Institute of Physics

# YORKSHIRE PHYSICS NEWS

The newsletter of the Yorkshire branch of the Institute of Physics

Winter 2006

# Next-generation neutron source comes step closer

In October, physicists across Yorkshire were delighted to learn that the European Strategy Forum for Research Infrastructures (ESFRI) had included the European Spallation Source (ESS) on the European Road Map as a "high priority" project that is ready to move to the construction phase.

The ESS will be the world's most powerful source of neutrons, overtaking sources currently under construction in the US and Japan, and will serve up to 5000 users annually from across all scientific, medical and engineering disciplines.

The unprecedented intensity of the beams of low-energy neutrons provided by the ESS will create new opportunities for the development, characterisation and optimisation of complex functional materials for use in medicine, information technology, nanotechnology, energy production and improving the environment. It will be possible to study in unimaginable detail materials of biological, pharmaceutical, chemical and even archaeological origin non-destructively, unlocking the secrets of their structure, magnetic properties and dynamic behaviour. The ESS will also enable industry to develop complex materials for our technological world and optimise their production.

*The proposed site layout of the ESS at Burn, near Selby, Yorks.*

Yorkshire has identified an ideal site for the ESS at Burn, near Selby, and it is expected that this location, along with competitor sites in Sweden, Germany, Hungary and Spain's Basque Country, will be considered as a possible home for this major and prestigious scientific project.

Now that the ESS has been designated a priority project, the way is open for governments to discuss how the €1 billion ESS should be funded and where it should be built. The Yorkshire ESS (YESS) team will continue working with its competitor sites, the representatives of Europe's neutron scientists and Europe's major neutron labs within the ESS Initiative lobby group to move the project rapidly to the construction phase.

Prof. Bob Cywinski, scientific and technical adviser to the YESS, commented, "This is tremendous news. The ESS is desperately needed by European scientists in all disciplines to understand the structure and behaviour of materials at the atomic level, and to develop new materials for science, medicine, engineering and technology. Construction of the ESS will ensure that Europe's world lead in neutron science will be secure for at least the next half-century."

Dr Julian White, CEO of the White Rose University Consortium, added, "We're proud that Yorkshire has played a key part in keeping the ESS at the top of the European agenda and we now look forward to working with the UK Government and Research Councils to explore how we can bring this facility to the UK and to Yorkshire."

For further information about the YESS project, please see www.yorkshire-ess.org.uk.

**Visit the branch website at**
**http://yorkshire.iop.org**

## Do you know of a physicist in need?

The Institute's benevolent fund was set up to provide members or their dependants facing a critical need with assistance that will help improve their prospects of continuing to lead a fulfilling life. The fund can help people in the following categories:

- members or their families in need because of disability, illness, death or unforeseen problems;
- members facing critical career issues;
- members facing problems in employment;
- students of physics facing hardship through illness, disability or unforeseen problems.

If you feel that you meet these criteria, or know someone who might, please contact the secretary, Susan Dowling. Write to her at Crosswinds, Grovehurst Road, Iwade, Kent ME9 8RE, or send an e-mail to suemdowling@yahoo.co.uk.

The branch newsletters are published by Institute of Physics Publishing, Dirac House, Temple Back, Bristol BS1 6BE, UK.



Printed by Warners (Midlands) plc, Bourne, Lincolnshire, UK.



The Institute of Physics, 76 Portland Place, London W1B 1NT, UK.

Tel: 020 7470 4800.
Fax: 020 7470 4848.

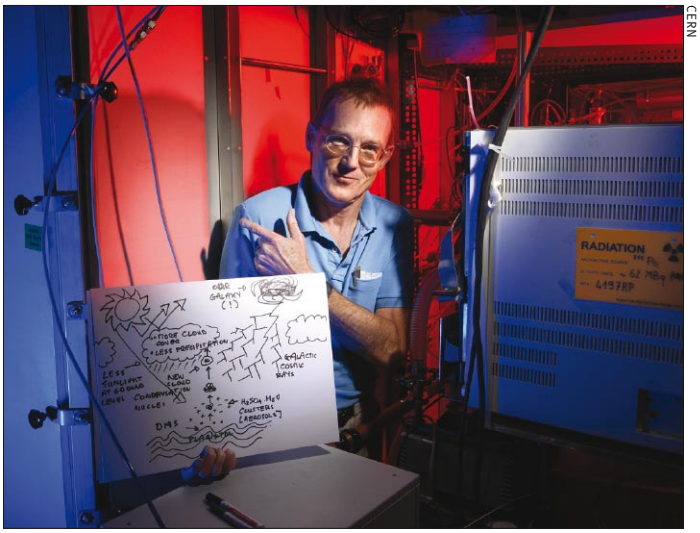
# Do cosmic rays affect clouds?

