INSTITUTE OF PHYSICS

IOP PAB GROUP NEWSLETTER

IOP Institute of Physics
Particle Accelerators and Beams Group

Issue 24

April 2022

Editorial

Welcome to Issue 24 of our PAB Group Newsletter. I write this with a feeling of great optimism, it feels like a time of renewal. The LHC has started again achieving an incredible 6.8 TeV following extensive upgrades to the beamline; the dust has settled on the European Strategy work and I am blown away by the number of new projects in discussion; and the world has finally begun to open up. Our community has truly thrived throughout one of the most difficult periods in recent global history and we have demonstrated just how vital our science is.

I am most excited to announce the launch of the first annual Particle Accelerator and Beams Conference in the UK which will take place this summer on the 25th and 26th of July 2022 in Liverpool. This conference is for everyone – a chance for heads of labs and departments, PhD students, post docs, lecturers and professors, from across the breadth of our field, to come together to present and discuss their work; forging bonds across our community which will strengthen and unify us internationally. While we have long been proud of our annual PABg meetings, we likewise recognise the need for a UK *event* conference where the full community can come together to discuss with, and learn from, one another, while having time to relax and get to know each other outside of a formal setting. The committee and I have been working so hard to create just such a conference and we cannot wait to welcome you to this year's inaugural event.

The physics program will include an exciting mix of: probing panel sessions, plenary talks, parallel sessions, a poster session and of course our much-loved "Prize Talk". The parallel sessions will include several short ~10min presentations and discussions, and are an excellent opportunity to show ongoing work and showcase the breadth of our field. We strongly encourage PhD students to submit a poster and senior PhD students, post docs and above to submit parallel talks.

(continued on the next page)

Inside this issue:

Editorial (continued)

You may come for the physics but you'll stay for the entertainment! Beginning with our poster session and drinks reception on the 25th at the Victoria Gallery & Museum (there will be a poster prize for the best poster) and continuing on to The Crypt Hall at the Metropolitan Cathedral for a delicious dinner. There will be live entertainment and an after party which only the promise of the next day's program could drag you away from. There will also be a few surprises along the way – so hold onto your hats. Registration will open soon and will be announced via: email, heads of departments and on the PAB group page. Abstract submission will be through the registration page.

I was recently reminded (at a remote meeting) just how diverse the work we do in the UK and Ireland really is and indeed how many of us are yet to meet. We have been working in isolation – in small teams who work at home and meet in video conferences for two years now. While this has been hard for all of us I feel, in particular, for our many early career colleagues who have yet to meet those outside of their teams. Our task now is to strengthen our ties, reconnect with our accelerator and beams colleagues outside of our research area and indeed connect with those we have yet to meet. So please come along to our Annual Conference, bring your students, bring your researchers, bring your boss. It will be an event not to be missed!

Another not-to-be-missed is this newsletter (which when I finally stop talking we can get to). Herein we take a look at the news from our laboratories including: £1.4m in funding for Daresbury to look into a new world-class materials science centre and progress on the ISIS long shutdown and change of leadership. We reflect on some recent events in the community, discuss some of our exciting recent work and share some individual success stories. In particular, I would like to congratulate previous PAB group Career Achievement Award winner Susan Smith, who was awarded an Order of the British Empire (OBE) for her many contributions to the field of accelerator science and technology over the years and for raising its public profile. Finally, a big welcome to our two new committee members: Hayley Cavanagh and Amir Sanjari. It is great to have new members to help keep our committee vibrant.

Melissa Uchida (Group Chair)

If there is anything you think we could do better or should know of, please feel free to contact us at mauchida@hep.phy.cam.ac.uk and follow us on Twitter for updates of what is happening in our community @PartAccelBeams.

PABG Annual Conference Poster!

PABG Annual Conference

25th - 26th July 2022 | Liverpool

The IOP Particle Accelerators and Beams Group (PABG) invite you to the Particle Accelerators and Beams Annual Conference. This new two-day conference replaces the PABG one-day annual meeting, to become the UK's premier national event in the field of particle accelerators.

Bringing together the entire community, this in-person event will comprise two days of vibrant physics discussion, knowledge sharing, and networking. We encourage participants at all career stages from PhD students, through postdoc to senior professors.

The conference will take place on 25th and 26th July 2022 at the University of Liverpool. The first day will start at 11:00 to allow for travel to Liverpool. In the evening of the first day, there will be a drinks reception with poster session and a conference dinner.

The conference promises to be a very special event and we hope that you will join us for this long-needed inaugural UK Particle Accelerators and Beams Annual Conference.

Further details will be announced soon via the Group's e-mail list and on social media.

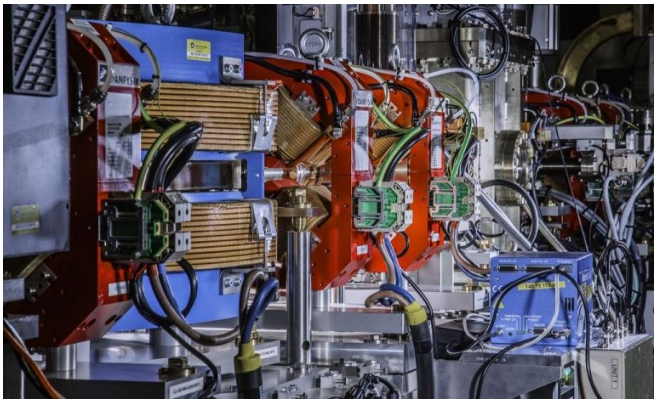
IOP Institute of Physics

Twitter: @PartAccelBeams

News from the Laboratories — Daresbury

£1.4m funding to look into a new world-class materials science centre at Daresbury Laboratory

A new project to look at creating a world-leading materials science centre at the Science and Technology Facilities Council's (STFC) Daresbury Laboratory is underway after receiving more than £1million funding. If built, the new facility's state-of-the-art capabilities would provide UK scientists insights in personalised medicine, energy storage, renewable energy and more. Thanks to the investment from UK Research and Innovation's Infrastructure Fund, scientists can now start to design what this centre could look like.



