IOP | Institute of Physics
Merseyside Branch

PHYSICS ON MERSEYSIDE

The newsletter of the Merseyside Branch of the Institute of Physics

September 2010

Message from the new branch chair

I am writing here to say a few words of welcome to this, the first newsletter since the branch AGM in April. My name is Andy Newsam and I am the new chair of the Merseyside Branch. Before I tell you anything more about myself though I want to thank Mike Poole, who has chaired the committee for the last four years. Mike's wide experience, his enthusiasm and his commitment to the work of the branch have made his tenure a highly successful one, and I will be happy if my own stint goes half as smoothly. I think that I speak for everyone when I thank Mike for helping to make the branch what it is today.

The AGM also brought a few more changes to the committee, including a well-earned rest for some and a few new faces. I would particularly like to thank Steve Bennett, who has stood down after an extended period in the thankless task of branch treasurer, and Mike Houlden whose contribution to the Institute over a number of years has been exemplary – I'm sure that we all wish him a happy retirement.

For those who do not know me, I am an astronomer in the Astrophysics Research Institute of Liverpool John Moores University and I have been on the branch committee for a number of years. As well as research, I have a strong interest in public engagement with science, particularly in schools – you may have come across me as the director of the National Schools' Observatory project. This also led me to become the Institute schools' lecturer for 2009, which was an extraordinary and rewarding experience, mainly through the chance to meet and talk to so many pupils all over the country, but also because of the insight it gave me into the excellent and varied educational work done by the Institute – something that I hope will feed into the future work of the branch.

Speaking of future ideas for the branch, it is traditional for anyone becoming the "leader" of an organisation to seek to put his or her mark on things and to make some changes that show their calibre and progressive ideas. I can assure you that I have no such plans in mind. It has been a privilege over the last few years to be a part of the work of the branch and, while you may see my prejudices for education and public engagement having a slight influence on the programme, I see no need for wholesale change to something that works extremely well (as the 2010–2011 programme in this newsletter shows).

However, that does not mean that I am opposed to change or new ideas (and nor are any of my colleagues on the committee). I am very much aware that the branch committee exists for your benefit, not it's own, and it is essential that we reflect your views and provide a programme that meets your interests and professional needs. This is particularly important in the current straightened circumstances where we may have to make some uncomfortable decisions about which activities to give priority to. Can I therefore end this short introduction by asking for your help. If you have any thoughts on what the branch can do to support you, or have suggestions for events or activities, let us know. Just contact me or any of the other committee members, or post a message in the Merseyside Branch Group on *MyIoP* – we would be delighted to hear from you. Enjoy the year!

Andy Newsam, chair

David Cox

Committee members left to right. Back row: Mike Poole, Stuart Ross, Steve Barrett, Andy Newsam, Adam Patchett, Steve Bennett and Neil Marks. Front row: Marion Leibl, Peter Rowlands , Nicholas Clitherow, Louise Butcher, Ann Marks and David Cox.

Astrophysics Research Institute, Liverpool John Moores University

On top of the world: physics students from the University of Liverpool and Liverpool John Moores University enjoy a recent field trip.

Merseyside students get the best of both worlds

Perhaps the more cynical among us may assume that the two biggest universities in Liverpool, the University of Liverpool (UOL) and Liverpool John Moores University (LJMU), are bitter rivals that fight for the fee income of potential students.

As far as physics is concerned, however, this is decidedly not the case. Since 1998 the UOL and LJMU have been collaborating to provide joint undergraduate degree programmes in astrophysics. The marriage of the two universities brings together the complementary areas of expertise of many academic staff: the UOL has a Department of Physics with staff having extensive research experience in particle physics, nuclear physics and nanoscale physics; LJMU has the Astrophysics Research Institute with astronomers who study areas ranging from stellar evolution and gamma-ray bursts to galaxy formation and cosmology. In the late 1990s it was recognised that the strengths of the two universities complemented each other beautifully, and that collaboration on undergraduate degree programmes that could be delivered jointly was a win–win decision.

A three-year BSc and a four-year MPhys programme were set up and the first intake of students was admitted in September 1998. Since then there have been hundreds of students taking the astrophysics degrees, all of them benefiting from being taught by expert physicists and expert astronomers, and having access to all of the facilities of both universities. Not only can students use the libraries and computing resources of the UOL and LJMU, they can graduate from both universities as well!

Every few years, the arrangements between the two universities are reviewed to ensure that students receive the highest quality education and never "fall between the cracks" of two large organisations. One such review has recently finished and has concluded that the student experience is enriched by the involvement of both universities and that the joint organisation is essentially seamless. Having just graduated the 10th cohort of students, it is no surprise to find that both universities are recommending that the collaboration continue and we all look forward to another decade of astrophysics students coming through our doors.

As far as we know, this level of integration and cooperation in delivering an undergraduate physics degree is unique among universities in the UK, and it is an example of how two "rival" organisations can collaborate to provide a world-class education for our students.

Dr Steve Barrett

Visit the branch website at merseyside.iop.org

Liverpool researcher scoops top prize for early-career physicists

Laura Harkness, from the Nuclear Physics Group at the University of Liverpool, is one of the two outstanding young physicists who were jointly awarded the 2010 IOP/Shell Very Early Career Woman Physicist of the Year award.

The £1000 prize sponsored by Shell and awarded by the IOP Women in Physics Group (WIPG) seeks to recognise the work done by female physicists who are embarking on a career in physics and to promote the career opportunities that are open to people with physics qualifications. The winners are chosen for their work and outreach activities by judges from the WIPG advisory panel.

