INSTITUTE OF PHYSICS

IOP Institute of Physics
Particle Accelerators and Beams Group

IOP PAB GROUP NEWSLETTER

Issue 14

December 2016

Editorial

The Particle Accelerators and Beams Group was founded about 8 years ago with just a handful of members. I'm happy to say that, after the stewardship of the Group Chairs Mike Poole of STFC ASTeC and then Phil Burrows of Oxford University and John Adams Institute, we are now approximately 450 members of which 95 are students, 115 are Members, 32 are Fellows, 109 are Associate Members and 90 are Affiliates – a good spread across our membership base. While this result is certainly due to Mike, Phil and the other committee members' commitment to making the PABG work, and we thank them greatly for that, it is also due to the dynamic and diverse range of topics and interests that PABG members represent.

I know as incoming Chair that our Group Officers, Aled Jones (Group Secretary) and Jonny Smith (Group Treasurer) and the other members of the committee (see our short biographies on pages 2, 3 and 4) will be working hard to maintain our level and standard of assistance in the organisation of topical meetings and outreach. We are also here to help inform our members of issues that affect their professional activities and to help reflect their views to the wider world including funders and policy makers – an important function in these 'interesting times'.

I think you will agree from the range of events reported in this and previous newsletters, that the activities we support and organise truly are 'dynamic and diverse'. However, we know we can always do better. So, ideas and suggestions are very welcome from across our membership – please drop me an email.

Finally, as the festive period approaches, I would like to wish you and yours a peaceful and merry Christmas!

Brian McNeil

Group Chair

Inside this issue:

The Particle Accelerators and Beams Group Committee

Brian McNeil (Group Chair) is an academic in the Department of Physics at the University of Strathclyde in Glasgow and from early 2017 will be a member of the Cockcroft Institute. He conducts research into the theory of collective effects in systems of particles and has concentrated on studying such effects in relativistic electron beams as sources of tunable, coherent light – Free Electron Lasers. Brian has had a close collaboration for many years with ASTeC staff at the STFC Daresbury Laboratory and is currently involved in their research towards a UK X-ray Free Electron Laser. He teaches Properties of Matter and Statistical Thermodynamics at undergraduate level and has supervised several PhD students over the years.

Aled Jones (Group Secretary) is the Team Leader for Pulsed Power Science and Neutron Tube Physics Teams at the Atomic Weapons Establishment (AWE) in Aldermaston UK. His research interests include developing technologies to compress electrical energy in order to create high intensity X-ray flashes for the radiography of explosive experiments. He has led several interactions with both the US and French government counterparts; instigating collaborations on target surface preparation and particle-in-cell modelling. He is also AWE's Technical Authority for Pulsed Power, responsible for providing authoritative advice on the subject, developing the long range planning and underwriting the technical output of this sub-function at AWE. Aled is a Chartered Physicist with the IoP and a Senior Member of the IEEE.

Jonathan Smith (Group Treasurer) is a computational accelerator physicist employed by Tech-X UK Ltd as a research scientist and application engineer. After five years designing RF sources at e2v, he completed a PhD at Lancaster University on the topic of collimator wakefields in electron positron colliders and has been with Tech-X since 2009. He specialises in the use of high performance computing for calculations in 'novel' acceleration schemes, technological plasmas and microwave devices.

Talitha Bromwich is a PhD student at Oxford University based in the John Adams Institute for Accelerator Science. Her research focuses on developing technologies for future high-luminosity linear colliders, particularly on beam-based feedback systems. She conducts her research in Oxford and at the KEK Accelerator Test Facility in Japan. She completed her Masters at the University of Sussex in dark matter direct detection techniques.

Philip Burrows is Professor of Accelerator Physics at Oxford University and Associate Director of the John Adams Institute for Accelerator Science. He works on high-energy electron-based accelerators, in particular future electron-positron colliders, and specialises in ultra-fast feedback systems for beam trajectory control. He is Spokesperson of the CERN-based Compact Linear Collider (CLIC) accelerator project.

Graeme Burt is a senior lecturer in Engineering at Lancaster University and the Cockcroft Institute, and has a PhD in physics from Strathclyde University. His research interest is RF systems for particle accelerators, particularly in deflecting cavities, RF sources, THz acceleration and security and medical applications of accelerators. Graeme is the project manager for HL-LHC-UK, is a co-founder of the cross IoP/IEE/IMechE Accelerator Engineering Network, and is an associate director of Security Lancaster.

Stephen Gibson is a Reader in Accelerator Physics at Royal Holloway University of London, with a background in Particle Physics on the ATLAS experiment at Oxford and CERN. His current research in the John Adams Institute for Accelerator Science is focused on the High-Luminosity upgrade of the Large Hadron Collider, especially on the collimation system and he leads the development of advanced instrumentation to monitor intra-bunch motion with fast electro-optic pick-ups. His group also specialises in laserwires to measure the properties of intense hydrogen ion beams at new accelerators such as CERN's Linac4 and the Front End Test Stand at RAL.

Particle Accelerators and Beams Group Committee members hard at work at Institute of Physics headquarters in September 2016
(Credit: PABG)

Andrew Rossall joined the Medium Energy Ion Scattering (MEIS) Facility at the International Institute for Accelerator Applications (IIAA), University of Huddersfield in October, 2015. His current role at Huddersfield is to provide a computational capability for beam interaction physics, to assist with the consolidation and expansion of the MEIS facility and to assist with and help further develop the MEIS research programme. Prior to joining Huddersfield, PhD research was undertaken at the University of York (York Plasma Institute) and examined the use of laser produced plasma sources as probes for plasma opacity, a source for fast particle production and the 2D imaging of hydrodynamic instabilities. He gained postdoctoral experience at the Institute of Cancer Research (ICR) researching detector technology for multi-spectral (colour) X-ray imaging and at the University of York developing a computational framework to simulate EUV and X-ray beam interaction with solid material.

Susan Smith is Head of Daresbury Laboratory and Director of STFC's Accelerator Science Technology Centre (ASTeC). A graduate of Glasgow University, Susan started as a physicist in 1985 at Daresbury Laboratory on the development of the SRS and then the design of the Oxford Compact Source. From ~1995 until 2007 she led the lattice design for the UK's Diamond Light Source and then progressed to the leadership of accelerator studies.