Part of the CLARA facility at Daresbury (Credit: STFC)

The new facility, known as RUEDI (Relativistic Ultra-fast Electron Diffraction and Imaging Facility), will be designed to be based at Daresbury Laboratory to exploit the existing infrastructure for other similar-sized electron accelerators, such as CLARA and VELA.

The proposal, funded by the Engineering and Physical Sciences Research Council (EPSRC), is led by Professor Nigel Browning at the University of Liverpool. The proposal has also received support from the Rosalind Franklin Institute at Harwell and staff at STFC's Accelerator Science and Technology Centre (ASTeC).

RUEDI would use extremely short bunches of electrons to probe the structure of materials at atomic length scales. What will make this unique from previous accelerators is RUEDI will effectively be able to produce movies of these processes as they happen in real time.

RUEDI would provide UK scientists with unprecedented capabilities to deliver transformative innovations in the science and technology. The variety of topics that could be investigated include:

- Personalised medicine
- Energy storage, both grid and transportation
- Renewable energy, such as energy generation, transformation and advanced manufacturing
- Materials operating under extreme conditions.

STFC Professor Jim Clarke, Head of ASTeC, said: *"This is a wonderful opportunity for STFC Daresbury Laboratory, in collaboration with the University of Liverpool and the Rosalind Franklin Institute at Harwell, to develop a world-leading capability that will provide unprecedented insights into molecular and biological processes as they happen in real time.*

"The facility can provide insights into chemical and biological processes that are important across a wide range of scientific and industrial applications and contribute to the UK's knowledge-based economy through the many insights it will provide."

Professor Graeme Burt, acting Director of the Cockcroft Institute at the time of the announcement, added: *"RUEDI is yet another world-leading accelerator project being build on the Daresbury campus, highlighting the cutting-edge nature of research going on at the laboratory."*

Tim Noakes

Susan Smith recognised in Queen's New Year Honours

Professor Susan Smith, ASTeC Director Emeritus and Honorary Professor at the University of Liverpool, has been recognised by The Queen in her New Year honours list for her services to science and technology. The honours system recognises people who have 'made achievements in public life' and 'committed themselves to serving and helping Britain'.

A group of 10 independent honours committees, each covering a specialist subject area such as science, sport or health, consider nominations. The recommendations of these groups of independent experts and senior civil servants are passed on to the Prime Minister, and ultimately The Queen for approval.

Susan Smith (Credit: STFC)

Professor Smith was awarded an Order of the British Empire (OBE) for her many contributions to the field of accelerator science and technology over the years and for raising its public profile. Amongst her many contributions are the operation and upgrades of the SRS at Daresbury Laboratory, taking a lead in the accelerator design for the Diamond facility at RAL, and leading the construction of the energy recovery linac ALICE, as well as the EMMA and CLARA facilities at Daresbury. Most recently, Professor Smith was Director of Daresbury Laboratory, a role from which she retired in November 2020.

Professor Mark Thomson, the executive chair of the Science and Technology Facilities Council, said that this honour was very mush deserved. He added: *"It is incredibly pleasing to see this public recognition for the major contributions and innovation made by Professor Smith throughout her career in accelerator and light source sciences."*

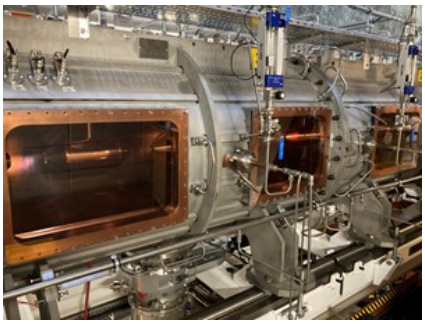
Carsten Welsch

News from the Laboratories — RAL

ISIS Long Shutdown Progress and Change of Leadership

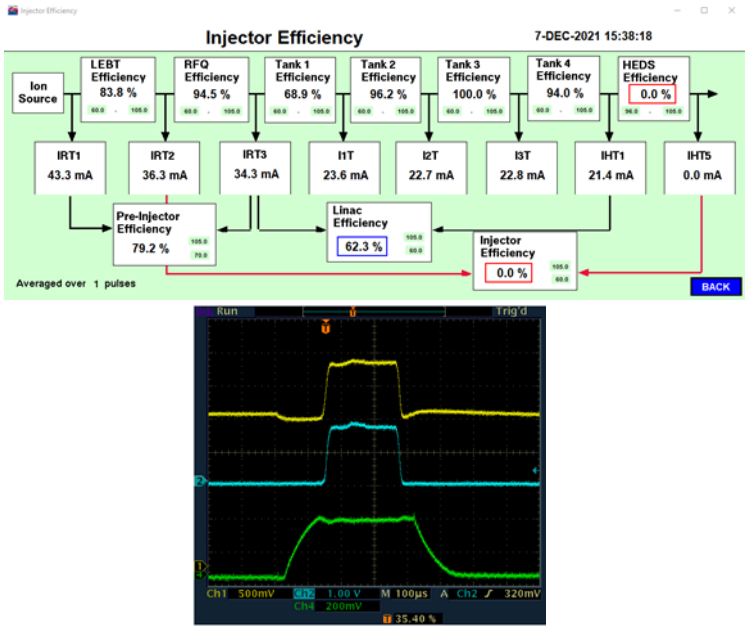
As this newsletter is written, the programme of accelerator work for the present ISIS long shutdown has recently come to an end, having started on 21 June 2021. These extended maintenance periods allow the installation of major upgrades to the facility.

A main focus of this shutdown was the replacement of Linac Tank 4 (as anticipated in previous issues of this newsletter June 2018 and July 2021). The original 12 m tank, installed in 1976, was removed in July and after extensive testing the six 2 m sections of the new Tank 4 were installed.



