no single action will be sufficient to achieve drastic changes. Solutions and increased understanding need to be sought everywhere. Some comments would no longer be heard openly in Swedish physics departments, including indicating that it is not a problem if girls opt out of physics if they study something they prefer more, or that it is nothing to worry about since it is the same in other countries.

Tall trees require deep roots. To reach far we must start with the young. This was one of the messages from Khalija Mohd Salleh from Malaysia in the closing session. The meeting brought together many highly competent women from different countries. It is great to have them as role models and leaders, and new trees may grow under their protection.

**Development, reflection, evaluation, research**

Can a scientific approach be applied to physics education? The originality of a lesson is not a primary factor for students’ learning, but building on other people’s experiences and results can be very fruitful in education. Reflection and careful evaluation of learning are important tools for teachers to improve education.

Learning is not only restricted to students. Many speakers presented different types of teacher development scheme, including one to make primary teachers more familiar with experimental activities and one to bring a nation’s teachers into action research as a way to continue to improve their teaching.

Teaching ideas presented at ICPE2007 ranged from applications of classical physics in unusual situations to advanced theoretical and/or experimental developments adapted for classroom use.

The talks showed a wide variation in their relation to educational research. Some of the developments were solidly based in research whereas other presentations gave the impression that student reactions or learning were seen as irrelevant. Other speakers chose not to present information about students, even if material was available. The documentation of student learning and involvement thus might be absence of comment, a description (sometimes including reflection) of student reactions, more formal evaluation of learning and documentation of various conceptions (as well as the development of instruments for such evaluations), or large-scale video-analysis of student behaviour in relation to documented learning.

Most of the research presented during the conference could be characterized as action research. Discussions of learning theories were essentially absent, although some presentations mentioned assimilation and accommodation, with implicit references to Piaget and constructivism, but with a strong focus on the need for interaction and discussion among students. Presentations that explicitly mentioned the ‘nature of science’ were more likely to relate to a sociocultural approach.

When does physics education become physics education research (PER)? I found it fascinating to observe the variation in participants’ relationship to PER. It reminded me of the ‘staircase of teaching’ that Lena Renström identified [6] after interviewing teacher educators and student teachers about their conceptions of learning and teaching.

Two misconceptions were floating about during the conference, Elena Sassi noted during the ICPE committee meeting following the conference. The first was that any activity involving physics education is PER. The
second was that anything involving physics is physics education.

For those who are initiating their path in physics education and PER, these two misconceptions can be dangerous and misleading. Elena Sassi thus suggested that, just like in the case of the misconceptions of students and teachers, these should be clearly addressed in order to improve the quality of any conference on physics education.

Some good moments
A conference with many participants and many parallel sessions sends everyone home with different highlights. I mention here a few of my personal favourites.

Laurence Viennot from Paris talked about the need for attention to coherence in physics education. She discussed the teaching rituals that we go through, often without reflection [7], and how students appreciated the additional effort of challenging some of these rituals.

Joachim Schlichting challenged participants with confusing photographs of lights, shadows and reflections. His website [8] has a monthly photo challenge, as well as a copy of his presentation.

Ron Thornton told us about studies of behaviour on learners who had turned out to be teaching-resistant, as evaluated using the force and motion concept evaluation [9]. He noted that the concept diagnoses that have been developed have probably done the most good to undergraduate physics teaching.

During the closing session, Khalija Mohd Salleh from Malaysia talked about physics for sustainability, but also shifted the question around to a need for a curriculum reform to ensure sustainability of physics, in view of declining interest among new students. She challenged us not to forget to share the values of physics; that physicists have a special way of thinking.

The proceedings, to be published by the American Physics Society, will include many more examples and details.

A shared language
‘I believe that all electrons in the universe have the same charge and mass’, stated Brian Petley [10] in the preface to his book on fundamental constants. We could add that we also believe that the charge and mass of the electron is independent of the race, creed, gender, class or other properties of the observer.

Khalid Berrada and his organizing team did an excellent job of bringing together physicists from so many different cultures and backgrounds for ICPE2007, showing that physics is a language that we can all share.

