

# PHYSICS IN SCOTLAND

The newsletter of the Institute of Physics in Scotland

January 2006

## A message from the IoPiS chair

I should like to start by thanking the outgoing chair, David Saxon, for his sterling work during the past two years as vice-chair. In difficult act to follow. My personal involvement with the Institute of Physics in Scotland committee extends over the past two years as vice-chair. In Scotland we are very fortunate to have a committee that is populated with members who are both committed and enthusiastic.

Peter Ball's role as the Institute's representative in Scotland ended in September. We thank him for his dedication to the committee's work and for his many effective contributions. We welcome Alison McLure, formerly of the Scottish Leadership Foundation, as the full-time national officer for Scotland. She attended her first Institute of Physics in Scotland committee meeting at the end of September and is now getting up to speed in her new role.

This is a time of change for physics in Scotland and below I highlight two developments of considerable importance.

The Scottish Universities Physics Alliance (SUPA), which involves physics departments from the universities of Edinburgh, Glasgow, Heriot-Watt, Paisley, St Andrews and Strathclyde, was officially launched in April 2005. The SUPA unites Scotland's physics researchers to create the largest such strategic grouping of universities in the UK, with a vision of leading the world in creating an environment attractive to researchers and sponsors alike.

Prof. Ian Halliday, a distinguished particle physicist



*Looking to the future: the new chair of IoPiS, Robert Chapman.*

and previously chief executive and deputy chairman of the Particle Physics and Astronomy Research Council, has recently taken up the post of chief executive officer of SUPA. He is also set to become the next president of the European Science Foundation in January 2006. More information about SUPA can be found at [www.supa.ac.uk](http://www.supa.ac.uk).

The Institute of Physics in Scotland will continue to take a strong interest in the curriculum review – “A curriculum for excellence” – currently being undertaken by the Scottish Executive. The Institute of Physics is in a strong and possibly unique position in Scotland to provide input to the review. This is based on its experience of developing the A-/AS-level curricula, its interest in the International Baccalaureate, its engagement with almost the entire Scottish teaching workforce through the Teacher Network, its links with the Scottish Higher Education sector and its wider UK links

with industry through Business Partners. We look forward to joining the debate on curriculum review when we enter the period of consultation.

Recently the Royal Society of Edinburgh (RSE) has taken the lead in addressing the crucial issue of the supply and demand of energy in Scotland. We have joined the debate by responding to the RSE consultation document. The Institute of Physics in Scotland was also represented at the public meeting in October held by the RSE's Independent Energy Inquiry Committee. The joint IOP/IOPiS submission can be found at <http://policy.iop.org/Policy/public.html>. We can make an impact at a national level by responding to such calls for input and evidence not only from the RSE, as in the above case, but also from the Scottish Executive and other bodies.

We participated again in Science and the Scottish Parliament, an event that is now officially five years old. This time it was held on 2 November 2005 in the Edinburgh Science Centre and was dubbed “Our dynamic Earth”, and with 300 guests it was certainly a celebration. The event is organized by the Royal Society of Chemistry in association with eight other science organizations, including the Institute of Physics in Scotland.

Nicol Stephen, the deputy first minister, kicked off with an uplifting speech on the central role that science now plays in Scotland's economic policy. He encouraged participants to help to achieve his vision “for Scotland to develop as a ‘science

nation’ where research, creativity and innovation are fundamental to its future success”.

During Einstein Year the Institute of Physics in Scotland committee supported a wide range of outreach activities. This newsletter contains information about the next Institute of Physics in Scotland funding round, which will provide grants to organize, promote or support physics outreach activities. We would like to continue a high level of support of outreach activity in Scotland during 2006. It is worth giving some advance publicity here to a series of talks to be delivered during April 2006 in Aberdeen, St Andrews, Glasgow and Edinburgh that will commemorate the 175th anniversary of the birth (in 1831) of James Clerk Maxwell. Further details appear elsewhere in the newsletter.

The Institute of Physics in Scotland is very much aware of the need to engage with Scottish physics students, with schools, with Institute members working in all areas of employment and with those members who have retired from full-time employment.

Incidentally, we run a successful series of Lunchtime Rendezvous events for members of the Institute of Physics in Scotland Seniors Group, which have in the past attracted capacity audiences. However, we would like to improve our contacts with Institute members employed in Scottish industry and I invite such members to contact me.

Finally, I should like to wish everyone a very happy New Year. **Robert Chapman, chair, IoPiS**  
[robert.chapman@paisley.ac.uk](mailto:robert.chapman@paisley.ac.uk)

# The Institute of Physics in Scotland reaches out with a national officer

Alison McLure became the new full-time national officer for the Institute of Physics in Scotland at the end of October. The Institute hopes that by creating this position it will increase significantly its impact and presence in Scotland. The post will work across the range of Institute activities, including physics outreach, influencing public policy on physics and supporting Institute members.