Laura won the award for her research work on the ProSPECTus project and for her contribution to many outreach activities. The ProSPECTus project is aimed at improving the sensitivity of the GAMMA camera systems used in medical imaging by a factor of up to 100. Conventional single photon emission computed tomography (SPECT) systems in hospitals use technology that is up to 40 years old and photomultipliers that do not work inside the magnetic field used for MRI imaging. ProSPECTus will use semiconductor detection technology that has been developed in nuclear physics experiments and it will make combined SPECT/MRI systems possible.

Laura's outreach work includes visits to schools, where she promotes physics and her research as a Researchers in Residence champion with responsibility to promote the scheme to teachers. She ran sessions involving the use of radiation detectors at a teachers' conference run by the York National Science Learning Centre (co-sponsored by the Institute of Physics and the STFC). During the BA festival in 2008 she met schoolchildren to describe life as a scientist and she was invited to the House of Commons as part of SET for Britain 2009 to present her work on medical imaging to MPs and other visitors. Throughout, her lively personality and her enthusiasm for physics are key ingredients in her outstanding success.

Laura welcomes all invitations to visit schools in the Merseyside area.

Prof. Paul Nolan and **Ann Marks**

Laura Harkness celebrates at the IOP/Shell presentation event.

Particle physicists celebrate the start-up of the Large Hadron Collider

So it has happened. After more than 20 years of planning and construction, and a short-lived start-up in 2008, CERN's Large Hadron Collider (LHC) powered up at the end of March this year and it has been running ever since. It is operating at half the design energy, which is still more than three times as energetic as any previous particle accelerator. Each experiment is working well and taking data as fast as possible. CERN is buzzing – every particle physicist in the world who works on the LHC wants to be here at the moment, desperate to study the data and see what light the LHC can shed on the smallest constituents of the universe.

At the moment CERN is focused on producing the first LHC results for the major particle-physics conferences this summer. This will be the first time that we can really start to survey the subatomic universe and see if it looks like we expect. The LHC has been built to investigate our biggest mysteries – antimatter, dark matter, where the missing Higgs particle is, and although we won't find the answers to those for a while, our results will tell us if our investigations are on the right track.

Working at CERN now is so different. There is suddenly purpose; experiments are racing each other to make the best measurements, and particle physicists are trying their best to manage with minimal sleep to cram more working hours into the day. Whatever time it is, whatever day of the week you are here, there are always people working – on shift at the experiment, combing through the data in their offices, all wanting to find evidence of the fundamental particles and forces at work. There is always a queue at the canteen for coffee. Wherever you are, there is always a conversation about data within earshot.

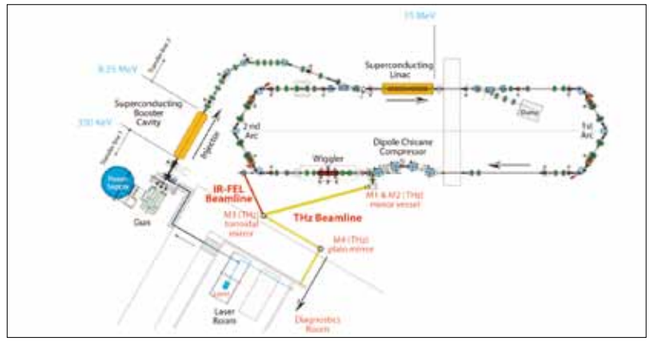
Students finally have real data to look at after years of making do with simulated versions. It's quite a shock. Real data contains quirks that you need to understand and there are no easy answers. There are computer programs to battle to access the data, parts of the experiment that might not be behaving in the way that you think they should and even the data might not be behaving in the way that you think it should. That's the exciting bit, when you are learning more about what the universe is really like. That's why we're all working such crazy hours at the moment. It's such a privilege to be able to take part in these experiments and to explore the universe at these tiny scales. None of us would swap it for the world.

Dr Tara Shears

ALICE fills the terahertz gap

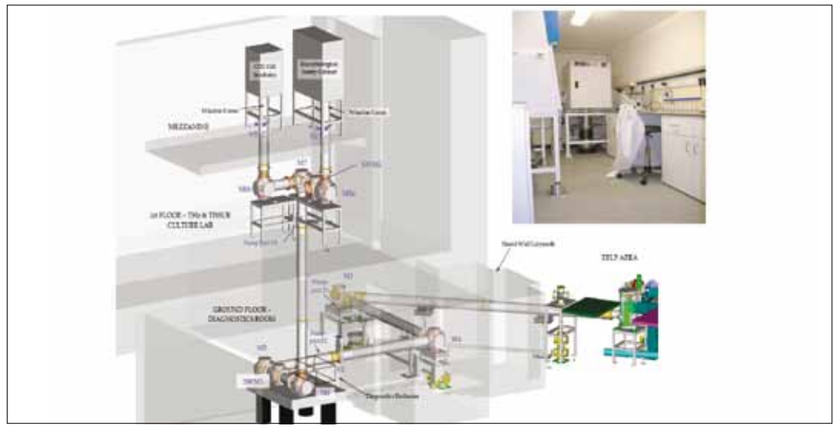
There is a region of the electromagnetic spectrum between microwaves and the infrared where it is very difficult to make intense sources of radiation. This has been called the "terahertz gap" because it is centred on frequencies of 10^{12} hertz. This terahertz (THz) gap has recently been filled by the commissioning of the ALICE accelerator at the STFC Daresbury laboratory. ALICE is an energy recovery linear accelerator (ERL). It is the first in Europe and the fourth in the world. ERLs offer unprecedented power levels arising from coherent emission of radiation when the wavelength of emitted light becomes longer than the length of the circulating electron bunch in the accelerator.[1] On ALICE the coherent emission covers the range 0.1–1 THz making it the most intense source of broad-band THz radiation in Europe.

