

# IOP PAB GROUP

## NEWSLETTER

Issue 20

December 2019

### Editorial

Welcome to Issue 20 of our Newsletter. As I sit here writing this on polling day, I know that everybody will know of the outcome by the time you read this. Whatever the outcome is, I hope there will be a little more stability and direction than we have seen in the recent past! What I am certain of is that the dedication and quality of work carried out by the members of our PAB Group will continue. Inside this Newsletter you will find many examples of this.

One way we can celebrate the good that we do is to recognise those that initiate and drive it forward via the Outstanding Professional Contribution Prize that we award each year at our Annual Conference (Friday 24 April, 2020 at University of Liverpool). So, please have a think and consider nominating one of these people – details on page 2.

Examples of current work reported in this Newsletter include new research being conducted by users of the CLARA facility at Daresbury Laboratory. The first user meeting in the Summer sounds like it was a great success with lots of new high quality research going through the publication pipeline. Let us hope that CLARA will also be used as it was first intended, as a test-facility for a future UK XFEL. There is currently a consultation series of workshops for potential UK XFEL users and I know there is a lot of exciting new science and applications being proposed by the UK community – thanks to Jon Marangos of Imperial College for leading these workshops.

Phil Burrows, of the John Adams Institute, tells us about progress of the European Strategy for Particle Physics (ESU) and gives us a snapshot of the current state-of-play and possible future directions for accelerators for colliders. This area of science has long lead-times and many interested countries, so the deliberations of the ESU Strategy Group meeting next month in Germany are awaited with bated breath.

It is good to see our community interacting with other IOP Groups via the joint event on Machine Learning with the Plasma, Computational and Polymer Physics Groups, held in October in the new IOP HQ at Kings Cross, London. Some sessions were at capacity and many new contacts were made.

The RF drivers of accelerators were discussed at the National Vacuum Electronics Conference, which PABG helped sponsor, held at Strathclyde University last month. There is a close industry interface here and the meeting included talks on a scary (well, for a theorist such as myself) 200 kW, CW RF generator with 3,000 transistors and an 89% efficiency!

Of course, we also need to keep the public informed, engaged and educated in the work we do. This was greatly helped by the Cockcroft Institute event at Liverpool University on a joint Star Wars/Accelerator theme. There is talk of 'The Force' and how it binds us all together, or something. Actually, we could do with a bit of that in the UK just now! How did the vote go, by the way?

If there is anything you think we could do better or should know of, please feel free to contact me at [b.w.j.mcneil@strath.ac.uk](mailto:b.w.j.mcneil@strath.ac.uk) and follow us on Twitter for updates of what is happening in our community [@PartAccelBeams](https://twitter.com/PartAccelBeams)

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## IoP Particle Accelerators and Beams Group Annual Conference, Annual General Meeting and Group Prize

The Particle Accelerators and Beams Group's Annual Conference will be held on Friday 24 April 2020 at the University of Liverpool. This will also include the Group's Annual General Meeting (AGM) and the award of the Group Prize for Outstanding Professional Contributions.

The group is always looking for enthusiastic members to join the group committee. The committee normally meets about 5 times a year. Its work includes organising topical workshops in the field of particle accelerators and beams, producing a group newsletter, awarding prizes for distinguished achievement in the field, and providing expert advice on consultations. This year we will have vacancies for:

- Chair
- Treasurer
- Ordinary Members

A call for self-nominations for the posts will be made in the New Year with an election process where necessary being held electronically before the AGM. The membership of the Institute is diverse — therefore we encourage our group committees to reflect this and we welcome nominations that reflect and celebrate the breadth, geographic spread and diversity of our community.

We will also be welcoming nominations for the Group Prize for Outstanding Professional Contributions which will be awarded at the meeting. Further details can be found on the [Group Webpages](#). The deadline for nominations is Friday 28 February.

[Andy Smith](#)  
*Group Secretary*



Previous Group Prize winners (clockwise from top left): Richard Walker (2018),  
Andy Wolski (2017), Mike Poole (2016), Chris Prior (2014),  
Ian Gardner (2013) and Neil Marks (2012).

