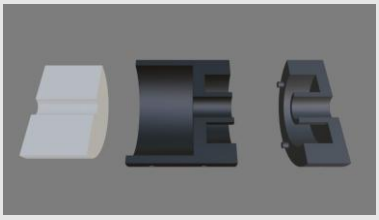
EuPRAXIA Doctoral Network

>>> Newsletter

Latest developments in plasma accelerator research and training.

>>> Highlights



New real-time monitoring technique promises enhancements for next-generation radiotherapy

EuPRAXIA-DN Camp III on Innovation held in Pécs

EuPRAXIA-DN at IBIC 2025

>>> Welcome

New EuPRAXIA leadership and training excellence

As 2025 comes to an end, this issue highlights our advances in accelerator technology and training. You can read about impressive scientific progress, which will be important for the future of EuPRAXIA.

Our final camp on innovation in Pécs, Hungary provided a vibrant space for our Fellows and experts to explore applications across medicine, chemistry, and materials science. Strong participation at IBIC 2025 and other conferences underlined the growing visibility of our network.

On a strategic level, the EuPRAXIA-PP General Meeting at ELI Beamlines and our engagement at the RTI Summit in Copenhagen underscored our role in shaping Europe's future research infrastructure landscape.

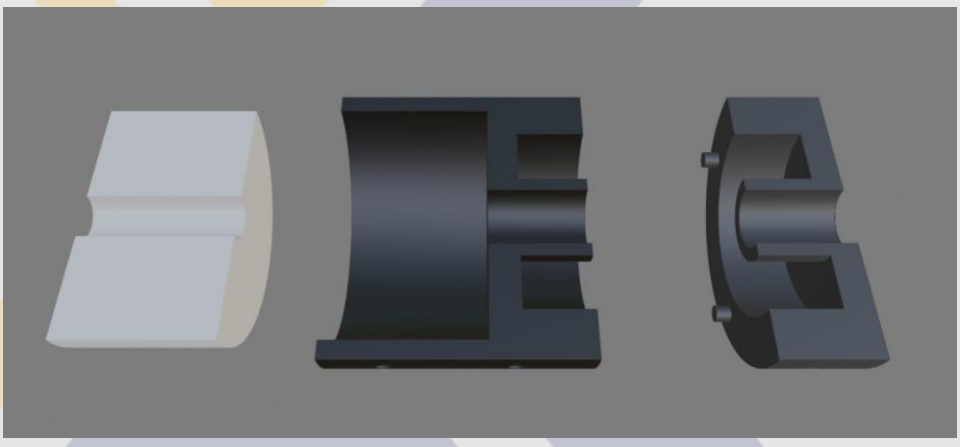
Looking ahead, I encourage you to join our upcoming events, including next year's "Innovations for a Sustainable Tomorrow" Symposium and of course our final conference in Elba!

I wish you a peaceful holiday season and a successful start into 2026!

Prof Carsten P. Welsch
Coordinator

»» Research Highlights

New real-time monitoring technique promises enhancements for next-generation radiotherapy



Graphical scheme of the ICT enclosure used in the experiment designed in open-source software Blender®

EuPRAXIA DN Fellow David Gregocki conducted an experiment involving researchers from the National Institute of Optics (CNR) in Pisa, the University of Pisa, and the National Institute of Nuclear Physics (INFN) to unveil a promising new method for real-time dose monitoring in laser-driven electron beam experiments. Their findings, published in the journal Instruments under the title “Real-Time Dose Monitoring via Non-Destructive Charge Measurement of Laser-Driven Electrons for Medical Applications,” could mark an important step toward advancing next-generation radiotherapy systems.

The study focuses on laser-driven Very High Energy Electron (VHEE) beams characterized by their kinetic energy in the range of approximately 50 to 300 MeV, which are being actively explored for use in radiotherapy, particularly in the so-called “FLASH” regime. FLASH radiotherapy delivers ultra-high dose rates that can kill tumour cells while sparing surrounding healthy tissue. Given the ultra-high dose rates and its medical application, one of the field’s key challenges is the development of non-destructive beam diagnostics capable of providing real-time response.

To address this, the researchers developed a monitoring system capable of measuring both the charge and dose of the electron bunches that strike a target without interrupting or damaging the beam. The system relies on an Integrating Current Transformer (ICT) paired with RadioChromic Films (RCFs), allowing it to record charge and dose data simultaneously. By establishing an analytical relationship between the charge and the delivered dose using both experimental measurements and Monte Carlo simulations, the team demonstrated that, for thin samples, those thinner than the penetration depth of the electrons produced in the experiment, the dose is approximately proportional to the electron charge. As a result, ICTs, which are normally used for charge measurements, can serve as non-destructive dose-measuring devices as well. While the results were averaged over several shots, future development aims to achieve single-shot dose monitoring, requiring more sensitive detectors than the radiochromic films currently used.

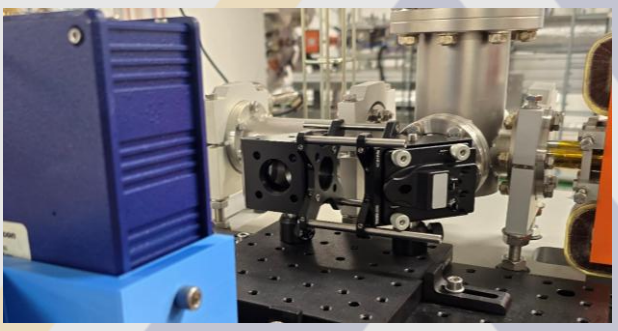
These results provide a potential step toward the future of FLASH radiotherapy in both preclinical studies and future clinical systems based on laser-driven VHEE beams. Beyond medical applications, the technology could also benefit research fields that focus on real-time beam characterization and monitoring.