The physics department of the University of Liverpool has recently constructed, with support from the North West Science Fund, a THz beamline on ALICE and equipped it with a tissue-culture facility for research on human tissue. This unique combination of high-power THz radiation and a tissue-culture laboratory has considerable potential for research in biology and medicine. An important feature of the THz output of ALICE is that it is concentrated in a very short burst of about 0.5 pico seconds long that repeats 20 times per second. We are not yet sure of the peak power but it could be as high as 70 kW. At first sight such a high-power level might suggest that it would not be very useful for the study of biological systems because they would be heated to destruction. However, when the time structure of the source is taken into account the average power is really rather low and there should be no significant heating effect. For example, it would take more than a year for the THz beamline to boil a kettle. In fact this combination of a high peak power and a low average power makes it possible to separate the effects of THz radiation from thermal effects in the study of biological systems. This is important because, while we have a good understanding of the effects of heat on biological systems, we have little knowledge of the effects of intense THz radiation. Consequently one of the research programmes that is now underway is to find out the effects of THz radiation on human tissue. This will make it possible to determine the safe levels of human exposure to THz radiation and in particular of repeated low-level exposure since THz systems are now being used for security screening.



Top: layout of the ALICE accelerator at the Daresbury laboratory system. The tissue culture facility is located immediately above the diagnostic room.

Bottom: the layout of the THz beamline. The tissue culture facility is shown on the top right.



A more fundamental research programme is also underway funded by the EPSRC on "Experimental studies of the mechanism of biological organisation". These experiments are designed to test a theory due to Herbert Fröhlich, a Liverpool physicist, who died in 1991. Fröhlich's hypothesis is that the mechanism by which living things organise the chemical reactions on which they depend involves vibrations at THz frequencies. This hypothesis is important because, if it is true, it has profound implications for the understanding of life and the progress and treatment of disease. However, it is also controversial since, whereas Fröhlich produced very good theoretical arguments[2] that such modes of vibration should be very long-lived and capable of promoting the self-organisation of living things, there are equally good theoretical arguments[3] that such modes should decay before they have time to exert any effect in the crowded and wet environment of a living cell. What is needed are experiments. In particular, since Fröhlich was unable to predict exactly which THz frequencies are important, one needs a broadband THz source with a high peak power and low average power, and equipped with a tissue-culture facility. We now have one.

Prof. Peter Weightman, University of Liverpool

References

[1] G L Carr, M C Martin, W R McKinney, K Jordan, G R Neil and G P Williams 2002 *Nature* **420** 153

[2] G J Hyland and P Rowlands (eds) 2006 *Herbert Fröhlich* (Liverpool)

[3] R K Adair 2002 *Biophysical Journal* **82** 1147

How accelerators can save Earth

On 25 February Prof. Roger Barlow (University of Manchester) gave a talk entitled "Accelerator-driven sub-critical reactors' (with the subtitle "How accelerators can save the planet") to the branch. Prof. Barlow set out to explain how accelerators could overcome some of the existing objection to nuclear power and also to introduce the concept of using thorium as an alternative fuel to uranium.

Commencing with the clear message that the use of fossil fuels had but a limited future, Prof. Barlow emphasised the point that renewable-energy sources could never supply sufficient capacity to fully meet the nation's demand. Even major (country-scale) developments will not be enough – all possible alternatives (wind, tidal and solar power; improved insulation or even a retreat to the middle ages) are not able to supply the deficit.

The solution lies in a mix of power sources, which, of necessity, will need to include a significant supply from nuclear power. This raises a number of major issues – some real, others more a matter of public perception. They include reactor safety; waste disposal; and the dangers of proliferation by rogue states and terrorist organisations, and they all need to be addressed.

Conventional reactors run with the parameter k (the ratio between neutrons generated and neutrons lost per fission) equal or slightly greater than one. It is obvious that if some event occurs that changes that situation and increases the value of k, the reactor becomes unstable and a serious nuclear incident would result. A reactor with k less than one is inherently stable but would not generate power. This is where the accelerator comes in because fission in a sub-critical assembly could be maintained by continually "seeding" the core with neutrons and these would be generated by bombarding a spallation target with a flux of protons from a high-current proton accelerator – an accelerator-driven sub-critical reactor (ADSR). Such a system would be fail-safe because if the accelerator ceased to operate, either by being switched off by the operators or failing as a result of a fault, the neutron flux in the reactor would just collapse.

Prof. Barlow discussed the requirements for such an accelerator. It is obvious that the power requirements for this machine would need to be substantially less than the electrical output of the nuclear installation but an energy balance could easily be achieved, with a 5 mA, 1 GeV, 5 MW circular machine seeding a 1 GW nuclear source. Possible accelerator types included a high-energy linac ("very expensive"), a modern sector-focusing cyclotron ("on the edge to meet the required energy"), the synchrotron ("probably not able to supply the beam current") and an FFAG – a novel accelerator considered in the past but now being re-investigated ("cyclotron currents at synchrotron energies").

