IOP | Institute of Physics
Merseyside Branch

PHYSICS ON MERSEYSIDE

The newsletter of the Merseyside Branch of the Institute of Physics

September 2009

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Prof. Neil Marks

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You can find more about the teacher networks and how the Institute can help your school at http://teachingphysics.iop.org.

Local branches matter

This is the time of year when our members get to see the programme that their committee has been busy preparing. We have deliberately set out to provide a varied programme and you will find several unusual and interesting topics. If you have not attended branch events before you will receive a friendly welcome at the physics department of Liverpool University, Daresbury Laboratory and Liverpool Medical Institution. Do make the effort to come.

Many organisations have suffered from the effects of the recession. The Institute is no exception and it has to look seriously at its finances. The costs of running branches and producing branch newsletters are clearly under the microscope and this will be even more true if new branches are formed.

In early July the Institute made a draft report of the Review of Branches working party available to branch committees. Readers might remember that last autumn branch members and committees were asked to complete a questionnaire on the future of branches. Merseyside Branch generated 81 responses from individual members, amounting to 7.43% of membership. This was the second highest response with most branches under 6%. We also had the highest percentage of respondents who have been involved in branch activities in the last two years – possibly boosted by the Capital of Culture events – and the lowest percentage of respondents wishing to get involved with a smaller, more local, branch.

In all branches, the proportion of members who responded was small so we do not have any sort of statistical significance but this does suggest that our members are more satisfied with the present set-up than in some other parts of the country. It does not mean that we should get complacent, but we must understand that other branches that are more geographically spread or have a greater number of obvious centres of activity do have logistical problems; change is needed with implications for all branches.

The draft proposals make a number of recommendations, including encouraging the creation of new branches where demand exists, a statement of minimum requirements for a branch, an increased role for the Nations and Branches Forum and the channelling of Institute education and outreach funding through a more centralised allocation mechanism.

The new model proposes a branch committee of three officers, between three and six members and up to three co-opted members. This compares with Merseyside's current four officers, 11 committee members and three co-opted members. Our experience is that all four officers are very busy and we need to have a range of representation if we are to do a good job. Our officers and committee donate unpaid time and the branch also benefits from the generous support of the University of Liverpool physics department and Daresbury Laboratory.

The fact is that local people, who give their time freely and have the local knowledge to make projects succeed, inspire most of the innovative events that happen around the country. This cannot be directed centrally. We need to ensure that we don't get bogged down in a one-size-fits-all scenario where, to promote activity in one area, we tie the hands of volunteers elsewhere.

I believe that, in its branches, the Institute has a resource beyond price and there is a real danger of losing the enthusiasm of members. There is no genuine reason why branches should all work to the same model. Let us support evolution, not revolution. These are my personal views but I would guess that others share them.

In the meantime, at the risk of repeating myself, let me remind you that we would love to hear from you. It is likely that we are going to be making more use of *MyIOP* as a cost-effective means of communication. Please do log on regularly and if you put a picture there or add to your profile, so much the better. Remember that *MyIOP* is intended to put members in control so use the facility to have your say.

If you have any difficulties with the site, let us know and we will try to help. Within the Merseyside Branch network you can use the forums to comment on relevant matters and upload files and pictures that might be of interest to other branch members.

David Cox, editor

North-west bids farewell to LIAL

As Lab in a Lorry (LIAL) comes to the end of its run in the north-west (there are just a few dates left in Bolton and Warrington) it is worth reflecting on its successful tour and looking at some other opportunities for members to get involved.

LIAL is an interactive mobile science laboratory that is staffed by volunteer practising scientists and engineers. Its aim is to give young people (ages 11–14) the opportunity to do experimental science in the way that it actually happens: exploratory, accidental, informed by curiosity and intuition, but also bounded and guided by the experience and insight of practising scientists.

LIAL started in 2005 as a project in partnership between the Schlumberger Foundation and the Institute of Physics. In 2008 it came to the north-west for a tour, in partnership with the Ogden Trust, the Royal Commission for the Exhibition of 1851 and the Society of Petroleum Engineers.

Lab in a Lorry in Warrington, July 2009.

A dedicated north-west co-ordinator (Dayna Mason and more recently James Bamford) was appointed. Many thanks go to Dayna and James, without whom the tour would not have been possible.

The involvement of volunteers who actually work in science has always been one of the great strengths of LIAL, if finding them has sometimes been one of the greatest challenges.

Potential host schools and volunteers can still sign up via the website (www.labinalorry.org). The Institute keeps all details and will be in touch if/when it's in the region again.

If you are a volunteer and are now suffering LIAL withdrawal symptoms, fear not! There are many other ways to get involved with outreach for the Institute in the north-west. If you have registered as a STEM ambassador (the new name for SEAs), you will no doubt get many requests for help. If you would like to be kept informed of forthcoming Institute outreach events needing volunteers, do get in touch (e-mail louise.butcher@iop.org).

One exciting development is that the Big Bang Science Fair will be held in the north-west in 2010, and the Institute plans to have a strong presence there. The event in 2009, held in London, was the UK's biggest celebration of science and engineering, and it is set to become an annual event. With 5000 young people attending, the Institute will no doubt need many volunteers.