You can access the full paper here.

Further reading:
David Gregocki, et al., ‘Real-Time Dose Monitoring via Non-Destructive Charge Measurement of Laser-Driven Electrons for Medical Applications’. Instruments 2025, 9(4), 25; https://doi.org/10.3390/instruments9040025

New paper on femtosecond-resolution beam diagnostics

A new study from the University of Liverpool's QUASAR Group, with collaborators from the MAX IV Light Source, describes a pioneering design for a "bunch-length monitor" capable of measuring ultra-short electron bunches with femtosecond-level resolution, using spatial images of Coherent Transition Radiation (CTR). The work is published in the open-access journal Instruments under the title Designing a Femtosecond-Resolution Bunch Length Monitor Using Coherent Transition Radiation Images.



The broadband coherent imaging system installed and operational in the MAX IV SPF.

The authors, led by QUASAR and EuPRAXIA-DN Fellow Ana Guisao-Betancur and Dr Joseph Wolfenden, Plasma Accelerator Research Fellow in the QUASAR Group, present the conceptual design and first demonstration of a CTR-based imaging system at the MAX IV short-pulse facility (SPF), intended to monitor the longitudinal profile (bunch length) of high-energy electron beams.

Their approach uses a broadband spatial imaging system. When a relativistic electron bunch crosses a boundary (a metallic foil), it emits CTR; by focusing this radiation with mirrors onto a camera, the spatial image distribution can be analysed to infer the bunch length. This avoids the complexity of full spectral measurements or disruptive beamline devices.

In initial tests at SPF (operating at 3 GeV), the device captured CTR images for bunches in the 35–100 fs FWHM range at ~100 pC charge. Analysis of the spatial profile (e.g., width and intensity) showed trends consistent with independent reference measurements using a transverse deflecting cavity (TDC), indicating the potential of CTR imaging as a diagnostic tool.

As accelerator technology advances, especially in areas such as compact plasma-based accelerators or next-generation free-electron lasers (FELs), there is a growing demand for reliable, high-precision diagnostics of ultrashort electron bunches. Traditional tools like TDCs are powerful but often costly, bulky, and disruptive to the operation of the beamline for users and experiments.

The CTR-imaging technique described here offers a compelling alternative. It could provide single-shot, minimally invasive, and compact bunch-length diagnostics. For facilities where footprint and flexibility are paramount (e.g., plasma accelerators or compact FELs) such a monitor could become an essential tool for real-time beam control and optimisation. By lowering the instrumentation barrier, this method may help accelerate the adoption of advanced accelerator technologies in academic, medical, and industrial settings.

The authors are clear: the current prototype is a proof-of-concept. While the initial results are promising, further development and refinements are needed before the monitor can deliver high-accuracy, fully reliable measurements.

Key next steps include, improving the imaging optics to better resolve spatial features in the CTR image, and expanding the system's spectral bandwidth to increase sensitivity to shorter bunches. Work is also under way developing advanced image-analysis methods utilising machine-learning-based techniques to extract bunch profile information from CTR images.

If these challenges are overcome, the method could evolve into a robust, widely deployable diagnostic, enabling real-time monitoring of ultrashort electron bunches in cutting-edge accelerators.

Dr Joseph Wolfenden, who has led this work over the past 7 years, says, "This represents a significant milestone toward more compact, flexible, and accessible beam diagnostics. It aligns strongly with our groups broader research goals: reducing the size, cost, and complexity of accelerators whilst maintaining performance."

Further reading:

A. Guisao-Betancur, et al. "Designing a Femtosecond-Resolution Bunch Length Monitor Using Coherent Transition Radiation Images", Instruments, 9(4), 29 (2025). https://doi.org/10.3390/instruments9040029

EuPRAXIA-DN Camp on Innovation held in Pécs

On 6th - 7th October 2025, the EuPRAXIA Doctoral Network held a two-day Camp hosted between the University of Pécs and Szentagothai Research Centre in Pécs, Hungary. The camp explored the innovations that the EuPRAXIA facility and plasma accelerators in general will enable. Talks looked at how plasma accelerators can lead to innovative applications across medicine, biology, chemistry and material science among other areas.

The talks were split across four main sessions. Each of these sessions was introduced by an hour-long invited keynote talk, followed by selected contributed talks. There was also a poster session and an opportunity to attend a lab tour at the Szentagothai Research Centre to gain an awareness of the valuable work being carried out there.

Professors András Komócsi during the opening talk.

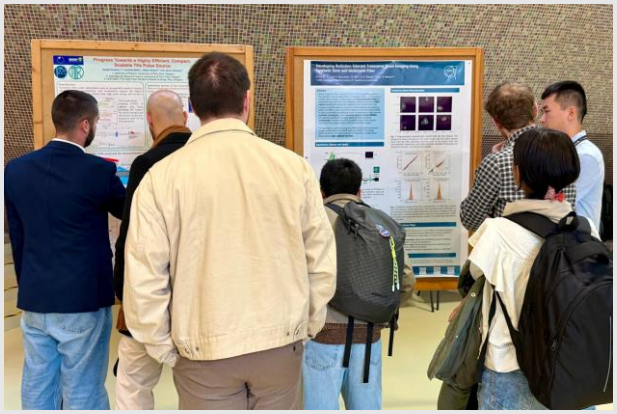
To open the camp, network coordinator Professor Carsten P Welsch, and Professors András Komócsi and Gábor Almási of the University of Pecs welcomed the 27 workshop participants, amongst whom there were Fellows from the Doctoral Network, invited key-note speakers and external participants from institutions across Europe.