McLure has a physics degree from Aberdeen University. Following graduation, she joined the Meteorological Office to research and develop remote meteorological instrumentation especially for the tops of mountains. She then moved into weather forecasting and did various jobs that took her to London and Aberdeen weather



*New face: Alison McLure (right) at Science and the Parliament.*

centres, a couple of RAF stations, a five-month secondment in Antarctica and finally back home to Glasgow and its weather centre. After a short stint on *BBC Reporting Scotland*, she decided to go back to basics and moved to Argyll on the west coast of Scotland to manage a yacht marina and spend more time sailing and kayaking.

The next career move took her back east again to the Scottish Executive Environment and Rural

Affairs Department, where she was caught up in the crisis caused by foot and mouth disease. This varied career meant that the Scottish Leadership Foundation thought that she would be ideal to run the People Exchange Programme, and she spent three years learning about leadership and the public sector in Scotland.

McLure is pleased to be going back to her roots and working with the physics and science community again. "My parents were both physics teachers and that passion never leaves you," she said. She looks forward to meeting as many of you as possible over the next few months and will be picking your collective brains for ideas to promote physics and the Institute of Physics in Scotland.

## Get ready for a lunchtime rendezvous

Following the successful Lunchtime Rendezvous held in 2004 and 2005, two more are planned for 2006 for members, partners and friends.

The first is to be held at the University of Glasgow on 26 January, commencing with tea or coffee in the Gilbert Scott Building, University Avenue, at 10.00 a.m. Dr Peter Waddell, former reader in the Department of Mechanical Engineering, University of Strathclyde, Glasgow, will give a lecture entitled "John Logie Baird's contributions to modern television". This will outline Baird's contributions from the first public TV display to the demonstration of a 600 line all-electronic 3D colour TV receiver.

Mr John Butler, principal computing officer in the School of Informatics, University of Edinburgh, will then give a lecture called, "Hidden traps within the PC: beneath the surface the PC contains traps for the unwary, and the incautious user can come unstuck". The talk will discuss viruses, spam, identity theft and malware in general, plus pointers on how to avoid them, as well as good

system-maintenance practice. Finally, Butler will explore the reasons why, occasionally, things can go disastrously wrong when using the Internet.

These talks are to be followed by a visit to the Chapel and Bute Hall, culminating in a four-course seated lunch with wine.

The second 2006 Lunchtime Rendezvous is to be held at the James Clerk Maxwell Foundation, 14 India Street, Edinburgh, on 22 March, commencing at 10.00 a.m. with tea or coffee. Stewart Crockett of Close Wealth Management, formerly Nelson Money Managers, will deliver a lecture entitled "Financial education". This will describe the different types of financial investment available and the importance of adopting a sound financial strategy. Such a strategy will take proper account of the need for access, security, income, growth and tax efficiency. A balanced investment portfolio contains a range of different investments in order to give a reliable income and to minimize the risk involved. Prof. Edmund F Robertson, professor of mathematics, University of St Andrews, will give a lecture

called "P G Tait: his life and work on knot theory". In addition to being professor of physics at Edinburgh from 1860 until his death in 1901, P G Tait was a close friend of Sir William Rowan Hamilton, William Thomson (Lord Kelvin) and James Clerk Maxwell, and their common interests in physics led to deep questions in topology, a topic that was just beginning to be studied. As on the previous occasions, these talks will be followed by a four-course seated lunch with wine.

Further details, including booking forms, menus and prices, are being published on our website at <http://scotland.iop.org> and will also be sent to senior members in the Edinburgh and Glasgow areas.

Suggestions for lecture topics and speakers for the Lunchtime Rendezvous, as well as other activities for the Seniors Group, are always welcome.

For further information, please contact Dr John Higinbotham, Seniors Group coordinator, The Institute of Physics in Scotland, 12 (1F2) Bruntsfield Gardens, Edinburgh, Scotland EH10 4EA (e-mail: [john.higinbotham@physics.org](mailto:john.higinbotham@physics.org)).

## Get expert advice on your career

Vishanti Lall, the Institute's careers advisor, will be visiting Glasgow and Aberdeen on 26–27 April 2006 to conduct careers surgeries. Potential topics on which she can advise include changing careers, redundancy, taking a career break, retiring and updating your CV. Consultations will be on a confidential one-to-one basis, probably in city-centre hotels. Venues will be confirmed in the next newsletter.

If you would like to take advantage of this free service for members, you can book yourself a 45 minute appointment by contacting Vishanti (e-mail: [vishanti.lall@iop.org](mailto:vishanti.lall@iop.org); tel: 020 7470 4906). More general careers advice is available from the Institute's careers website at <http://careers.iop.org/>.