In October, academics from the University of Leeds were excited to take the first data for a novel experiment – known as CLOUD (Cosmics Leaving OUtdoor Droplets) –using a prototype detector in a particle beam at CERN, the world's largest laboratory for particle physics. The goal of the experiment is to investigate the possible influence of galactic cosmic rays on Earth's clouds. This is the first time that a high-energy physics accelerator has been used for atmospheric and climate science.

The CLOUD experiment is designed to explore the microphysical interactions between cosmic rays and clouds. Cosmic rays are charged particles that bombard the Earth's atmosphere from outer space. Studies suggest that cosmic rays may influence the amount of cloud cover through the formation of new aerosols (tiny particles suspended in the air that seed cloud droplets).

Clouds exert a strong influence on the Earth's energy balance, and changes of only a few per cent have an important effect on the climate. The CLOUD prototype experiment aims to investigate the effect of cosmic rays on the formation of new aerosols.

Understanding the microphysics involved under controlled laboratory conditions is key to unlocking the connection between cosmic rays and clouds. CLOUD will reproduce these interactions




CERN

*Jasper Kirkby in front of the CLOUD prototype, with a sketch of the possible link between galactic cosmic rays and cloud formation.*

for the first time by sending a beam of particles – the "cosmic rays" – from CERN's Proton Synchrotron into a reaction chamber. The effect of the beam on aerosol production will be recorded and analysed.

The collaboration comprises an interdisciplinary team from 18 institutes and nine countries in Europe, the US and Russia. UK scientists from the universities of Leeds and Reading and CCLRC Rutherford Appleton Laboratory are members of the CLOUD collaboration. The experiment brings together atmospheric physicists, solar physicists, and cosmic-ray and particle physicists to address a key question in the understanding of clouds and climate change.

"The experiment has attracted the leading aerosol, cloud and solar-terrestrial physicists from Europe; Austria, Denmark, Finland, Germany, Switzerland and the UK are especially strong in this area," said CLOUD spokesperson Jasper Kirkby of CERN.

"CERN is a unique environment for this experiment," he continued. "As well as our accelerators, we bring the specialist technologies, experimental techniques and experience in the integration of large, complex detectors that are required for CLOUD." An example in the present CLOUD prototype is the gas system, designed by CERN engineers, which produces ultrapure air from the evaporation of liquid oxygen and liquid nitrogen. "It's probably the cleanest air anywhere in the world," said Kirkby.

Prof. Bob Bingham, a UK CLOUD collaborator from CCLRC Rutherford Appleton Laboratory, said, "By studying the microphysical processes at work when cosmic rays hit the atmosphere, we can begin to understand more fully the connection between cosmic rays and cloud cover."

Dr Giles Harrison, a UK CLOUD collaborator from the University of Reading, added, "We know that charged particles and cluster ions occur throughout the lower atmosphere but the physical consequences of their charge for cloud and aerosol processes is an under-explored area of atmospheric science. CLOUD should provide unique new measurements in atmospheric aerosol science and atmospheric electricity."

The first results from the CLOUD prototype are expected by summer 2007. The full CLOUD experiment includes an advanced cloud chamber and reactor chamber equipped with a range of external instrumentation to monitor and analyse their contents.

The temperature and pressure conditions anywhere in the atmosphere can be recreated within the chambers, and all experimental conditions can be controlled and measured – including the cosmic-ray intensity and the contents of the chambers. The first beam data with the full CLOUD experiment is expected in 2010.

# Institute's careers adviser visits Yorkshire

The Institute of Physics Careers Service will be holding two career surgeries in Yorkshire in November. If you are contemplating a career move or career break; wish to review your career and consider your options; need professional career support during a period of organisational change or following redundancy; or want to get input into your CV, practise your interview technique or solicit some advice on a job-hunting strategy, you will find the 45 minute sessions of great use.

Access to the Careers Service is one of the benefits of membership of the Institute, and you are invited to book a 45 minute session with careers adviser Paula Summerhayes absolutely free of charge.

The local sessions are:

- **Sheffield** Wednesday 29 November at the Novotel Hotel, 50 Arundel Gate, Sheffield, S1 2PR. See www.novotel.com/novotel/fichehotel/gb/nov/1348/fiche_hotel.shtml.
- **York** Thursday 30 November at the Grange Hotel, 1 Clifton, York, YO30 6AA. See www.grangehotel.co.uk/index.html.