Professor Bernhard Hidding of Heinrich Heine University Düsseldorf was the first to deliver an invited talk, introducing the topic of high-brightness X-rays for biology and chemistry. After lunch, Dr Sonja Gerlach of Ludwig Maximilian University (LMU) Munich gave the second invited talk on the medical applications of plasma accelerators. After some time to discuss the day's presentations, the academic element of day one was concluded with a poster session, allowing for discussion and relationship building between camp participants.

Dr Sonja Gerlach (LMU) Munich gave a talk on the medical applications of plasma accelerators.

In the evening, attendees had the chance to dine at Pécs TV tower, enjoying traditional Hungarian food as well as a spectacular view over the city of Pécs.

Day two kicked off with an invited talk by Professor Zulfikar Najmudin of Imperial College London who introduced Betatron radiation applications. This was followed by half-hour long invited talks by Dr Gergő Krizsán and Professor László Pálfalvi of the University of Pécs about terahertz pulse sources and terahertz-driven electron acceleration using a parabolic mirror or a paraboloid ring. The final invited talk in this session was given by Dr István Földes of the Wigner research centre and covered spectral interferometry with high harmonics, isolated attosecond pulses from laser plasmas on solid targets.



Poster session at the EuPRAXIA-DN Camp.

Group photograph of the attendees at the EuPRAXIA-DN Camp III.

After lunch, the final session began with an invited talk from Dr Thomas Pacey of STFC, which covered high-impact beamlines for R&D hubs. Dr Mark Aladi of the Wigner centre followed with a talk on configurations of targets and detectors for femtosecond laser-driven acceleration and fusion.

Prof Welsch said: “The Camp was a fantastic opportunity for our Fellows to exchange ideas with leading experts and to see first-hand how cutting-edge accelerator research can lead to real societal impact.”

The EuPRAXIA Doctoral Network would like to express its thanks to all invited speakers for their valuable contributions. Special thanks go to Szabolcs Turnár and Krisztina Fertői-Héra and the team at University of Pécs for their support in organising the camp.

All presentations can be found at the event website.

All images credit: University of Pécs/EuPRAXIA

EuPRAXIA-DN at IBIC 2025

The largest-ever European edition of the International Beam Instrumentation Conference (IBIC 2025) was hosted at The University of Liverpool from the 7th -10th September 2025. This 14th edition of the conference brought together more than 300 world-leading experts to discuss developments in and share knowledge on beam instrumentation.

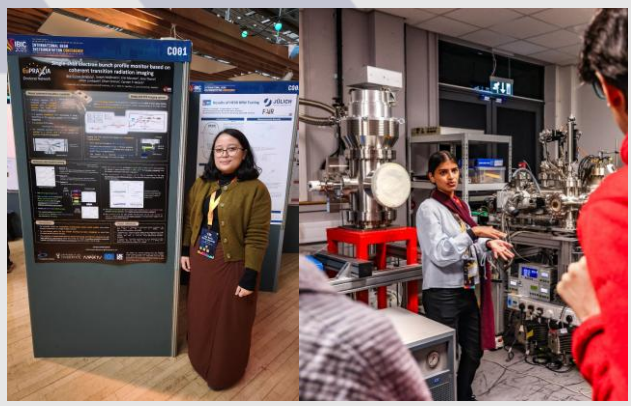
Hannah Acton and Dr Ricardo Torres from the University of Liverpool's Project T.E.A.M hosted a booth to promote the portfolio of EuPRAXIA projects as part of the industry exhibition, demonstrating, amongst other things, how this new infrastructure can serve as a cornerstone for innovation and development across multiple fields.

Hannah Acton, EuPRAXIA-DN Project Manager (right), and her colleague Naomi Smith, LIVINNO Centre Manager, at the industry booth.

The booth featured information from the preparatory phase project, PACRI and the EuPRAXIA doctoral network. It was shared with the LIV.INNO Centre for Doctoral Training, with which the doctoral network has jointly organised a number of training events. It attracted many visitors and acted as a key location for networking and information sharing. Additionally, booth visitors had the opportunity to participate in a Liverpool-themed quiz with a unique Liverpool-themed goody bag on offer as the prize. Congratulations to Alexander Gottstein of the University of Bern who won the prize!

EuPRAXIA-DN Fellows Ana Guisao-Betancur and Farhana Thesni Mada Parambil had the opportunity to participate in the conference and presented their latest research through poster contributions. IBIC 2025 was a fantastic opportunity for them to connect with experts from around the world, discuss ideas, and receive helpful feedback. It allowed them to highlighted their work within EuPRAXIA-DN and provided them with fresh insights and inspiration from the latest developments in the field.
Farhana presented recent simulation results of the new design of a novel ionization profile monitor for FLASH proton therapy. She showed results from CST simulations for clinically relevant proton beam energies and currents, incorporating ionization cross sections. Her work explores the potential of gas jet–based monitors in compact medical accelerators and next-generation FLASH proton radiotherapy systems.

Ana's poster featured the latest developments in fs-resolution bunch profile monitors. A prototype device was installed at MAX IV in Sweden earlier this year. The coherent transition radiation imaging method for reconstructing the bunch profile was tested through simulations, and was now validated with experimental data for electron bunches <80 fs from the 3 GeV and ~100 pC electron beam at the MAX IV short pulse facility.



Ana (left) next to her poster and Farhana (right) during the Daresbury laboratory tour.

In addition to their presentations, Ana and Farhana were involved in the conference organisation. Ana was part of the local organising committee (LOC) in the student pathway team and involved in coordinating the buddy program and a range of career-supporting activities. Farhana helped in the poster session set up and organisation. Both also acted as guides during the delegated tour of Daresbury Laboratory.