## News from the Laboratories — Daresbury

### CLARA Holds First User Meeting

Phase 1 of CLARA successfully delivered ultra-high brightness electron beam of up to 40 MeV to 12 experiments from September 2018 - March 2019. The experiments included novel acceleration research with dielectric waveguides, direct acceleration with THz light and electron beam-laser plasma interactions, advanced electron diagnostics for future accelerators, superconducting in-vacuum undulator demonstration, industrialisation of accelerator components and the first measurements of high energy electron damage to single and double strands of DNA for potential cancer therapies of the future. The experimental programme was very successful and achieved excellent results. At least 6 journal papers have been published or are in the process.

On 17 June ASTeC hosted the first CLARA User Meeting, which was sponsored by the IoP Particle Accelerators and Beams Group and attended by about 60 academics and industrialists eager to hear about the results from the first exploitation period of CLARA and prospects for the future. In the morning there were two short talks concerning the beam allocation process (which essentially follows STFC and EPSRC good practice), the written feedback that had been solicited from the users and the changes that were being implemented in the current shutdown period. The feedback from the users was overwhelmingly positive with practically every experiment being judged to be successful. Some extra features, such as additional diagnostics, were suggested for future periods to enhance the output of the facility. More flexibility in the beamtime scheduling was also a common theme.



This was then followed by a number of wide ranging talks from the users of the first exploitation period covering the results they had achieved with CLARA as well as their plans for future experiments. Several speakers highlighted the pioneering aspects of their research and their plans for publication of results in high impact journals in the near future. The feedback on the CLARA accelerator performance was extremely positive and the positive attitude of the ASTeC and Technology Department staff towards making each experiment a success was mentioned by many speakers.

Some time was set aside in the afternoon to focus on the design and delivery of Phase 2 of CLARA, which will provide a dedicated user area fed by 250 MeV electrons with peak current of up to 6 kA. This upgrade was enthusiastically welcomed by the user community, with many highlighting new, world-leading experiments that will be made possible. Several new ideas were generated at the meeting as well. Finally it was announced that the next call for beamtime would be sent out in July 2019, with the first beam being made available in January 2020, following the Phase 2 preparation shutdown.

When the call was sent out it was again oversubscribed by a factor of two. Ten experiments (including three through the Horizon 2020 ARIES Trans-National access programme) were allocated beamtime and are scheduled over the period February to August 2020. CLARA is proving to be a unique European facility to test novel concepts and ideas.

[Jim Clarke](#)  
[Deepa Angal-Kalinin](#)

## New Vertical Test Facility Installed in Daresbury

A new Vertical Test Facility (VTF) developed by a multidisciplinary team of scientists from the Cockcroft Institute has been commissioned at Daresbury Laboratory for testing superconducting radio frequency (SRF) cavities at 2K.

Starting next year, the VTF will support an intensive testing schedule as part of the UK's in-kind contribution to the European Spallation Source (ESS). The ESS, currently under construction in Sweden, will be the world's most powerful pulsed neutron source.



Some of the Cockcroft Institute team involved in the design and build of Daresbury Laboratory's unique Vertical Test Facility.  
(Credit: STFC)

Key components of the ESS accelerator are the 84 high-beta SRF cavities which will be tested by the Cockcroft Institute team at Daresbury. The cavities will be tested for both their accelerating gradient and how efficiently they are able to sustain the radio frequency power used to provide the electric fields for accelerating the particle beam. Fantastic results have been seen in testing of the first prototype cavity.

Up to three cavities at a time can be assembled in the cavity support insert. The insert is mounted inside a 4 metre deep cryostat. The cryostat itself is housed in a deep well in a concrete bunker to provide radiation shielding. In here the team can cool the cavities to temperatures of less than 2K and perform a series of tests on each individual cavity.

The VTF has been designed in-house to reduce helium consumption by up to 70% and it recycles the gas to be reused. This represents a significant saving in terms of running costs.

This commissioning represents a significant step forward in the UK's accelerator testing and reprocessing infrastructure.

The team would like to thank STFC management, as well as international partners at CEA, DESY, ESS, INFN and JLab.