The possibility of using thorium as a fuel was then introduced. It appears that there is only sufficient uranium worldwide to meet power-source needs for a further century. However, thorium is far more abundant. It occurs only as the 232 isotope, which is not fissile but is fertile (i.e. it is capable of being converted into fissile material). The conversion is by neutron bombardment. After neutron capture and two beta decays, the thorium is transmuted to uranium 233, which is fissile. An accelerator-driven system provides the initial neutron flux to start the conversion process and then maintains the fission of the 233U in the sub-critical assembly.

This approach to nuclear-power generation points to solutions to many of the currently perceived problems associated with nuclear power:

- as previously mentioned, thorium is abundant and it is available from many locations around the world;
- the waste problem is much reduced, for there are no long lifetime minor actinides produced in the fission process;
- the materials are proliferation resistant – it is not possible to make a bomb from thorium and extracting the fissile material from partly fertilised thorium (not necessary for power generation) is both technically difficult and presents major hazards.

Summarising, ADSRs provide a form of nuclear power that avoids the real and perceived problems of criticality accidents. It also makes possible the use of thorium as fuel. It is worth a closer look.

Prof. Neil Marks

Sixth-formers experience a spectrum of physics

On 22 June in the Department of Physics at the University of Liverpool, lower-sixth students from the local area gathered for a day of lectures, problem solving and practical challenges. Entitled "A spectrum of physics", organised by the Merseyside Branch and keenly hosted by the physics department, the event was inspired by a perceived need to develop young physicists' experience of the subject outside the classroom, particularly at a time when their choice of university course begins to crystallise. In addition, it was felt that the experience should be very much hands-on and provide an opportunity for students from different schools to share their experience and enthusiasm, as well as to introduce them to physics undergraduates who might provide them with a view from the inside.

David Cox

Students focus in on their physics skills during the one-day event.

After an opening plenary lecture, the students rotated around a number of related activities that included determining the trajectory of a charged particle in an electric field; optical, X-ray and gamma ray spectroscopy; visits to research laboratories; and a concluding lecture about the Large Hadron Collider.

Responses from students in an evaluation of the event showed that the day had been a very enjoyable one that had provided a genuine extension to their knowledge of physics. Though a majority of students were already highly likely to study physics at university and this choice was confirmed, there was a significant minority whose tentative interest in studying for a physics degree developed into a highly likely outcome. On that basis alone one can consider the day a success, and with student comments such as "great day", "really enjoyed it" and "a wide range of activities well pitched", an event that deserves repeating – currently scheduled for July 2011.

Dr Adam Patchett

Merseyside Branch programme of events 2010–2011

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 UOL, see www.liv.ac.uk/maps/visiting.htm.

- 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)

24 September
CLT UOL, 12.15 p.m.
Freshers Lecture – The wonderful world of gamma radiation
Prof. Paul Nolan, University of Liverpool

Gamma rays are emitted when quantum states in nuclei decay. The pattern of gamma radiation detected outside a nucleus tells us about its properties. For example, spherical nuclei and deformed nuclei emit completely different patterns of gamma radiation. As the nucleus is a quantum system the energy of the gamma rays are unique to a particular nuclear decay. This means that a decaying nucleus can be identified and the quantity of the radioisotope measured through gamma-ray detection. A number of examples of how gamma radiation can be seen around us will be covered including: medical imaging, radioactive waste, natural radioactivity and aspects of homeland security.

16 October
Chadwick Laboratory UOL
Liverpool Physics Olympics

The Liverpool Physics Olympics is an annual event organised by the Department of Physics at the University of Liverpool. For further information and examples of past challenges, visit www.liv.ac.uk/physics/olympics.

14 October
SSRC UOL, 6.30 p.m.
Relaxing in the Sun: solar-coronal heating and solar flares
Prof. Philippa Browning, Jodrell Bank Centre for Astrophysics, University of Manchester

A long-standing puzzle in astrophysics is to explain why the temperature of the solar corona is over a million degrees (compared with a surface temperature of about 6000 degrees). It is now well established that the mechanism for coronal heating must involve the magnetic field but the details remain controversial. This talk will outline the basic properties of the solar corona and the coronal-heating problem, including advances from recent space telescopes.

A strong candidate for dissipating magnetic energy is a process known as magnetic reconnection, which will be explained, as well as the close relationship between solar flares and coronal heating. Recent theoretical results concerning energy dissipation by magnetic reconnection as coronal-loop magnetic fields relax to a new minimum-energy state will be presented.

3 November
CLT UOL, 7.30 p.m.
On the shoulders of eastern giants: the forgotten contribution of the medieval physicists
Prof. Jim Al-Khalili, University of Surrey

We learn at school that Isaac Newton is the father of modern optics, that Copernicus heralded the birth of astronomy, and that it is Snell's law of refraction. But what is the debt that these men owe to the physicists and astronomers of the medieval Islamic empire? Men such as Ibn al-Haytham, the greatest physicist in the 2000-year span between Archimedes and Newton, and whose *Book of Optics* was just as influential as Newton's seven centuries later; or Avicenna and Biruni the Persian polymaths who argued over such topics as why ice floats and whether parallel universes exist; or Ibn Sahl who came up with the correct law of refraction many centuries before Snell; or the astronomers Al-Tusi and Ibn al-Shatir, without whom Copernicus would not have been able to formulate his heliocentric model of the solar system. In this lecture Jim Al-Khalili will recount these characters and more from his new book on the subject.