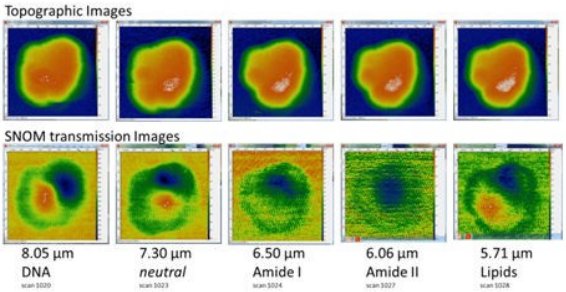
John Thomason is Accelerator Division Head for the ISIS spallation neutron source, responsible for ISIS accelerator operations and the R&D which will support running optimally and sustainably for the lifetime of the facility. He also coordinates efforts towards the design of potential ISIS accelerator upgrades and more generic high power proton drivers. John is a member of the STFC Accelerator Strategy Board and the Accelerator Technical Advisory Committees for the US and Chinese spallation neutron sources.

Melissa Uchida is a post doctoral research associate in particle physicist at Imperial College London. She is currently working on the MICE Muon Ionisation Cooling Experiment aiming to reduce the transverse emittance, while maintaining the longitudinal emittance of a muon beam, for use in a muon collider or neutrino factory. She previously worked on the cryogenic Neutron Electric Dipole Moment experiment at the Institut Laue Langevin (Grenoble) with the University of Sussex and on the T2K long baseline neutrino oscillation experiment in Japan with Queen Mary University of London, work which won her and her colleagues the Breakthrough Prize in Fundamental Physics in 2016.

Peter Williams is a senior physicist at Daresbury Laboratory in STFC's accelerator science department. He specialises in electron beam dynamics simulations and their applications to accelerator-based facility design. Currently Peter is the lead accelerator physics designer for CLARA - the UK's free-electron laser test facility. Previously, he has conducted commissioning and experimental work on the Daresbury ALICE energy recovery linac and EMMA non-scaling fixed-field alternating gradient accelerator, and design work on the New Light Source and 4GLS projects. Peter has also been involved in a number of international projects, in particular conducting tolerance studies for the Swedish Max-IV linac.

News from the Laboratories — Daresbury

ALICE Sheds Light for Cancer Research



Data obtained using the ALICE FEL in March 2016 (Credit: ASTeC)

The final ALICE (Accelerators and Lasers in Combined Experiments) run for the EPSRC funded cancer research consortium was highly successful, justifying the investment in the accelerator, beamlines and user equipment during the course of the grant. The consortium consisted of scientists from Liverpool, Manchester, Lancaster and Cardiff Universities working with clinicians from the Christie, Royal Liverpool and Broadgreen Hospitals and the Lancaster Royal Infirmary and the Welsh Cancer Bank. The first chemical map of a glandular gastric/oesophageal cancer cell was generated using the ALICE infrared free electron laser, and the highlight of the run was the production of the sub-diffraction chemical imaging of a chromosome in a cancer cell. The team is currently working on the detailed analysis of the data taken during this run. The science consortium involved has strongly supported ARTFUL (Advanced infraRed/ Teraherz Facilities for Users of Lasers), a mid-range facilities bid to EPSRC. This seeks to secure access to infra-red FEL light for the UK science community going forward.

Accelerators in Europe

ASTeC has secured key responsibility in both the ARIES Integrated Activity and AMICI Infrastructure and Innovation H2020 proposals, which were successfully submitted to the EC in March 2016. ARIES (Accelerator Research and Innovation for European Science and Society) comprises 42 collaborating institutes with a total EC funding request of €10M. ASTeC will take leading responsibility for the work package on thin films for superconducting cavities, whilst also providing the electron photo-injector facility VELA at Daresbury, as an accelerator platform for trans-national access for European researcher utilisation. AMICI (Accelerator and Magnet Infrastructure for Cooperation and Innovation) comprises 10 collaborating institutes with funding of €2.3M. ASTeC will take leading responsibility for the work package on innovation with industry.

LINAC2020

At LINAC16 in East Lansing, Michigan (25-30 September 2016) a UK collaboration between ASTeC and the Cockcroft and John Adams Institutes won the competition to host LINAC 2020 in Liverpool. Peter McIntosh (ASTeC) will chair the local organizing committee and Graeme Burt (Lancaster University) will chair the scientific programme committee.

High Power Proton Beams Workshop

The Open Collaboration Meeting on Superconducting Linacs for High Power Proton Beams (SLHiPP) was born in 2011 as a more general successor to the Superconducting Proton Linac (SPL) collaboration programme. This meeting was initiated in order to foster collaborative opportunities across synergetic groups working in the field of superconducting high power proton linacs, encompassing all aspects of accelerator system development from SRF cavity and cryomodule designs, input and HOM coupler technologies, RF control, optimisation and RF amplifier systems.

Delegates to SLHiPP-6
(Credit: Cockcroft Institute)

The 6th meeting in the series was held at the Cockcroft Institute at Daresbury Laboratory (23-24 May 2016), which provided more than 65 participants from 18 international organisations an opportunity to exchange updates and developments in new technology areas and applications for high intensity proton linacs utilising superconducting RF techniques.

Photocathodes for Particle Accelerator Applications

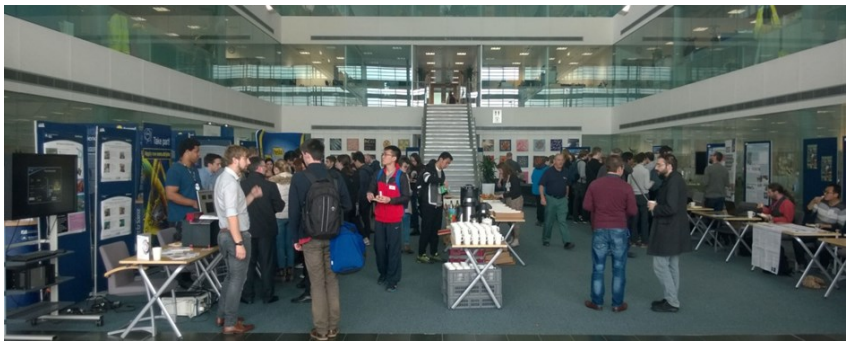
ASTeC organised and hosted the first European Workshop on Photocathodes for Particle Accelerator Applications at the Cockcroft Institute in June 2016. This first European workshop focused on advanced photocathodes with participants from 23 international Laboratories, Universities and Industries, covering fields of metallic, semi-conductor and alkali photocathodes, photo-emission theory and photocathode performance.