Left: Original (1976) 12 m Tank 4 being craned out. Right: Minor adjustments to drift tube positions in the newly installed tank. (Credit: ISIS)

After almost 10 years of project work, spanning initial design through manufacturing, testing and installation, the tank successfully demonstrated acceleration on Tuesday 7 December 2021, with 94% transmission efficiency - an excellent result at the first attempt. In early January, following completion of the long shutdown, a programme of commissioning commenced in readiness for ISIS to resume operations (scheduled for March 2022).



Upper: First beam accelerated in Tank 4, 7 December 2021. Lower: Beam current monitors before/after Tank 4 (top two traces) and Tank 4 RF field level (bottom trace). (Credit: ISIS)

An eighteen-month project, spanning much of the pandemic, to upgrade the synchrotron interlock and search procedures has also been successfully completed. The introduction of light-curtains enables a safer and quicker search of controlled areas prior to beam.

Left: Part of the light curtain installation in the inner synchrotron. Right: Darren Smith (ISIS Crew), Mark Arnold and Elliot Taylor (ISIS Interlocks) with the light curtain control rack.
(Credit: ISIS)

Other projects progressed during the long-shutdown include the replacement of synchrotron RF high power drives, muon collimator replacement and target upgrade on ISIS Target Station 1. Further details of these, and Tank 4 commissioning will be provided in the next issue!

In October 2021, ISIS said a fond farewell to Robert McGreevy who retired after nine years as ISIS director. Robert first joined ISIS as a staff member in 2002 but was initially connected to the facility when he arrived as one of the first users from the University of Oxford in 1985. Roger Eccleston has been appointed as the new Director of ISIS. He joins from Sheffield Hallam University where he was Deputy Vice-Chancellor (Academic), having previously been Pro-Vice Chancellor for Research and Global Engagement. However Roger's career has been entwined with RAL from the start, firstly as a sandwich student at ISIS in 1987 and then returning as an ISIS Instrument Scientist, Group Leader, and Division Head and later as Director of the Technology Department at RAL.

Left: Robert McGreevy with Alan Partridge, Director National Laboratories at the retirement celebration in October 2021. Right: Roger Eccleston (Credit: ISIS)

STFC's Executive Director for National Laboratories: Large Scale Facilities, Alan Partridge, said, "*We are delighted to welcome Roger back to RAL and STFC. His background in neutron science and his leadership in research, innovation and knowledge exchange stand him in great stead for leading ISIS into its next phase. The facility has gone from strength to strength under Robert McGreevy's leadership, and we look forward to building on that success under Roger's stewardship.*"

Roger says, "*It is a privilege to have the opportunity to lead ISIS through the next phase of its development. ISIS is in great shape with nearly four decades of development, innovation, research excellence and leadership. Looking forward, the Endeavour programme and ISIS-II provide exciting opportunities to take the facility to the next level, extending our scientific productivity and cementing our position as the world's leading neutron and muon source. I am looking forward to working with dedicated colleagues to ensure ISIS continues to provide world-leading facilities and produce outstanding research in partnership with the user community.*"

Science and Technology Facilities Council

ISIS Neutron and Muon Source

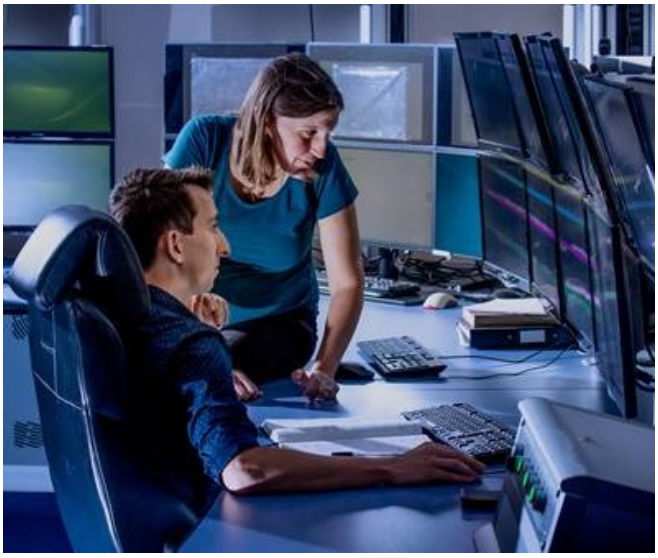
Hayley Cavanagh

John Thomason

New PAB Group Committee Members

The PAB Group Committee recently welcomed two new members—Hayley Cavanagh and Amir Sanjari.

Hayley Cavanagh is the Beam Physics Operations Section Leader at the ISIS Neutron and Muon Source at RAL. She joined in 2009 on the STFC Graduate Scheme as an Accelerator Physicist, becoming a Senior Accelerator Physicist in 2017 and then began her current role in 2020.



Hayley Cavanagh in the ISIS control room (Credit: STFC)

Outside of leading the operational beam physics programme of machine setup and operation, Hayley's R&D work has mainly focussed on injection stripping foils and collimation studies for ISIS upgrades, most recently multi-MW designs for ISIS-II. She has also enjoyed participating in injection commissioning experiments at J-PARC's Rapid Cycling Synchrotron and CERN's Proton Synchrotron Booster.

A profile of Amir will feature in the next edition.

Particle Accelerator Engineering Network Annual Meeting

The Annual Meeting of the UK's Particle Accelerator Engineering Network took place on 9-10 November 2021, bringing together engineers working on accelerators at Universities, Laboratories and in Industry and featuring talks on topical applications, such as thin-film SRF and E-beam welding.

The network is a collaboration between the IET, IMechE and IOP to support all types of engineers and technicians working in the accelerator field. The network is currently chaired by Prof. Graeme Burt (Lancaster University and Cockcroft Institute) who co-founded the network with Dan Faircloth (ISIS). Its annual meeting is an important way to keep abreast of the latest developments in accelerator engineering. The event was held virtually, spread over the afternoon of 9 November and the morning of 10 November.