References
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IUPAP needs your vote
IUPAP is seeking to establish a list of seven physics-related technological wonders of the world—discoveries or inventions that have truly changed the way that we live and the way in which we view our Earth and the universe. A list of 21 possible items has been compiled with the help of members of the ICPE.

Now IUPAP wants your help. Vote for the seven items that you consider most suitable for being called wonders of physics and technology at www.icpe2007.org/index.php?option=com_wrapper&Itemid=319.
**Physics education fun in York**

Bungee jumping was a great attractor for the many school and college students who came to York Racecourse to obtain their adrenalin thrill at the British Association for the Advancement of Science Meeting. It was organized by Glyn Jones of York College with Science City York, and sponsored by the Institute of Physics. Staff from Feedback Instruments provided a number of Pasco Xplorer GLX dataloggers with associated sensors for students to attach to themselves for the jumps and, no surprise, their pulse rates really rose. It was fortunate that they did not have sound sensors attached because the screams and other utterings might well have been beyond the respectable in some cases.

To aid further work back in the laboratory, the Yorkshire Branch of the Institute provided the schools with a free CD-ROM with a generic version of a model bungee jumper (Action Man) activity for a vast array of dataloggers, complete with information about bungee jumping, the physics of the force and accelerometer sensors used, teachers’ and technicians’ notes, associated weblinks and typical results.

A number of schools videoed the jumps and the film produced by Joseph Rowntree School in York has been made available for all to see on their website, www.JosephRowntreeSchool.co.uk. Go to the physics bungee section to view it.

The unveiling of a blue plaque commemorating the 18th-century ‘father of seismology’, physicist and astronomer, the Revd John Michell BD FRS, at Thornhill Parish Church near Dewsbury, was further celebrated at the BA meeting by a brief presentation on his life and work by the Hon. Henry Cavendish (aka Chris Butlin, the Yorkshire Branch’s honorary secretary at that time).

Michell is perhaps most famous for being the first person to provide a scientific explanation for why earthquakes occur, for predicting the existence of what we now call black holes, and for the design and development of the apparatus with which his friend Henry Cavendish conducted experiments to calculate the density of the Earth (commonly referred to as the ‘G’ experiment). A short pamphlet is available free as a Word file on request via e-mail to chrisabutlin@aol.com. It contains information about Michell’s work, weblinks, and book and journal references.

Chris A Butlin
The latest Ciencia en Acción took place in Zaragoza, Spain, on 19–21 October 2007. The final event was organized in two parts in the Plaza del Pilar, the central square of Zaragoza, with some activities also taking place in the reception saloon of the Town Hall and in Foro’s Museum.

Ciencia en Acción, the Spanish version of Science on Stage, is organized every year by the Consejo Superior de Investigaciones Científicas, the Fundación Española para la Ciencia y la Tecnología, the Real Sociedad Española de Física and the Real Sociedad Matemática Española. This time it benefited from the local support of Ayuntamiento de Zaragoza, the Gobierno de Aragón and the Fundación Zaragoza Ciudad del Conocimiento.

Every year the quality and number of projects presented increases and 2007 was the first year in which projects were accepted from all Spanish and Portuguese speaking countries. More than 100 projects from primary and secondary schools and universities were presented to more than 15,000 visitors over two days. Participants from all of the Spanish regions, Portugal, Argentina, Colombia, El Salvador and Uruguay showed their proposals, distributed into 14 categories. These were physics demonstrations, chemistry demonstrations, mathematics lab, biology and geology lab, science and technology projects, didactic materials (on paper and on digital support), outreach work (on paper and on other supports), sustainability, values of science and engineering, performances and science films.

During the festival we enjoyed physics demonstrations, chemistry demonstrations, mathematics lab, biology and geology lab, science and technology projects, didactic materials (on paper and on digital support), outreach work (on paper and on other supports), sustainability, values of science and engineering, performances and science films.

The participants who put science into action for the public of Zaragoza, Spain.