[Mark Pendleton](#)

## News from the Laboratories — RAL

### ISIS Operation with SNS Stripping Foils

As previously reported [Newsletter Issue 13, June 2016], in 2016 ISIS transitioned from using in-house produced aluminium oxide foils to commercially sourced carbon foils to strip  $H^-$  ions to protons at injection into the synchrotron. The carbon foils delivered significant savings in staff time and received dose, but useful lifetimes were limited to around 25 days of typical operation. [The SNS at Oakridge National Laboratory](#) (ORNL) has operated with specially developed, nano-crystalline carbon foils since 2006 with beams exceeding 1 MW. Their foil lifetime is routinely >4,000 Coulombs — equivalent to 200 days of ISIS operation.



A standard foil used at SNS and schematic of the strengthening corrugation pattern.  
(Credit: SNS)

In 2018 a collaboration was started and SNS provided ISIS with some sample foils for testing. These foils are produced by chemical vapour deposition (CVD) onto a corrugated silicon wafer. The corrugation pattern adds strength and stability to the foils which reach temperatures of 1500 K under beam at SNS and 500 K at ISIS. The foils were tested during machine development time at the end of ISIS User Cycle 2018/2 and a high-intensity beam with low injection loss was quickly established. The foil showed no signs of deformation after 1 day of full power operation. However, the standard SNS foil size restricted beam tuning capability and so the foil had to be removed for user operations.

This year the ISIS Synchrotron Group submitted a research proposal to the Oakridge Centre for Nano-Phase Materials to source some new foils made to ISIS specifications. These foils are  $55 \times 30$  mm in size with an areal density of  $\sim 200 \mu\text{g}/\text{cm}^2$ . The foils were etched from their silicon substrates at RAL and one was successfully installed into the synchrotron on 13 March 2019.

The SNS foil proved to be a great improvement on the previously used carbon foils. It was removed on 25 November when a hole was identified (although it had not affected its performance). The foil survived 140 days of full power beam, equivalent to three full user cycles. If this performance is typical of these foils, only two would be needed for a nominal ISIS operating schedule of 220 days per year.

A second foil has been etched and installed into the synchrotron and has performed well for the first two days of operation. If it survives it could see another 150 days of beam before the ISIS long shutdown beginning in September 2020. Four more foils are held at RAL and ORNL have indicated a small number per year could be made for ISIS. However, this production cannot be guaranteed and an alternative supplier is being sought in collaboration with STFC Central Laser Facility and the University of Bristol CVD Diamond group.



SNS Foil before (left) and after (right) operation at ISIS.  
(Credit: ISIS)

[Bryan Jones](#)  
[Hayley Cavanagh](#)

## New PABG Committee Members

Welcome to Andy Smith, who has joined the committee as secretary and Ben Pine who has joined as an ordinary member.



Andy Smith spent much of the earlier part of his career working as a beamline scientist at Daresbury's SRS. As well as supporting user research, his principle speciality was in beamline instrument development and X-ray optical design. Following the closure of the SRS he moved onto a number of projects covering beamline projects at Diamond and within ASTeC. He brought his optical beamline experience to the ALICE IR-FEL project and its subsequent exploitation in IR-imaging, working with the team that established lasing in the FEL. He now works at the University of Manchester's Dalton Cumbrian Facility where he is responsible for the operation and development of the ion beam facility there.

Ben Pine has recently joined Opera Software, part of the Dassault Systemes Simulia brand, as a Solutions Consultant. Opera is a finite element electromagnetic software which is used to simulate magnets including superconducting ones, electrical machines and charged particles. Ben is part of the team offering customer support as well as training and development of technical materials. Prior to that he was a Senior Accelerator Physicist in the Synchrotron Group at the ISIS Spallation Neutron and Muon source, where he worked for 15 years. During that time Ben worked on operations, accelerator R&D in particular beam simulation codes and the effects of space charge and upgrades for the ISIS synchrotron. Ben received his doctorate from Oxford University in 2016 on space charge and image forces driven resonances in high intensity proton synchrotrons. He was a visiting lecturer at the John Adams Institute at Oxford where he gave lectures on Hamiltonian Dynamics.