## On air: the hills are alive with the sound of physics

Just to prove that physics is relevant everywhere you go, Alison McLure was interviewed on Radio Scotland recently. She was asked onto the *Out of Doors* programme because of her mountaineering and weather-forecasting experience, but she managed to get in a physics plug. The interview was about lightning – what causes it and how to avoid it in the mountains – but electricity and Van der Graaf generators came up as well.

## Physics on the run

Congratulations to Garrie Vickers who completed the Great North Run (half marathon) in September for charity. He would like to use some upcoming events in 2006, including the Edinburgh/Caledonian Run and Great Winter Run in Holyrood Park, to promote physics in sport in schools. Let's show that physicists can be sporty, and have influential careers in sport disciplines. If anyone is interested in participating or helping out, contact Garrie (e-mail: [garrie.v@virgin.net](mailto:garrie.v@virgin.net)).

# The physics-education scene

## Physics Summer Schools 2005 and 2006

The 2005 Summer School for physics teachers was the fifth course of its kind and the first to be run in Glasgow, in the department of physics and astronomy at the University of Glasgow. As for previous Summer Schools, the programme was a mixture of inspirational, updating physics lectures, industrial and research lab visits, a day out to Edinburgh University and the Royal Observatory, and lab-based workshops.

The nature of the lab sessions was, however, different from previous years in that the aim of the activities was to produce a multimedia resource to support the teaching of a particular physics topic/concept. Apparatus that is not necessarily found in schools was made available and help was on hand to enable participants to explore the topic and its difficulties with regard to pupils' learning, and to develop skills in editing video, producing PowerPoint material, etc. At the end of the week, each participant took away a CD-ROM containing the results of the work of each group.

Teachers and tutors both learned many lessons during the course of the week and experienced real feelings of challenge, endeavour and achievement. That the course was a success was evident, not least in the e-mail from one teacher wanting to sign up almost straightaway for the 2006 course. Thanks are due to three members of the tutorial team in particular, namely Jim Jamieson, Bob Kibble and Miles Padgett, and also to Lucy Murray on the administrative side for making it all happen.

And so to 2006. The planning committee has had several meetings and the 2006 course programme is all but finalized – details will have gone to all schools by the time this newsletter is circulated. It will again be run at the University of Glasgow, on 27–30 June. There will be elements relating to the

latest developments in the science curriculum – “A Curriculum for Excellence” (ACfE) – and alternative teaching and learning strategies. If you are a physics teacher hoping to attend, make sure you point out these aspects to your senior management team now.

The organizing team is grateful to the Institute for its sponsorship, and to the Scottish Executive for funding Supporting Scottish Science Education through CPD, through a supplementary grant.

## Teacher Network

Morale is high among the members of the Teacher Network team in Scotland, despite all the demands of their day jobs in addition to the time that they devote to supporting local teachers. Various local and regional meetings have been held this term. Inevitably, those run in Glasgow and Edinburgh attract the biggest audiences. A particular mention is merited by the meeting organized jointly by the two coordinators in the west of Scotland and held at the Glasgow Science Centre in October. On possibly the wettest night of the year that far, 120 physics teachers attended the event, including some from the Highland region and from Aberdeen, Edinburgh and Fife. The Edinburgh meeting, held a week or so later, also attracted a good-sized audience.

However, this is not to lessen the importance of the smaller meetings. The latter require organizational time and very often the expertise and energy of the local coordinator as presenter, and they provide welcome opportunities to get together for physics teachers who are not well served with any other subject-related INSET locally. There have been meetings in the Borders, Moray, Aberdeen, Perth, Stirling, Fife and Inverness during the course of this term. The weather was not kind for the Inverness meeting – it snowed heavily. However, 19 teachers attended a twilight-hours session, some travelling considerable

distances to be there.

SPUTNIK, the Scotland-wide electronic network for physics, continues to be very busy with requests for ideas/resources, observations, news and mini-debates on such issues as the true level of mains voltage and questions about the current stage of development of two curriculum initiatives (see below).

The long-awaited transfer of a rich variety of teaching resources that physics teachers throughout Scotland have been willing to share, from an individual teacher's site to the Institute's *Teaching Physics* website, has now taken place. Initially it will be a closed site, accessible to SPUTNIK subscribers only.

## Stirling Physics Meeting 2006

The date for this has been set as 31 May 2006, and the organizing committee has met twice to advance the planning process. As usual there will be talks on physics and talks on education, the latter focusing on developments of the science/physics curriculum (see below). The presentation of awards to students and an exhibition of physics teaching resources will complement the formal talks.

## Curriculum development

There are currently two major curriculum-development/review exercises being undertaken. The bigger of the two is ACfE. Originated and financed by the Scottish Executive, it covers the full length and breadth of the 3–18 curriculum. Science is one of nine subject areas under review and a report from its review group is expected shortly.