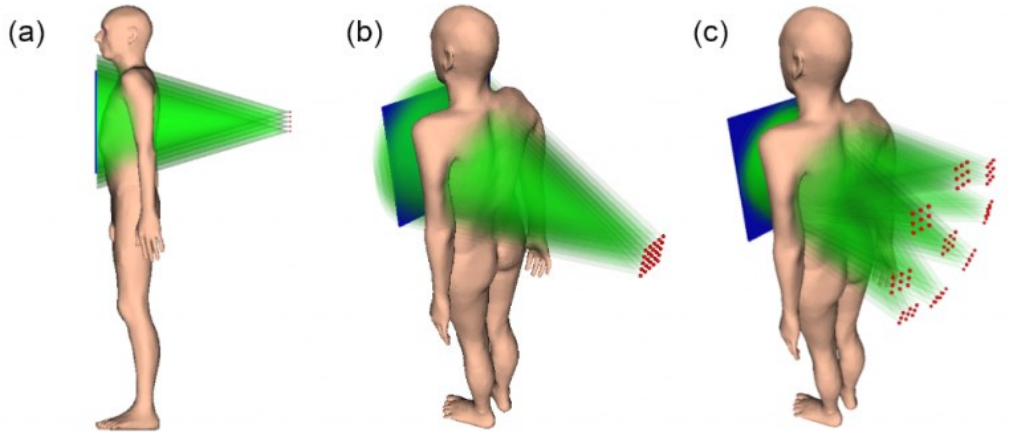
Lancaster University and Cockcroft Institute student Ruth Peacock won the event's Early Career poster prize. Ruth's poster was on the effect of H- irradiation on the conditioning of high field copper surfaces using pulsed DC. Ruth is in the final year of her PhD in Lancaster University, based at CERN. Her research is directly related to the development of high gradient proton accelerators and RFQ's and is focused on the RFQ for Linac4 at CERN. The prize is sponsored by the Institution of Engineering and Technology.

Poster prize winner, Ruth Peacock

Graeme Burt

ASHE helps pave the way for portable low cost, low dose 3D imaging

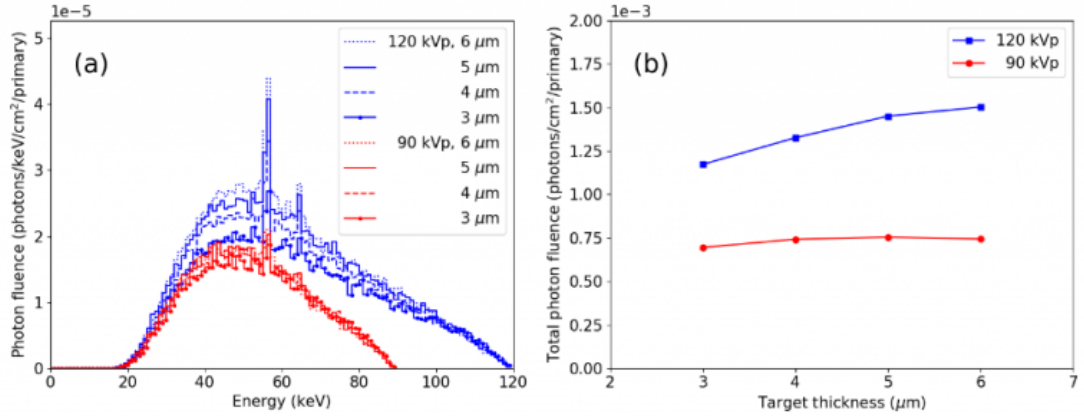
The state of the art in 3D X-ray imaging involves the use of an X-ray tube which is in some way translated and rotated in space relative to a patient. By doing so, X-ray images from 10s or 1000s of different projection angles are generated and then reconstructed in 3D. However, this mechanical movement puts a heavy toll on the time it takes to complete a 3D scan, limiting patient throughput and adding motion artefacts from the moving organs, especially the heart and the lungs. It also means that the patient is subject to a certain level of radiation. In an open access paper just published in the journal *Biomedical Physics & Engineering Express,* ASHE researchers from the University of Liverpool and industry partner Adaptix showed that a compact, rectangular array with several miniature cold-cathode field emitters can be used stationary, with each emitter fired electronically to generate X-ray images from different projection angles without having to slowly move a large X-ray tube.



3D models of the irradiation geometry of tomosynthesis with a single flat panel source array (a, b) and of a concept irradiation geometry with a multi-panel system (c). Emitters are activated sequentially but here they are all drawn simultaneously active for illustration purposes. (Credit: Thomas G Primidis et al 2022 Biomed. Phys. Eng. Express 8 015006)

The technology itself is simple. Micrometre wide metallic needles inside an electric field have extremely high electric field gradients near their tip. This causes electrons on that tip to escape relatively easily (field emission) without extra power from a heated filament, as is the case with conventional X-ray tubes. Without that extra heating and with their very small size, these field emitters can be grouped in large numbers in an array the size of a tablet and with some smart electromagnetic engineering, they can be activated sequentially to send electrons towards an X-ray target. The X-ray beams that are produced originate from different positions on the target and so different projections angles needed for 3D X-ray imaging are produced without any source movements. Moreover, field emission technology requires less power to use and is much more compact, lighter and cheaper to build than conventional X-ray tubes, something that is expected to help more and smaller clinics to adopt the technology and perhaps pave the way for truly portable 3D X-ray imaging in the future. Adaptix has used square emitter arrays at 60 kVp to get digital tomosynthesis (DT) images of small animals, teeth, human cadavers and electronic devices. DT is a modality similar to computed tomography but uses fewer projections and in a narrower angular range, offering 3D information at a lower dose and lower cost.