## European Strategy for Particle Physics Update (ESU) – an Update

In the last newsletter [Newsletter Issue 19, June 2019] I reported on the process of updating the European Strategy for Particle Physics (ESU). An important step was preparation of the 'Briefing Book' – the document that gives a snapshot of the field and provides the basis for the Strategy Group to prepare the ESU. Caterina Biscari, Lenny Rivkin, Frank Zimmerman and I were charged with producing the accelerator chapter of the Briefing Book and this was released as part of the [complete document](#) on 1 October 2019.

Chapter 10, 'Accelerator Science and Technology' comprises 25 (of the 250 total!) pages and represents a mini 'where we are' status report on accelerator options for future particle physics facilities. The chapter includes discussion of the state of technologies for both electron-positron and proton-proton colliders, as well as brief summaries of the different options for their implementation.

The  $e^+e^-$  collider options are the International Linear Collider (ILC) proposed for realisation in Japan, and the Compact Linear Collider (CLIC) and the Future Circular Collider (FCCee), both proposed for implementation at CERN; the Circular  $e^+e^-$  Collider (CEPC) is an option for realisation in China. Proton (circular) collider options include FCCpp (Europe) and CppC (China). The circular machines require a new large tunnel with a circumference in the range 50-100 km.

	T <sub>0</sub>	+5	+10	+15	+20	...	+26
ILC	0.5/ab 250 GeV		1.5/ab 250 GeV	1.0/ab 500 GeV	0.2/ab 2m <sub>top</sub>	3/ab 500 GeV	
CEPC	5.6/ab 240 GeV		16/ab M <sub>Z</sub>	2.6/ab 2M <sub>W</sub>	SpC =>		
CLIC	1.0/ab 380 GeV			2.5/ab 1.5 TeV		5.0/ab => until +28 3.0 TeV	
FCC	150/ab ee, M <sub>Z</sub>	10/ab ee, 2M <sub>W</sub>	5/ab ee, 240 GeV	1.7/ab ee, 2m <sub>top</sub>		hh,eh =>	
LHeC	0.06/ab		0.2/ab	0.72/ab			
HE-LHC	10/ab per experiment in 20y						
FCC eh/hh	20/ab per experiment in 25y						

Nominal timelines for operation of the suite of future collider possibilities.

It is somewhat unlikely that more than one such new facility could be realised in both Asia and Europe, and an ideal, globally-balanced scenario would comprise one new collider of each type being realised, e.g. an electron-positron collider in Asia and a proton-proton collider in Europe, or vice versa! The most mature technology option for a next-generation machine is generally agreed to be an electron-positron collider to serve as a Higgs-boson factory, while a future high-energy proton-proton collider relies on development of high-field dipole magnets — 16 T is the target for FCCpp, which it is estimated might take up to 25 years to develop towards a production version.

A potential nearer-term option is an electron-proton collider based on a new electron accelerator providing electrons to collide with the existing LHC beam. For the distant future, discussions include the application of plasma-based, high-gradient wakefield-acceleration techniques towards a very high-energy electron-positron collider, as well as the idea of a muon collider that could potentially be housed eventually in the LHC tunnel.

The Strategy Group will meet in Bad Honnef in January 2020 to hash out all the issues and the community eagerly awaits the results of their deliberations.

[Phil Burrows](#)

*John Adams Institute Interim Director  
Scientific Secretary for Accelerators to the ESU Preparatory Group*

## Correction

In the article 'Accelerating the Future: Designing a Robust and Affordable Radiation Therapy Treatment System for Challenging Environments' in Edition 19 of this Newsletter, we neglected to mention that Prof. I.V. Konoplev from the John Adams Institute also attended the workshop in Botswana.

## Machine Learning Applications in Physics Joint Meeting

The IoP held an inaugural 'Physics in the Spotlight' event from 22 - 25 October, celebrating the move to the new HQ in King's Cross with events organised by many groups. On Thursday 24 October the Particle Accelerators and Beams Group hosted a joint event on Machine Learning Applications in Physics together with the Computational Physics Group, Plasma Physics Group and Polymer Physics Group.