A reduction of the content has been one of the principal aims, to allow more time for in-depth exploration of topics, more investigative work and the employment of a wider range of teaching and learning strategies. The group has identified key scientific themes for the 3–15 curriculum that will develop appropriate scientific skills and understanding and will fit the aims/purposes of the whole curriculum, as set out by the Scottish Executive, namely that

all young people should become successful learners, confident individuals, effective contributors and responsible citizens. A second newsletter on ACfE is now available at [www.acurriculumforexcellence.scotland](http://www.acurriculumforexcellence.scotland).

The second exercise is from the Scottish Qualifications Authority (SQA) and is being conducted in each of the school subject areas, including physics. It is focusing on the National Qualifications (Intermediate 1, Intermediate 2, Access, Highers and Advanced Highers.) The physics group has initially been focusing on Higher Physics, but is now working on Advanced Highers. The SQA Physics Review Group is aware of the deliberations of the ACfE group and, like them, it is likely to recommend that the content of Highers should be reduced so that students achieve a deeper understanding of the knowledge element. Other recommendations will be that courses should be modern in present-day terms and designed so that they can be kept up to date. Experimental work should be integral to all courses. The SQA Physics Review Group will also recommend changes to the assessment regime.

There will be speakers from each of the review groups at the Stirling Physics Meeting.

**Catherine Wilson**

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# Hot coffee and cold Irn Bru: Stirling

The 31st Stirling Physics Meeting took place on 1 June at the University of Stirling. With an attendance of around 250, it proved as popular as ever, despite the poor weather.

In his welcoming remarks, Gemmill Millar from the Institute of Physics in Scotland congratulated Rhona Goss (in her absence) for her Institute of Physics Teacher's Award, which had been presented in London. He also reminded the meeting that this was the fifth anniversary of the formation of the Scottish Qualification Authority (SQA), and joked that the M8 was the "Long Highway Collider" with two massive and inert bodies at either end. These were collided together to produce the SQA. The interaction also produced a new particle of knowledge, the Scottish Quantum of Required Knowledge (SQARK), which can only be detected by an instrument known as a NAB (No Appreciable Benefit/Needless Additional Bureaucracy).

Hamish Budge, curriculum development officer from Western Isles Council, presented "Making physics interesting in S1 and S2". Delegates were treated to a range of teaching aids including: eye-grabbing animated PowerPoint slides; a small and inexpensive webcam microscope for fieldwork; and a scientific report-writing tool called Textease. Budge also showed how to create animated PowerPoint slides, and then used datalogging and two probes to investigate the "cooling coffee" problem – will the coffee cool down more quickly if the milk is added now or later?

Budge went on to review concept cartoons as lesson starters, and performed an experiment using a DJB electronic balance interfaced to a laptop. A can of Irn Bru (what else?) was opened and placed on the balance. Whether the mass went up, went down or stayed the same could be clearly seen by the projected data output from the balance. The combination of the concept cartoon, the data-capture and display technology, and the potential for class discussion



and report writing made this a compelling demonstration.

Louise Turnbull, CDO from West Lothian District Council, gave a presentation on formative assessment and collaborative learning. Seconded from Primary, she spoke on behalf of a physics colleague who had been seconded for a quarter of a week for two years, but could not make the meeting. Turnbull went on to describe the five aspects of formative assessment (Black and William):

- provision of effective feedback to pupils;
- active involvement of pupils in their own learning;
- adjustment of teaching to take account of assessment;
- recognition of the profound influence that assessment has on the motivation and self-esteem of pupils; and
- the need for pupils to be able to assess themselves and understand how to improve.

She gave an account of her colleague's experience during the pilot, including an audit of existing practice that highlighted, among other things, content being delivered

effectively but mostly via direct teaching with little pupil or staff/pupil collaboration.

Following a decision to create a collaborative learning environment, he proceeded to use a range of techniques such as traffic lights, concept cartoons, card-sort tasks, odd-one-out and matching tasks. Marking tests also became a collaborative exercise. Pupils were encouraged to make up their own marking scheme and mark the tests themselves. Finally, fourth-year pupils each wrote a "Letter to me", following their preliminary exams. These were posted to their homes and contained a self-evaluation of their performance and what they could do to improve.

John Fleming, PT Science at Bathgate Academy, appeared alongside Turnbull as a practising physics teacher. Involved in a pilot scheme with primary and secondary schools in West Lothian, he was impressed by how good primary pupils were at investigations and collaborative working. Like the rest of us, he wondered what happened to these skills by the

time pupils got to the third year in the average secondary school. He gave an account of a school pilot on positive feedback and described his work with an Intermediate 1 class with whom a random discussion of a Tom Cruise movie involving hi-tech surveillance equipment became a lesson on input devices.