If you have outreach ideas that you would like to implement, you can apply for an IOP Public Engagement grant (for details, visit www.iop.org/activity/outreach/Resources/Putting_on_your_own_event/Funding/page_5878.html).

Louise Butcher

Physics education: the future

Prof. Peter Main, the Institute's director for education and science, took an unusual angle for his talk on 26 March. He began by asking, "What is physics?" After a lively discussion, he suggested that, "Physics is the process of understanding and explaining phenomena in terms of a small(ish) number of fundamental laws." This removes reference to content, distinguishes the physicist from the engineer and requires mathematical manipulations as well as measurement and instrumentation. He argued that, because no other subject has this approach, physics must continue.

The public views physics as a difficult subject, with A-level entries dropping and university departments shutting. Physics is widely agreed to be the core science but it is disguised so that few understand what physicists do. At school, physics underpins a wide range of subjects. In universities the Research Assessment Exercise pushes applied physics into other university departments. Physics-based industry is not seen as connected with physics.

Apart from general studies, physics is rated as the most difficult A-level. However, Prof. Main asked, is the reduction of mathematical content at this level putting the most able off? If so, should there be two strands: one for the specialists and one to underpin another subject?

Physicists study big questions including the theory of everything and there are exciting new developments such as spintronics, photonics and quantum cryptography. According to Prof. Main, a physicist using models derived from non-linear systems to explain how the ear works is doing physics, not biology – just one example of how physics is being used increasingly widely.

Physics is used on arrhythmic heartbeats, ecosystems, the stock market and the atmosphere. Sophisticated medical diagnostic imaging techniques use physics. Nanoscience is breaking down barriers between physics and chemistry. In the next 15 years physics will play a major role in attempts to solve the problems of renewable energy, climate change, transport, nuclear fusion and space travel.

The Wakeham report stated that physics is in rude health. Physics graduates are among the best paid. However, future interdisciplinary physics-based degrees may not require an A-level in physics. Most of Europe has a longer route to doctorates. How do these statements link with the fact that about 50% of new academic physics appointees have not been educated in the UK?

Prof. Peter Main.

In Prof. Main's dream for the future, physics would be an essential part of a science Baccalaureate (or diploma) and at A-level it would be available as a mathematical subject. Experiment and critical thinking would be central to training and physics would be taught as a process, principally via a problem- or context-based approach. In reality, a science diploma will be introduced in 2011, raising issues for progression to university physics.

Ann Marks

Physoc embraces a new year

After an eventful year for Physoc, the AGM in May saw the election of a new committee for the coming year.

In what is now becoming a tradition, the new committee held a post-exam barbecue on the rooftop court of the Oliver Lodge Building in May. Mercifully, the rain held off until the end of what was a highly successful event that was enjoyed by all who attended. The committee would like to thank Dr Dickson and Dr Moran for their help with this event.

The committee is currently planning future events. The popular monthly lunchtime lectures will continue and students can look forward to parties at Hallowe'en and Christmas, as well as other social outings.

Our astro officer is arranging a number of practical astronomy evenings and our webmaster is investigating new ways to improve the existing online facilities of the society.

A social event will be arranged in welcome week to introduce new first-year students to the society and fellow students.

Andrew Rigby, Physoc president

2009/2010 Physoc committee

Andrew Rigby – president
James Tulip – general secretary
Douglas Young – social secretary
Thor Dymond – comms officer, webmaster
Brian Bolton – astro officer
Elizabeth Cocklin – treasurer

Big physics can look into the past

Our branch lecture in February was given by Dr Andy Smith, a photon scientist from the STFC Daresbury Laboratory. In a fascinating insight into the application of modern research tools to history, Dr Smith explained how photon and neutron probes could be used to solve questions regarding the provenance, manufacture and conservation of vital parts of our cultural heritage.

He began by reminding us of the powerful, accelerator-driven sources of synchrotron radiation and spallation neutrons that are now available, though these are more often associated with fundamental research in materials science and biology. Neutrons are also available from reactors. These two different types of source can probe matter in a complementary manner and have only quite recently been applied to archaeometry.

It is always important to have non-destructive techniques available when dealing with valuable items. Neutron beams allow the techniques of diffraction and attenuation to generate information about the manufacture of objects, while activation analysis can be applied to solving their provenance. These beams are particularly suitable for crystalline samples (e.g. ceramics and metals). Hidden features can be discovered but in general the spatial resolution is low (millimetres). In contrast, X-rays give more information about chemistry and surfaces and can have much better resolution (microns).

Dr Andy Smith works at STFC Daresbury Laboratory.

The Mary Rose Trust

The Mary Rose *was raised from the sea bed in 1982.*

Dr Smith presented a series of exciting examples, including the ability to identify fake coins and late repairs to items such as a helmet in Manchester Museum that is nearly 3000 years old. Interesting results, but with less clear-cut answers, were those on the Essenite clothing fragments from the Qumran Caves, attempting to elicit their geographic origins.

A practical application concerned damage to the marble façade of Milan Cathedral, extensively investigating the corrosion chemistry on its exterior. Forensic studies of paintings were illustrated by one example of novel green pigmentation, attempting to understand the Gothic artist's unique recipes. Similar detective work was undertaken on Islamic lusterware, involving nanoparticles deposited in a glaze. This technique was highly specialised and has been tracked around the Mediterranean from its origins in the Middle East.