16 November
SSRC UOL, 6.30 p.m.
How to find a dead body: an insight into forensic geophysics
Dr Jamie Pringle, School of Physical Sciences and Geography, Keele University

This lecture will cover important applications of forensic geophysics. Successful detection of clandestine graves of murder victims is relatively poor in the UK for a variety of factors. This can include large survey areas, poor intelligence and a lack of knowledge of search teams on optimal technologies to utilise.

The talk will present current research efforts to better understand physical properties of both the search area and the potential target(s) to aid search investigators. The main operating equipment types will be discussed, with some detail about how they work. Key findings from geophysical research on both simulated clandestine burials and case-studies will be shown.

2 December
SSRC UOL, 6.30 p.m.
The Radium Committee of the Royal Society and the possible usage of its radium at Liverpool by Chadwick from 1935 to 1949
Dr Neil Todd, Faculty of Life Science, University of Manchester

In this talk Dr Todd will give an outline of the history of the Radium Committee of the Royal Society, and give an account of the use to which its radium was put over the first half of the 20th century, with some focus of local interest at Liverpool. Founded in 1903, the status of the committee was enhanced in 1904 when a donation of £1000 was made to establish a radium research fund. Two years later the fund was used to purchase 500 kg of pitchblende residues from the Austrian government. The French chemist Armet de Lisle was contracted to carry out the first stage of extraction, resulting in the delivery of 412 g of barium–radium chloride to the society in late 1906. The process of purification by fractional crystallisation was carried out at the Government Laboratory during 1907 by the government analyst T E Thorpe, with an estimated yield of 70 mg of radium chloride. The radium was then lent out over the next half century successively to James Dewar, J J Thomson, the 4th Lord Rayleigh, Frederick Lindemann, James Chadwick, G P Thomson and Samuel Devons, in whose hands it was last recorded in 1953. The fate of the society's radium remains an enigma.

8 December
CLT UOL
Sixth-form Christmas lecture*
2.00 p.m.
Public lecture** 6.00 p.m.
The unknowns of particle physics
Prof. Mark Lancaster, Department of Physics and Astronomy, University College London

What happened in the first nanosecond after the Big Bang has shaped the evolution of the universe and made life possible. Particle-physics experiments, such as CERN's Large Hadron Collider, re-create the conditions that existed just after the Big Bang and they are attempting to answer fundamental questions about the nature of our universe. Are there more than three spatial dimensions? Why did all of the antimatter disappear at the start of the universe? What is mass? We are now at a crossroads in our understanding.

Prof. Lancaster will discuss what we don't know and how thousands of particle physicists worldwide are going about trying to find the answers.

*Teachers wishing to bring groups to this lecture should contact David Cox (e-mail dcox-iop@virginmedia.com) giving attendee numbers and full contact details.

**No bookings are required for the evening lecture and all are welcome.

8 February 2011
LMI, 7.00 p.m. (coffee available from 6.30 p.m.)
Advances in MRI
Conor Mallucci, consultant neurosurgeon at Alder Hey Children's Hospital
Joint meeting with Liverpool Medical Institution

This will be a lecture on brain surgery in children using the latest imaging equipment.

1 March 2011
SSRC UOL, 6.30 p.m.
Dark matter
Dr Phil James, Astrophysics Research Institute, Liverpool John Moores University

Dark matter is central to our current view of the universe. It is generally assumed to be the dominant contributor to the mass of the universe (if not the mass–energy), it controls the large-scale kinematics of galaxies and it plays a key role in the formation of all objects from dwarf galaxies to superclusters of galaxies. Dark matter cosmologies have achieved widespread (but not universal) acceptance but all is not well with dark matter: some properties of galaxies refuse to behave as expected, and there is still no clear laboratory-scale detection of dark-matter particles.


ESA
Dark matter: 1 March 2011.

Dr James will discuss the current situation of dark matter from an observational astronomer's point of view, with particular reference to the properties of nearby galaxies and he will look to the future of dark-matter research.

15 March 2011
DL, 6.30 p.m.
R&D challenges of next-generation nuclear systems
Dr John Roberts, Dalton Nuclear Institute, the University of Manchester
Joint meeting with the Manchester Branch

Two nuclear reactor designs are currently undergoing a Generic Design Assessment by the Nuclear Directorate of the HSE and the Environment Agency. These reactors are currently being constructed in China, Finland and France but research and development is still required to support the deployment and operational performance of UK new nuclear-build systems. The Centre for Nuclear Energy Technology (C-NET) at the University of Manchester will have a research focus on reactor systems, nuclear engineering and materials performance. The Nuclear Advanced Manufacturing Research Centre (Nuclear AMRC) is a partnership of the universities of Manchester and Sheffield and it will focus on research to support the nuclear-manufacturing supply chain.

This presentation will provide an overview of the current situation in the UK regarding new nuclear build and discuss the R&D work of these two new centres.

31 March 2011
CLT UOL, 6.30 p.m.
John Porter Memorial Lecture – Star formation: a turbulent tale
Dr Rene Oudmaijer, School of Physics and Astronomy, University of Leeds

During the last century astronomers have arrived at a well-versed theory of the formation of stars. In this talk Dr Oudmaijer will summarise the main ideas behind this theory and discuss the most recent developments in the field. In parallel, the lecturer will show that star formation is not a gentle and slow process as one might expect. On the contrary, the birth of stars is often associated with violent and energetic phenomena.

Dr Oudmaijer will present examples of the turbulent and shocking star-forming process, and discuss the challenges that they pose for our current understanding.