As possibly the highlight of the morning session, Dan Hillier from the Royal Observatory of Edinburgh described the Faulkes Telescope Project. He was supported by Dawn Knight of Dalkieth High School. Funded by a £10 m grant from the Dill Faulkes Trust plus contributions from PPARC and the DfES, the project comprises two telescopes: one in Hawaii in the Northern Hemisphere and one in Australia in the Southern Hemisphere. This arrangement allows whole sky coverage all year round from two fine-weather high-altitude sites. Each telescope weighs 24 tonnes, is fully remotely controlled, has a 2 m reflecting mirror, has professional CCD and has a large field of view. They have a clamshell rather than a

# Meeting strikes a balance



*Clockwise from top: Richard Louie of Kinetic Books, US, demonstrates digital physics textbooks, delivers a presentation and talks to delegates; attendees at the 31st Stirling Physics Meeting look around the stands during a break; Ronna Montgomery and Tom Dickson; the meeting stimulates lively discussion.*

Ronna Montgomery of Bearsden Academy, and an area organizer of the Teacher Network, presented an overview of the Physics Teacher Network in Scotland. She reminded delegates of the purpose of the network and highlighted some past successes and forthcoming events in Glasgow and Dundee. SPUTNIK was showcased as an excellent example of collaboration and sharing of particularly high-quality support material for physics courses at all levels. It will be moving from Dave Spittal's website to a home of its own in due course. A surprise presentation was made to Dave for his considerable help in hosting SPUTNIK on behalf of the network.

Gary Williams, editor of *Physics Education* and national coordinator of the Teacher Network, concluded the morning session. He focused on the Institute's desire to encourage teachers to collaborate and share good practice through writing for *Physics Education*. He felt that it would be useful to consider writing reviews of equipment, and he invited delegates to contact him for further details.

David Saxon of Glasgow University introduced the Institute of Physics in Scotland prize-giving ceremony. Winners were as follows:

#### **Advanced Higher Physics**

**1st** Richard Davison, Williamwood High School Glasgow (not present)

**1st** Daniel Scislowski Oldmachar Academy, Bridge of Don, Aberdeen

**3rd** Kerr Johnson, Brae High School, Brae, Shetland

#### **Higher Physics**

**1st** Bo Zheng, The Glasgow Academy, Glasgow

**2nd** George Bowler, Dollar

Academy, Dollar.

In the afternoon, keynote speaker Prof. Miles Padgett celebrated the centenary of Einstein's most famous year in "Does God play dice with nature?" Some of Einstein's papers from 1905 were discussed: special relativity, the atomic theory of matter (Brownian motion) and the theory of the photoelectric effect (photons). Photons gave rise to the idea of wave-particle duality. The Young double-slit experiment, when the intensity was reduced to nearly photon levels, yielded issues for Einstein from which the references to God and dice originated. In Taylor's experiment of 1910, single photons at a double slit landed on screen where bright fringes would have been at high intensity. The question was this: "When does the photon 'decide' in which bright fringe it will be observed?" Einstein believed that the behaviour was predetermined at the source by hidden conditions. Bohr believed that the photon was "undecided" until it was measured. Thus began a debate that was not resolved for more than half a century.

The presentation then developed into an elegant and conceptually demanding review of quantum mechanical developments over the last 50 years. The key ideas covered included mathematical modelling involving photons that could not decide which way to be polarized; the Bell inequality; the experiments that solved the Bell inequality and confirmed Bohr's view; quantum superposition; collapse of the wave-function; quantum entanglement; and action at a faster-than-light speed. The presentation concluded with a lively question-and-answer session. In a far-reaching, well researched and highly engaging presentation, Padgett, with his characteristic enthusiasm, re-ignited the flame that took us into physics all those years ago.

Planning has already started for the next Stirling Physics Meeting, which will be on 31 May 2006.

**Michael McVey**

## Touring lecture calls at Monifieth and St Andrews

The Institute of Physics touring lecture for schools visited Monifieth and St Andrews in September. Dr Karen Bultitude and Dr Laura Grant gave a tremendous presentation on "Our planet – our future". They looked at how science and technology are helping us to understand the impact that human life has had on the planet and what we can do about it.

Bultitude and Grant used exciting demonstrations to illustrate key points, and the audience employed voting handsets to choose the direction of the lecture and to respond to various questions about what choices they would make. The presentation was well scripted and gave the impression of a live TV show. A video clip of one of the presenters on a *Scrapheap Challenge*-style TV show added some celebrity value.

Response from the school teachers at the event was very positive, and they rated the science content and the enthusiasm-generation highly.

## Paperclip Physics Competition 2006

Paperclip Physics is a nationwide competition for 14–18-year-old students to demonstrate a scientific principle using only the kinds of equipment that they might find around the home. Ian Cuthbert is running this year's competition in Scotland. The two heats will be held in Glasgow on 28 February 2006 at Glasgow University and in Edinburgh on 8 February 2006 at Heriot-Watt University. The grand final will be held towards the end of March.