(Left) Physics, music and dance at the Foro Museum. (Right) One of the biggest experiences at the event—the looping bike.
The Physics and Ethics Education Project website (www.peep.ac.uk) was formally launched in November 2007. It is an interactive web-based resource for secondary-school science teachers, aimed at supporting them in teaching scientific issues arising within physics that have a significant controversial or ethical component. It covers a range of topics, such as climate change, nuclear weapons, alternative energy sources, costs of space exploration and mobile phone use. Each topic is used to highlight the relevant ethical principles, and activities are suggested that can be carried out in class or for homework.

The site was designed and developed by a team from the Graduate School of Education at the University of Bristol and its development was supported by the Institute of Physics.

The website is designed to:
- provide up-to-date information for students and teachers about scientific issues involving moral or ethical questions;
- raise science teachers’ confidence in dealing with difficult topics;
- facilitate students’ and
teachers’ discussions of these issues;
• enhance students’ learning of the science topics involved.
The site is targeted at 15–17-year-old students studying science at Key Stage 4 or physics at AS level and their teachers. However, it is designed to remain useful to older and younger students and those following courses such as the A level in science for public understanding.

The site can easily be searched for material relevant to individual exam specifications by using the ‘Search by syllabus’ option. It was evaluated by year-10 (14-year-old) classes in six schools in 2007. Of these students, 95% indicated that they had found their time using the website useful. They liked it for reasons including:
• ‘Lots of information, easy to navigate and find information’;
• ‘Because it wasn’t patronizing or hard and it wasn’t like Bite-size, which is annoying’;
• ‘Because it had information arranged by units for the exams’;
• ‘The website taught me stuff I didn’t even know [existed]’.

The site also hosts a moderated online discussion area to enable students to practise developing their ideas and justifying their point of view using science-based argument. Passwords to use the discussion area will be issued to teachers on request.

In fact, the site designers hope that teachers will feel able to contribute to the site’s ongoing development. There is a ‘contact us’ link on every page for suggestions and the team will happily share any relevant teaching resources that are sent in.

Jocelyn Wishart

**UK Olympiad team goes to Iran**

Together with competitors from another 72 countries, a UK team and its leaders attended the International Physics Olympiad (IPhO) held in Iran in July 2007. There, the teams answered a five-hour theoretical paper and a five-hour experimental paper. The teams and their leaders were able to attend an extensive scientific, cultural and social programme.

IPhO is an annual competition held so that up to five pre-university students from each applicant country around the world can compete via theory and experimental sessions for medals and at the same time participate in a cultural programme.

IPhO is one of a number of Olympiads held internationally in different subjects. Last year the 38th IPhO was held in Isfahan, more than 300 km south of Tehran. Not only did this prove to be an outstanding scientific experience for students and teachers, but it was an introduction to an especially attractive historic city.

**Selecting and training the team**
The UK competition starts with a 90 minute test paper (Paper 1) for those schools and students wishing to participate. This needs to be based on the common core of the A level and consist of topics that students should have covered at this time.
Students who obtain more than 60% are then encouraged to enter the BPhO competition, for which there is an entry fee. This three-hour paper (Paper 2), taken in November preceding the international competition, is still designed to cover work already studied by students but the questions are of greater difficulty. In November 2006, 750 students took the paper. On the basis of this, gold, silver and bronze awards were made and there was a reception and presentation at the Royal Society in London for the highest-scoring students and their teachers. After the presentation a lecture on the Big Bang was given by Dr Simon Singh.

However, the syllabus and the requirements of IPhO are very demanding, so further selection needs to be made. The top 50 students were invited to go on further, but they were asked if they expected to be available to travel to Iran. They then attended a four-day training session in Abingdon. This included a practical examination and a further one-hour paper to enable final selection of the team. There were four further days of training in Cambridge immediately prior to travelling to Iran. Students even spent most of their time on the flight to Tehran solving physics problems.

The team that was selected to go to Iran consisted of Peter Ford, Royal Grammar School, Worcester; Thomas Hiscock, Bexhill College, Sussex; Paul Gillard, Aquinas College, Stockport; Alice Webster, Richard Huish College, Somerset; and Carter Zhou, Dean Close School, Cheltenham. Four members of the British Olympiad committee accompanied the team.

