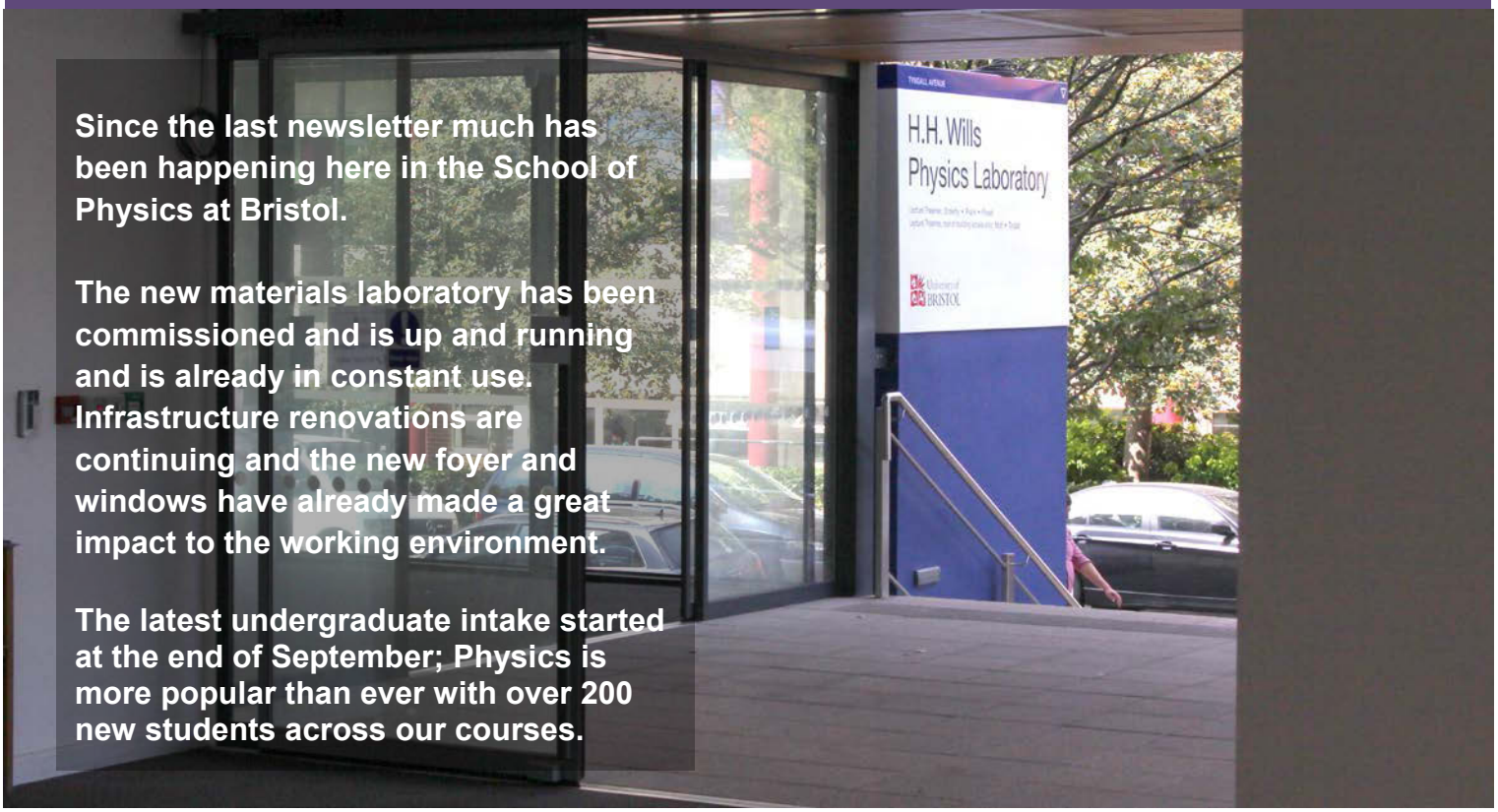
School of Physics Newsletter October 2013



Since the last newsletter much has been happening here in the School of Physics at Bristol.

The new materials laboratory has been commissioned and is up and running and is already in constant use. Infrastructure renovations are continuing and the new foyer and windows have already made a great impact to the working environment.

The latest undergraduate intake started at the end of September; Physics is more popular than ever with over 200 new students across our courses.

Bristol academics continue to be recognised for their world-class research.