11 May 2011
SSRC UOL, 6.30 p.m.
How Britain became an island
Dr Jenny Collier, Department of Earth Science and Engineering, Imperial College

Megaflood events involving sudden discharges of exceptionally large volumes of water are rare but they can significantly affect landscape evolution, continental-scale drainage patterns and climate change. Analysis of English Channel high-resolution sonar data shows a large valley containing landforms indicative of large-scale subaerial erosion by high-magnitude water discharges, supporting the megaflood model in which breaching of a rock dam at the Dover Strait instigated catastrophic drainage of a large pro-glacial lake in the southern North Sea basin. Megaflooding explains the permanent isolation of Britain from mainland Europe during interglacial periods and consequently patterns of early human colonisation of Britain, together with the large-scale reorganisation of palaeodrainage in north-west Europe.

19 May 2011
DL, 6.30 p.m.
Astronaut training: the Columbus laboratory
Dr Gail Iles, astronaut instructor, European Astronaut Centre
Joint meeting with the Manchester Branch


ESA
Astronaut training: 19 May 2011.

So you want to be an astronaut? Dr Iles will train delegates in some of the basics of day-to-day operations aboard the International Space Station. Highlights will include the performance of a scientific experiment aboard the Columbus Laboratory (the European Segment of the ISS) and attendees will watch the docking of the Automated Transfer Vehicle, Europe's logistics-supply spacecraft. Delegates will learn about the five sub-systems necessary for maintenance of human life in space: power, computing, thermal control, life support and communications.

The talk will explore the constraints involved in operating a scientific payload and it will introduce some of the emergencies encountered by astronauts through a role-play scenario.

30 June 2011
Chadwick Laboratory, UOL
Annual Liverpool Physics Teachers Conference – Free INSET for all science teachers

For the first time the Annual Liverpool Physics Teachers Conference will combine with the Physics Can be Easy! Conference as a major joint event for all teachers of physics, both local and national. There will be sessions to inspire the teaching of physics at KS3, KS4 and A-level. Dame Prof. Jocelyn Bell Burnell will give a keynote talk and workshops will be run by the IOP Teacher Network coordinators. Watch out for more details nearer the time.

Contact Steve Barrett (e-mail s.d.barrett@liverpool.ac.uk) or Lucas Hayhurst (e-mail lht@sfx.liverpool.sch.uk) for more information or suggestions.

Annual event inspires local teachers of physics

"It would be easy to go to four separate INSET days and only get the same amount of information," declared one delegate at the end of the 2010 Liverpool Physics Teachers Conference. Sixty-five teachers had attended and once again we had welcomed many of the IOP PEP students. The event has run annually for nearly 20 years and this year's innovation was to increase the number of workshops attended by the delegates from two to three. This proved popular and there was a lively buzz to the day.

The day started with a talk by Prof. Tim Greenshaw, outlining plans for a next generation ground-based gamma-ray observatory, which will serve a wide astrophysics community. It will link arrays in the southern hemisphere with one in the northern hemisphere to provide new insight into the non-thermal high-energy universe.

Gary Williams, the national co-ordinator of the teacher co-ordinators ran a workshop where teachers built dragsters and launching devices, then raced them down the long corridor of the Chadwick Building. Teachers went home with the kits that they had built. Helen Pollard's workshop, "Variety 3", was also excellent providing numerous impressive activities to enliven lessons. These are just two examples of the five valuable workshops.

The closing lecture, by Prof. Mike Poole, just retired as director of the Accelerator Science and Technology Centre within STFC, celebrated the 50th anniversary of the laser. Then he explained how free-electron lasers worked and the huge step forward they have the potential to provide for accelerators of the future. This was a very appropriate manner to end a conference aiming to inspire the education of future physicists. Finally, we would like to record our thanks to the education department of the Institute for their support and point out that presentations from the conference are on the website.

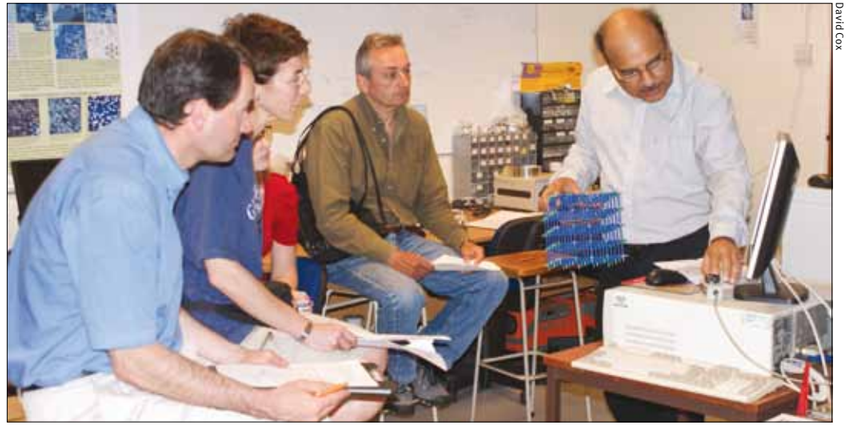
Ann Marks, on behalf of the organising team


David Cox

Helen Pollard (East Midlands teacher network co-ordinator demonstrates a variety of new experiments.