For further details and to book online, visit http://members.iop.org/careersguidance.html.

When you book online, you will be asked to complete a confidential questionnaire, which should be returned to the Careers Service no later than five days in advance of your appointment. This will help us to ensure that you get the most out of your meeting.

If you have any queries that the website does not answer, then please get in touch by e-mailing members.careers@iop.org.

# Intelligent sensors gear up for flood monitoring

An intelligent flood-monitoring system, which could give advance warning of the type of rapid flooding that engulfed the Cornish village of Boscastle in 2004, is under test in the Yorkshire Dales. Danny Hughes, Phil Greenwood and colleagues from Lancaster University won an award for their paper describing the system at the UK e-Science All Hands Meeting in Nottingham in October.

The system, which makes use of Grid computing, could reduce the cost of flood damage by providing early local flood warnings that would enable people to take pre-emptive action. Most current systems issue general warnings over large areas because they rely on sparsely distributed sensors that send information to a central point for analysis. The new system, based on a network of intelligent sensors that can be placed in flood-prone sites, promises rapid, low-cost location-specific warnings.

Prof. Paul Watson from Newcastle University, who chaired the AHM programme committee, said, "We were impressed by [how] the UK e-Science Programme has encouraged the formation of a multidisciplinary team to address an interesting problem of great practical importance to the population as a whole; flooding is a major concern in the UK and many other countries. By making advances in a set of scientific fields and then combining the results, the team has built a novel and interesting new system."

*A flood-monitoring system is being tested in the Yorkshire Dales.*

The system undergoing trial in Yorkshire consists of 13 depth sensors fixed in different locations across a flood plain and a digital camera which, rather like a traffic-speed camera, monitors the rate of the water flow from the speed of flotsam travelling between two points.

Each sensor incorporates a powerful computer, no bigger than a packet of gum, that communicates wirelessly with other sensors in the network to form a computing grid. The software that enables the sensors to operate as a grid has been developed under the UK e-Science Core Programme (Open Overlays project). The North-West Development Agency is funding the flood-monitoring work.

When flood waters are rising, the sensors can change how they operate together so that the network can continue to monitor the situation even if some sensors are submerged or swept away. The sensors are also able to adjust their power consumption so batteries are conserved during dry times and power is available for increased activity during flooding. "As soon as the sensors detect water coming down the valley, the network gears up," explained Hughes.

To provide flood warnings, the system uses flood-forecasting models developed at Lancaster by Prof. Peter Young and colleagues. The models can be run on the sensor computing grid and adjusted so that their predictions stay in line with what the sensors are recording. "An interesting possibility is to use such a local warning system to give advanced warning, even in catchments where the response to rainfall is very fast, making flood forecasting very difficult," suggested Prof. Keith Beven of Lancaster who is also involved in the project. "One example [of this] was the Boscastle flood in 2004, where a general forecast of heavy rain was issued, but the event was too localised to be able to give a warning to Boscastle residents. Fortunately, nobody was killed," he said.

# Lecture brings light to schools

Next term, schoolchildren in Yorkshire will be visited by the bright lights of Dr Pete Vukusoc's lecture about light.

The science of light and colour is fantastically important in an enormous number of areas: from observing and understanding the universe in astronomy to diagnosis and treatment processes in medicine, and efficient communications and signal-processing in industry. Light, colour and the effects that create them not only manage many of nature's own processes – they also help us to understand the physical world around us.

"Light fantastic: the science of colour" will open pupils' eyes to the basic concepts of the science of light and colour and show how modern technology is making the most of light's astonishing properties.

*"Light fantastic" will teach the basic concepts of light and colour.*

This presentation will include demonstrations, hands-on activities and movie clips to shed light on the science of colour. We will explore the properties and characteristics of radiant electromagnetic energy and discover how the use of light has created the world we live in today and will shape the world we will live in tomorrow.

Dr Vukusic is an experienced science communicator and former secondary-school science teacher. He now works as a researcher and lecturer at the University of Exeter's School of Physics. For many years he has delivered talks on light and colour science to international audiences of all ages and backgrounds. He is one of the leading scientists in the world involved in broadening our understanding of how nature uses and controls the flow of light and colour.

The lecture lasts an hour and is suitable for 14–16 year olds. The talk will be presented across Yorkshire, probably in York, Leeds and Sheffield. To receive information about the dates and venues when they are confirmed, please send your contact details to Alex Brabbs at alex.brabbs@iop.org.