Professor Sandu Popescu has been awarded the Templeton Frontiers Distinguished Visiting Research Chair in Quantum Foundations by the Perimeter Institute for Theoretical Physics (along with Stephen Hawking and Nobel prize winner Gerard t'Hooft), and Professor Jeremy O'Brien has recently been awarded the Institute of Physics Bates prize for "his outstanding research in experimental quantum optics and quantum information science."

David Townsend, a Bristol Physics graduate from 1966, received an honorary degree for his pioneering work on PET-CT scanners this summer.

It's always great to hear from our alumni so please feel free to get in touch!

Professor Nick Brook, Head of School

Above: the HH Wills Physics lab looks good and functions more efficiently following refurbishment and (inset) how the building looked in 2011.

New materials laboratory

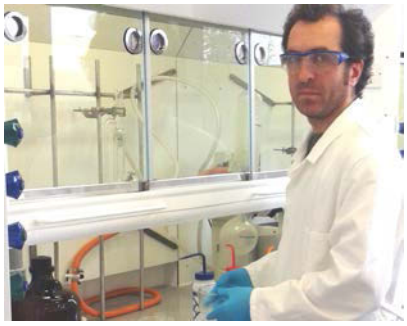
Making cleaner and better characterized materials is a crucial part of discovering and explaining novel physics.

The new materials facility aims to accommodate the increasing needs of the School.

The facility is divided into two laboratories; a wet lab where chemicals are usually used in solutions, and a dry lab or furnace lab for chemistry in the solid state. Alongside standard fume cupboards, special features include a glovebox for work in controlled atmosphere, a stainless steel fume-cupboard for work with naked flames - and even walk-in fume cupboards, where large pieces of equipment can be used safely with hazardous chemicals.

The facility is equipped with the basic apparatus necessary for synthetic procedures, and uses range from organic synthesis to etching surfaces, all in a safe environment.

The first researchers started in April 2013 and there has been a constant increase in user numbers since then.



The materials facility is managed by Germinal Magro, *pictured left,* who moved to Physics in 2011 following seven years as a researcher in the School of Chemistry. Trained as an organic synthetic chemist, Germinal has worked on supramolecular systems such as dendrimers, anion recognition, and was involved in the design and production of a novel water quality test kit.

Germinal helps users and potential users to devise new experiments, to write risk assessments or even to synthesise materials for their research purposes, drawing on his considerable laboratory and chemical safety experience.

Research profile - Professor Rob Richardson

Professor Richardson's research area is soft condensed matter, with a particular interest in liquid crystals.

Figure 1, above, left to right:
Professor Rob Richardson, Dr Wiebe de Vos (former Bristol post doc), Dr Stuart Prescott (former Bristol Chemistry Lecturer), Laura Mears (PhD student in Physics), Dr Max Skoda (Instrument Scientist for INTER reflectometer, ISIS)

He writes: These materials generally comprise elongated organic molecules, perhaps two or three nanometres in length. They are ubiquitous because of their application in liquid crystal displays (LCD) which require a fluid with an optic axis. Liquid crystals are a fascinating area of science - with the bonus that a deeper understanding can lead to new or improved applications.

I am exploring two new directions. The mysterious part of LCD technology is that the optic axis of the liquid can be anchored to a surface. I'm studying the structure of liquid crystal interfaces to find out more about the underlying science of this phenomenon. We prepare materials and chemically modified surfaces at Bristol - and it turns out that the best probe is a neutron beam.

We use reflectometers at the ISIS neutron source (Oxfordshire) and at the Institut Laue Langevin (Grenoble) to study the structure and composition of "buried" liquid crystal to solid interfaces. The objective is to understand and eventually control the anchoring mechanism by addition of surface active components. Neutron reflection experiments need a lot of people to run them. Figure 1 (previous page) shows the team inside the INTER reflectometer at ISIS. I am the one on the left!

Looking further ahead we aim to incorporate new properties into liquid crystals, so that the benefits of their strong response to applied fields can be taken into non-display applications such as optical signal processing. This is very interdisciplinary work, with vital contributions from Chemistry colleagues. As a "model" system, we have prepared suspensions of gold nanorods that have been stabilized in a normal liquid crystal and study their properties using optical and electron microscopy.