Examples of photocathode R&D at (l - r) CLARA, SwissFEL and FLASH
(Credit: ASTeC)

News from the Laboratories — RAL

National Particle Accelerator Careers Open Day

On the Wednesday 26 October 2016, the Rutherford Appleton Laboratory hosted the National Particle Accelerator Careers Open Day, sponsored by the Institute of Physics, the Science and Technology Facilities Council (STFC), the John Adams Institute for Accelerator Science (JAI) and the Cockcroft Institute of Accelerator Science and Technology (CI). The day was organised to show university undergraduates what a rich variety of post-graduate careers and training options are available in the world of particle accelerators, and of course spreading the word to universities is a key PR and recruitment goal for the accelerator community. The event attracted a total of 45 students from 10 universities and had a strong attendance of female students at 33% of the total.



The industrial exhibition in the atrium of Diamond House
(Credit: STFC)

Starting with a networking session over a buffet lunch in the atrium of Diamond House, the day moved on to a series of talks. Diamond Light Source CEO Andrew Harrison welcomed the group and described the valuable work that STFC undertakes for UK science using accelerator technology. Phil Burrows from the JAI gave a comprehensive overview of particle accelerators worldwide and their diverse uses and outlined the mind-boggling array of possible paths students could take, emphasising the importance of collaborations between the three main sectors of academia, national laboratories and industry. Jose Abelleira Fernandez from the JAI described the exciting opportunities afforded by PhD studies of accelerators. David Posthuma de Boer from the ISIS neutron and muon source gave a very interesting account of working on proton beam diagnostics as part of the STFC graduate training scheme. Finally Per Bergfjord and Marianna Kydonieos from Elekta discussed the fast-paced life of a commercial medical accelerator company manufacturing two linacs every day.

After the talks were two further activities. The group had the opportunity to discuss career options in person with 11 exhibitors from STFC, CERN, universities and industry; the exhibition was a lively event with video displays, vacuum systems and facility models. In parallel with this were tours of the UK's two large accelerator based facilities, ISIS and Diamond. The students found it exciting to see real working equipment, and to be shown around by enthusiastic, expert staff members.

Overall, the Careers Open Day was a great success. Feedback was excellent, with both the students and exhibitors appreciating the chance to network and find out more about the many career opportunities available in the accelerator sector.

John Thomason

EuPRAXIA — the First Year from a JAI Perspective

The EU project EuPRAXIA (European Plasma Research Accelerator with eXcellence In Applications) started on 1 November 2015. By the end of 2019, EuPRAXIA will produce a conceptual design report for the world's first 5 GeV plasma-based electron accelerator with industrial beam quality and dedicated user areas. EuPRAXIA is the required intermediate step between proof-of-principle experiments and versatile ultra-compact accelerators for industry, medicine or science, *e.g.* at the energy frontier of particle physics as a plasma linear collider. The study will design accelerator technology, laser systems and feedback systems for improvement of the quality of plasma-accelerated electron beams. Two user areas will be developed for a novel free-electron laser, high-energy physics and other applications. An implementation model will be proposed, including a comparative study of possible sites in Europe, a cost estimate and a model for distributed construction, but with installation envisaged at one central site. As a new large research infrastructure, EuPRAXIA should place Europe at the forefront of the development of novel accelerators driven by the world's most powerful lasers in the 2020s. The EuPRAXIA project is supported by a grant of €3M awarded to 16 laboratories and universities from five EU member states (six from the UK). Additional in-kind contributions come from participating institutions as well as from 22 associated partners.

Participants at the Pisa workshop
(Credit: EuPRAXIA)

During the first busy year of the design studies, workshops held at the end of June in Pisa, Italy, played a particularly important role. Particle accelerator experts from around the world met together with experts from the laser and novel accelerators communities to discuss the design of a European Plasma Accelerator in the framework of the EuPRAXIA and EuroNNAc (European Network for Novel Accelerators) projects. More than 120 registered workshop delegates discussed the parameters and technical specifications required at the interfaces between lasers, plasmas and particle beams, as well as particle beams and foreseen applications such as Free Electron Lasers (FELs), developments of High Energy Physics detectors, ultra-compact X-ray devices and other applications. Roman Walczak (University of Oxford) gave a plenary talk on applications other than FELs. The aim was to collect the input from all interested parties in order to define a full parameter set that will be used as the core of a conceptual design.

Of the 11 EuPRAXIA workshops held in the first year, two were co-organised by JAI members:

Arnd Specka (CNRS) and Roman Walczak, coordinators of Work Package 7 on High Energy Physics and other Pilot Applications, organised the EuroNNAc and EuPRAXIA Workshop on Pilot Applications of Electron Plasma Accelerators. The workshop took place at Ecole Polytechnique, Palaiseau, France (11-13 October 2016). 22 invited participants from four countries (nine from the UK) surveyed potential applications and corresponding requirements for EuPRAXIA electron beams. There were 22 presentations in six sessions, including one on plasma accelerators as a source of femtosecond X-rays for probing matter under extreme conditions by Stuart Mangles from Imperial College London. More than half of the time in each session was dedicated to discussions. The requirements in terms of beam parameters and infrastructure were defined.

Brigitte Cros (CNRS) and Zulfikar Najmudin (Imperial College London), coordinators of Work Package 3 on High Gradient Laser Plasma Accelerating Structure, organised a related workshop to prepare for the first report on the design of an electron injector and laser plasma accelerator stage. This was held on 26 October 2016 at Ecole polytechnique. During the workshop Zulfikar Najmudin reviewed the accelerator parameters required by the EuPRAXIA project; Thomas Audet (CNRS) and Matt Streeter (Lancaster University) reviewed techniques for controlling electron injection; and Simon Hooker and Brigitte Cros reviewed potential methods for guiding the driving laser pulses over the long distances required to reach the 5 GeV goal of EuPRAXIA. On the following day, Zulfikar Najmudin presented a summary of the workshop at the first yearly meeting of EuPRAXIA.

Participants at the first yearly meeting of EuPRAXIA
(Credit: EuPRAXIA)

During the two days of the first yearly meeting of EuPRAXIA, all aspects of the project activities were discussed. This included the formation of the collaboration, hiring of new personnel, investigation of facility parameters and outcomes of all 11 workshops. An executive session of the EuPRAXIA Collaboration Board was held on 27 October 2016. Among other decisions taken by the Collaboration Board, Massimo Ferrario from LNF-INFN was elected chairman of the Collaboration Board and the first members of the EuPRAXIA Advisory Board were approved: the companies Thales (France), Amplitude (France) and TRUMPF Scientific (Germany). The meeting finished with presentations on CILEX (France), EuSPARC (Italy), SINDBAD/ATHENAe (Germany) and the GEMINI upgrade project (UK; presented by Daniel Symes (STFC, Central Laser Facility)). These presentations kick-started the first brainstorming on the ESFRI roadmap and possible sites for a future EuPRAXIA research infrastructure in Europe.