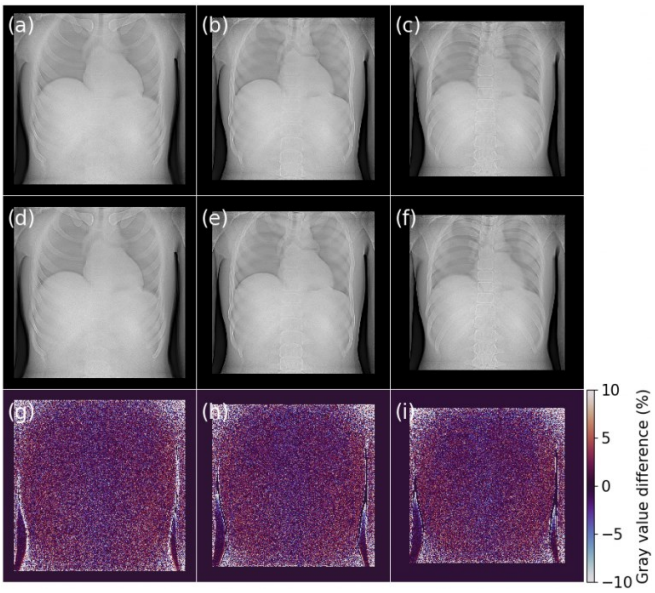
Thomas Primidis (University of Liverpool and QUASAR Group) and co-workers have now conceptualised an upgrade of this system from 60 kVp to 90 or 120 kVp, more suited for chest tomosynthesis. In their study, they compared the photon yield and resulting X-ray spectrum using different combinations of accelerating voltage and X-ray target thicknesses. They calculated the effective dose from doing a DT scan with emitter arrays at 90 and 120 kVp with results shown in the following figure. A significant aspect of their design was the reduced distance between source and detector to 80 cm to achieve a higher photon density.



a) FLUKA generated energy spectra with source designs having different accelerating voltage and different transmissive target thickness, b) total photon fluence calculated as the area under the curve of each spectrum. (Credit: Thomas G Primidis et al 2022 Biomed. Phys. Eng. Express 8 015006)

Through their detailed simulations, the authors found that target thickness had only a minor effect on the width of the X-ray spectrum and that the photon yield at 120 kVp was 1.7 to 2 times that at 90 kVp. Furthermore, they demonstrated that both emitter arrays can produce 3D images of the chest and that the quality of these images was essentially identical, allowing to operate the system at lower voltages.

The authors concluded that stationary, cold-cathode, flat panel X-ray source arrays are a versatile tool to create high quality 3D images of the human chest and that there is clinical benefit in reducing the accelerating voltage to only 90 kVp. Their work paves the way for more compact, low dose, low cost and possibly truly portable 3D imaging systems which are expected to benefit patients around the world.



a-c) Tomosynthesis slices at different depths using the 120 kVp source array, d-f) same slices with the 90 kVp source array, g-i) relative percentage difference between 120 kVp and 90 kVp. (Credit: Thomas G Primidis et al 2022 Biomed. Phys. Eng.

Thomas Primidis, the lead author of the paper, said: *"I am amazed by how much smaller this technology is than conventional X-ray tubes. I have seen that it works as an imaging solution for teeth and small animals, as well as a non-destructive testing tool for electronic devices. We have now demonstrated that this is also suitable for 3D chest imaging. In a next step, we will investigate multi-panel designs and how we can optimize the overall image quality."*

This work was undertaken on Barkla, part of the High-Performance Computing facilities at the University of Liverpool, UK and it was funded by the Accelerators for Security, Healthcare and Environment CDT supported by the Science and Technology Facilities Council under grant number ST/R002142/1.

Further information: *'3D chest tomosynthesis using a stationary flat panel source array and a stationary detector: A Monte Carlo proof of concept.'*, Thomas G Primidis et al 2022 Biomed. Phys. Eng. Express 8 015006, https://doi.org/10.1088/2057-1976/ac3880

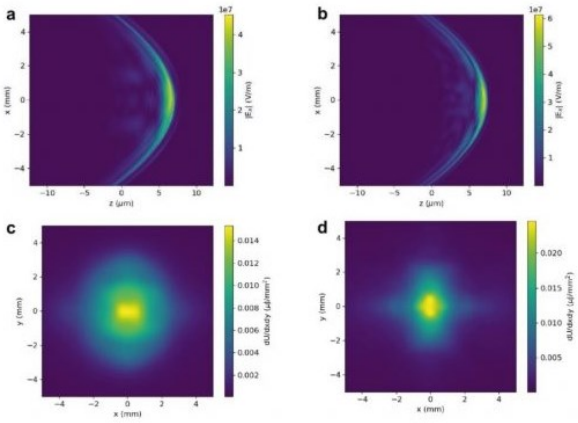
Thomas Primidis

Generating coherent light from laser-accelerator electrons

A new way of producing coherent light in the ultra-violet spectral region, which points the way to developing brilliant table-top x-ray sources, has been produced in research by researchers at the Cockcroft Institute and collaborators.

In an open-access paper in Nature Scientific Reports, predictions are made that intense, extremely short-wavelength ultraviolet light can be obtained by direct emission from ultra-short electron bunches driven by laser wakefield acceleration (LWFA).

Coherent light sources are powerful tools that enable research in many areas of medicine, biology, material sciences, chemistry and physics. An LWFA-based coherent source can be highly compact, fitting into a single laboratory room and enabling 'table-top' research using femtosecond pulses of light.



Undulator radiation obtained using GPT for a LWFA modelled using the particle-in-cell code FBPIC. (a) Electric field generated for 110 MeV mean energy and (b) 130 MeV mean energy. (c) Spatial distribution generated for 110 MeV mean energy and (d) 130 MeV mean energy. (Credit: E. Brunetti et al. Scientific Reports, 11, 14595 (2021))

A proof-of-principle experiment is planned at the SCAPA beamline at Strathclyde University to characterise the performance of such sources, pointing the way to generation of X-rays in a similar way.