The plenary sessions were a sell-out, hitting the 140 capacity of the lecture theatre in the new venue, showing the appetite and interest in the field. With keynote speakers from Turing Institute, STFC's Scientific Machine Learning Group and an ex-accelerator scientist turned FinTech machine learning consultant who refreshed us on the journey machine learning had taken since his work with it on ion beam spectroscopy a decade ago, there was a strong and varied programme on forefront techniques.



Delegates to the meeting.  
(Credit: IoP)

The afternoon allowed time to explore developments more specific to particular groups' interests, with the Plasma Physics Group and Particle Accelerators and Beams Group getting together to understand commonalities in large facility design and data exploration. Presentations by Matt King and Hannah Kockelbergh and a panel discussion featuring Stephen Dann set the scene for a discussion session, which overall highlighted the need for cross-community training to help those looking to exploit machine learning and data-centric methods for physics.

The day also featured the launch of the IoP Journal 'Machine Learning: Science and Technology', and as well as an introduction to the scope of the journal, there was a cake cutting at the end of the day. Discussions continued over refreshments into the evening.

[Jonny Smith](#)

### Physics in the spotlight

A four-day physics forum for UK and Ireland physicists

The Institute of Physics (IoP) is convening a new type of forum - four days of discussion, debate and knowledge sharing at the IoP's flagship King's Cross building.



22-25 October 2019, Institute of Physics, London, UK

**IoP** Institute of Physics

## National Vacuum Electronics Conference 2019

The National Vacuum Electronics Conference (NVEC) 2019 was held on 13 November in the Technology and Innovation Centre, Glasgow, UK. It was hosted by the Atoms, Beams and Plasmas (ABP) research group of the Department of Physics, [SUPA](#), University of Strathclyde.

NVEC is principally a UK-based international forum in science and technology of RF, microwave and millimetre wave sources and application of RF in accelerators. NVEC aims to foster academic-industry collaboration and to engage young scientists researching electron beam driven RF and microwave systems. A unique opportunity was seized by the scientific committee with the invitation of Prof. Graham Smith of the School of Physics and Astronomy at the University of St Andrews to give an update on the use of vacuum electronic devices in the field of Electron Paramagnetic Resonance Spectroscopy.

A second invited talk was given by Dr. John Walker of Integra RF Power Devices who gave an overview of the RF generator on the Soleil Synchrotron, which consists of four 200 kW, continuous-wave, 352 MHz solid state generators made up of 3,000 solid state transistors combined with 89% efficiency.



Dr. Jonathan Gratus of Lancaster University giving a presentation on concepts of spatial dispersion using wire media (left) and delegates at NVEC 2019 (right).  
(Credit: University of Strathclyde)

In addition to Prof. Smith's and Dr. Walker's invited talks there were 14 high-quality contributed oral presentations. Modern computational modelling techniques of a 93 GHz pulsed magnetron using CST Particle Studio followed by an overview of 48 GHz gyrotron klystron modelling using Particle-In-Cell simulations were presented. An update on current state-of-the-art gyrotron amplifier performance followed by a talk on a high-power, wideband millimetre travelling wave vacuum tube amplifier was given. Other radiation source talks included: novel split ring resonator loaded interaction cavities for electron beam gyro-devices; planar THz radiation slow wave sources based on sheet electron beams generated by a plasma cathode; the use of artificial materials in an instantaneous time mirror system for the amplification of electromagnetic waves. A talk on wireless communications using resonant tunnelling diodes for multi-gigabit links was presented. Diverse accelerator topics covered included: breakdown studies in accelerating cavities; superconducting dual axis cavities for energy recovery linacs (ERLs) and design of ERLs; longitudinal field profile shaping using wire media and RF analysis of a photoinjector electron gun.

There were 40 participants at NVEC 2019 including 15 students and 2 industrial delegates. Sponsorship was gratefully received from the IoP Particle Accelerators and Beams Group.