The UK team, after the closing ceremony in Isfahan.

The city of Isfahan and the competition programme

Iran chose to hold the competition in Isfahan, a highly attractive city that originated as a centre on the international spice route. The UK team arrived by air into Tehran, as did most teams, and was given VIP treatment by the Ministry of Education. We chose to travel by minibus to Isfahan across the desert, rather than fly, although we decided to fly back. Without travelling outwards by road, it is doubtful whether we would have appreciated the exceptional nature of Isfahan, with its existence on the banks of the impressive Zaindeh River, which originates in the mountains and disappears in the desert.

As usual during the competition, the accommodation of the students was kept separate from that of team leaders and observers. This is because leaders participate in modification of the questions as proposed by the host country. The students were accommodated in the Isfahan University of Technology on the outskirts of the city, while leaders and observers stayed at a hotel in central Isfahan.

The first morning was taken up with the opening ceremony at the Isfahan University of Technology, which all students, leaders, observers and main organizers attended. In the afternoon the students participated in the first part of the cultural programme, visiting various attractions in the city while leaders discussed the theory questions. Leaders were then up most of the night translating the questions into the language of their country. On the next day the students completed this theory paper while leaders and observers experienced their first day of cultural activities.

This pattern repeated during the next two days with leaders discussing and translating the experimental paper and then the students carrying out the experi-
ment, followed by another day of activities. Meanwhile, Iranian leaders marked all of the papers and national leaders marked the papers of their own teams. Later in the week, Iranian markers and team leaders were able to discuss and negotiate significant variations in the marking but the amount of discussion necessary turned out to be very limited despite the wide variation in languages of the participating students.

**In theory**

For the theory paper, students were presented with three questions, which were colour coded rather than numbered in order to avoid any priority. The questions showed considerable originality and were a challenge to the students. Nevertheless, they were at a level that meant that the majority of candidates made considerable progress on each.

The blue question centred on black holes, Hawking radiation and cosmic background radiation. Students were led into the topic by more classical ideas. They were told about dimensional analysis and then led into the derivation of the dimensions of a number of fundamental constants to be used in the question.

Using such analysis, they showed how the event horizon of a black hole depends on the universal constant of gravitation, the speed of light and the mass of the black hole. Using the information derived, but moving on from dimensional analysis, they found an expression for the Hawking temperature and how the rate of change of mass depends on the temperature. (From Hawking’s arguments, black holes radiate energy similar to that of a black body and at the so-called Hawking temperature.) Hence the time for a black hole to evaporate and also its heat capacity could be calculated. Finally, the balance was considered between outgoing and incoming radiation for a black hole exposed to the cosmic background radiation, and the students were left to deduce mathematically that no stable equilibrium is possible.

The orange question concerned a simplified model of accelerators used to activate the safety airbags in cars. The device involved a mass, \( M \), set between two springs of spring constant, \( k \), and attached to a movable plate that could move back and forth between two fixed plates. The movable plate then operated a switch that had two states, \( \alpha \) and \( \beta \). One side of the circuit had a capacitor, \( C_s \), and two sources of equal potential were inserted into the circuit.

The students were asked introductory questions on the force between a pair of capacitor plates and the energy involved and then asked for calculations concerning the accelerometer system as the movable plate moved a distance, \( \chi \), away from the central position. They were asked to obtain an expression for the acceleration of the movable as a function of the movement, \( \chi \), and, assuming then that the switch was in state \( \beta \), the voltage across the capacitor, \( C_s \).

From here students calculated various aspects relevant to the use of the accelerometer in operation in a car. This included looking at the ratio of electrical force to spring force (small ratio) and the maximum displacement of the movable plate under sudden braking. A value of \( C_s \) was calculated for fast enough activation to prevent the driver’s head from hitting the windscreen or steering wheel. By estimating the distance between the driver’s head and the steering wheel, students obtained a necessary time of approximately 0.4 s, which was better by more than a factor of 10 than the timescale within the problem.