### DEADLINE

The deadline for the next newsletter is 5 March 2006. Please e-mail your articles, thoughts, photos, letters, etc to Alison McLure at [alison.mclure@iop.org](mailto:alison.mclure@iop.org). I look forward to hearing from you.

conventional dome cover, which allows rapid movement of the telescope. Most important, they are intended for use by schools. The cost of three 30 minute observation sessions is £160 + VAT for each school or institution. More information can be found at [www.faulkes-telescope.com/](http://www.faulkes-telescope.com/).

The telescope is live and totally controlled by the school involved in the observation. Its use applies to the Space Physics unit in SG and to parts of the 5–14 Environmental Science course. Eventually, for staff there will be CPD workshops, astronomer support and visits to science centres.

Knight described how the telescope had been used at Dalkieth High School as part of a workshop with S4 SG pupils. She described some of the planning and research that had gone into the session and the excitement of all of those involved. Attendees were treated to clear and colourful images of the Eagle and Ring nebulae, produced during the meeting. The presentation concluded with a live session, which produced a monochrome image.

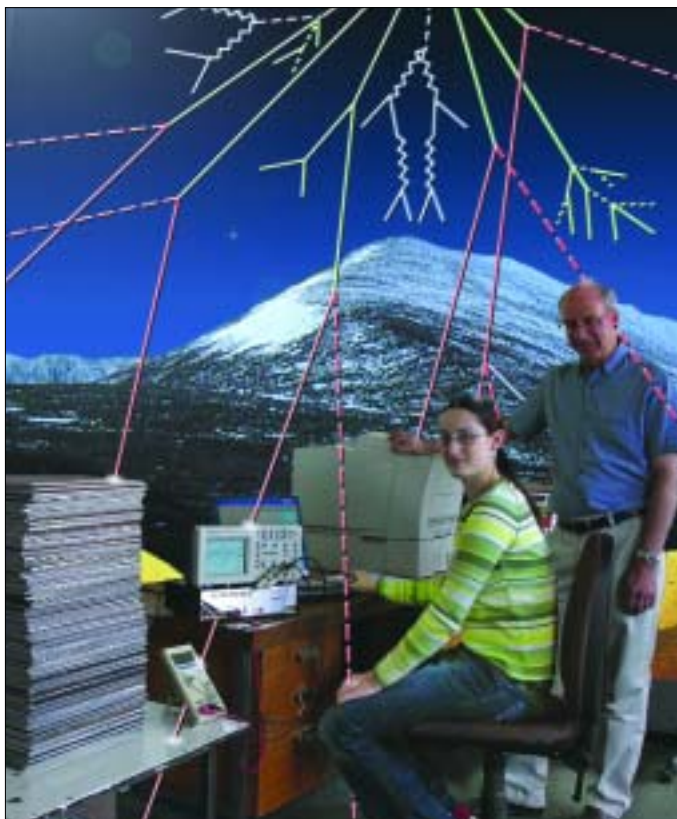
# Mountain-top physics: Scottish schoolgirl challenges Einstein

In October 2005 a Scottish schoolgirl chose Cairn Gorm, one of Scotland's highest mountains, as the venue for an experiment to challenge an effect predicted by Albert Einstein 100 years ago. However, before she could conduct the experiment, which measured the speed of subatomic cosmic particles, Ingrid Burt, from Penicuik's Beeslack High School, had to solve the logistical problem of transporting nearly 400 kg of steel and other equipment to a suitable location at a high altitude.

Having identified a potential site close to the summit of Cairn Gorm, the young physicist, whose experiment was supported by Edinburgh University's Department of Physics to celebrate Einstein Year, approached Cairngorm Mountain Ltd for its assistance. The company operates the Cairn Gorm Funicular Railway as part of a year-round visitor attraction and was quick to offer its support for this unique scientific experiment. The railway's Top Station, situated at 1097 m above sea level, was not only an ideal location from which to measure the speed of subatomic particles called muons but, perhaps more pragmatically, also offered direct access for the easy transportation of all of the necessary equipment via the mountain railway.

So from 14 to 24 October 2005, visitors heading for the Top Station at Cairn Gorm were able to see a unique experiment being conducted by a young Scottish schoolgirl seeking to prove the validity of Einstein's Theory of Special Relativity, first published in 1905.

Alan Walker of Edinburgh University's Particle Physics Experiment (PPE) group explained: "Einstein's Theory of Special Relativity explained many of the puzzles for natural phenomena and physics at that time and made extraordinary predictions about the behaviour



*Was Einstein right? Ingrid Burt aimed to test his Theory of Special Relativity in an experiment at the top of Cairn Gorm mountain.*

of fast-moving objects, including the theory that time slows down for bodies moving close to the speed of light.

"The Earth is bombarded from outer space by a huge number of primary cosmic rays, mostly very-high-energy protons that collide with molecules of air in the upper atmosphere to produce additional high-energy particles that form cascades of secondary cosmic rays. The most penetrating of these rays is the muon, many of which reach the surface of the Earth, where they can be detected. The muons break up and have a characteristic lifetime of just 2.2 millionths of a second. Travelling at the speed of light, very few muons would be expected to survive the 15 km journey through the atmosphere but very many are detected.