The talk concluded with an entertaining account of studies on the *Mary Rose*, sunk in 1545 but raised in 1982 from the sea bed. Such old ships exhibit a sulphur problem – yellow outbreaks on the hulls (seen also, for example, in Viking boats) that lead to acidic damage. This chemistry has now been extensively studied with synchrotron radiation by Dr Smith and co-workers and he showed important spectromicroscopy results that can lead to preservation solutions.

Mike Poole

Physics teachers: still learning

This year's Liverpool Physics Teachers Conference was held on 2 July at the Chadwick Physics Laboratory and again proved popular. Attendance exceeded 80, including a substantial contingent from the Institute's Physics Enhancement Programme.

This well established event targets mainstream physics teachers, particularly at A-level. Talks included an authoritative tour of the universe with Prof. Mike Bode, a first-hand account of work at the Large Hadron Collider from Dr Tara Shears and advice on the mysteries of the UCAS application system provided by Prof. Paul Nolan.

Gary Williams (national co-ordinator of the Institute of Physics Teacher Network) demonstrates how to convert a computer mouse to act as an optical timing gate for use in dynamics experiments.

The programme included workshops with delegates choosing two out of the five options offered and this proved successful. Some teachers said that they missed the Ask an Expert panel from previous years but unfortunately there is a limit to what can be fitted in to one day. The evaluations received to date indicate a high degree of satisfaction with the tried-and-tested format.

GRBs: the new big bangers

Starting with a whistlestop tour of the universe, Prof. Carole Mundell of the Astrophysics Research Institute at Liverpool John Moores University introduced the idea of imaging astronomical objects using different parts of the electromagnetic spectrum. Observing the high-energy end of the spectrum – gamma rays – gives access to regions of extreme physics: very strong gravitational forces and high magnetic fields.

This is the realm of neutron stars and black holes. Prof. Mundell described the first observations of gamma-ray bursts (GRBs) by military satellites in the 1960s and the subsequent debates about their origin (local to our galaxy or at extreme distances).

Prof. Carole Mundell, Liverpool John Moores University.

Artistic impression of a gamma-ray burst.

Dana Berry, Skyworks Digital

The need for a fast response to the detection of a GRB was explained. Some GRBs are followed by an optical afterglow that fades rapidly after only a few minutes, so imaging by an optical telescope to help determine the nature of the source of the gamma rays has to be carried out very quickly after its discovery. The robotically operated Liverpool Telescope in La Palma fulfils that need as it can be tasked to image a GRB source within a minute of its discovery by an orbiting satellite – an impressive feat.

The physical origin of the GRB is thought to be the result of the outward flow of plasma from a cataclysmic event producing a shockwave in the surrounding material – the wonderfully named "relativistic fireball shock model". These are some of the most distant objects measured and hence observation of GRBs allows us to look back to a young universe to see some of the first stars that ever formed.

Steve Barrett

Delays at CERN cause trouble for PhD students

You would have to have been living on a desert island to have missed the "Houston, we have a problem" moment after the start-up of the Large Hadron Collider (LHC) last September. The failure of an electrical connection to a superconducting magnet had a knock-on effect, which caused serious damage and delayed the experiment by at least a year. As well as allowing the Higgs boson to keep its secrets a little longer, it also delayed the work of many young scientists relying on LHC results for their theses.

Katharine Leney, a Liverpool third-year PhD student studying the ATLAS experiment writes: "After the excitement of the much anticipated switch-on of the LHC, it was disappointing when, just nine days later, a faulty electrical connection between two magnets caused a rupture, leaking 6 tonnes of helium into the LHC tunnel.

"Since then, repairs have been carried out and preventative measures have been put in place to ensure that this won't happen again or, if a problem does occur, then the damage won't be so bad.

The LHC's damaged components.

"We plan to restart with a single beam of protons, with collisions soon afterwards. We'll forgo the usual winter shutdown and run until enough data to produce some physics results has been collected.

"What isn't known yet is at what energy these collisions will be. Particles with higher energies need stronger magnetic fields to keep them in orbit, so lowering the particles' energy means that less strain will be put on the LHC magnets, allowing the engineers to operate the LHC in 'safe mode' while they test and build confidence in the repairs.

"The design energy of the LHC is 7 TeV per beam (collisions of 14 TeV), but for the 2009–2010 run we're expecting an energy of 4 or 5 TeV per beam. Even at these lower energies the LHC will still have a higher energy than any other facility and we'll still be able to make some interesting physics measurements. In fact, any collisions at all will help us to better understand the detectors, how to time them to match the timing of the LHC beams and how to pick out the interesting events.

"That's not to say that we've spent the last year twiddling our thumbs. The detectors have been running and taking data from cosmic rays. Each experiment has collected and analysed several hundred million cosmic-ray events now, which have been used to help commission the detectors and fully understand the nuances of the many components.

"Of course it's frustrating that we don't already have some data from proton–proton collisions, especially after having come so tantalisingly close. For many students, the absence of collisions meant that they didn't have any real data to include in their thesis, but could only use results from simulations. I'm more fortunate – with another year left before I submit I'll have enough time to look at the data we take from the first collisions.