More information about the conference can be found at http://www.ibic2025.org.

>>> Upcoming Events

Symposium - Innovations for a Sustainable Tomorrow

The symposium 'Innovations for a Sustainable Tomorrow' will be held on 10th July 2026 in Liverpool, UK

This event will bring together the LIV.INNO Centre for Doctoral Training and the EuPRAXIA community to explore how innovation and sustainability are reshaping fundamental research, medicine, electronics, the environment, and energy.

Scientists from across Europe will present highlights and advances in both the accelerator science and data intensive science fields and the enormous impact these have had on science and society. They will also offer unique insight into current research programmes and outline exciting plans for the future.

LIV.INNO's focus on efficient data usage, computational optimisation, and experiment design aligns directly with EuPRAXIA's mission to create more energy-efficient, resource-responsible research infrastructures. Together, these programmes demonstrate how next-generation researchers can build not only groundbreaking technologies, but also long-term, sustainable career pathways across high-tech sectors. This event celebrates a shared commitment to training innovators who will shape the future of sustainable, high-impact science.

The symposium will also offer an opportunity for potential new partners to present their research and to network with current staff, fellows, and collaborators to start a dialogue for future partnerships.

Further details including registration information will be published shortly on the event homepage https://agenda.infn.it/event/49199/

David Gregocki participates in Bright Night

EuPRAXIA-DN Fellow David Gregocki volunteered at the BRIGHT Night event held at CNR-INO in Pisa on 25th – 26th September 2025. The annual event invites schools and the general public to explore science and meet the people behind current research projects.

In preparation for the event, David contributed to the design and preparation of educational posters aimed at making complex scientific concepts accessible to a broad audience. He also assisted in assembling hands-on experiments, explaining and showcasing an experiment that demonstrated the properties of light reflection. This allowed the visitors to directly observe and better understand fundamental concepts of optics in an interactive way.
David said that “such outreach activities are both rewarding and educational, as they give the opportunity to contribute to science outreach, engage with diverse audiences, and develop valuable communication skills”.

BRIGHT Night, coordinated by universities and research institutes across Tuscany, is part of a Europe-wide initiative supported by the European Commission to promote public engagement with science. The event in Pisa featured open laboratories, interactive exhibits and talks, highlighting the breadth of research carried out in the region and offering visitors a closer look at the work of scientists like David and his colleagues.

For more information about BRIGHT-NIGHT, visit bright-night.it.

EuPRAXIA-DN Fellow David Gregocki (second from right) and his colleagues at BRIGHT Night.
(Image credt: Simona Piccinini)

Phani Deep Meruga Presents Research at The LLRF Workshop 2025

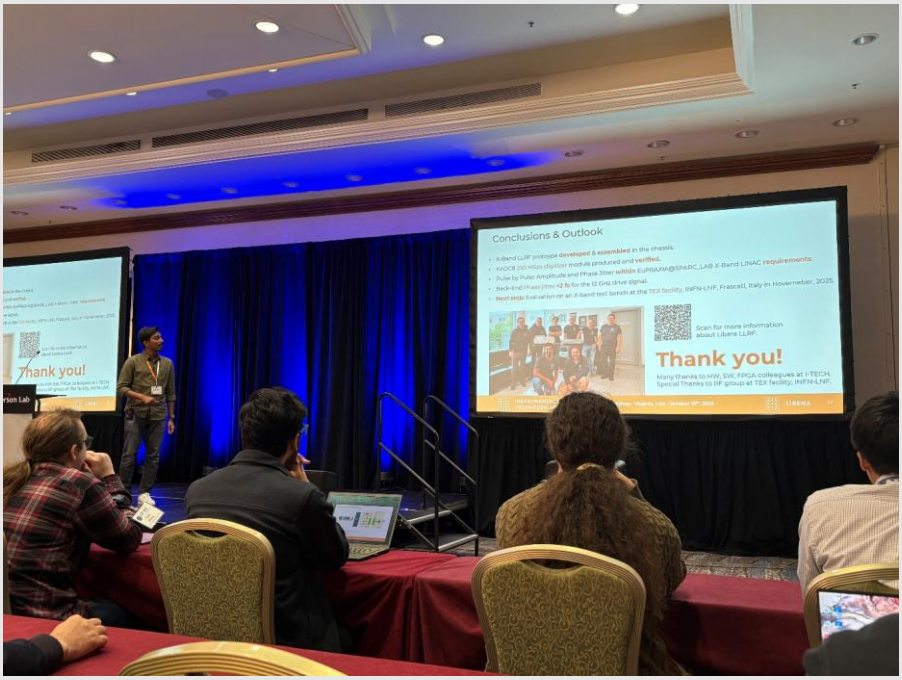
The biennial Low Level Radio Frequency Workshop (LLRF Workshop 2025), which convenes scientists and engineers worldwide to focus on precision radio frequency systems for particle accelerators took place from the 12th - 16th October 2025 at the Thomas Jefferson National Accelerator Facility (Jefferson Lab) in Virginia, USA.

EuPRAXIA DN Fellow Phani Deep Meruga attended the workshop and took the opportunity to present a talk entitled “Development and Testing of a Low-Noise X-Band LLRF Prototype System”.

The talk highlighted recent progress within the EuPRAXIA-DN project towards achieving ultra-stable RF control in the X-band frequency regime (~12 GHz) for compact accelerator applications. It also detailed the development of a low-noise X-Band LLRF prototype, combining precision analogue front-end design with custom digital back-end electronics, including an in-house 8-channel 250 MS/s ADC module and FPGA-based signal generation and processing. Phani outlined how experimental results have demonstrated pulse-to-pulse amplitude and phase stability within EuPRAXIA’s stringent specifications, with measured phase jitter below 2 fs on the 12 GHz drive signal.