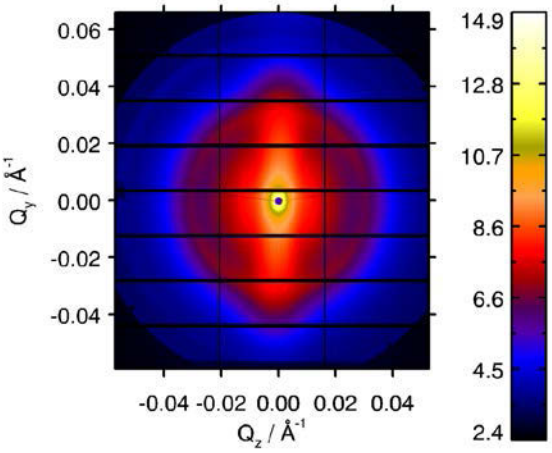


Figure 2: Scattering from a suspension of gold nanorods, taken at the I22 instrument at Diamond. The intensity is colour coded by the bar on the right. Q is a measure of the angle of scatter.

It is important to know whether the nanorods orient with the optic axis of the liquid crystal, because this determines whether an external field can change a property such as light absorption. We determine the nanorod orientation using small angle X-ray scattering in our laboratory and occasionally using synchrotrons (Diamond in Oxfordshire and ESRF in Grenoble). Figure 2 shows the X-ray scattering from a suspension of gold nanorods in a liquid crystal with the optic axis horizontal. The intensity of scattered X-rays indicates a good degree of parallel alignment, so we are optimistic for a successful outcome.

Video lectures on YouTube

A series of films published for the Faculty of Science featured Professors Jeremy O'Brien and Sandu Popescu's joint lecture on quantum mechanics – follow the link to see all of the Big Ideas in Science videos (including this one).

Professor Jeremy O'Brien, Centre for Quantum Photonics.

In case you missed it at the time, you may also be interested to see Dr Zoe Leinhardt's explanation of the importance of last year's transit of Venus in her film on the Physics World web site, and how the transit of Venus was used to calculate the distance between the Earth and the Sun.

School of Physics student society is the Best!

It's official - we've always known the School of Physics' student society is pretty good.

In summer this was confirmed, as the University of Bristol Students' Union (UBU) awarded Chaos the Best Student Society accolade in the UBU awards.

In June, the UBU held a week of celebration for outstanding student achievement by holding a series of awards evenings to honour students and staff who make a difference. Many congratulations to all on the Chaos team who work so hard to help make the experience of their fellow students so memorable!

Higgs Boson and the Nobel prize

In the last issue of the School newsletter Professor Dave Newbold, Head of the Particle Physics research group, told of the Bristol involvement in the CMS at CERN. We were delighted at the recent news that Professor Peter Higgs and Baron François Englert have been awarded the Nobel Prize 2013 "for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the Atlas and CMS experiments at CERN's Large Hadron Collider".

Professor Higgs was awarded an honorary degree by the University of Bristol in 1997. Last year, the retired Edinburgh University physicist gave a scientific lecture in Bristol's School of Physics, which was attended by over 600 staff and students.

PhD students lead charity events in the School of Physics

PhD students and staff from across the world have shared their baking expertise in charity fundraisers.

A cake sale in May raised a total of £172.50 to raise funds for Sparks medical research projects. This was followed by the Great Physics Bake Off, supported by the Physics Graduate School, in July which raised over £450 for IOP for Africa (supporting physics education in the developing world).

School of Physics judging was led by Professor Peter Barham, internationally renowned for his work in molecular gastronomy. Photographed are (from left to right) Professor Barham and co-judges Rachel Holley, Professor Walther Schwarzacher, Dr Natasa Vasiljevic and Dr Gemma Winter.

PhD student profiles – Janina Möreke and Sara Carreira

Organisers of the charity fundraiser, Janina Möreke and Sara Carreira are research students in the School of Physics.

Above left to right Janina Möreke and Sara Carreira

Sara Carreira, who won a prize at the recent ChinaNANO 2013 conference, is researching the functionalisation of a nanomagnetic protein for biomedical applications at the Bristol Centre for Functional Nanomaterials.

Following study at the Humboldt University in Berlin, Sara moved to the Department of Medical Physics and Bioengineering at University Hospitals, Bristol, to study the placental transport and toxicology of polychlorinated biphenyls (PCBs) and engineered nanomaterials.

Janina Möreke is a final year PhD student at the Centre for Device Thermography and Reliability. Janina was a Bristol undergraduate whose degree involved a year-long industrial placement at De La Rue plc working on security and durability features for banknotes, and research into vortex induced vibration to generate electricity from tidal creeks.

Janina's research investigates degradation mechanisms in nitride-based high electron mobility transistors for radar and satellite applications, through the use of electrical characterisation methods and liquid crystal electrography.

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