"In the grand scheme of things it's not so bad. In a few years' time, when we've found the Higgs and answered questions about the universe, such as the existence of supersymmetry and extra dimensions, these few months of waiting will be a distant memory!"

On 6 August CERN announced that the LHC will start again this November with a beam energy starting at 3.5 TeV, and rising later in the run.

Visit the branch website at merseyside.iop.org

The life of a Teacher Network co-ordinator

The Teacher Network has been running for about seven years now and it is going from strength to strength. It's difficult to summarise exactly what the network does because the brief I was given was rather vague. I presume that the same was true for the other 26 network co-ordinators in England and Wales and the 10 in Scotland and Ireland. However, this is part of the freedom and independence that we get that makes the job so enjoyable.

When I was asked to interview for the post I had recently moved from All Saints High in Kirkby to my current school, St Francis Xavier's College in Liverpool. The only other specialist physics teacher at All Saints had also recently left the school, to work for AQA. I had kept in touch with the head of science and other teachers there and I had travelled to Kirkby to run some after-school extra physics lessons when students were preparing for exams. When I saw the Institute's advertisement for the physics Teacher Network it was clear that one key strand of the work would be to support schools like All Saints that were without physics specialists or perhaps that had one physicist working in isolation.

The first three years of the Merseyside network saw Ann Marks and I working as a double act. We generated our initial members by putting together a workshop that became known as "Fun with forces" and we presented it to trainee teachers at Edge Hill, John Moores and Liverpool Hope universities. These days I regularly present workshops of my own devising on topics including energy, waves and electricity. All of the network co-ordinators can call up equipment for workshops from a central store, including rocket launchers, Van de Graaff generators and the Virtual Physical Laboratory software.

In that first year Ann and I organised a physics conference for science teachers who were not physics specialists, which we called Physics Can Be Easy. It ran in the summer term along similar lines to the annual Physics Teachers Conference. It has become a useful focus point for my work and provides a structure to work around rather than endlessly grinding through the academic year.

Now that I've planned and executed the last four conferences for non-specialists you may think it has become a straightforward task. I assure you that this is not the case. This year two of the workshop presenters pulled out, giving me only just enough time to find replacements. Then – just days before the event – one of the main speakers e-mailed to say that they were unable to attend. Having no time to draft in another speaker, I quickly cobbled together a talk based on the "Software for skint schools" workshop and creatively filled up the time. The frustration of these kinds of unforeseen problems can be quite stressful. However, this has to be balanced with the pleasure that is to be had from seeing a plan come together, getting positive feedback and feeling that I am making a contribution to the professional development of science teachers in the region.

The most satisfying thing about being the Merseyside Teacher Network co-ordinator is the fact that I get so many opportunities to discuss science and science education with lots of teachers, advisers and other professionals. It really is a refreshing change from the rather soul-destroying discussions one often has with school colleagues about target-setting, assessments, self-evaluation forms, departmental improvement plans and the various other kinds of paperwork that seem to be the obsession of Ofsted and headteachers at present. We have none of that in the network: it's science teaching and learning all the way.

Lucas Hayhurst

Physics made easy

Dr Dominic Dickson uses visual aids to illustrate his talk "Towards the Big Bang with the LHC".

Neal Gupta introduces teachers to paper-based exercises, which develop co-operative learning techniques.

East Midlands Teacher Network co-ordinator, Helen Pollard, adds variety to physics lessons by making and using simple apparatus.

Physics Can Be Easy is an annual conference for teachers run by the Institute's Teacher Network co-ordinator for Merseyside, Lucas Hayhurst. It is particularly aimed at PGCE students , newly qualified teachers and science teachers for whom physics is not their first subject.

This year, 34 participants attended a day consisting of lectures in the morning and workshops, run mainly by network co-ordinators from other areas, in the afternoon. We were impressed by the interest and enthusiasm of all who attended and the many valuable lessons learned.

Schools lecture looks to the sky

There was not an empty seat in the house when the Institute's 2009 Schools Travelling Lecture came to the Chadwick Theatre in Liverpool. This year's lecturer was our very own Dr Andy Newsam from Liverpool John Moores University's Astrophysics Research Institute.

Dr Newsam is director of the National Schools Observatory (NSO) based on Merseyside and has been involved in the development of the Liverpool Telescope project from its outset. More than 1000 schools are currently registered with the NSO and therefore able to commission observations using the 2 m robotic telescope in the Canary Islands and view the results on their school computers.

Astronomy has always captured the public's imagination. Since the Moon landings, 40 years ago, there has been a veritable explosion of knowledge about our universe, but what do our average 14–15-year-olds actually know? Do they know how old the universe is, when the Sun will die and where the atoms in our bodies were made?

The Liverpool Telescope is situated 2400 m above sea level on the Roque de los Muchachios, La Palma, Canary Islands.

At this lecture, students were given the chance to reveal their astronomical knowledge – or lack of it. The starting point was Galileo and the importance of his observations of our Moon and the satellites of Jupiter, which laid the foundations for real scientific progress 400 years ago.

The lecture then turned to modern astronomical telescopes and what they might be used to view, such as asteroids, exoplanets, white dwarfs, neutron stars and, of course, distant galaxies. Modern technology has extended the range of wavelengths that we can use for our observations and big mirrors and electronic image detectors resolve fainter and more distant objects. Telescopes are like time machines – the deeper into space we look, the further back in time we are seeing.