Phani Deep Meruga at the Jefferson Lab.

The presentation was well received, drawing strong engagement from experts interested in high-frequency RF control and system integration. The prototype will undergo further evaluation at the TEX facility at INFN-LNF (Frascati, Italy) later in 2025, marking a key step towards its industrialization and deployment in future X-band linear accelerators.



Phani presented a talk on ‘Development and Testing of a Low-Noise X-Band LLRF Prototype System’.

Ana Maria Guisao Betancur wins best talk prize at the Cockcroft Institute Post-Graduate Conference 2025

On Wednesday 15th October, the Cockcroft Institute Post-Graduate Researcher Conference 2025 was held at Daresbury Laboratory. The event gave researchers across the institute the opportunity to present their work through talks and posters covering a wide range of accelerator science topics, from radiobiology and femtosecond scale beam diagnostics to the UK XFEL and bright THz radiation. EuPRAXIA Doctoral Network Fellow Ana Maria Guisao-Betancur who is based at the Cockcroft Institute, gave a talk at the conference, which went on to be awarded the Best Talk Prize.

Through her talk, entitled “Single-shot electron bunch profile monitor based on coherent transition radiation imaging,” Ana shared an overview of the design and current development status of a single-shot bunch length monitor prototype. The prototype utilizes a broadband spatial imaging system for coherent transition radiation (CTR) and has recently been installed at the MAX IV Short Pulse Facility (SPF). The discussion was centred on the preliminary results to date, in which image features of the CTR images have been used to study changes in the bunch length, with reference measurements provided by a transverse deflecting cavity.

Ana said “the conference was a great space to connect with the rest of the students working on different projects across the institute’s universities through their talks and posters, and an opportunity to chat with postdocs and other academics, resulting in interesting discussions. We also had a good time at the end of the day, eating pizza during the social event and trying an escape room in town.”

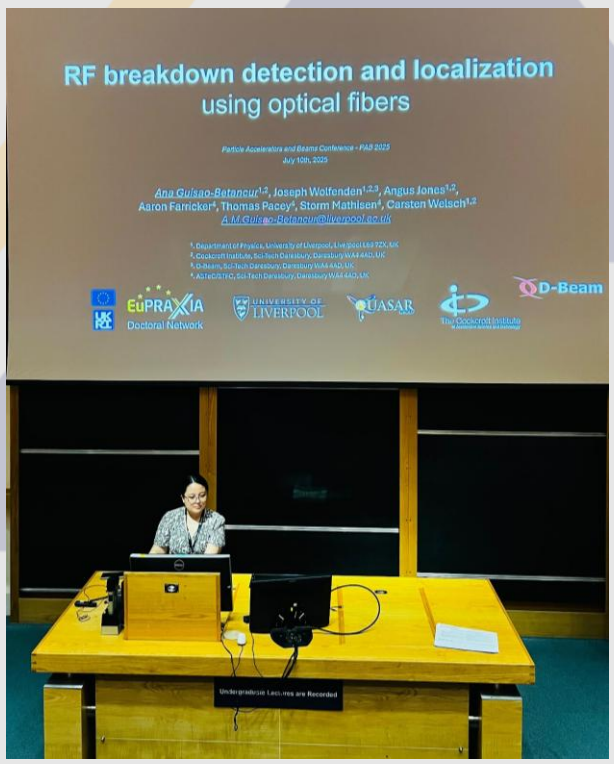
For more information on the conference, you can visit the Indico page.

Congratulations to Ana Maria!

Ana Maria Guisao-Betancur (left) was awarded Best Talk Prize at the Cockcroft Institute Post-Graduate Conference 2025.

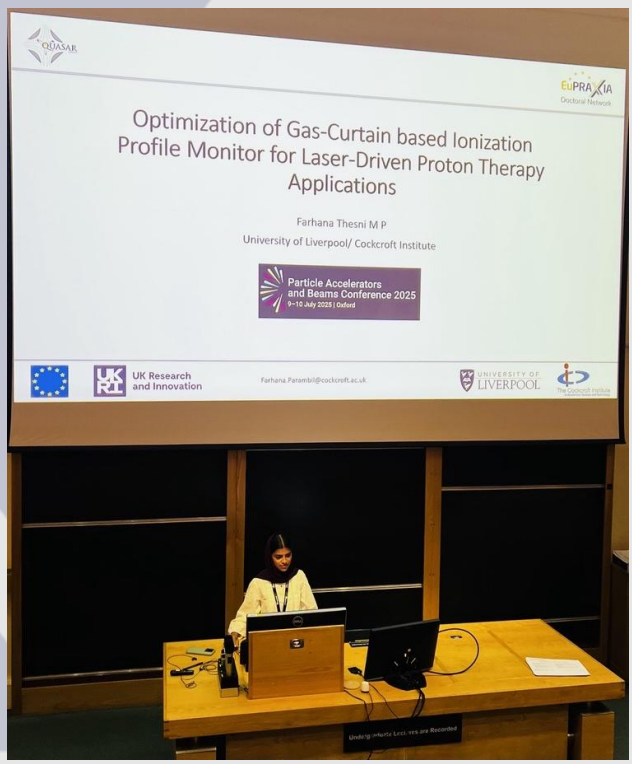
EuPRAXIA-DN Fellows participate in IOP Particle Accelerators and Beams Conference

Ana Maria Guisao Betancur and Farhana Thesni Mada Parambil, EuPRAXIA-DN Fellows based at The University of Liverpool and the Cockcroft Institute, joined over 100 researchers and industry delegates from across the UK for the Institute of Physics (IOP) Particle Accelerators and Beams Conference. The annual conference is the UK's premier event in the field of particle accelerators. This year, it took place in early July in Oxford and was hosted by the John Adams Institute and RAL. Both EuPRAXIA-DN Fellows had the opportunity to give contributed talks.