[Adrian Cross](#)

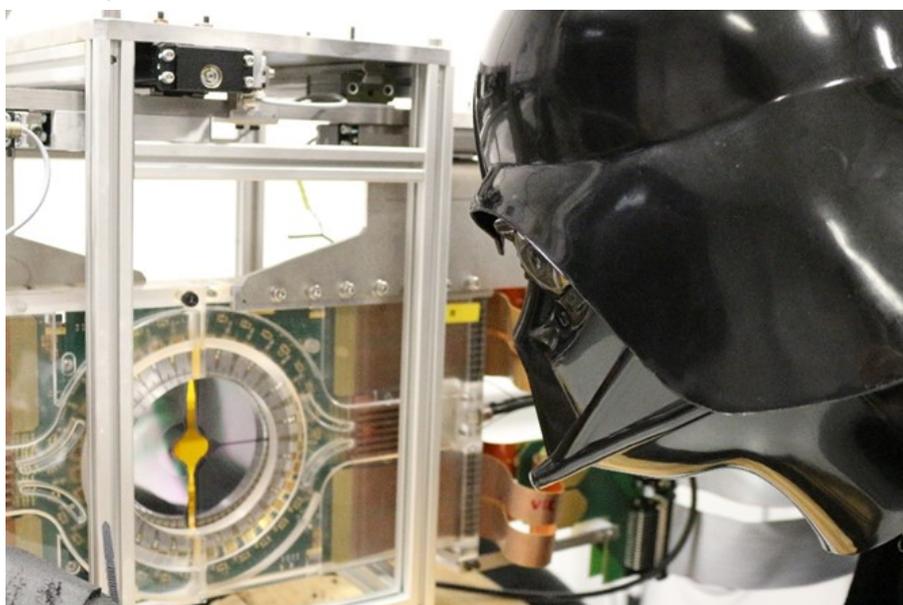
## How Star Wars Fantasy is Shaping Science Fact

Proton torpedoes, hyperspace, and the Force – is this science fact or science fiction? Building upon the great success of previous events, hundreds of local high school students, university students and staff came to the University of Liverpool on 20 November 2019 to learn how the world of Star Wars is connected with ongoing accelerator research at the Cockcroft Institute (CI).

The Physics of Star Wars event took place in the award-winning Central Teaching Laboratory, which was turned into a teaching space from a galaxy far, far away. An engaging lecture by event organizer Prof. Carsten Welsch, Head of Liverpool's physics department, introduced all participants to the world of Star Wars, whilst a range of Star Wars themed, hands-on experiments prepared by CI staff and students gave opportunities to experience accelerator science up-close.

### Proton Torpedoes

In the very first Star Wars movie, Luke Skywalker uses proton torpedoes to destroy the Death Star – the giant space station that annihilates planets. More than 40 years on, science fact has caught up with science fiction. Accelerator and clinical experts have been exploring ways to better control proton beams to improve cancer treatment. These beams can be used to destroy a tumour hidden deep inside the body. CI research targets the use of monitors, originally developed for the Large Hadron Collider (LHC) at [CERN](#), to characterise the treatment beam without touching it.



Lord Vader inspecting the VELO detector at the CI.  
(Credit: Cockcroft Institute)

Prof. Welsch says – ‘For the students to experience for themselves the problems of controlling a beam you can’t see, to hit an invisible target, fellows within the [Optimisation of Medical Accelerators project](#) have created a Star Wars themed proton mini golf challenge. They experience first-hand that targeting becomes much easier if an advanced detector helps them guide the ‘beam’, *i.e.* the mini golf ball.’

### The Force(s)

The Force is in the heart of the Star Wars universe, it 'gives the Jedi his powers. It's an energy field created by all living things. It surrounds us, it penetrates us, it binds the galaxy together' as Obi Wan Kenobi once explained to Luke Skywalker.



R2D2 helps align the High Luminosity LHC gas jet monitor.  
(Credit: Cockcroft Institute)

Physicists explore the fundamental forces using the LHC, which is now due to be upgraded. A particular challenge in upgrading to a High Luminosity LHC is to characterise the beam fully, as the currently used technique will no longer work. CI research targets the development of a gas jet-based beam monitor that can measure the beam's properties even at top energy. This new diagnostic has been developed in collaboration with CERN and [GSI](#). This technology was explained to event participants by the researchers behind the development.

Prof. Welsch comments – 'As the voice-over of Luke Skywalker says in the latest film trailer, 'We've passed on all we know', and that's exactly what we're hoping our Physics of Star Wars event will do – help inspire the next generation of scientists and researchers to dream about what they might be explaining to others in 40 years' time!'