As you might expect, the lecture was lavishly illustrated with beautiful colour images and there were opportunities for the audience to participate in demonstrations that could be repeated at home, such as using a CD as a diffraction grate. The advent of robotic telescopes has enabled schoolchildren to carry out serious investigations, for instance how to spot an asteroid.

As Dr Newsam said: "Telescopes have let us see the universe in many new ways. The more we look, the more we see and the more we see the more exciting it gets."

David Cox

Rocket scientist wins woman physicist award

Four female early-career physicists, along with their colleagues and families, came to the Institute of Physics on 27 May to join members of the Women in Physics group to hear who would win 2009's Very Early Career Woman Physicist of the Year award.

The award, sponsored by Shell, aims to recognise women who are working in physics-related fields and highlight how their skills, ambition and desire to inspire others in physics-related pursuits are bearing fruit, early in their careers.

The shortlist: Natalie Garrett, University of Exeter; Victoria Hodges, EADS Astrium (overall winner); Manda Banerji, University College, London; Suzanna Sheehy, University of Oxford.

The four shortlisted candidates gave presentations about their work, which were as varied as they were enthralling. There was one about research towards building particle-physics accelerators that are intended to zap inoperable tumours; another on the study of the effect of light on butterflies' wings; one on understanding dark energy and star formation; and, finally, one from a rocket scientist involved in designing the altitude control for a spacecraft. It was extremely difficult for the judges to choose between them.

The winner, however, was Victoria Hodges from Astrium who explained during her presentation that she is currently working on GAIA, one of the European Space Agency's cornerstone projects. It is due to be launched in 2012 and all involved hope that it will be able to map the billion or so stars in our galaxy and the local group.

Hodges has also given her time to an outreach programme for schoolchildren visiting the Astrium site in Stevenage. Our congratulations go to her.

Ann Marks

Branch events coming soon

Unless stated otherwise, talks start at 6.30 p.m. with refreshments available from 6.00 p.m.

- UOL = University of Liverpool (www.liv.ac.uk/maps)
- SSRC = Surface Science Research Centre (building 210 on map)
- CLT = Chadwick Lecture Theatre (building 207 on map)

For parking arrangements at the University of Liverpool, see www.liv.ac.uk/about/visiting.

- DL = Daresbury Laboratory, near Warrington (www.scitech.ac.uk/About/Find/DL/Introduction.aspx)
- LMI = Liverpool Medical Institution, 114 Mount Pleasant, Liverpool (www.lmi.org.uk/location.html)

2009

25 September
UOL CLT, 12.15 p.m.
Filling the gap in the electromagnetic spectrum
Freshers lecture given by Prof. Peter Weightman, University of Liverpool.

There is a region of the electromagnetic spectrum, with wavelengths between the microwave and the infrared, where it is difficult to generate radiation. This is termed the terahertz region because the frequencies are of the order of 10^{12} Hz. This corresponds to wavelengths of the order of 300 μm. Typical power levels that can be achieved by laboratory sources in this region are around 100 μW.

However, a radical new design of electron accelerator called an energy recovery linear accelerator (ERL) can give rise to massive power output in this region. An accelerator of this type called ALICE is nearing completion at Daresbury Laboratory. They have constructed a terahertz beamline on this accelerator and equipped it with a tissue culture facility for the growth of live human cells. This is a unique facility and it is about to become operational. It will deliver peak power of 70 kW – nine orders of magnitude higher than that available from other laboratory sources.

This lecture will describe the principle behind the ALICE accelerator and the importance of the terahertz region of the electromagnetic spectrum to research in a variety of fields.

7 October
DL
Sustainable energy: without the hot air
Joint meeting with Manchester Branch. Speaker to be confirmed.

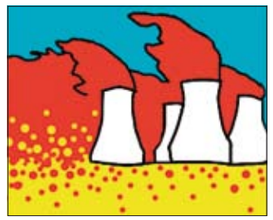
How easy is it to get out of our fossil fuel habit? Could Britain survive on its own renewables? How does our current energy consumption compare with our sustainable-energy options? This talk offers a straight-talking assessment of the numbers and demonstrates how to make energy plans that add up.

17 October
UOL CLT
Liverpool Physics Olympics
This is an annual day's event organised by the physics department at the University of Liverpool. Teams of four school students are invited to take part in tasks that require teamwork, problem solving and just a little physics. Although it is staged as a competition, it is designed to be fun.

For further information and examples of past challenges, visit www.liv.ac.uk/physics/olympics. To enter a team for the 2009 event, e-mail ajb@ns.ph.liv.ac.uk.

20 October
UOL SSRC
Structural studies of some copper proteins
Prof. S Samar Hasnain, School of Biological Sciences, University of Liverpool

Structure studies have transformed the way that we think of biology, allowing understanding of many biological processes at the molecular level. The tremendous success of structural biology during the last 20 years has been largely due to the availability of synchrotron X-ray facilities. Its importance is such that three Nobel prizes have been awarded during the last 11 years for structural biology work conducted at synchrotron centres, including the Synchrotron Radiation Source at Daresbury, which closed in 2008 after being the first dedicated facility of its kind.