Roman Walczak

USPAS Praises JAI Training Methods

The US Particle Accelerator School front web-page has recently been updated to highlight an achievement of which the John Adams Institute (JAI) should also be proud.

Students from Andrei Seryi's course present their work at NAPAC
(Credit: USPAS)

At the Summer 2016 USPAS session Prof. Andrei Seryi assisted by Dr. Aakash Sahai (JAI at Imperial College), taught the course 'Unifying Physics of Accelerators, Lasers and Plasma – Synergy and Bridges'. This class turned out even more successful than had been hoped.

USPAS colleagues wrote that 'As a class project, Prof. Seryi's students designed a novel light source based on a laser-plasma accelerator. They then wrote a paper detailing their idea for submission to the 2016 North American Particle Accelerator Conference. The paper was selected for an oral presentation and the talk was given by Marlene Turner, a PhD candidate from CERN. Congratulations to Andrei and to his entire class for their work. This is a first for a USPAS course'.

USPAS delegates at NAPAC
(Credit: USPAS)

The student design project, which is a very effective learning-by-doing approach, allows many areas of accelerator, plasma and laser physics to be connected and produces a detailed conceptual design after just a few-week-long course. This training approach was introduced in JAI by Prof. Ted Wilson, who we will all miss and remember (see obituary on page 22), and its success is a tribute to him.

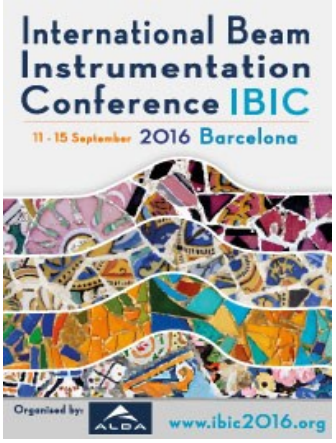
Andrei Seryi

John Adams Institute for Accelerator Science

U.S. Particle Accelerator School
Education in Beam Physics and Accelerator Technology

International Beam Instrumentation Conference

The International Beam Instrumentation Conference (IBIC) deals with the instruments and technology required to measure the properties of beams in particle accelerators. It brings together experts on both longitudinal and transverse beam diagnostics, and presents the commissioning of these devices at particle accelerators around the world.



For IBIC'16 in Barcelona (11-15 September 2016) a special 'speaker's corner' session was introduced, where any conference delegate could present a particular issue they were facing or suggest novel, untested ideas. It was particularly stimulating to see how experts in the field would engage to discuss their views and generously provide many suggestions to the speakers. I hope to see this type of session introduced in future conferences.

In addition to learning more about my specific area of research in beam position monitors and their application to fast beam position feedback systems, it was very interesting to find out about the particular requirements and challenges at other machines such as plasma accelerators. It is through conferences like this one that we can learn about each other's progress and exchange ideas to progress further.

A particularly memorable presentation was the talk given by Hermann Schmickler, which was different from the other technical presentations, as he delved into his own experience on the importance of international collaborations in our field. He shared his insight regarding some of the difficulties one can expect to encounter and how to prepare for them, but also emphasised the rewarding aspects of participating in such collaborations.

The conference closed with a tour of the ALBA synchrotron facility, half an hour drive from the conference venue in central Barcelona. We were taken inside the accelerator tunnel and around the beamlines, where experts described the functioning of the machine and their research expertise.

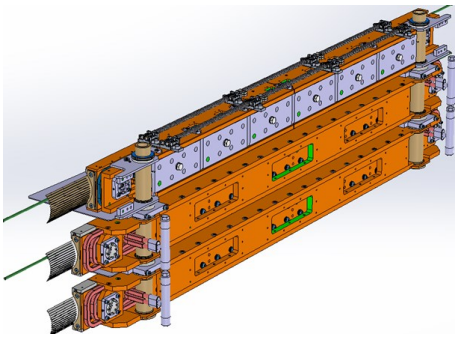
The IBIC conference photograph
(Credit: IBIC)

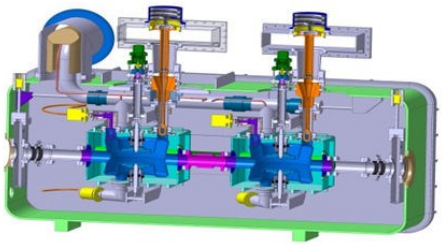
In my opinion, the conference was a success and I would recommend it to researchers working in beam instrumentation for particle accelerators. I would like to thank the Particle Accelerators and Beams Group of the Institute of Physics for making this trip to IBIC possible through the Early Career Researchers Fund.

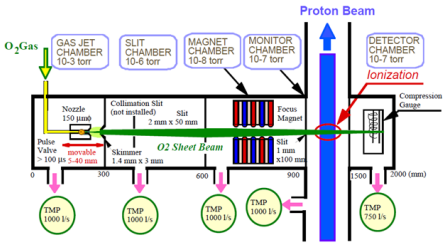
Neven Blaskovic Kraljevic

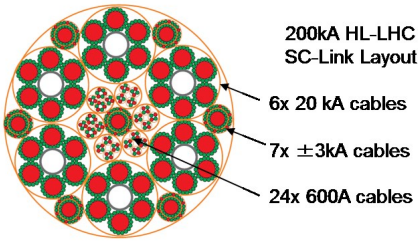
HL-LHC-UK Launches!

The LHC is now operating extremely well and searching for its next success after the Higgs boson. At the same time a large international team is preparing for the upgrade to the machine's luminosity in the 2020s, known as HL-LHC. This will enable scientists to look for new, very rare fundamental particles, and to measure known particles like the Higgs boson with unprecedented accuracy. This will be achieved by increasing the number of collisions per second, known as luminosity, which directly gives the number of physics events in a given time period. The chance of seeing very rare particles is increased and the higher number of collisions also makes measurements of particle's properties much more accurate, for example the properties of the Higgs boson. With this upgrade, the LHC will continue to push the limits of human knowledge, enabling physicists to explore beyond the Standard Model and Brout-Englert-Higgs mechanism.