Ana Maria Guisao Betancur presenting her talk.

Ana's talk on "RF breakdown detection and localization using optical fibres" discussed the progress made during her secondment with the instrumentation company D-Beam. She analysed Cherenkov radiation signals produced in an oBLM from RF breakdowns during the commissioning of one of the accelerating structures on the CLARA accelerator at Daresbury Laboratory. With her analysis, it is now possible to achieve centimetre-level localisation of the breakdowns, which is important for better accelerator and beam control.



Farhana Thesni Mada Parambil during her talk.

Farhana's talk in the "Optimization of a Gas-Curtain based Ionization Profile Monitor for Laser-Driven Proton Therapy Applications" introduced a novel, real-time, non-invasive beam monitoring technique for ultra-high dose rate proton radiotherapy such as FLASH. The device utilizes a thin layer of gas to generate a visible signal when hit by the beam,

which is then captured by a camera, enabling real-time beam monitoring. She discussed her CST simulations and successful testing of the system at the MC40 cyclotron facility at the University of Birmingham. Her work highlights the potential of gas jet-based monitors in compact medical accelerators and next-generation FLASH proton radiotherapy systems.

Aside from having the opportunity to present their latest research, the conference also provided Ana and Farhana with an excellent opportunity to network and form new connections. They also had the chance to have a tour of RAL, visiting the EPAC, ISIS and Diamond facilities.

For more information about the conference, visit https://indico.global/event/5645/

>>> Partner Updates

EuPRAXIA Consortium Convenes in Czech Republic for General Meeting

The 2025 General Meeting of the EuPRAXIA Preparatory Phase (EuPRAXIA-PP) project took place from Wednesday 29th - Friday 31st October 2025. The three-day meeting was held at the project's recently announced laser-driven accelerator site, ELI, specifically the ELI Beamlines facility, in Dolní Břežany, just outside Prague. This annual gathering of the consortium provided a valuable opportunity to review project progress. This year, particular attention was put on the Technical Design Reports of the two EuPRAXIA pillars (laser and beam driven) and their implementation status.

At the meeting, colleagues gathered to align scientific, engineering and facility planning efforts across Europe. The focus was on establishing collaboration between the EuPRAXIA National Nodes, technological clusters and EuPRAXIA pillars as well as exploring funding options that will support the implementation of the Project across both pillars.

Leaders from each of the 16 work packages delivered progress updates, with ample time factored in to discuss the developments in each of these. Four Invited talks were given across the three days. These covered photon science at ELI-ERIC, sustainability at large research infrastructures, PACRI and EuPRAXIA's technical design reports and China's laser plasma accelerator-based free electron laser programme. Invited speakers provided interesting insights and opportunities for dialogue around topics of particular importance to EuPRAXIA moving forwards. Participants also had the opportunity to tour the laser and experimental halls at the existing ELI Beamlines facility.

Group photograph of the participants at the General Meeting. (Credit: ELI)

The meeting saw the Collaboration Board come together for one of their bi-annual meetings, offering a space for strategic decision making to help the project advance. Additionally, the board of financial sponsors assembled, reviewing the project's financial viability.

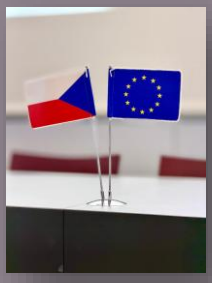
Dr Pierluigi Campana, Coordinator of the EuPRAXIA PP Project commented that "Organizing the 2025 EuPRAXIA GM in ELI-ERIC was a tribute to the decision to host here the laser-driven site. We all had the opportunity to appreciate the lively atmosphere of this unique infrastructure, where the second site of EuPRAXIA will be built."

This General Meeting took place at a pivotal moment for EuPRAXIA PP, as the project moves from conceptual studies towards concrete implementation. Achieving coherence between the two pillars and securing funding is key for the project's feasibility and timeline. As well as considering immediate next steps, the meeting also gave the consortium an opportunity to look to the future, reviewing plans for the establishment of a succession of the current collaboration framework.

The meeting served as a technical forum and a strategic coordination platform, helping EuPRAXIA to move one step closer to achieving its mission of delivering a compact, cost-effective accelerator infrastructure that supports scientific excellence and innovation throughout Europe.

For more details about the meeting, please visit the event page.






EuPRAXIA Showcases Future Accelerator Infrastructure at RTI Summit 2025

The Research and Technology Infrastructures (RTI) Summit 2025 took place from 22nd to 23rd October in Copenhagen, bringing together Europe's leading voices in science, innovation, and policy. Hosted under the Danish Presidency of the Council of the European Union, the event aimed to shape a shared European strategy for RTIs and explore how these infrastructures can drive scientific discovery, industrial competitiveness, and societal progress.

As Europe's first project to design and implement a dedicated plasma-based particle accelerator infrastructure, EuPRAXIA was proud to be among the exhibitors at this influential event. Represented at Booth 39, EuPRAXIA coordinator Dr Pierluigi Campana and colleagues Dr Antonio Falone, Dr Joseph Wolfenden and Dr Alessandro Vannozzi engaged with a wide range of stakeholders, from European Commission officials and national funding agencies to scientists, engineers, and innovation strategists, highlighting how the project is pioneering a new generation of compact, sustainable, and high-performance accelerator technologies.