For the pink question, students returned to the universe, this time a binary star system. They were given graphical data of the intensity received from the system (photometry data) as the stars rotated about a common centre of mass and passed in front of each other. Assuming black-body radiation from flat discs, the data enabled the calculation of the ratio of the surface temperatures of the stars and also the ratio of their radii. Next the question provided absorption data (from spectrometry) for the sodium D1 line. This enabled the orbital velocity of the stars and their masses to be calculated. Using empirical data relating the ratio of luminosity to the ratio of masses for stars in general, the question finally included a section on the luminosity of the stars.
and the aperture of a telescope needed to resolve them.

**The experimental paper**

The last paper constituted in effect a mini research project that could be completed in the five hours provided. More than 300 relatively simple spectrometers had been built specially for the competition. At the collimator end there was a built-in halogen lamp and at the telescope end there could be fitted a removable detector that connected to a photoresistor, which could provide a reading on a multimeter. All students were also provided with a diffraction grating and a glass substrate, plus a thin film sample mounted in a frame. The thin film sample consisted of a semiconductor containing nanosize particles of iron oxide (Fe$_2$O$_3$).

To begin with, students observed the diffraction pattern obtained using the diffraction grating. They determined the range of angles throughout the visible spectrum from blue to red for first-order diffraction. Then the photoresistive detector was inserted and the minimum resistance value was found and reported for this straight-through position. This enabled zero adjustment of the spectrometer and after this the experiment was carried out in the dark. The spectrometer was then set for minimum resistance of the detector (maximum intensity) for the first-order diffraction and this value noted. The uncoated glass substrate and the semiconductor sample could be placed in turn at the entrance hole to the telescope, and, with the spectrometer carefully set up, the main experiment could begin.

For a range of angles, resistances were measured for both the uncoated glass substrate and the substrate coated with the semiconductor layer. This required 20 data points for each sample so there was plenty to do. The reciprocal values of resistance were plotted for both samples, showing transmission peaks for each. The resistance ratios for the two samples at each angle enabled the film transmission to be plotted as a function of wavelength, giving an S-shaped curve.

For photon energies slightly larger than the bandgap of a semiconductor, the following equation is applicable:

$$\alpha h\nu = A(h\nu - E_g)^\eta$$

where \(\nu\) is frequency, \(\alpha\) is the absorption coefficient of the film, \(A\) is a constant that depends on the material of the film and \(\eta\) is a constant dependent on the absorption mechanism and structure of the film. Students were told that \(\eta = \frac{1}{2}\) was applicable for the sample and given a value for \(A\). The transmission ratio \(T_{\text{film}}\) for the film is given by:

$$T_{\text{film}} = \exp(-\alpha t)$$

where \(t\) is the film thickness.

Students were then asked to plot a graph of \(x = h\nu\) and \(y = (\alpha h\nu)^2\). For the \(x\) values, students needed to convert their wavelength values to frequency and for the \(y\) values they needed to use both the frequency values and \(\alpha t\) derived from the film transmission values. Why were they asked to plot \(x\) and \(y\) in this way? We have:

$$\alpha h\nu = A(h\nu - E_g)^\eta$$

$$\alpha (h\nu)^2 = A^2(h\nu - E_g)$$

$$\alpha h\nu^2 = A(t)^2(h\nu - E_g)$$

Hence, they measured the gradient, \(m\), of their graph in the linear region (the central region of the S) and this gave a value for \((At)^2\); hence \(t\). Meanwhile, by extrapolating the linear region to the \(x\) axis, the value of \(E_g\) was obtained.

As the films were all individually produced, every sample had been calibrated previously by the IPhO team. The samples had a thickness of approximately 200 nm and a bandgap of 2.17 eV.

**The cultural and social programmes**

Leaders and students participated in a full programme of events, although visits were usually at different times for the two groups because of the different times of involvement in the academic timetable. One of the early visits in the programme was to Menar Jonban (shaking minarets) mosque.
Although built to house the tomb of a hermit mystic in the early 14th century, it was designed as a large-scale resonance experiment analogous to two vibrating pendulums suspended from a common beam. The mosque consists of two minaret towers connected by the main building. The towers were built with a certain freedom to rock. This freedom is achieved by incorporating within the structure of each tower two wooden frames. When one tower is set vibrating (by a person climbing up and shaking its wooden frame by hand), the vibration is transferred to the other tower. The mosque was designed with a high safety factor and has remained safe over centuries, despite repeated demonstrations of this vibrational effect.