"In very simple terms, the

experiment measures how many muons exist in the atmosphere at the top of Cairn Gorm compared with how many still exist at sea level, where a secondary experiment was conducted as a follow-up. To demonstrate this, Ingrid's experiment used about 0.5 m of steel on Cairn Gorm to slow down the fastest muons and detect those that stopped and then broke up inside the scintillating plastic of the detector. During the 10 day experiment, the rate of muon decays was measured constantly, after which the process was repeated for another 10 days near sea level in Edinburgh, but with a layer of steel equivalent to the additional depth of atmosphere removed."

Using Einstein's Special Theory of Relativity, Burt had previously calculated that the difference in the ratio of the rate

of muon decays at the two sites, 1100 m apart in altitude, should be about 4.2 times that predicted without relativity. That difference should easily be detected and she confidently predicted that her experiment would simply prove that, 100 years ago, Einstein was right after all.

"Finding the right site and getting all of the equipment to the top of a mountain was a real problem," she said. "I am very grateful to Cairngorm Mountain Ltd for their assistance in making all of this possible. Physics has always interested me and I jumped at the chance to be involved in such a unique experiment. People won't see the sci-fi version of cosmic rays bombarding bits of metal. Real astrophysics is much less spectacular visually but no less real. It is important that we understand what is happening around us."

Bob Kinnaird, chief executive of Cairngorm Mountain Ltd, added: "We strongly support educational interpretation as part of our visitor experience and were happy to assist in making possible this unique experiment on a Scottish mountain. During the schools' half-term break, visitors were able to see the experiment running in the Top Station and find out lots of things about cosmic rays and subatomic particles. It was very exciting to be hosting an experiment as part of Einstein Year."

Earlier in 2005, Burt undertook a feasibility study that was funded by a Nuffield bursary. The work was undertaken in conjunction with the PPE group of the School of Physics at the University of Edinburgh, the Particle Physics for Scottish Schools (PP4SS) Project and the Scottish Science and Technology Roadshow (SCI-FUN). Her supervisors in the study were Alan Walker of PPE and PP4SS, and Peter Reid of PP4SS and SCI-FUN.

## CALENDAR OF EVENTS JANUARY – JUNE 2006

An up-to-date listing of Institute of Physics in Scotland meetings can be viewed on the website at <http://whatson.iop.org>.

**Tuesday 17 January 2006**

### **Chaos theory and dynamical systems**

Prof. Bernd Krauskopf and Dr Hinke Osinga, University of Bristol  
7.30 p.m., Royal Society of Edinburgh, 22–26 George Street, Edinburgh, [www.phy.hw.ac.uk/~phydtr/iop](http://www.phy.hw.ac.uk/~phydtr/iop)

**Thursday 26 January 2006**

### **Seniors Group Lunchtime Rendezvous**

University of Glasgow,  
<http://scotland.iop.org/LUNCHTIMERDVG3.doc>

**Thursday 2 February 2006**

### **The design of fy-by-wire flight control systems**

Chris Fielding, BAE Systems

6.00 p.m. for 6.30 p.m., joint with RAeS (Glasgow)/IEE/BINDT/IOP  
James Watt Building, University of Glasgow

**Tuesday 14 February 2006**

### **Physics and music**

Prof. Murray Campbell, University of Edinburgh  
7.30 p.m., Royal Society of Edinburgh, 22–26 George Street, Edinburgh, [www.phy.hw.ac.uk/~phydtr/iop](http://www.phy.hw.ac.uk/~phydtr/iop)

**Tuesday 7 March 2006**

### **Negative refractive index meta-materials**

Dr Martin McCall, Imperial College, London  
7.30 p.m., Royal Society of Edinburgh, 22–26 George Street, Edinburgh, [www.phy.hw.ac.uk/~phydtr/iop](http://www.phy.hw.ac.uk/~phydtr/iop)

**Wednesday, 22 March 2006**

### **Seniors Group Lunchtime**

### **Rendezvous**

James Clerk Maxwell Foundation, Edinburgh,  
<http://scotland.iop.org/wedLUNCHTIMERDVE3.doc>

**Thursday 6 April 2006**

### **Artificial pitches and the games they play on them**

Colin Walker, University of Strathclyde  
6.00 p.m. for 6.30 p.m., James Weir Building, Montrose Street, University of Strathclyde, Glasgow.  
Joint with IOP