EuPRAXIA's presence at the RTI Summit underscored its growing role as a pan-European research infrastructure bridging frontier science and technological application. The project's exhibit presented its vision of laser and electron beam-driven plasma wakefield acceleration, capable of providing electron beams and radiation sources with unprecedented efficiency and precision. Visitors learned about the project's roadmap towards implementation, including planned facilities in Italy and the Czech Republic, and how EuPRAXIA aims to serve a broad user community in fields ranging from materials science and medicine to electronics and high-energy physics.

Beyond showcasing its scientific and technological progress, EuPRAXIA used the Summit as an opportunity for strategic dialogue. In line with the event's overarching theme, the development of a coherent European strategy for research and technology infrastructures, EuPRAXIA sought input from stakeholders on operational models, governance frameworks, and long-term sustainability.

The Summit featured keynote talks from leading voices in European science policy, including Nobel Laureate Morten Meldal, Danish Minister for Higher Education and Science Christina Egelund, and José Luis Martínez, Chair of the European Strategy Forum on Research Infrastructures (ESFRI). Discussions explored how to strengthen the connection between research infrastructures and technology infrastructures, bridging the gap between scientific discovery and industrial deployment. For EuPRAXIA, these themes resonated strongly with its aim: to provide cutting-edge accelerator capability that supports both fundamental research and applied innovation.

Dr Joseph Wolfenden said "The RTI Summit was a valuable opportunity to show how EuPRAXIA is shaping the future of accelerator science in Europe. The discussions on bridging research and technology infrastructures, and on the value of distributed models, strongly resonated with our approach. EuPRAXIA brings together complementary expertise across multiple sites to deliver a unified, user-focused facility. We look forward to building on these strategic conversations as the project moves toward implementation."
The RTI Summit's emphasis on Europe's collective strategy for infrastructures aligns perfectly with EuPRAXIA's vision of distributed excellence. By connecting multiple national laboratories and research centres under a shared framework, the project exemplifies how collaborative infrastructure design can deliver innovation capacity across borders.

As Europe moves toward implementing its new RTI strategy, EuPRAXIA remains committed to playing a central role in shaping how advanced accelerator infrastructures contribute to scientific, industrial, and societal transformation. Engagements like RTI 2025 reaffirm the project's place within the broader European research landscape, linking visionary technology development with long-term strategic impact.

EuPRAXIA features on cover of Physics of Plasma

An important step forward for EuPRAXIA has been marked by the publication of the “Technical Status Report on Plasma Components and Systems in the Context of EuPRAXIA”. The article features on the front page of the November issue of Physics of Plasmas. A result of work done as part of Work Package 10, Plasma Components and Systems, of the Preparatory Phase Project, the article was prepared by experts across the EuPRAXIA collaboration. Their work reviews the current state of the art in this field for both laser- and beam-driven plasma accelerators and discusses the main challenges for implementing them in future EuPRAXIA facilities.

EuPRAXIA aims to construct two state-of-the-art research facilities based on plasma accelerator technology. The two facilities - one laser-driven, one beam-driven - are planned to produce electron beams with an energy in the range of 1-5 GeV and beam quality comparable to existing radiofrequency accelerators.

These beams could support applications such as compact free-electron lasers and advanced imaging for medical and industrial use. Plasma components and systems are central for both future EuPRAXIA facilities, and their design, fabrication, and optimization present a complex challenge that brings together expertise in fluid dynamics, materials engineering, and plasma physics.

Achieving precise control, diagnostics, and simulations of these systems is key to meeting EuPRAXIA’s goals, along with ensuring stable, high-repetition operation and seamless beamline integration.

The authors note that while plasma accelerators have achieved remarkable milestones, such as GeV-scale beams and improving stability, several challenges remain. These include maintaining beam quality, ensuring component durability, and achieving reliable, high-repetition operation. Addressing these issues will be key as EuPRAXIA transitions from concept to construction in the coming years.

Further reading:
A. Biagioni, et al.,‘Technical status report on plasma components and systems in the context of EuPRAXIA’, Phys. Plasmas 32, 110501 (2025) https://doi.org/10.1063/5.0286730

>>> Selected Publications

Diagnostics for plasma acceleration and secondary radiation sources for EuAPS project at FLAME laser facility

Stocchi, F.; Anania, M. P.; Cianchi, A.; Costa, G.; Curcio, A.; Del Giorno, M.; Dompe, V.; Francescone, D.; Galletti, M.; Ghigo, A.; Ferrario, M.

JOURNAL OF INSTRUMENTATION 20(6), C06079 (JUN2025)

https://doi.org/10.1088/1748-0221/20/06/C06079

The Laser WakeField Acceleration (LWFA) process in a gas target requires laser and plasma diagnostics to monitor the interaction, such as a Mach-Zehnder interferometer for plasma density analysis. In addition, other diagnostics are used to characterize the accelerated particle beams and the secondary X-ray radiation produced, such as an energy spectrometer and a CCD-X camera. This X-ray radiation has distinctive features that open up the possibility of significant applications in fields such as materials science, biological research, medicine and industry. In the next few years, these radiation sources will become a good alternative to conventional ones due to the reduction in cost and the smaller dimension of such facilities. In this contribution, we present the diagnostics and the experimental results of several experimental campaigns carried out to characterize the LWFA process at the Frascati Laser for Acceleration and Multidisciplinary Experiments (FLAME) facility at the Laboratori Nazionali di Frascati-INFN in the framework of the EuPRAXIA Advanced Photon Sources (EuAPS) project.