Other trips around Isfahan consisted of visits to the main square (Naghsh-e-Jahan, which has been recognized by Unesco as the ‘Tenth cultural heritage of mankind’), mosques adjacent to the square, the main bazaar, a historical palace, the central gardens and a walk along the river to view the various attractive historical bridges. Visits of a more scientific nature included one to the Royan Institute, where work on stem cells and genetics is undertaken (their cloned sheep was on view), and a research and technology centre within the extensive campus of Isfahan University of Technology.

A 180 km day trip was undertaken across desert and mountain regions to the somewhat isolated village of Abyaneh. This has maintained its traditions and crafts, although it also has international connections with former residents and visitors. Villagers put on a display of their crafts and welcomed their visitors in traditional dress.

During most evenings, participants were made welcome at an evening banquet. The climate is such that these were held in the open air in gardens attached to historic buildings of the city, including the Abassi Hotel, the Melli Bank and the Chehel-Sotoun Museum.

The closing ceremony
The last formal day consisted of the closing ceremony, where successful participants were presented with their medals and certificates, interspersed within...
There were also formal speeches, including one from the Iranian minister of education.

The UK team did very well to achieve a gold, a silver and a bronze medal, and honourable mentions for the remaining two members of the team. During the final evening, all were invited to yet another open-air reception, this time in the extensive Behesht-e-Ziba gardens of a local company (the Poly Acryl company).

What was so outstanding about the visit overall was the warm welcome that participants received, not just from the organizers but from the public and particularly the children that we met when out walking in the city.

There was, however, a sad aspect to the trip. Dr Waldemar Gorskowski, who for 23 years had been leader and then president of IPhO and its key driving force, died of a heart attack on the second day. During his leadership the number of participating countries increased from 10 to 90. His huge contribution was recognized at meetings during the competition.

After the Olympiad the team and leaders were entertained for tea and shown around the attractive British Embassy in Tehran by the British ambassador, Geoffrey Adams. The team finally left Tehran International Airport the next day with the support of the splendid organization of the Iranian hosts. It had turned out to be a highly notable and enjoyable visit.

For further information about IPhO, see www.ipho2007.ir and www.le.ac.uk/physics/BPhO/index.shtml.

Guy Bagnall, Margaret Hall, Robin Hughes and David Lovett committee members, British Physics Olympiad

### Forthcoming Events

**January**

3–5 Association for Science Education annual conference, University of Liverpool, UK. [www.ase.org.uk](http://www.ase.org.uk)

4 Deadline for submission of entries to the SciCast Physics competition. [www.planet-scicast.com/physics](http://www.planet-scicast.com/physics)

18–24 American Association of Physics Teachers winter meeting, Baltimore, Md, US. [www.aapt.org](http://www.aapt.org)

**February**

Venus is spectacularly bright this month in the twilight. Look west after sunset.

**March**

7–8 Association for Science Education Scotland annual conference, Crieff Hydro Hotel,

21 Lunar eclipse visible in the UK, with around 90% totality.
Crieff, Perthshire. The theme is ‘climates for change’. www.asescotland.org.uk

7–16 UK National Science and Engineering Week. For information about running activities and what’s happening in your area, see the website or contact a member of the organizing team (e-mail nsew@the-ba.net; tel 020 7019 4963). www.the-ba.net

20 Spring equinox

27–30 US National Science Teachers Association annual conference, Boston, Mass. www.nsta.org

March–April
National Particle Physics Masterclasses, various locations around the UK, including Rutherford Appleton Laboratory, Didcot, Oxfordshire on 12, 13 and 14 March. For information, contact Elizabeth Clarke (e-mail e.m.clarke@rl.ac.uk). hepwww.rl.ac.uk/put/st/masterclass.htm

25 March – 5 April Edinburgh International Science Festival. www.sciencefestival.co.uk

April
4–6 Physics Update, School of Physics and Astronomy, University of Leeds, UK. A residential course for teachers of physics. Accommodation at Westwood Hall Conference Centre and Hotel, Leeds. For information and booking, contact Leila Solomon (e-mail leila.solomon@iop.org; tel 020 7470 4821).