Energy generation: the debate.

This talk will describe recent research on a number of key copper proteins that are of importance to environmental and human health issues, such as motor neuron disease. It will highlight how addressing fundamental questions in such proteins has led us to the first step in translational research.

12 November
UOL SSRC
Extreme weather events
Joint meeting with the Environmental Physics Group. Talk by Dr Ross Reynolds, Department of Meteorology, University of Reading.

This presentation will focus on the origin, nature and prediction of severe weather in the US and the UK, focusing on tornadic storms, hurricanes and explosive depressions. All these phenomena have been and are still studied intensively, offering a significant challenge to researchers and operational meteorologists alike.

8 December
UOL SSRC
Active galaxies and super-massive black holes
Prof. Ian Robson, Royal Observatory Edinburgh

Active galaxies are the most powerful, long-lived objects in the universe. They shine with the light of hundreds or thousands of "normal" galaxies and this light is concentrated from an extremely small volume of space, about the size of our solar system. This tremendous energy output is due to the presence of a super-massive black hole, of mass between a million and a thousand million times that of our Sun, lurking at the centre of the galaxy. The gravitational attraction of the black hole sucks surrounding material into it and in the process creates the light energy that we now recognise as an active galaxy.

This talk outlines our place in the universe, describes the discovery of active galaxies, gives a simplified overview of the black hole, galaxy interaction and the difficulties of observation, and explains how we now believe that activity in galaxies may be a natural part of evolution. It looks at our galaxy and the evidence for a super-massive black hole at its centre.

16 December
UOL CLT, 2.00 p.m.
From physical attraction to noisy banging: magnetic resonance imaging and safety
Sixth-form Christmas lecture, given by Dr Peter Cole, University of Liverpool radiation protection adviser.

This talk describes the basic principles of magnetic resonance imaging (MRI) as used for medical diagnosis, before going on to highlight the safety issues surrounding the technology, the clinical staff who use it and the patients who get imaged by it.

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Extreme weather: a hurricane in the Gulf of Mexico.

The missile effect, superconducting quenches and cardiac pacemakers are all included, plus gory anecdotes of squashed brains, severed optic nerves and penile implants.

Teachers who wish to bring groups to this lecture should contact David Cox (e-mail davidcox@physics.org) with numbers and full details.

2010

4 February
UOL CLT
John Porter memorial lecture – Universal appeal? Adventures in astronomy education
Dr Andrew Newsam, reader in astronomy education and director of the National Schools' Observatory, Astrophysics Research Institute, Liverpool John Moores University

Whether it is black holes, cosmology, life in the universe or simply the night sky, astronomy has a fascination for all ages that is unmatched by almost any other area of science. But why is this? Can that interest be used to stimulate a better appreciation of science as a whole? This talk will draw on experience of a range of education and outreach projects to explore these questions and highlight some of the exciting resources available to the modern educator. There will also be a healthy scattering of mind-boggling facts and beautiful images.

25 February
UOL SSRC
Accelerator-driven thorium reactors
Prof. Roger Barlow, Manchester University

It is clear that we can no longer depend on fossil fuels for our energy needs. It is doubtful whether renewable sources can fill the gap. Nuclear power is apparently the only way to avoid reverting to the middle ages. But conventional nuclear power has problems with safety, long-term waste storage and the dangers of proliferation. Even if technical solutions are found, the public is negative and sceptical.

Accelerator-driven thorium reactors provide an alternative to the conventional uranium/plutonium system. Thorium is converted into uranium with the help of accelerated spallation neutrons. This is manifestly safe, as the reactor is always subcritical and if the accelerator is switched off the reaction stops.

There is no long-term waste problem because the long-lived minor actinides are not produced – indeed this system can be used to consume waste from conventional nuclear power plants by transmutation. And using it for the manufacture of weapons would be very difficult, perhaps impossible.

The talk will discuss these points in detail and present the latest developments in the UK and worldwide.

11 March
UOL SSRC
Radiating health: an α, β and γ of radionuclide imaging
Dr Elizabeth Parvin, Open University

Unlike X-ray and MRI, the use of radioactive materials for diagnostic imaging is comparatively unknown. However, such images can provide useful information about the function (as opposed to the structure) of all the major organs of the body and the technique is important in many diagnoses.

This talk will start by looking at the basic physics used, the choice of radionuclides for both gamma and PET imaging and the operation of the detectors used. Examples of clinical images will show the wide range of uses of this technique and the way that 3D images can be created. The most recent developments in this area are the combined SPECT/CT and PET/CT systems, which allow simultaneous imaging of structure and function.

25 March
DL
A physicist in the city: stranger in a strange land
Joint meeting with Manchester branch. Talk by Dr Jessica James, managing director of CitiFX, Citibank.

In the last 20 years, it has become commonplace for physicists to leave their careers – at any stage from graduate to postdoc – to go into city trading. Some are famous for doing it; most are not. It turns out that the combination of maths and computing, modelling and data handling that becomes second nature to a physicist is a valuable skill set in financial markets.

Many of the mathematical methods used in the physical sciences are applicable to the financial markets, and the association goes back further than many people realise. Newton was master of the Mint. Einstein's equations for Brownian motion were independently discovered four years earlier to explain the behaviour of the stock market.