Professor Dino Jaroszynski, of Strathclyde's Department of Physics, led the research. He said, *"This work significantly advances the state-of-the-art of synchrotron sources by proposing a new method of producing short-wavelength coherent radiation, using a short undulator and attosecond duration electron bunches.*

"This is more compact and less demanding on the electron beam quality than free-electron lasers and could provide a paradigm shift in light sources, which would stimulate a new direction of research. It proposes to use bunch compression – as in chirped pulse amplification lasers – within the undulator to significantly enhance the radiation brightness. The new method presented would be of wide interest to a diverse community developing and using light sources."

Electrons passing through the undulator radiate incoherent light if the electron are far apart from each other. By generating them carefully in a short bunch around 1 femtosecond in length, the electrons emit light as if they were a single 'big' electron. The emitted intensity is then proportional to the square of the number of electrons rather than being linear as it is for incoherent light. This doesn't sound important, but even a tiny bunch with 1 picocoulomb of charge contains a billion electrons; that tiny bunch if short enough therefore has its emission boosted by a billion times. Generating and controlling bunches to have short durations therefore allows compact accelerators to make intense light pulses for researchers.

The research collaboration involved the Universities of Strathclyde and Manchester, Pulsar Physics in the Netherlands, and ASTeC at STFC Daresbury Laboratory. The study benefited from EPSRC funding to support the wider 'Lab in a Bubble project', and from STFC.

The paper can be read on the Nature Scientific Reports website:

https://doi.org/10.1038/s41598-021-93640-8

Carsten Welsch

Liverpool academic recognised for 'exceptional contribution to physics education'

Dr Chris Edmonds, from the University of Liverpool and Cockcroft Institute, has been awarded the 2021 Institute of Physics Daphne Jackson Medal and Prize in recognition of his *'exceptional contribution to physics education, by improving access for the visually impaired, enhancing teacher training and creating award-winning teaching materials'*.

Dr Chris Edmonds (left) during a Tactile Collider workshop. (Credit: Cockcroft Institute)

A lecturer with a background in accelerator science and a passion for inclusive education, Dr Edmonds has been involved in numerous innovative outreach and engagement activities that aim to enhance physics education and communicate the importance and excitement of physics to a range of communities and audiences.

He co-created and delivered the Tactile Collider project, an immersive workshop that teaches visually impaired students about particle accelerators in a fun, accessible way. The project provided much-needed opportunities for young people with visual impairments to learn about physics through the use of soundscapes and specially developed tactile objects. It has also overseen the development and delivery of continuing professional development sessions, enabling teachers to communicate physics research to VI-inclusive audiences.

Dr Edmonds also created acceleratAR, a first-of-its-kind augmented reality app that enables anyone with a smartphone to build a particle accelerator on their coffee table.

He was the academic lead behind Interaction Point, a collaboration with arts organisation FACT, which looked at ways art and accelerator science can be brought together to explore multidimensional perspectives and allow people to explore physics using their own language.

During 2020's lockdown, Dr Edmonds also designed home lab kits and interactive learning strategies to ensure students continued to gain hands-on lab experience.

He said: *"This IOP award recognises projects that have enabled me to work with people from a wide range of backgrounds, which has been an incredibly interesting and rewarding experience. It's an honour to have been recognised by the IoP for this work, and I look forward to continuing to make science education accessible for all."*

Professor Peter Ratoff, Director of the Cockcroft Institute, said: *"I am really delighted to hear this news because Chris Edmonds has been one of the most active members of the Cockcroft Institute's internationally renowned public engagement team. Across a broad range of highly impactful outreach activities, Chris and his colleagues have significantly raised public awareness of the world class science and engineering that we do at the Institute. It is especially gratifying that they have reached audiences who had not previously been given much opportunity to learn about the work that we do."*

Institute of Physics President, Professor Sheila Rowan, said: *"On behalf of the Institute of Physics, I warmly congratulate all of this year's Award winners. Each and every one of them has made a significant and positive impact in their profession, whether as a researcher, teacher, industrialist, technician or apprentice. Recent events have underlined the absolute necessity to encourage and reward our scientists and those who teach and encourage future generations. We rely on their dedication and innovation to improve many aspects of the lives of individuals and of our wider society."*

Carsten Welsch

Paper on FLASH proton therapy receives prestigious award

The Galileo Galilei Award in Medical Physics is given every year to the best paper published in the European Journal of Medical Physics in the previous year.

Galileo Galilei Award
(Credit: Physica Medica)

The journal has just announced that this year the paper *"Technical challenges for FLASH proton therapy"* by Drs Simon Jolly and Marco Schippers, as well as Cockcroft Institute researchers Dr Hywel Owen and Professor Carsten P Welsch, published in Physica Medica, Volume 78, October 2020 has been elected the best paper published in the journal in the year 2020.

The selection of the best paper has been performed on the basis of citations and downloads together with the assessment by the Editors, Associate Editors and members of the Editorial Board.

The journal published the following statement: *"In this paper the authors performed a comprehensive and systematic study and analysis of the technical challenges posed by the accelerator technology in order to be able to deliver FLASH proton therapy. Particular attention was given to FLASH proton delivery methods concluding that the hybrid approaches employing a combination of the scattering and scanning methods, particularly the use of scanned beams with patient-specific range modulators, are likely to method of choice for clinical proton FLASH delivery. Their work can be regarded as one of the major step towards the clinical implementation of the FLASH treatments using protons."*

The four researchers were all members of the pan-European OMA network which facilitated the collaborative research. Study leader Dr Simon Jolly said: *"It is an honour and a privilege for us to receive this award. We are absolutely delighted that both our work on FLASH proton therapy and the burgeoning field of FLASH radiotherapy has been recognised in this way. It is a pleasure to share this award with a team of authors who have contributed so much to the field of accelerator physics, in particular the applications of medical accelerators."*

Congratulations to the winners of the Galileo Galilei Award 2020!