[Carsten Welsch](#)



The Cockcroft Institute  
of Accelerator Science and Technology



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## International Calendar



### 11th International Particle Accelerator Conference (IPAC 2020)

Caen, France, 10 - 15 May 2020

<http://www.ipac20.org/>



### 11th International Conference on Mechanical Engineering Design of Synchrotron Radiation Equipment and Instrumentation (MEDSI 2020)

Chicago, IL, USA, 13 - 17 July 2020

<https://web.cvent.com/event/2c9d7ee3-1702-4ffe-8b44-7190d2954b05>



### 26th Conference on Application of Accelerators in Research and Industry and the 52nd Symposium of North Eastern Accelerator Personnel (CAARI-SNEAP 2020)

Las Vegas, NV, USA, 5 - 7 August 2020

<https://caari-sneap.com/>



### 30th International Linear Accelerator Conference (LINAC 2020)

Liverpool, UK, 30 August - 4 September 2020

<http://linac2020.org/>



### 9th International Beam Instrumentation Conference (IBIC 2020)

São Paulo, Brazil, 13 - 17 September 2020



### 8th Euro-Asian Pulsed Power Conference (EAPPC), 23rd International Conference on High-Power Particle Beams (BEAMS) and 17th International Conference on Megagauss Magnetic Field Generation and Related Topics (MG-XVII)

Biarritz, France, 13 - 17 September 2020

<http://eappc-beams2020.org/>



### 64th ICFA Advanced Beam Dynamics Workshop on High Intensity and High Brightness Hadron Beams (ICFA-HB2020)

Chicago, IL, USA, 28 September - 2 October 2020

<https://indico.fnal.gov/event/20593/user/login?returnURL=https%3A%2F%2Findico.fnal.gov%2Fevent%2F20593%2F>

## PAB Group & UK Events

Annual General Meeting of the PAB Group  
University of Liverpool, 24 April 2020



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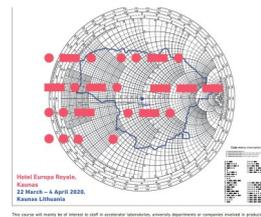


## Upcoming schools

CERN Accelerator School — RF For Accelerators

Kaunas, Lithuania, 22 March - 4 April 2020

<https://cas.web.cern.ch/schools/kaunas-2020>



CERN Accelerator School — Mechanical Materials Engineering  
for Particle Accelerators and Detectors

Sint-Michielsgestel, Holland, 25 May - 6 June 2020

<https://cas.web.cern.ch/schools/sint-michielsgestel-2020>



## Useful Links

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

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

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

[www.diamond.ac.uk](http://www.diamond.ac.uk)

[http://www.desy.de/index\\_eng.html](http://www.desy.de/index_eng.html)

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

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

<http://www.jacow.org/>

The Institute of Physics

The Institute of Physics  
37 Caledonian Road  
London  
N1 9BU  
UK

Phone: 020 7470 4800  
Fax: 020 7470 4848  
Email: [physics@iop.org](mailto:physics@iop.org)

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**Particle Accelerators  
and Beams Group**

## IoP Particle Accelerators and Beams Group

### IoP PAB Committee

**Chair: Dr. Brian McNeil (Strathclyde)**

**Secretary: Dr. Andy Smith (Manchester)**

**Treasurer: Dr. Jonathan Smith (STFC Hartree)**

**Dr. Graeme Burt (CI Lancaster)**

**Miss Kay Dewhurst (CI Manchester)**

**Dr. David Dunning (STFC Daresbury); Newsletter**

**Dr. Stephen Gibson (JAI RHUL); Web Manager**

**Dr. Ben Pine (Opera Software)**

**Dr. Andrew Rossall (Huddersfield)**

**Prof. Susan Smith (STFC Daresbury)**

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

**Dr. Melissa Uchida (Cambridge)**

**Dr. Peter Williams (STFC Daresbury)**

**Deadline for submissions to the  
next newsletter is  
29 May 2020**

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*This newsletter is also available on the web and in larger print sizes.*

*The contents of this newsletter do not necessarily represent the views or policies of the Institute of Physics, except where explicitly stated.*