Examples of HL-LHC-UK developments for (t - b) collimation, transverse deflecting cavities, beam diagnostics and cold powering (Credit: HL-LHC-UK)

HL-LHC-UK is a collaboration consisting of seven UK institutions that will perform cutting edge R&D and deliver essential hardware to the HL-LHC. It launched in April this year and comprises the University of Manchester (Cockcroft Institute), Lancaster University (Cockcroft Institute), the University of Liverpool (Cockcroft Institute), the University of Huddersfield (International Institute of Accelerator Applications), Royal Holloway University of London (John Adams Institute), the University of Southampton and the Science and Technology Facilities Council (STFC). The spokesperson is Rob Appleby (Manchester) and the project manager is Graeme Burt (Lancaster).

These institutions will perform R&D and deliver hardware to the LHC upgrade in four areas. The first area is novel techniques to control stray, or halo, protons through sophisticated beam collimation, vital to the high intensity and high-energy operation needed to produce the luminosity. The second requires the development and test of transverse deflecting 'crab cavities' to rotate the colliding proton bunches to maximise the luminosity. The third is the development of novel beam diagnostics to measurement the beam properties and optimise the luminosity. The final area is the delivery of sophisticated cold powering cables, necessary for the complex cryogenic cooling of the upgraded LHC.

The collaboration has an open plenary meeting twice a year around the UK, which is open to anyone from the community.

Rob Appleby

Cockcroft Institute Accelerator Science Lecture Series Publically Available Online

The Cockcroft Institute runs an education and training programme through a biannual series of lecture courses. All lectures are captured by webcast and both the archived recording and accompanying lecture slides are made available to everyone via the Cockcroft Institute webpages.

The Cockcroft Institute is an international centre for accelerator science and technology in the UK. It is a joint venture of Lancaster University, the University of Liverpool, the University of Manchester, (the University of Strathclyde is to officially join soon) the Science and Technology Facilities Council and Northwest Regional Development Agency. This provides an exceptional breadth across accelerator science research and makes the lecture topics both diverse and cutting edge.

The Cockcroft Institute
of Accelerator Science and Technology

The courses are organised under five themes: general accelerators, beam dynamics, radio frequency systems, magnets and radiation sources, and short-wavelength accelerators (including plasma-based and dielectric accelerators). A series of introductory lectures covers the foundation topics and introduces the fundamental principles of accelerator science. Courses on more specialised topics, such as Free Electron Lasers, superconducting RF and Plasma Wakefield Accelerators, introduce and explore advanced and innovative technologies and research topics.

The Cockcroft Institute currently has several PhD studentships advertised on the website if you would like to experience the lectures first hand! (Closing date 13 January 2017).

For more information please contact Dr Louise Willingale.

IoP Particle Accelerators and Beams Group Prize

The Particle Accelerators and Beams Group of the IoP is seeking nominations for the 2017 Prize for Outstanding Professional Contributions. This will recognise the contribution made by an individual to the field of accelerator science and technology in the UK or Ireland whilst also enhancing the public profile of the subject.

Previous recipients of the prize are Mike Poole (2016), Chris Prior (2014), Ian Gardner (2013) and Neil Marks (2012).

The Prize can be awarded to a person of any nationality although the nomination must be made by an IoP member. The identified personal contributions should be demonstrated to have had significant impact on major scientific or technological advancement, or alternatively to have promoted important educational or outreach activities.

A maximum two page summary case must be submitted, together with a small amount of ancillary material, including major citation evidence (where relevant). Up to three letters of support for the candidate may also be included. The material must be submitted to the PAB Group Secretary, Aled Jones by the nomination deadline of 26 February 2017.

A Prize Committee has been appointed and will meet to determine the award winner. The recipient will be presented with a certificate at the PAB Group Annual Conference on 7 April 2017 at Royal Holloway and will be invited to give the prize lecture at the PAB Group Annual Conference 2018.

Neutrino 2016

The XXVII International Conference on Neutrino Physics and Astrophysics (Neutrino 2016), jointly organised by Imperial College London and the Institute of Physics, was held in South Kensington (4-9 July 2016). Somewhat to the organisers', and certainly to the venue's, surprise, registration was so rapid in advance of the 2 May 2016 early registration deadline that registration was closed on 15 May 2016 to ensure that the number of delegates would not exceed 700, the maximum that the venue can accommodate. The large attendance reflects the growing interest in the field and the resulting growth in the neutrino-physics community in recent years.

Neutrino 2016 proved to be an exciting celebration of the fundamental physics of the neutrino and its applications in the areas of security, geoscience and detector development. The meeting started with presentations from the two 2015 Nobel Laureates in Physics, Professors Kajita and McDonald, on the work they had done to establish the phenomenon of neutrino oscillations. The new data presented at the conference included tantalising results that hint that matter/antimatter symmetry is violated by neutrinos, evidence for extremely high energy neutrinos from astronomical sources, new limits on the existence of neutrinoless double-beta decay and much more besides. Experiments that measure the properties of extra-galactic neutrinos to allow the study of the Universe were presented and, following a presentation of the recent discovery of gravitational waves, the rich new field of 'multi-messenger astronomy' was explored in a dedicated session.

The next generation of accelerator-based experiments, the Deep Underground Neutrino Experiment (DUNE) in the US and Hyper-K in Japan, were discussed along with the Short Baseline Neutrino Program at Fermilab. To realise these experiments requires the energetic detector R&D programme that is presently being executed across the world. A centrepiece of this programme will take place at the CERN Neutrino Platform that will host prototypes of the DUNE liquid-argon time-projection chambers as well as other detector-development activities. The sensitivity of DUNE is based on the assumption that the Long Baseline Neutrino Facility at FNAL will provide a proton-beam power of 1.2 MW on target by 2026, with an upgrade to 2.4 MW by around 2030. Similarly, the sensitivity of Hyper-K rests on the assumption that the J-PARC neutrino beam will be served by a 1.3 MW proton beam by 2025.

An energetic programme of accelerator R&D is required to deliver high-power proton beams of the quality necessary to serve the DUNE and Hyper-K collaborations. Novel techniques will be required should it be necessary to mount experiments with a sensitivity that exceeds that of DUNE and Hyper-K. Therefore, supported in part by the Particle Accelerators and Beams Group's generous sponsorship of the conference, a dedicated session on the accelerator R&D required to deliver the requisite beams and targets at FNAL and J-PARC was organised. This session also included a contribution on the development of high-brightness muon beams to provide neutrino beams of high quality. Recent results from the international Muon Ionisation Cooling Experiment (MICE), which is underway at RAL, were also presented. The novel accelerator techniques required to deliver particle-decay at rest experiments and the physics potential of novel neutrino beams from pion and muon decay were also presented.