# Do your bit for Lab in a Lorry!

*The shattering glass is just one of the experiments that you'll find on show in the Lab in a Lorry.*

The Institute of Physics' famous Lab in a Lorry will be visiting Yorkshire in November and December, and the team is looking for volunteers to help staff the lorry and help out with the experiments.

The lorry gives young people aged 11–14 the opportunity to do experimental science in the way it actually happens; exploratory, accidental, informed by curiosity and intuition, but also bounded and guided by the experience and insight of practising scientists. Most of the experiments, which are accessible and interesting, are self-explanatory, but there will be full training for the volunteers in the morning before the Lorry opens.

The Lorry will be at Birkbeck School, North Somercotes on 30 November, McAuley Catholic School, Doncaster on 4–6 December and Bramcote Lorne School, Retford on 7 December. If you are interested in getting involved, please contact Liz Jeavens (e-mail: elizabeth.jeavans@iop.org). You can find out lots more about the Lorry at www.labinalorry.org.uk.

# Upcoming events in York

**Wednesday 6 December 2006**
**Riding on magnetic fields: the miraculous world of superconductors**
Prof. Ludwig Schultz (IFW Dresden, Institute of Metallic Materials)
**2.15 p.m. P/X001, Department of Physics, University of York (note unusual time)**
At this lecture different concepts of magnetic levitation will be discussed. The conventional system is the Transrapid, which mostly runs between Shanghai Airport and Shanghai Centre. In Japan a test track has been established for the MAGLEV, a train supported by superconducting coils.

Our approach is a passive superconducting magnetically levitated system, which uses bulk superconductors cooled only to the temperature of liquid nitrogen. At low temperatures, superconductors do not only carry electrical current without any resistance – they are also able to freeze in a magnetic field of any configuration.

In the presentation, this will be explained for different types of superconducting magnetically levitated trains, which can be in an upright position, suspended or moving along a wall without any mechanical contact. With regard to scaling-up, the SupraTrans project will be presented.

**Monday 11 December 2006**
*Christmas lecture*
**The heat is on**
Prof. Howard Wilson (Department of Physics, University of York); Prof. Peter Cox (science director climate change, CEH Dorset)
**7.00 p.m. mulled wine and mince pies. 7.30 p.m. P/L001, Department of Physics, University of York**
Scientific evidence that world temperatures are rising because of greenhouse-gas emissions is now overwhelming. In the first half of this presentation, Prof. Peter Cox will review this evidence and describe the scientific basis for predictions of climate change over the next century. The message is clear: we need to find ways to reduce emissions of carbon dioxide at a time when global energy demand is likely to increase.

Fusion energy promises to be part of the longer-term solution. It is clean and produces no greenhouse gases, and there are abundant fuel resources. In the second half of this presentation Prof. Howard Wilson will explore the scientific challenges facing scientists who are striving to make fusion energy a reality, working with fuels on Earth that are 10 times the temperature of the Sun.

**Tuesday 6 February 2007**
**A recipe for the universe**
Dr Pete Edwards (Department of Physics, University of Durham)
**7.30 p.m. Tempest Anderson Hall, Yorkshire Museum**
*Joint with Yorkshire Philosophical Society*
How and when did our universe begin? What made it look like this? How will it end? These are all questions that have preoccupied humanity since the beginning of civilisation.

The last three years have seen considerable progress in our understanding of what makes our universe tick. Results from ground- and space-based telescopes have revolutionised our view of the cosmos. For the first time in human history we are getting close to answering the question: "How did the universe evolve into the beautiful place we see today?"

"A recipe for the universe" will take the audience on a journey through the cosmos, exploring some of the latest results from astronomy and what they reveal regarding the birth, life and death of our universe.

**Monday 12 February 2007**
**Severe weather – origins and prediction**
Dr Ross Reynolds (Department of Meteorology, University of Reading)
**6.00 p.m. coffee. 6.30 p.m. P/L001, Department of Physics, University of York**
Severe weather occurs on a variety of scales, from the short-lived, small-scale tornado to the much longer lived, 1000 km-wide hurricane. Understanding the origin of these two phenomena is one step on the path to successful weather prediction. Advances in the routine observational network combined with increasing scientific understanding of their birth and evolution has led to significant improvements in their prediction.

Dr Reynolds will discuss tornadoes in both the US and the UK as well as hurricanes over the North Atlantic.

**Please send articles for inclusion in the next issue of Yorkshire Physics News to**

**t.greenoughgraham@physics.org**