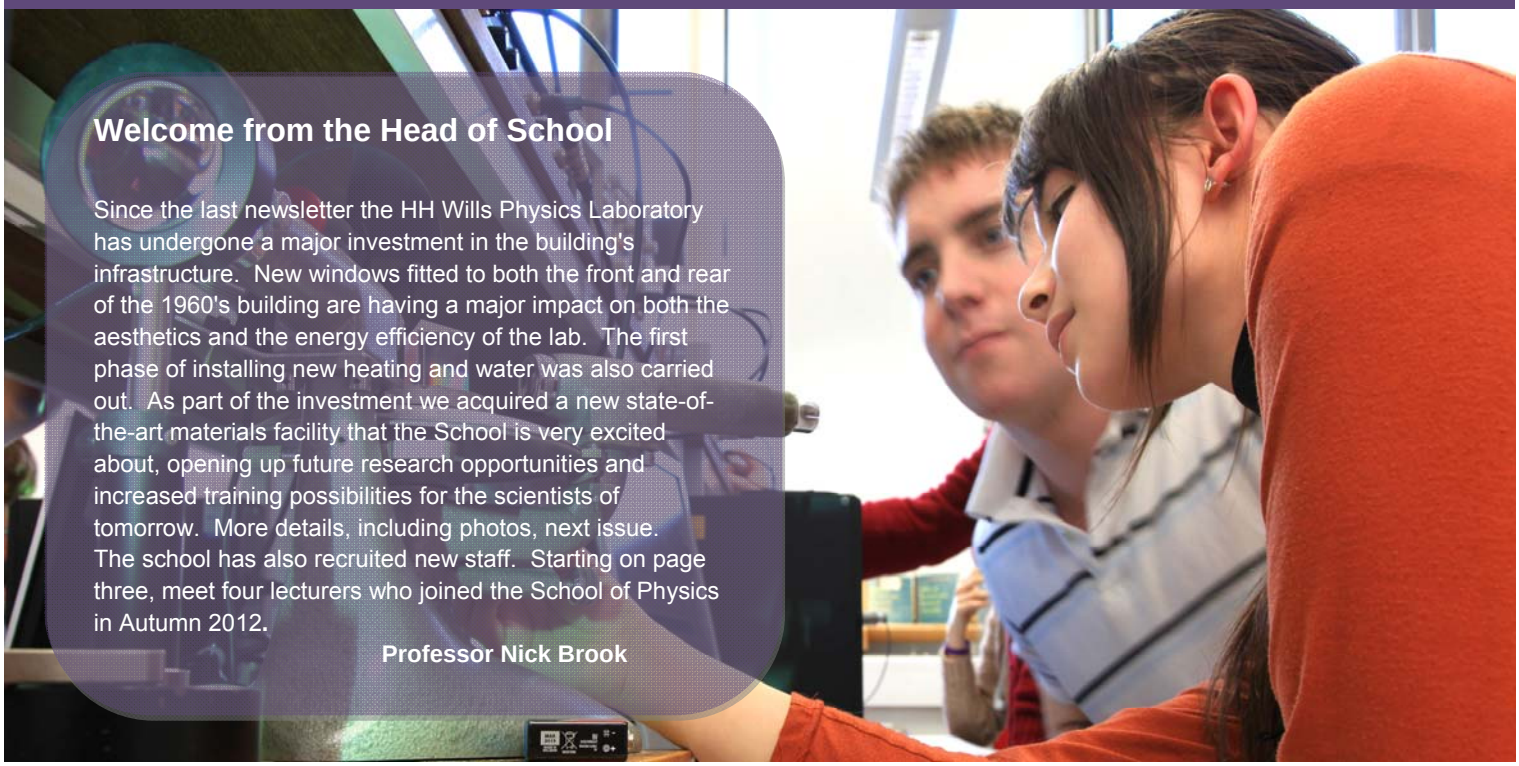
School of Physics Newsletter

University of BRISTOL

February 2013



Welcome from the Head of School

Since the last newsletter the HH Wills Physics Laboratory has undergone a major investment in the building's infrastructure. New windows fitted to both the front and rear of the 1960's building are having a major impact on both the aesthetics and the energy efficiency of the lab. The first phase of installing new heating and water was also carried out. As part of the investment we acquired a new state-of-the-art materials facility that the School is very excited about, opening up future research opportunities and increased training possibilities for the scientists of tomorrow. More details, including photos, next issue. The school has also recruited new staff. Starting on page three, meet four lecturers who joined the School of Physics in Autumn 2012.

Professor Nick Brook

The Higgs Boson – discovered at last?

Fifty years in the making, with a cast of thousands, one of the highest-profile discoveries of the decade was announced in 2012 – with Bristol playing a key role.