In parallel with the excellent scientific programme, a vibrant outreach programme was delivered through three activities, each targeted at a particular group. Brian Cox gave a public lecture that was open to high-school students and the general public. The hall at the Royal Geographical Society was packed out and the question-and-answer session carried on long after the formal lecture had finished. Six groups of ten students from different junior high schools in outer London were treated to a day of neutrino-themed activities in Imperial's purpose-built Wohl Reach-Out Laboratory. Activities included a live satellite link to IceCube scientists at the South Pole, a planetarium session on supernova neutrinos and the chance for the students to build their own cosmic-ray detectors and to detect neutrino-induced muons. A centrepiece of the outreach programme was a national competition for primary- and high-school students from across the UK to create a design to be painted on the magnetic shielding walls of the MICE experimental hall. Schools were invited to bring groups of students for a day to RAL to learn about the science for which MICE is a technology demonstrator and to visit the MICE Hall. Older students attended lectures on particle physics and its engineering challenges, while our younger visitors learnt about the structure of matter and made models of particles that they could take home. Two finalists were selected from the many entries received. The finalists were invited to the public lecture given by Brian Cox and the prizes were presented by Brian Cox and Art McDonald at the start of the public lecture.

The Neutrino 16 conference photograph
(Credit: Neutrino 2016)

Many national funding agencies and other bodies expect scientists to show the impact of their research and its relevance to the wider community. Therefore a session with the title 'Impact: wider applications of neutrino science' was organised. The main objective of this session was to show that neutrino science has allowed a diverse range of applications to be developed that have benefited industry and/or have impact beyond pure neutrino science. The 'impact session' was followed by a poster session together with an 'Industry Reception'. In addition to the conference delegates, those invited to the impact session included representatives of the Institute for Security Science and Technology, members of the Imperial College Physics Industry Club, the industrial exhibitors and members of the STFC impact team.

Incremental development of present accelerator techniques is vital to delivering the sensitivities promised for the next generation of accelerator-based neutrino experiments. Looking beyond the next-generation experiments, novel techniques, such as particle-decay at rest or muon-based neutrino sources, will be required to reduce beam-related systematic errors. In the short term, facilities such as nuSTORM have the potential to serve programmes of measurement by which the sensitivity of experiments such as DUNE and Hyper-K is maximised. By becoming a sponsor of Neutrino 2016, the Particle Accelerators and Beams Group was able to contribute to the shining of a spot-light on the critical contribution that accelerator science has to make in the future of studies of the properties of the neutrino.

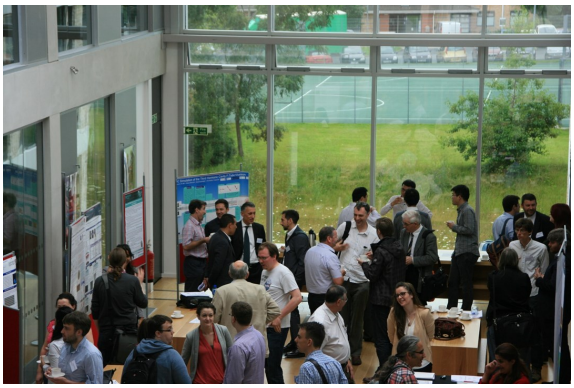
Ken Long

National Vacuum Electronics Conference

The National Vacuum Electronics Conference (NVEC) 2016 took place on 18 July 2016 at Lancaster University. Once again the conference proved to be an excellent opportunity to gather researchers and engineers from both academia and industry who contribute to the on-going development and advances in Vacuum Electronics and RF Science and Engineering research and development in UK. In particular, the NVEC 2016 meeting encouraged contributions from early career researchers and PhD students, providing many opportunities for networking and engaging with the leaders steering UK research and development in this field.

The conference comprised four sessions during the day and covered a wide range of topics around RF science and vacuum electronics, including vacuum tube design (klystrons, gyrotrons and backward wave oscillators), mm-wave/ THz components and accelerators, metamaterials for high power vacuum electronics, gun and cavity design for particle accelerators, field emission, microfabrication technology and computational aspects. The plenary talk was given by Dr. Peter Huggard of RALSpace, STFC Laboratories on 'THz source and detector development at the Rutherford Appleton Laboratory'.

NVEC opening address
(Credit: Lancaster University)



NVEC delegates
(Credit: Lancaster University)

A special session of short talks was scheduled in the afternoon to maximise the opportunities for PhD students and early career researchers to give an oral presentation. Also, a talk from e2v Technologies provided early career researchers with an overview of what should be expected in the transition from academic research to industry. A total of 18 talks were provided during the day by colleagues from Lancaster University, the University of Strathclyde, the University of Huddersfield, the Cockcroft Institute, ASTeC STFC, Cambridge University, e2v, and CST. In addition, a poster session and a CST exhibition was organised during the lunch and coffee breaks.

All the sessions were well attended and generated a lively and constructive discussion.

Rosa Letizia

Lancaster University

Designing Future X-ray FELs

The workshop photo
(Credit: Daresbury Laboratory)

At the end of August, Daresbury Laboratory hosted an international workshop 'Designing Future X-ray FELs'. This was the first such workshop of its kind and was attended by over 50 leading international scientists who create the software using the latest computer hardware to design and squeeze the best possible performance from future Free Electron Lasers. Staff from the Cockcroft Institute/ASTeC and the Hartree Centre were heavily involved, as could be expected on the site where the CLARA FEL test facility is being built.

The Chair of the workshop, Brian McNeil of Strathclyde University, said 'There was a lot of international interest in the workshop and we managed to attract participants from as far afield as Stanford and Spring-8, to our EU colleagues at DESY, SwissFEL and many others. Many new ideas were discussed and a few collaborations started as a result of the workshop. We have had some great feedback. None of this would have been possible without the fantastic support from staff at ASTeC and the Hartree Centre who organised demonstrations of many of the design codes.'

Delegates designing future X-ray FELs
(Credit: Daresbury Laboratory)

The workshop dinner was held at the marvellous Ruthin Castle in North Wales where a medieval banquet was held. Copies of the talks and summaries of the Q&A sessions can found at the workshop website.