7–9 Salters Horners Advanced Physics (SHAP) AS teachers course.
9–10 SHAP technicians course.
9–11 SHAP A2 teachers course.

Held at the University of York, UK, these courses will be particularly valuable for those who are preparing to teach the new Edexcel GCE physics from September 2008 and intending to adopt a context-led approach for all or part of their teaching. www.york.ac.uk/org/seg/salters/physics

21 Lyrid meteor shower—these swift and bright meteors disintegrate after hitting our atmosphere, often producing luminous dust trails that can be observed for several seconds.

June
4 Stirling Physics Teachers Meeting, University of Stirling, UK. For information, contact Leila Solomon (e-mail leila.solomon@iop.org).

5 20th Annual Meeting for Teachers of Physics, Rugby School, UK. For information, contact Chris Butlin (e-mail chrisabutlin@aol.com).

21 Summer solstice

26 Annual Liverpool Physics Teachers Conference. For information and downloads from 2007, see the website or contact Dr Steve Barrett (e-mail s.d.barrett@liv.ac.uk).

www.liv.ac.uk/~iop/PTC/index.html

30 June – 3 July Royal Society Summer Science Exhibition, London. For more information, add yourself to the mailing list (e-mail events@royalsoc.ac.uk).

29 June – 19 July CERN high school teachers programme. http://public.web.cern.ch/Public/Content/Chapters/Education/TeacherProgrammes

July
This month the European Space Agency plans to launch the Herschel space observatory and the Planck satellite to study relic radiation from the Big Bang.

1 Introduction to Advancing Physics AS teachers course.
2 Introduction to Advancing Physics A2 teachers course.
3 Advancing Physics technicians course.

Held at the Department of Physics and Astronomy, University of Birmingham, UK, these courses, run jointly with OCR, will cover all aspects of teaching and learning Advancing Physics. This will include an introductory CD session, reflecting the revisions made to the specification for September 2008. http://advancingphysics.iop.org/teacher/index.html

2–4 SHAP AS teachers course (a repeat of the April course), University of York, UK. www.york.ac.uk/org/seg/salters/physics
News

9–10 Residential summer school for AS physics and maths students, University of Birmingham, UK. www.ph.bham.ac.uk/prospective/schools/summerschoolinfo.htm

19–23 American Association of Physics Teachers summer meeting, Edmonton, Alberta, Canada. www.aapt.org

17–26 International Youth Astronomical beginners summer school, Rohzen, Bulgaria. www.geocities.com/astroschool2008

20–25 Goldsmiths’ free residential courses for teachers, Cambridge and Brunel Universities, UK. Including particle physics, materials science and sustainable development. www.thegoldsmiths.co.uk/education/sciencesociety.php

25 National Physics Laboratory Water Rocket Challenge, Teddington, Middlesex, UK. For information, e-mail waterrockets@npl.co.uk.

August
1 Partial solar eclipse visible in the UK.

5–14 International Youth Astronomical advanced summer school, Rohzen, Bulgaria. www.geocities.com/astroschool2008

12 Perseids meteor shower (peak)

18–22 International Research Group on Physics Teaching (GIREP) international conference and Multimedia in Physics Teaching and Learning workshop, Nicosia, Cyprus. The theme is physics curriculum design, development and validation. For information, see the website or e-mail girep2008@ucy.ac.cy. www.ucy.ac.cy/girep2008

24–29 European Science Education Research Association summer school, University of York, UK. www.esera.org

September
6–7 Residential teachers conference, University of Birmingham, UK. For teachers of physics in the UK. www.ph.bham.ac.uk/prospective/schools/forthcomingevents.htm

7–13 BA Festival of Science, University of Liverpool, UK. The theme is sustainability through science. www.the-ba.net

22 Autumn equinox

October
4–10 World Space Week www.spaceweek.org