This talk will explore the many connections between city trading and physics, give some examples of financial analysis, and give a quick tour of life on the trading floor.

20 April
UOL SSRC
Surfaces: incubators of homochiral complex matter?
Prof. Rasmita Raval, University of Liverpool

Chirality, or handedness, holds a fascinating place in scientific history and has laid the foundation for significant scientific advances, such as the proposition of the tetrahedrally co-ordinated carbon and the emergence of stereochemistry and chirality in chemistry; progress in mathematical crystallography and parity violations in weak interactions of elementary particles.

Equally fascinating is the discovery that life on Earth has evolved to be homochiral: a single mirror form of amino acids and sugars has been rigorously selected. The question at the centre of this is: how can we break the mirror symmetry of a system where equal populations of right- and left-handed objects exist?

This talk will outline the mechanisms that underpin mirror-symmetry breaking during self-organisation of molecules at surfaces, leading to the expression of homochirality across a large length scale.

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Chocolate: a scientific product.

13 May
LMI
Chocolate: food of the gods
Joint meeting with the Liverpool Medical Institution. Talk by Dr Stephen T Beckett (retired, formerly Nestlé Product Technology Centre).

It is remarkable that chocolate, as we know it, was ever developed, not only because of its unpromising origins as a fatty drink, but also because of its relatively complicated structure.

This talk looks at the history of chocolate and reviews its method of manufacture. Science plays an important role in both the flow properties and the crystallisation. Both must be correct to obtain a product with the right weight control, shape, texture and shelf life.

The industry has changed dramatically in recent years, from a low-throughput craft base to a highly mechanised one. This has required more in-depth scientific knowledge to be obtained of both processes and products. Several problems remain to be explored, however.

The lecture will be followed by a supper at the LMI. If you wish to attend, contact Stuart Ross (e-mail stuart.ross@physics.org).

June – date to be announced
UOL Chadwick Laboratory
KS3 and KS4 conference for all teachers of physics
At this event, there will be workshops, free software, discussions, networking, fun demonstrations to fit into your lessons, an exhibition of materials and equipment to try. The Institute's network co-ordinators will be there to share innovative teaching ideas.

Contact Lucas Hayhurst (e-mail lht@blueyonder.co.uk) to register.

SciCast enters third year

SciCast, the Institute's short-film competition for schools, is about to enter its third year. Disappointingly, it has not really taken off in the north-west, despite promotional events. As in 2008, many branches found that they had to combine to choose a regional winning team. This was not the case in south-east England where there were a large number of entries, amounting to some 60% of the total. This year's winner for our group of four branches was a team from Merchant Taylors' School in Crosby. It was later chosen to be one of the final six teams to attend the grand presentation event at the Royal Institution in London on 30 March.

The SciCast project was conceived as a competition, which was intended to make it easier for groups of youngsters to enter without disrupting the life of their school. Science teachers could encourage their pupils to take part without having to cope with the logistics of taking groups out of school and obtaining the necessary staff cover. From a school point of view, involvement in SciCast puts students in charge of their own learning – you cannot explain a concept to others if you have not really mastered it yourself – and it promotes valuable cross-curricular links.

I think that the approach has a lot to offer but, to find out why we have not been besieged with entries, I decided to get a student perspective. I asked the Merseyside team that produced "How our TV works" in 2008 to look back on its experience and to give us a few pointers that might encourage others to enter.

Dominic McDonald replied: "When first approaching the competition, I thought that by far the hardest part would be coming up with the subject of the video, and that filming it would be fairly straightforward. As it turned out, we decided to make our video about how a television works within half an hour of being told about the competition (after quickly deciding that making a miniature tornado would be impractical) and then took a few months working most lunchtimes to film and edit it.

The 2009 north-west winners – (L–R) Alastair Houston, William Devine, Richard Kirkwood and Vamsee Bheemireddy.

The team from Merchant Taylors School, Crosby, at the SciCast final at the Royal Institution in London.

"Our video won the Merseyside round of the competition and we were invited to make another video (on diffraction) at Liverpool University, with a professional director. This was at a teachers' conference, and we had a lot of fun roping unsuspecting teachers in to help with the required measurements. The aim was to calculate the wavelength of laser light, which we did quite accurately.

"If I were to do another video, I would definitely allow more time for editing because it was a rush to complete it in time for the closing date and there were a few tense moments at the computer putting together the final edit and burning it onto a CD. We had fairly easy-to-use editing software, but it still took quite a while to get used to it – much longer than I had anticipated – and we probably would have had major problems had we had to work with anything more complicated.

"I still find it amazing that it took so long to produce such a short film but I suppose a lot of that time was spent setting up cameras and other equipment, and perhaps we were not as efficient with the time available as we could have been. Despite this, I feel that it was a worthwhile experience, not just because of the physics I learned but also because it improved my presentational skills."

So producing a two-minute film is perhaps not quite so easy as one might suppose but it is certainly a worthwhile experience for those who take part. If you are a branch member who has contact with a local school, especially if you have some experience of film, then you might be able to help by offering your services or just providing some encouragement.