The workshop dinner at Ruthin Castle
(Credit: Daresbury Laboratory)

Brian McNeil

ADSR Workshop

The ADSR workshop - or 'International Workshop on Accelerator-Driven Sub-Critical Systems & Thorium Utilization' to give its full title - is a gathering of the widely-scattered community of ADS experts and thorium enthusiasts. It started in 2010 in Virginia, followed by Mumbai in 2011, and Virginia again 2014. In 2016 it was held in Europe for the first time, in Huddersfield, over three days (31 August - 2 September).

Delegates at the fourth ADSR workshop
(Credit: Bob Cywinski)

The need is definitely there. Climate change is upon us and no-one can doubt the consequences if we fail to kick the habit of using fossil fuels. A little arithmetic and common sense shows that this can't be made up by solar, wind and hydro power: that only nuclear power has the capacity to replace our dependence on coal and oil. But nuclear power brings its own problems, particularly the disposal of the long-lived radioactive waste. ADSR and thorium – together or separately – can provide a technical solution.

We know how to do it. There were many talks on reactor and accelerator designs, including the experience from accelerators already operating, such as ISIS and PSI, or under construction, such as the ESS in Sweden. The science and the engineering are in place.

Politically the scene is not so positive. In the US there is a lot of talk, but no action. In the UK there is not even talk; although we are, unlike Germany and Switzerland, committed to building new nuclear power stations, Hinkley Point is depressingly conventional. There are only two schemes getting off the drawing board in Europe: in Belgium, where a new accelerator system is being planned and is on the path of being designed and funded, and in Russia, where plans to convert an existing accelerator at Troitsk to a small ADSR are well advanced.

A 3D design of the MYRRHA accelerator and reactor planned at Mol, Belgium
(Credit: MYRRHA)

The good news comes from China. The growing demand for energy in the 1.4 billion population is being met by a programme of power station construction, including a large expansion of nuclear power. They are looking to ADSRs to solve the waste problem: plans are drawn up and prototypes are being constructed. It is hoped that the community, as represented at this conference, can help them in making this happen and then spread that to the rest of the world.

Talks focused partly on the relevant nuclear processes, and partly on the issues of building and operating the high current proton drivers that will be needed for such reactors. They covered a mixture of simulations for future machines and practical experience with past and present accelerators. We are looking not just at the physics, but at issues like reliability and cost. There was plenty of discussion both inside and outside the auditorium: it was a workshop in the real sense, not just (as sometimes happens) a collection of presentations. People talked to each other and one could feel collaborations being formed in what was a very pleasant and positive atmosphere.

The workshop in session
(Credit: John Thomason)

Sponsorship and support from the IoP Particle Accelerators and Beams Group, from the IAEA, and the University of Huddersfield contributed very significantly to the success of the conference.

Copies of the talks are can be found on the workshop website, whilst the proceedings are being gathered and are, or will be, available.

Roger Barlow

Workshop on the Physics and Engineering Opportunities at the Electron-Ion Collider

The first UK workshop on the US-based Electron-Ion Collider (EIC), focussing on the physics and engineering opportunities which the facility presents to the wider scientific community, was successfully held at Ross Priory on Loch Lomond (13-14 October 2016), organised by Daria Sokhan from Glasgow University and co-sponsored by the STFC and the IoP.

Delegates at the first EIC workshop
(Credit: Glasgow University)

Talks were spread over two days with a wide range of presentations by those leading the EIC effort across multiple fronts: on the accelerator design, the theoretical motivations and experimental opportunities and the detector R&D. There was much animated discussion both after the talks and in the evening, facilitated by the excellent catering at Ross Priory, the beautiful scenery and a whisky tasting. Some participants joined remotely and a number of areas of interest and opportunities for UK involvement became clear in the discussions, which also focused on the mutual benefits of a greater European involvement in the project. The new ideas are being pursued after the workshop and will hopefully lead to new collaborations. The success of this pilot, and its much-applauded venue, lays the ground for a larger scale workshop in the future.

Ross Priory
(Credit: Glasgow University)

The physics motivations for the high-luminosity EIC, which will be the world's first polarised electron-ion collider, span a broad range of QCD phenomena under different conditions. There was an extensive account of the two versions of the collider under consideration — JLEIC, to be based at Jefferson Lab (JLab), Virginia, where an electron accelerator already exists, and eRHIC, which would make use of the existing ion beam-line at Brookhaven National Lab (BNL), New York — given by Dr. Fulvia Pilat, the deputy associate director of the accelerator division at JLab, and Dr. Ferdinand Willeke, the director of the accelerator

division in the photon sciences at BNL. The discussion generated interest from the UK community and possibilities of collaboration are being explored as a result. A number of talks focused on detector R&D and Dr. Laura Gonella presented the Birmingham group's work on silicon tracking and vertexing for the EIC, which has recently been awarded funding.

The EIC programme will study aspects of nucleon structure across the widest range of scales, from the most 'active' and valence quarks to the quark-gluon sea, and investigate the behaviour of quarks and gluons in the full range of nuclear densities. The physics case was presented by Prof. Deshpande of Stony Brook University, Dr. Yoshida and Dr. Aschenauer who are leading the EIC programme at JLab and BNL respectively, and a number of European and US collaborators, who also gave the perspectives of the French and Italian teams working on the project.

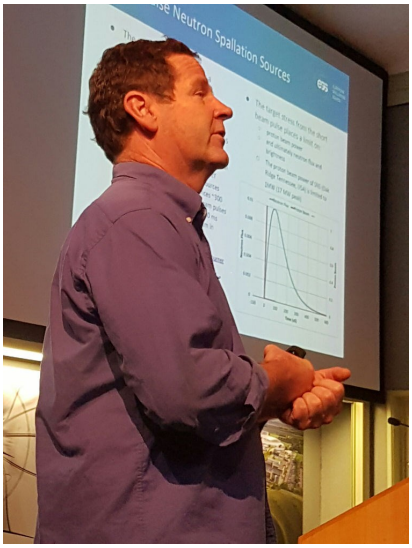
The programme and all talks are available through the main workshop website.