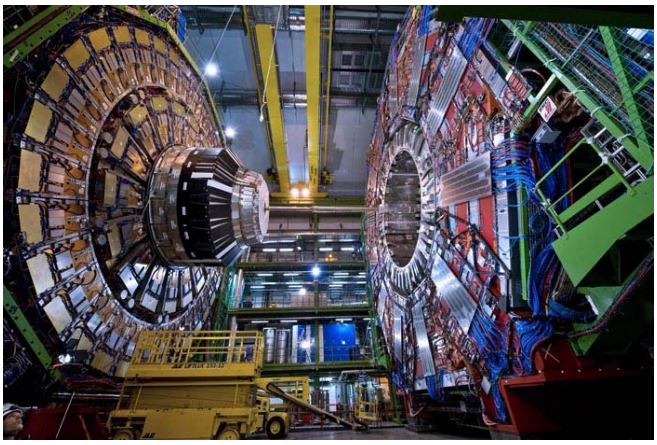
Particle physics aims to answer the same questions that have been asked since the time of the ancient Greeks: 'What is everything made of?' and 'What forces give the world structure?'. Our current understanding is encapsulated in a theory known as the Standard Model, built up over the last fifty years from experimental discoveries at increasingly high energies. The model has been highly successful in making predictions, but is also known to be inconsistent under extreme conditions – for instance, those found in the early Universe. Recent experimental research has targeted the 'gaps' in the model where a more profound theory might be revealed. Among these is the search for the Higgs boson.

For the last twenty years, the Particle Physics research group has played an important role in the design and operation of two large detector systems at the CERN Large Hadron Collider (LHC) – the Compact Muon Solenoid experiment (CMS) and Large Hadron Collider beauty (LHCb) experiments.

CMS, one of two experiments looking for the Higgs boson, contains important instruments designed at Bristol, including the electromagnetic calorimeter. Comprising over 100,000 large lead-tungstate crystals, this device detects high-energy photons with greater precision than any previous instrument. The observation of pairs of these photons is a principal means of detecting the decays of a Higgs boson. The whole CMS detector produces over 40Tb/s (or terabits per second) of data when running at full capacity – around fifty times the total internet traffic of the entire UK.

This flow of data cannot be stored using current technology, and so a series of complex filtering and data analysis systems are used to select only the most interesting data and transfer them around the world for scientific scrutiny. The software behind the central parts of this system was designed and built at Bristol.

After sifting through the 'debris' of quadrillions of proton-proton collisions, both CMS and a sister experiment simultaneously announced in July 2012 the detection of a new particle with the expected properties of the Higgs boson.



The CMS detector in its cavern, 125m below the French countryside. The endcap electromagnetic calorimeter (see text) is the silver object at the front of the left-hand part.

This is the end of an important chapter in particle physics. The discovery opens up a huge range of new research; and it is still possible that the detected particle is not the one predicted by Higgs and his collaborators in the 1960s but an impostor with similar properties and quite different origins. Work is under way around the world to establish this.

At Bristol, we are now engaged in the search for the next 'holy grail' of particle physics – the identification of dark matter – and in the improvement of the CMS detector for the first full-energy run of the LHC in 2015. The scientific programme is expected to continue until around 2030, and an era of physics discoveries has only just begun!

Dr Dave Newbold, Head of Particle Physics Research Group

For more information:
http://www.bristol.ac.uk/physics/research/particle

Find out more about CERN at
http://cms.web.cern.ch/

Chaos abroad!

In July last year Chaos, the Bristol student physics society, took 37 students to CERN, Geneva, for the first time since 2006. Whilst they were there they toured some of the facilities including the ATLAS control centre.

In Geneva, students also took the opportunity to see landmarks such as the Old Town or the Jet d'Eau, Geneva's 140 metre tall fountain situated on the edge of the lake, to visit the United Nations and to hire boats on Lac Leman.

In the words of one student, Matt Elverson: "The CERN trip was one of the highlights of my first year at University."

Not satisfied with one trip, Chaos also travelled to the European Space Research and Technology Centre (ESTEC) the European Space Agency's facility in the Netherlands, in partnership with the University of Southampton's Physoc.

Kayleigh Derricutt, assistant trip rep on the CERN trip, is now this year's trip rep and has organised a trip to Prague over Easter. She is planning another CERN trip if there is enough interest.

Alex Dawn, Chaos Trip rep 2011-2012 and MSci Physics student

Top and below - physics students on tour!

Project Juno in Bristol

Project Juno was set up by the Institute of Physics as an initiative to recognise and reward universities that demonstrate they have taken action to address the under-representation of women in university physics and to encourage better practice for both women and men.

Last year Bristol's School of Physics was awarded 'Juno Practitioner' status thanks to its commitment to achieve those aims across the School, for staff and students.

The School has taken positive action to ensure inequality is not being perpetuated, either knowingly or unconsciously. For example, the proportion of female postgraduate helpers involved in undergraduate teaching is being monitored, to ensure the number of 'visible' postgraduates with whom the undergraduates interact reinforces the message to undergraduates that postgraduate opportunities exist for all, regardless of gender.