Article reference: 'Technical challenges for FLASH proton therapy', Simon Jolly, Hywel Owen, Marco Schippers and Carsten Welsch, Physica Medica 78, 71 – 82 (October 2020)
https://doi.org/10.1016/j.ejmp.2020.08.005

Carsten Welsch

John Adams Institute News

Congratulations to Suzie Sheehy, Royal Society University Research Fellow at the John Adams Institute, Oxford University, who has taken up a Senior Lectureship in the Physics Department at the University of Melbourne from January 2022.

Suzie has also written a book: 'The Matter of Everything: Twelve Experiments that Changed Our World', that will be available from 28th April: https://www.bloomsbury.com/uk/matter-of-everything-9781526618962/

Suzie discusses the book and other topics in a recent interview in The Observer.

Suzie Sheehy, and the cover of her new book (Credit: Bloomsbury Publishing)

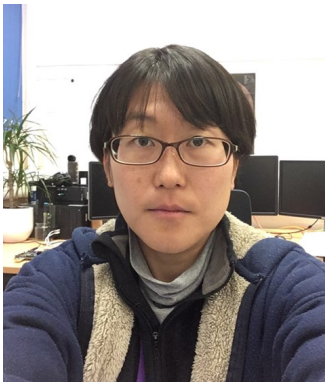
Congratulations to Bucker Dangor of the John Adams Institute and Distinguished Research Fellow at Imperial College, who has been awarded the 2021 IoP Michael Faraday Medal and Prize for outstanding contributions to experimental plasma physics, and in particular for his role in the development of the field of laser-plasma acceleration.

More details are available here: https://www.iop.org/about/awards/2021-michael-faraday-medal-and-prize

Bucker Dangor

Congratulations to Steve Rose of the John Adams Institute and Professor at Imperial College, who has been elected a fellow of the American Physical Society. And also congratulations to Emi Yamakawa of the John Adams Institute, who has been awarded a permanent staff position at ISIS, starting January 2022.

Steve Rose



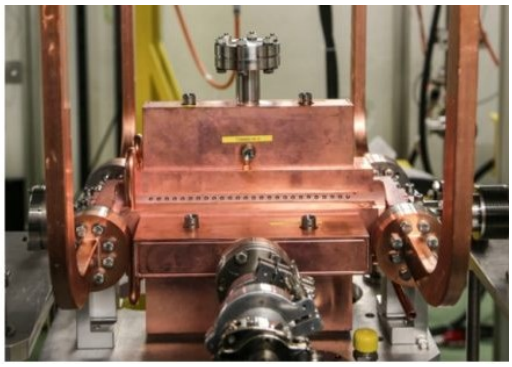
Emi Yamakawa

Phil Burrows

Cockcroft students successfully complete their PhDs

Cockcroft Institute PhD students, Lee Millar and Laurence Nix, successfully passed their vivas over the summer of 2021.

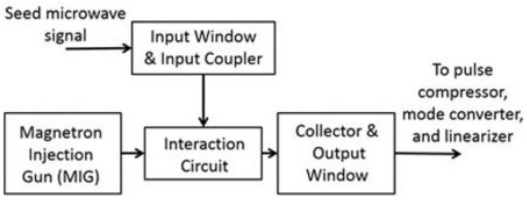
Lee, from Lancaster University, defended his thesis in July. The work on "Operation of Multiple Accelerating Structures in an X-Band High-Gradient Test Stand", was examined by Alessandro Gallo from INFN (Italy). In his thesis, Lee examined issues with the operation of two RF structures in series and powered by a single RF source, known as a superstructure. Evidence was shown for an arc in one structure causing an arc in its partner via reflected power, as well as the study of capture of dark current. As well as this, Lee developed a Monte Carlo based algorithm for the prediction of structure conditioning that has been able to predict, and study, previously misunderstood features in actual structure tests. Lee has just started a CERN Fellowship on Linac4.

Dr Lee Millar and one of the X-band structures tested.

Laurence, from the University of Strathclyde, passed his viva in September with a thesis entitled "Design of a High-Power 48GHz Gyroklystron Amplifier for Accelerator Applications".

Laurence participated in the H2020 project CompactLight, for which he was responsible for the design and simulation of a high power (2 MW), 48 GHz amplifier to power a SLED II compressor to drive a high harmonic lineariser for an X-ray Free Electron Laser. The CompactLight design for a next-generation XFEL utilises a C-band (6 GHz) injector, which requires that the harmonic system is used to linearise the beam's phase space. The optimum frequency for the harmonic system was found to be in the range of frequencies from 36 to 48 GHz.

Dr Laurence Nix and flow diagram of the high power amplifier.

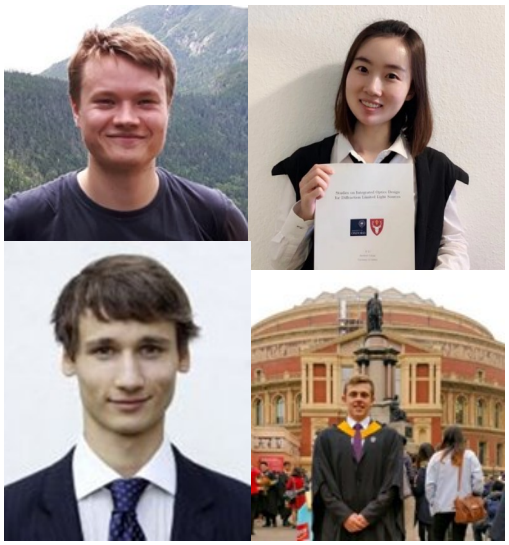
Congratulations to Lee and Laurence!