For the coming 2010 competition it has been decided that all of the entries will be judged nationally. To give groups more time the closing date has been extended until 16 April 2010 but entries can of course be submitted at any time earlier. For more details and entry forms visit the Planet SciCast website at www.planet-scicast.com.

David Cox, Merseyside SciCast co-ordinator

Could time travel become reality?

Dr Robert Lambourne.

On 5 March, Dr Robert Lambourne gave his lecture "Travelling through time" to the branch. Anyone expecting a recipe for time travel (or even a fully working TARDIS) will have been disappointed. However, nobody else was.

This was not a talk about answers but that other, perhaps more important, aspect of science: asking the right questions. Of course, no question is useful without background knowledge.

So, while carefully leading the audience through some of the relevant intricacies of relativity (both special and general) and their potential limitations, Dr Lambourne also gave a guided tour of some of the problems that beset the potential time traveller – whether it is the "grandfather paradox" or the fundamental problem of defining "time" in the first place.

But what of the solutions? Does the "many world hypothesis" provide a loophole? Or are wormholes the answer?

In this entertaining and thought-provoking evening, Dr Lambourne ably skirted the borders of science and science fiction, and he left his audience, perhaps not enlightened, but certainly invigorated.

Andy Newsam

Physics Communicators Group meeting and AGM
76 Portland Place, London
Wednesday 9 September 2009
The keynote speech will be delivered by Prof. Bill Wakeham, who will be linking his benchmark review on the future of physics to the need for effective communication of physics. The following AGM will have a standard agenda, which will be published nearer the date of the meeting.

Phunny physics

After years of hearing nothing about the claims of fusion occurring at close to room temperature, the subject appears to be coming alive again, which prompts the following little limerick:

Cold fusion is causing confusion,
With 'pro-fusionists' heard in profusion;
But I've reached the conclusion
It's all a delusion;
Solved by analysis of palladium diffusion.

Neil Marks

Neutrino physics promises great things to come

Prof. Christos Touramanis.

The T2K project in Japan – a slide from Prof. Touramanis' talk.

Back in April, Prof. Christos Touramanis, from the University of Liverpool's Department of Physics, gave an extensive overview of all things neutrino.

From the "desperate hypothesis" of the 1930s of the requirement for such a particle to save energy conservation, Prof. Touramanis took us on a journey through the neutrino experiments of the latter half of the last century and the early part of this century. He covered the solar neutrino problem in the 1970s and 1980s (not enough to be consistent with the nuclear reactions assumed to be operating within the core of the Sun); the birth of neutrino astronomy with the supernova of 1987; the changing identity of neutrinos that oscillate back and forth between the three types; and the discovery of geoneutrinos originating within the Earth.

One current experiment was described in detail: the T2K project will investigate neutrino oscillations by generating a beam comprising neutrinos of one type in Tokai, Japan, and seeing how many of them change their identity into one of the other types on reaching a detector in Kamioka, 300 km away. One of the detectors to be used in this experiment was designed by a team at Daresbury Laboratory and has recently undergone its first stage of testing at CERN in Switzerland.

A better understanding of neutrinos will help to explain why our universe is dominated by matter (an equal mix of matter and anti-matter would have left us with nothing if it all annihilated) and may hold the key to the inflationary stage of development of the universe. Together with the applications in neutrino astronomy and the fascinating prospect of geoneutrino studies, Prof. Touramanis made it clear that there are exciting times ahead in neutrino physics.

Steve Barrett

The deadline for contributions to the March 2010 issue of this newsletter is Friday 22 January

E-mail material to davidcox@physics.org

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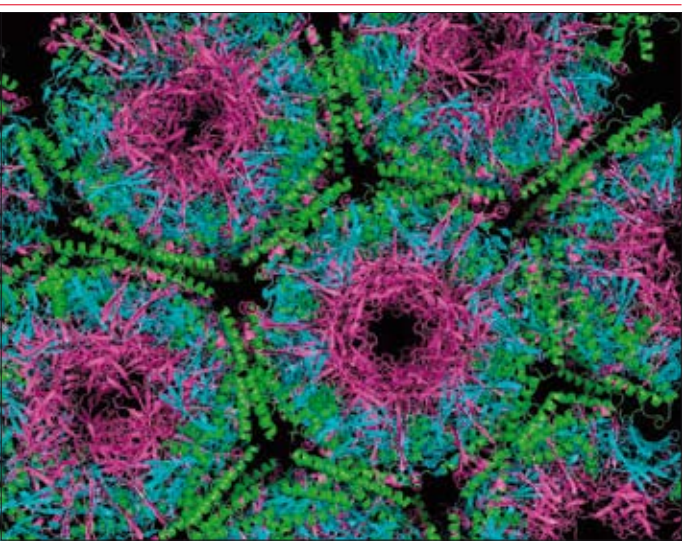
Liverpool Physics Teachers Conference

This annual conference will be held at Chadwick Laboratory, University of Liverpool, on Thursday 1 July 2010.

At this informative, free event for physics teachers, speakers will cover a range of topics interspersed with discussions and hands-on activities, and opportunities to question a panel of physicists. Feedback from previous years indicates that the event provides a good opportunity to update, network and try new experiments and software. For more information, visit www.liv.ac.uk/~iop/PTC.



What is it? To find out, come to the branch talk on 20 October.