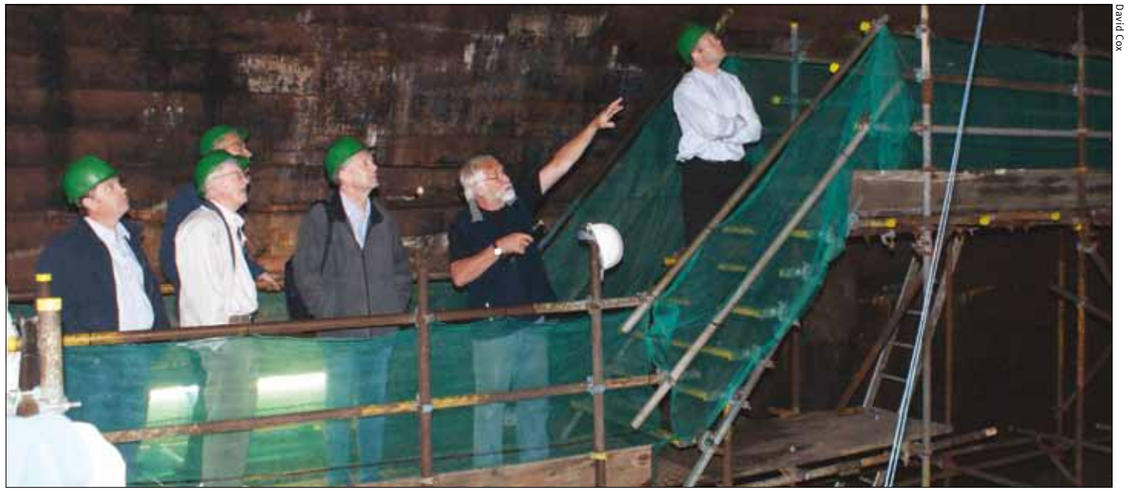

David Cox

Teachers make rocket launchers in a workshop run by Gary Williams.


David Cox

Vin Dhanak (right), senior research fellow, at work in the Nanomaterials Characterisation Laboratory.

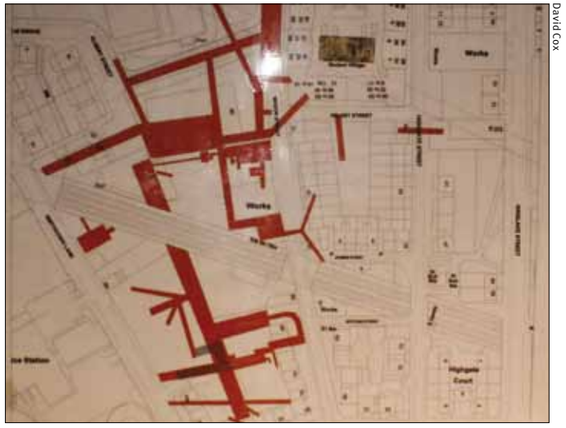
Branch members disappear into a mysterious black hole


David Cox

A tour guide leads intrepid branch members into the dark depths of the tunnel network at the Williamson Tunnels Heritage Centre.


David Cox

The tour continues with its exploration of the subterranean world.



David Cox

Detail of a map showing the extent of the tunnel network (in red).

We try to organize a branch visit each year. Last May, 28 members booked in advance for an evening at the Williamson Tunnels Heritage Centre, which included an underground tour followed by a buffet. As they say, "a good time was had by all"!

For those who have never been there, this network of well-engineered tunnels is an amazing phenomenon and many parts of it are still to be explored. Built in the early 19th century, the tunnels serve no purpose and appear to lead nowhere. Our party was divided into two groups for the tour and we all donned fetching green hard hats to enter the bowels of the Earth.

Joseph Williamson, an eccentric locally known as the "King of Edge Hill", made his wealth in the tobacco trade. The popular view is of a philanthropist employing men who would otherwise have been redundant, particularly following the Napoleonic wars. Williamson left neither maps nor drawings. When he died in 1840 the tunnels fell into disuse, became forgotten and were slowly buried under the rubble of centuries. They were rediscovered in modern times.

We try to have a branch fun event or visit each year, preferably in the late spring when the nights are light. If you have an idea for a visit suitable for branch members (of scientific interest if possible) and perhaps their families, we would love to hear from you.

David Cox

Merseyside Branch pays tribute to astrophysicist Dr Chris Moss

It is with the greatest sadness that we have to report that Liverpool Telescope (LT) support astronomer Dr Chris Moss died in the Royal Liverpool Hospital on 12 May after a short illness. His untimely death came as a great shock to everyone at the JMU Astrophysical Research Institute (ARI) and the wider community. Prof. David Carter has written a short tribute.

"Chris was a remarkable person. Some people have two careers or even more but most undertake them sequentially. Chris had parallel careers in theology and astrophysics, of which I am much more familiar with the second. I knew him first in the early 1970s, when he was a research student working with Bob Dickens at the University of Sussex and the Royal Greenwich Observatory, and when I was at Cambridge.

"Chris worked on clusters of galaxies, obtaining redshifts of cluster galaxies from the Isaac Newton Telescope before its move from Herstmonceux Castle to La Palma. His great interest was, and remained, star-forming galaxies in clusters and the mechanisms by which star formation is triggered.

Dr Chris Moss.

"After completing his PhD he spent periods at Steward Observatory and at the Vatican Observatory. Among his close collaborators were Mark Whittle and Gerard de Vaucouleurs. Chris returned to the UK, where a position as dean of St. Edmunds Hall, Cambridge, allowed him to continue his research career alongside his considerable administrative duties. He continued to research star formation in cluster galaxies, where in a series of papers with Mark Whittle *et al* he advocated that gravitational tidal interactions, in particular during mergers in subclusters, were a major factor in driving star formation, more important than the rival mechanism of ram-pressure effects.