**Friday 14 April 2006**

### **James Clerk Maxwell**

Malcolm Longair  
Edinburgh Science Festival

**Tuesday 25 April 2006**

### **Maxwell, the man who changed everything**

Basil Mahon, author  
Aberdeen

**Wednesday 26 April 2006**

### **Maxwell, the man who changed everything**

Basil Mahon, author  
St Andrews/Dundee

**Thursday 27 April 2006**

### **Maxwell, the man who changed everything**

Basil Mahon, author  
Glasgow

**Friday 28 April 2006**

### **Maxwell, the man who changed everything**

Basil Mahon, author  
Edinburgh

**Wednesday 31 May 2006**

### **Stirling Physics Meeting**

University of Stirling

**Monday 26 June – Friday 30 June 2006**

### **Summer School for Physics Teachers**

University of Glasgow

## Science and the Parliament celebrates its fifth birthday in style

The Institute of Physics took part in the Science and the Parliament event, which is now officially five years old. With some 300 guests, the event was held on 2 November at the Edinburgh Science Centre,

Our Dynamic Earth was certainly a celebration. The Deputy First Minister Nicol Stephen kicked off with an uplifting speech about the central role that science now plays in Scotland's economic policy. He encouraged the

participants to help Scotland to achieve his vision "for Scotland to develop as a 'science nation' where research, creativity and innovation are fundamental to its future success".

The day carried on as it began. The Parliamentary Question Time was addressed by nine senior MSPs, including three conveners and a minister, in four break-out sessions covering health, education, enterprise, and lifelong learning and the environment. This was

followed by a session with five representatives of the Scottish Science Advisory Committee.

The awards ceremony paid tribute to some excellent young scientists who achieved top marks in their exams, with Education Minister Peter Peacock presenting the prizes.

The exhibition was extended to cover the registration and mid-afternoon break in addition to the usual evening slot. Participants were able to relax and network among the 25



*Nicol Stephen, Deputy First Minister and Minister for Enterprise and Learning.*

exhibitions, which were put on by a range of societies, science centres and companies.

The event was organized by the Royal Society of Chemistry in association with eight other science organizations, including the Institute of Physics.

# Further information about the Institute of Physics in Scotland can be found at

# <http://scotland.iop.org>

# Summer School 2005

Twenty-three physics teachers spent a week in June in Glasgow at the fifth Physics Teachers' Summer School. This year's event, hosted by the University of Glasgow, was a departure from previous formats held in Edinburgh. Teachers chose to collaborate on topics of particular interest to them and worked with a deadline in mind. They pledged to produce a CD-ROM by the end of the week – a resource that all would take away and make use of in their teaching. The target was achieved and the finished product, complete with colour cover and professionally printed label, was duplicated by staff at department of physics and astronomy in Glasgow, ready to be taken away by close of play on Friday. This work represented a significant achievement for the teachers and the team who managed the Summer School.

Although the CD-ROM represented a tangible achievement, the Summer School offered a wide-ranging programme of visits, lectures and social events. Teachers visited centres of cutting-edge



*Happy days: Miles Padgett (left) and Bob Kibble at Summer School.*

research at the universities of both Strathclyde and Edinburgh, spent time at the Glasgow Science Centre and the Burrell Collection, and were hosted by Glasgow University in the Hunterian Museum and in the Kelvin Building.

The event was made possible with support from the universities of both Glasgow and Edinburgh, the Institute of Physics and SSERC. Particular thanks are due to students from the physics research teams at Glasgow, mobilized and led by Prof. Miles Padgett. The sixth Annual Physics Teachers Summer School is planned for 26–30 June 2006 in Glasgow.

**Bob Kibble**

# TUSLIP day of physics gives pupils a taste of life at university...and beyond

Sixth-year pupils studying physics from across Tayside and Fife converged on St Andrews University at the end of September for a day of physics-based activities. The event was supported by the Institute of Physics in Scotland, was organized for the Tayside Universities and Schools Liaison in Physics group, and was advertised by STEM Tayside, among others. More than a hundred participants came along and spent the day experiencing various aspects of university-level physics study, and watching presentations on careers in physics.

The visitors first spent two hours exploring physics in the university's teaching labs, then after lunch went to a real first-year lecture. A short presentation on astronomy was followed by discussion groups with current students, then by a presentation showing something of the range of careers available for physicists both in physics-based industry and in more general careers. The day

concluded with a talk entitled "Why bother doing physics research?", in which both the pure and applied aspects of physics were highlighted.

The event was initiated at the request of local schoolteachers to allow sixth-year physics students in the area to meet with other such students and to learn more about the opportunities available to them through studying physics.

**Bruce Sinclair**

## IOPIS GRANTS

Every year the Institute of Physics in Scotland funds various events. Given that 2006 is 175 years since the birth of James Clerk Maxwell, there will be a number of events to celebrate this anniversary.

Individuals or organizations can apply to the Institute of Physics in Scotland for small grants to organize, promote or support outreach activities. Bids for the next round of funding should be e-mailed to [alison.mclure@iop.org](mailto:alison.mclure@iop.org) by 10 March 2006.

## INSTITUTE OF PHYSICS IN SCOTLAND COMMITTEE MEMBERS 2005/6

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