Our designated 'Juno committee' works closely with the Student Staff Forum and the Graduate School Committee to ensure any gender equality and diversity issues among the undergraduates and postgraduates are addressed. We hope that, by committing to Project Juno and aiming toward 'Juno Champion' status, the School will develop and maintain a culture that is open, inclusive and transparent.

Rachel O'Leary, MSci Physics and Philosophy student

Below: Undergraduates work together in a Skillsets activity – see right.

Graduate Student Paper Prizes

This year's School of Physics Graduate Student Paper Prize ended in a tie. The prize was awarded for the best paper published between October 2011 and September 2012 where a student was the major contributor.

We congratulate the joint winners:

Michael Thomas (left) for his paper 'Nematic Director-Induced Switching of Assemblies of Hexagonally Packed Gold Nanorods' (MR Thomas et al., Advanced Materials 24,4424 (2012)); and

Poemwai Chainakun (right) for his paper 'Ionized X-ray Reverberation Mapping: Testing a Light-Bending Model for 1H0707−495' (P Chainakun and AJ Young, Monthly Notices of the Royal Astronomical Society 420, 1145 (2012)).

Skillsets: strategies for success

Over the last few years our current undergraduates have benefited from alumni evenings, in which a small number of recent graduates have returned to Bristol to talk about their first steps in employment.

We are looking to complement these events by having some of our more experienced alumni come back and tell us how their physics degree has facilitated their careers. If you would be willing to give a short talk about yourself and your career, and then chat more informally with them over a glass of wine, do please get in touch with Stephen Dugdale (s.b.dugdale@bristol.ac.uk).

New to Bristol

Dr Paddy Royall is a Royal Society University Research Fellow and has taken a joint appointment between Physics and Chemistry from August 2012.

A Physicist by training, he had been in the School of Chemistry since 2007. Following his PhD, he worked in the City of London for a year before returning to science to take postdocs in Utrecht, Netherlands and Tokyo. His research interests

concern the liquid state, which represents the meeting place of most of the great questions of statistical physics and materials science such as how do fluctuations in stress or structure relax in liquids? How do we describe the first unstable fluctuations in metastable liquids out of which crystallinity evolves?

Dr Tony Short joined the Theoretical Physics group as a Royal Society University Research Fellow with appointment as a Lecturer guaranteed when the Fellowship ends. His research focuses on addressing fundamental physics problems using the tools and insights developed in quantum information theory.

Tony obtained his first degree and doctorate in Oxford, then worked as a post-doctoral researcher in Bristol from 2004 - 2007. He subsequently moved to Cambridge for five years, before returning to Bristol in summer 2012. He and his wife Cath met at the HH Wills Physics Laboratory, and they have a one year old son called Matthew.

Dr Henning Flaecher joined the Bristol Particle Physics group as a Lecturer in October from the University of Rochester, New York.

After graduating from the University of Heidelberg in Germany he obtained his PhD from Royal Holloway, University of London, where he carried out precision measurements of CKM (Cabibbo–Kobayashi–Maskawa or 'quark-mixing') matrix elements and the bottom and charm quark masses by analyzing the data collected with the BaBar experiment at SLAC National Accelerator Laboratory in Stanford, California.

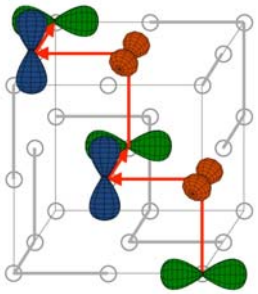
For the past five years Henning has been working on experiments at the world's most powerful particle accelerator, the Large Hadron Collider (LHC), at CERN in Geneva, Switzerland.

As a member of the CMS collaboration his current research is focused on searching for signs of supersymmetric particles produced in proton-proton collisions at the LHC.

In October, **Dr Jasper van Wezel** joined the Theoretical Physics group in Bristol as a Lecturer in Condensed Matter Theory.

Jasper (right) is interested in the physics of spontaneously ordered arrays of electric charge density. Such arrays may take on all kinds of shapes and periodicities, and Jasper recently discovered that in certain material types, the electrons can even spontaneously organise themselves into corkscrews of charge density. The left or right handedness of these structures provides an opportunity for new and potentially useful properties to arise in the materials hosting them.

Jasper came to Bristol from Argonne National Laboratory in Chicago, where he held the Aneesur Rahman Fellowship. Before that, Jasper was a Junior Research Fellow at Homerton College, Cambridge, and he obtained his PhD from Leiden University in the Netherlands.



New to Bristol – pictured clockwise from top right: Dr Paddy Royall, Dr Henning Flaecher, Dr Jasper Van Wezel and Dr Tony Short.

Image above left shows a schematic view of the configuration of electron clouds in Tellurium. The resulting corkscrew of electron density is indicated by the red arrows.

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