"Around 2002 Chris began yet another career as salesman and contract negotiator for Telescope Technologies Limited (TTL), manufacturer of research-class telescopes on Merseyside. He was a principal negotiator for the sale by TTL of a 2.4 m telescope to the Yunnan National Observatory in China. As recently as April he was able to use the newly installed and now very successful Yunnan telescope at its site near Lijiang to obtain some observations in support of his theory that gravitational effects, rather than ram-pressure stripping, triggered star formation, in this case in some galaxies in the Abell 1367 and Coma clusters.

"Following the sale of TTL to a US company Chris moved full time into the ARI where he acted as LT support astronomer, organising the time-allocation process, making sure that telescope users had the correct information to carry out their observations effectively, and acting as advocate for the users to the LT operations and technical groups. He continued his research career, taking part in the supervision of two research students and forming new collaborations through his knowledge of the LT. In addition he was an effective and popular teacher of undergraduates.

"Chris had a great affinity with eastern cultures, and a network of friends in the Far East. He was key to developing our partnerships with astronomers in China and Thailand.

"He was a very private person, yet a friend to everyone he met. We will all miss him."

Event targets future engineers

"Engineering your future", a careers day for lower-sixth-formers, will take place on Thursday 21 October at Liverpool Town Hall.

Students will be able to discover the broad range of engineering careers that are open to them and to access the inside story from young engineers.

Small workshop-style meetings and presentations will give students the opportunity to put questions to men and women in the engineering field.

Numbers will be limited so early booking is recommended. Teacher attendance is not required.

To register your interest, contact Christopher Cottier (e-mail christopher.cottier@rtcnorth.co.uk).

Liverpool University physics group reaches out

The Physics Outreach Group offers exciting, hands-on workshops for schools and colleges. The Photons in the Classroom project has introduced many classes to the National Schools Observatory in their own classrooms over the past year and it will continue until December. The A-level interactive session "What can you do with a physics degree?' will also continue for another year, now with Institute of Physics support making it free for all schools.

In the coming academic year we will continue to offer schools and colleges the chance to visit the Department of Physics. We are launching our new "A-level master-classes" in January 2011, "GCSE physical sciences revision" and "Extreme physics" events next Easter, and the "Spectrum of physics" A-level event in June 2010. For more information, e-mail physicsoutreach@gmail.com. Our homepage on the UOL website launches in August.

Dr Lynn Moran

Lucas Hayhurst

Having a blast: Terry "Rocket Man" Horsman (left) helps delegates to test-fire the rockets that they have just made.

Physics Can Be Easy! gets teachers all fired up

This year the Physics Can Be Easy! Conference at the University of Liverpool had a decidedly astrophysical feel to it. In "Exploring the dynamic universe", renowned galaxy hunter Andrew Newsam gave a superbly engaging talk about how the entire universe is a laboratory full of ever-changing experiments for astronomers to investigate. He gave insights into new developments in space exploration, which are beginning to open up whole new branches of study and which will shed new light on the formation of planets, stars and galaxies.

Following this, we enjoyed the opportunity of building our very own high-pressure rocket launchers and to experiment with different designs of rocket shapes, ably guided by Terry "Rocket Man" Horsman. Interestingly, as well as developing an understanding of the effects of lift and drag on the flight of a rocket, we also learned a good deal about plumbing too.

Of course, no space-themed physics conference would be worth its salt without some discussion about the most important of the planets so far discovered: Earth. Thankfully, we had Dr Ros Todhunter from Keele University's Earth Science Education Unit to guide us through how Earth science can be used to liven up a number of topics in the KS3/4 curriculum.

Graduates from the University of Liverpool working for an outreach project in the Science Communication Unit introduced us to software that is freely available from the National Schools Observatory (NSO). Pupils can use this to easily track asteroids or investigate the Moon. We found out that the NSO can be quickly and simply introduced into the classroom to give a real insight into the work of astronomers.

A refreshing change to all this space science came in the form of David Featonby and his case-full of tricks entitled "What happens next?". David showed us a series of interesting phenomena all designed to stimulate no end of questions, answers and discussion.

All in all it was a terrifically productive day. All delegates went home with ideas and materials aplenty to take into their classrooms.

My thanks go to the physics department at the University of Liverpool for the use of its excellent facilities.

Lucas Hayhurst

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Do physicists make good financiers?

David Cox

Dr Jessica James: a physicist who has made her career in finance.

Dr Jessica James, managing director of CitiFX, Citibank, is a physicist. She is based in London but spends a considerable proportion of her time jetting around the world. On 25 March, Jessica gave a talk entitled "A physicist in the City: stranger in a strange land". Because of the wide interest, the event was held at Daresbury Laboratory, STFC, and the Manchester Branch was invited.

Jessica started by describing the typical characteristics of a physicist and the skills gained during a physics education, which make a physicist such a valuable member of the banking community. The ability to use models and analyse complex systems, coupled with solid mathematical knowledge and problem-solving skills, is particularly useful for City traders.

Jessica went on to explain calculations used to predict fluctuations in the international money markets. They sounded rather simplistic but she described their limitations and developed optional methods of analysing the situations, thereby giving an intriguing picture of life on the trading-room floor.

We are pleased that Jessica's lecture was one of four consecutive Merseyside Branch talks given by women.

Ann Marks

The deadline for your contributions to the next issue of this newsletter is

Friday 14 January 2011

E-mail your materials to dcox-iop@virginmedia.com