Daria Sokhan

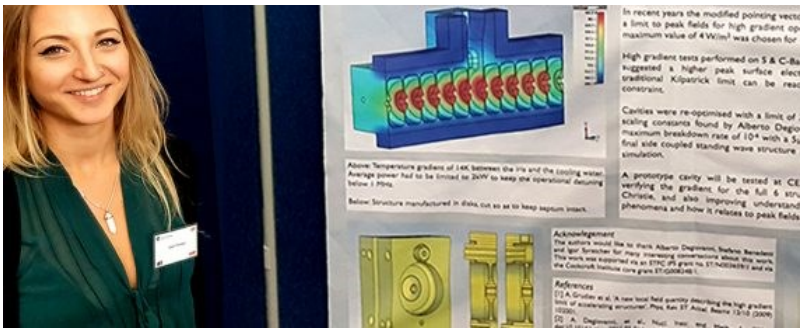
Accelerator Engineering Network Meeting

The 3rd Accelerator Engineering Network meeting, sponsored by IoP, IET and IMechE, took place at the Rutherford Appleton laboratory on 9 October 2016. The event had 121 registered attendees including engineers, physicists and technicians interested in the engineering of particle accelerators. The meeting was kicked off by a brief introduction from the network's lead, Dan Faircloth, followed by an invited talk on 'The Engineering of ESS' by Dave McGinnis, Head of Engineering at ESS. The event had an IET sponsored student poster prize which was won by Samantha Pitman of Lancaster University for her work on proton energy boosting extensions for medical imaging. The day before the event the network held the second technician training event, where technicians working on particle accelerators could learn about accelerator physics, technology and applications. This event was well received by all attendees and it is planned to be run again next year.

Graeme Burt



Invited speaker Dave McGinnis
(Credit: Dan Faircloth)



Poster prize winner Samantha Pitman
(Credit: Cockcroft Institute)

Obituary — Ted Wilson
(1938 - 2016)

I am very sorry to have to inform you of the death of Prof Ted Wilson. Ted played a key role in the development of accelerators at CERN, which he joined in 1967, and was involved in particular in the creation of the SPS accelerator together with John Adams. Following his work on the antiproton accumulator he became involved in in the conception of the LHC design and then in leading the CERN Accelerator School.

Ted's contribution to establishing accelerator science teaching at the John Adams Institute was enormous. Ted in particular introduced the student design projects, which connect the theoretical materials given during lectures with practice — this is now known as a worldwide JAI trademark.

Ted was working on preparing for JAI lectures for this term and for the student's design project until just a few weeks ago. We will all miss him enormously and will always remember his dedication to science.

The JAI-fest meeting on 2 December was dedicated to the memory of Ted Wilson.

Andrei Seryi

A more extensive obituary from CERN follows:

Edmund 'Ted' Wilson, a particle physicist and visiting professor at Oxford University and former head of CERN Accelerator School died after a short illness on 3 November.

Ted Wilson was born on 18 March 1938 in Liverpool, the son of school teacher John Wesley Wilson and nurse Anna Wilson. His passion for mathematics and physics was quickly recognized by his teachers at the Liverpool Institute High School for Boys, leading him to be accepted at Oxford University, where he graduated in Physics in 1959. Ted first worked in experimental particle dynamics at the Rutherford Laboratory but soon became interested in the theory of particle accelerators.

He moved to Switzerland in 1967 to become right-hand man to Sir John Adams - the "father" of the giant particle accelerators - preparing the design of the Super Proton Synchrotron (SPS), seven kilometers in circumference and stretching across the border between Switzerland and France. During SPS construction, he spent a sabbatical at Fermilab near Chicago, where he brought his experience to bear in coaxing Fermilab's new 500 GeV synchrotron into life. Ted returned to CERN to lead the commissioning of the SPS before joining CERN's ground breaking Antiproton Accumulator team which converted the SPS into a proton–antiproton collider.

It was while working in this field that Ted established a strong friendship with Fang Shouxian - the director of China's Institute of High Energy Physics, who had been seconded by the Chinese government to work with the physicists at CERN on the Antiproton Accumulator project. That friendship led Ted to travel to China on a number of occasions in the early 1980s as a guest of the government in a period when there were few links of any kind between China and the West. It is difficult to appreciate today just how unusual such collaboration was at that time. Ted achieved this in part through force of personality, a great sense of humour and natural diplomacy but also his underlying belief, gained through his work at CERN, in the value of international scientific collaboration.

Throughout his career he worked with laboratories across the globe, including Germany, Russia, the US and Japan. He was also a true internationalist. In his private life, he met his German wife Monika, while working in Switzerland and took Swiss nationality after 50 years of residence. In the later stages of his career and in retirement Ted turned his attention to inspiring international groups of young mathematicians and physicists in the design and use of particle accelerators in a variety of applications including medical science. He spent twelve years as head of the CERN Accelerator School and then rekindled his connection with Oxford University, becoming Visiting Professor in Oxford's John Adams Institute for Accelerator Science where he taught post-graduate students.

Ted believed the language of mathematics to be deeply intertwined with the language of music and this showed in his lifelong passion for classical music and opera. He was a keen and talented amateur pianist and singer and never happier than on his frequent visits to the opera. He was the author of two works on accelerators: Engines of Discovery and An Introduction to Particle Accelerators.

Ted is survived by his wife Monika; three sons, Martin, Alexander and Nicholas and five grandchildren.

Ted Wilson in the SPS control room in 1977
(Credit: CERN)

PAB Group & UK Events

Annual General Meeting of the PAB Group
Royal Holloway University of London, 7 April 2017

International Calendar

8th International Particle Accelerator Conference (IPAC'17)
Copenhagen, Denmark, 14 - 19 May 2017
https://ipac17.org/

Workshop on Energy Recovery Linacs (ERL'17)
CERN, Switzerland, 18 - 23 June 2017

The International Conference on RF Superconductivity (SRF'17)
Lanzhou, China, 17 - 21 July 2017

International Beam Instrumentation Conference (IBIC'17)
Grand Rapids, MI, USA, 20 - 24 August 2017

16th International Conference on Accelerator and
Large Experimental Physics Control Systems (ICALEPCS'17)
Barcelona, Spain, 8 - 13 October 2017
http://www.icalepcs2017.org/

Upcoming schools

CERN Accelerator School — Beam Injection, Extraction and Transfer
Erice, Italy, 10 - 19 March 2017
http://cas.web.cern.ch/cas/IET2017/IET-advert.html

CERN Accelerator School — Vacuum for Particle Accelerators
Lund, Sweden, 6 - 16 June 2017
http://cas.web.cern.ch/cas/Lund2017/Lund-advert.html

Useful Links

http://www.scitech.ac.uk/

http://www.cockcroft.ac.uk/

http://www.adams-institute.ac.uk/

www.diamond.ac.uk

http://www.desy.de/index_eng.html

http://www.linearcollider.org/newsline/

http://home.web.cern.ch/

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Dr. John Thomason (STFC RAL); *Newsletter*

Dr. Melissa Uchida (Imperial)

Dr. Peter Williams (Daresbury)

Deadline for submissions to the next newsletter is
9 June 2017