Riccardo Torres

JAI students completed PhD theses

In the past year another eight John Adams Institute students have completed their PhD theses, despite all the difficulties related to dealing with the Covid19 pandemic; all have moved on to new positions in and beyond the accelerator domain.

At Oxford University, Jakob Jonnerby (whose thesis was titled 'Multi-pulse laser wakefield acceleration'), has been awarded a PDRA position at Imperial College. Ji Li ('Studies on Integrated Optics Design for the Diamond Light Source'), has been awarded a fellowship at the Chinese Academy of Sciences Institute of Physics, Beijing. Marko Mayr ('Study of novel electron injection mechanisms for laser-wake field accelerators'), has been awarded a PDRA position at Oxford University. And Alex Picksley ('Low Density Plasma Waveguides for Multi-GeV Laser Wakefield Accelerators'), has been awarded a PDRA post on BELLA at LBNL.

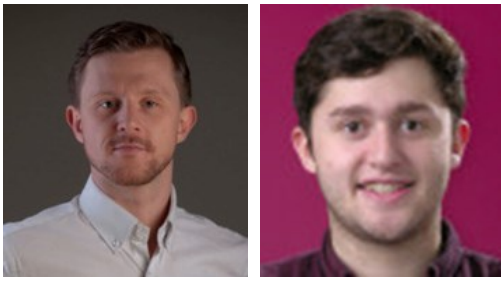


Clockwise from top left: Jakob Jonnerby, Ji Li, Alex Picksley and Marko Mayr.

At Royal Holloway, University of London, Kirill Fedorov ('Non-invasive Longitudinal Beam Profile Diagnostic Exploiting Coherent Cherenkov Diffraction Radiation'), has been awarded a PDRA post at RAL's Central Laser Facility. Andrei Oleinik ('Investigation of the fluxes of X-rays and electrons generated with a periodic variation in the temperature of single crystal of lithium tantalate'), has been appointed as Senior Researcher in Belgorod National Research University, Russia.

Kirill Fedorov (left) and Andrei Oleinik (right).

At Imperial College, Jan-Niclas Gruse ('Development of laser wakefield accelerators'), has taken a post in data science at 'd-fine' in Berlin. And Robbie Watt ('Monte Carlo Modelling of QED Interactions in Laser-Plasma Experiments'), has been awarded a PDRA post at SLAC.



Jan-Niclas Gruse(left) and Robbie Watt (right).

Phil Burrows

International Calendar

Many events are planning to return to in-person events this year where circumstances allow. Updates are available at: https://www.jacow.org/About/UpcomingEvents

International Conference on Accelerators for Research and Sustainable Development: From Good Practices Towards Socioeconomic Impact
23-27 May 2022 , Vienna, Austria
https://www.iaea.org/events/accconf22

13th International Particle Accelerator Conference (IPAC'22)
12-17 June, 2022, Bangkok, Thailand
https://www.ipac21.org/

IAEA Workshop on Innovative Approaches of Accelerator Science and Technology for Sustainable Heritage Management
13-16 June, 2022, Vienna, Austria
https://nucleus.iaea.org/sites/accelerators/Pages/Accelerators4Heritage.aspx

14th International Symposium on Electron Beam Ion Sources and Traps (EBIST 2022)
14-17 June, 2022, Whistler, Canada
https://meetings.triumf.ca/event/103/

Inaugural Particle Accelerators and Beams Group Annual Conference
25-26 July, 2022, Liverpool, UK

North American Particle Accelerator Conference (NAPAC 2022)
7-12 August 2022, Albuquerque, USA
www.napac2022.org

40th International Free Electron Laser Conference (FEL2022)
22-26 August 2022, Trieste, Italy
https://www.fel2022.org/

31st International Linear Accelerator Conference 2022 (LINAC 2022)
28 August – 2 September 2022 , Liverpool, UK
https://linac2022.org/

Upcoming schools

Upcoming accelerator schools are a mix of in-person (CERN Accelerator School) and virtual (USPAS). Information is available at: https://cas.web.cern.ch/ and https://uspas.fnal.gov/.

7th Superconductivity Summer School
5 July – 8 July 2022 , Oxford, UK
https://www.iop.org/events/7th-superconductivity-summer-school

Community Meetings

Do you have an idea for a meeting of interest to the community? See our advert below for details on applying for support from the Group.

IOP Particle Accelerators and Beams Group - Half Day Meetings

The meeting should be of **interest to the community at large**, bringing together experts and non-experts from different areas of the field. (Must use IOP Conference Service.)

You can request up to **£500** to help cover the cost of a half day meeting in any area of accelerator physics.
£750 for a 1 day meeting.
Or £750 (½) £1500 (1 day) shared meeting with another IOP group.

If you have an idea for a meeting and/or would like to discuss it further please email Ben Pine at **yafizicist@gmail.com.**

IOP Institute of Physics
Particle Accelerators and Beams Group

Ben Pine

Useful Links

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

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

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

http://www.diamond.ac.uk

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

http://www.linearcollider.org/

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

http://www.jacow.org/

The Institute of Physics

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IOP Institute of Physics
Particle Accelerators and Beams Group

IoP Particle Accelerators and Beams Group

IoP PAB Committee

***Chair*: Dr. Melissa Uchida (Cambridge)**

***Secretary*: Dr. Andrew Smith (Dalton Cumbrian Facility)**

***Treasurer*: Dr Glenn Christian (Diamond Light Source)**

Dr. Graeme Burt (CI Lancaster)

Hayley Cavanagh (STFC RAL)

Dr. Tessa Charles (CI Liverpool)

Dr. Kay Dewhurst (CERN)

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

Dr. Stephen Gibson (JAI RHUL)

Dr. Ben Pine (Opera Software)

Malik Salaam (BAE Systems)

Dr. Amir Sanjari (NuRadMP)

Deadline for submissions to the next newsletter is
15 July 2022