Optical and structural requirements for x-ray distributed feedback lasing across a resonant thin film

Rameshbabu, Sharath; Zenklusen, Raffaele; Muller, Arnold; Vockenhuber, Christof; Bleiner, Davide

JOURNAL OF APPLIED PHYSICS 138(9), 093107 (SEP 2025)

https://doi.org/10.1063/5.0278763

The requirements for developing chip-scale distributed-feedback x-ray lasers were investigated to address the critical challenge of miniaturizing coherent short-wavelength laser sources. A central concept introduced in this work is the use of "Röntgen materials" that can simultaneously serve as a gain medium and support the optical feedback structure required for lasing. As a model system, $La_{0.5}Sr_{0.5}CoO_3$ (LSCO) was selected due to its high atomic number constituents, tunable stoichiometry, and favorable optical properties. High-quality LSCO thin films were synthesized using pulsed laser deposition to ensure epitaxial growth and precise compositional control. Structural and compositional integrity was confirmed via x-ray diffraction, reciprocal space mapping, and Rutherford backscattering spectrometry. The gain performance was evaluated based on fluorescence efficiency, crystal orientation, and lattice plane alignment. A key finding was that high-Z materials with optimal refractive index contrast and reduced non-radiative Auger losses support conditions for coherent x-ray amplification. By leveraging higher-order diffraction planes and targeted gain optimization strategies, this work advances the feasibility of compact x-ray laser systems with potential applications in biomedical imaging, materials analysis, and high-resolution spectroscopy. (c) 2025 Author(s).

Development of a high charge 10 GeV laser electron accelerator

Rockafellow, E.; Miao, B.; Shrock, J. E.; Sloss, A.; Le, M. S.; Hancock, S. W.; Zahedpour, S.; Hollinger, R. C.; Wang, S.; King, J.; Zhang, P.; Sisma, J.; Grittani, G. M.; Versaci, R.; Gordon, D. F.; Williams, G. J.; Reagan, B. A.; Rocca, J. J.; Milchberg, H. M.

PHYSICS OF PLASMAS 32(5), 053102 (MAY 2025)

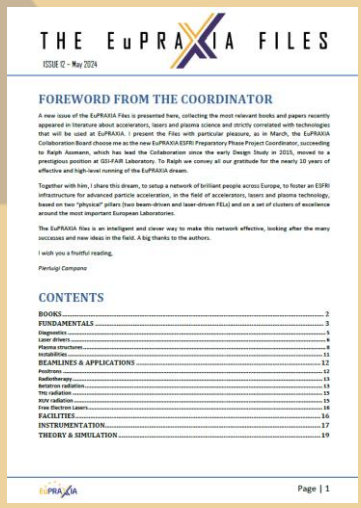
https://doi.org/10.1063/5.0265640

Low-density meter-scale plasma waveguides produced in meter-scale supersonic gas jets have paved the way for recent demonstrations of all-optical multi-gigaelectronvolt laser wakefield acceleration (LWFA). This paper reviews recent advances by the University of Maryland, which have enabled these results, focusing on the development of elongated supersonic gas jets up to ~ 1 m in length, experimental and simulation studies of plasma waveguide formation, and a new three-stage model for relativistic pulse propagation dynamics in these waveguides. We also present results from recent LWFA experiments conducted at the Laboratory for Advanced Lasers and Extreme Photonics at Colorado State University demonstrating high charge, low divergence electron bunches to ~ 10 GeV , with laser-to-electron beam efficiency of at least ~ 30%.

The EuPRAXIA Files

The EuPRAXIA Files is a collection of publicly available abstracts of published articles that are relevant to the EuPRAXIA project. Putting together the latest research in plasma accelerators, the aim is to facilitate the work of the many researchers involved in EuPRAXIA and to highlight the scientific outcomes of the various projects supporting the initiative.

The latest EuPRAXIA Files Issue 14 and previous issues can be accessed here: https://www.eupraxia-pp.org/research-resources


THE EuPRAXIA FILES

ISSUE 12 – May 2024

FOREWORD FROM THE COORDINATOR

A new issue of the EuPRAXIA Files is presented here, collecting the most relevant books and papers recently appeared in literature about accelerators, lasers and plasma science and strictly correlated with technologies that will be used at EuPRAXIA. I present the Files with particular pleasure, as in March, the EuPRAXIA Collaboration Board choose me as the new EuPRAXIA-ESFRI Preparatory Phase Project Coordinator, succeeding to Ralph Assmann, which has lead the Collaboration since the early Design Study in 2015, moved to a prestigious position at GSI-FAIR Laboratory. To Ralph we convey all our gratitude for the nearly 10 years of effective and high-level running of the EuPRAXIA dream.

Together with him, I share this dream, to setup a network of brilliant people across Europe, to foster an ESFRI infrastructure for advanced particle acceleration, in the field of accelerators, lasers and plasma technology, based on two "physical" pillars (two beam-driven and laser-driven FELs) and on a set of clusters of excellence around the most important European Laboratories.

The EuPRAXIA files is an intelligent and clever way to make this network effective, looking after the many successes and new ideas in the field. A big thanks to the authors.

I wish you a fruitful reading,

Pierluigi Campana

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EuPRAXIA YouTube Channel

The EuPRAXIA YouTube Channel features a variety of content, including interviews with leading experts such as Ralph Assmann, Founding Coordinator of the EuPRAXIA ESFRI and Preparatory Phase projects, and episodes of the EuPRAXIA Seminar Series.

The EuPRAXIA seminar series will cover the role of simulations and diagnostics in developing plasma accelerators, the principles and applications of free electron lasers, innovative linac technologies, the advantages of beam-driven plasma wakefield acceleration and key applications of plasma accelerators beyond conventional technologies.

The YouTube Channel can be accessed here: https://www.youtube.com/@EuPRAXIA-facility

>>> Job Opportunities

Fellowships and Grants at the University of Liverpool / The Cockcroft Institute

We invite expressions of interest for a number of prestigious Fellowships and Grants. These funding schemes offer outstanding supporting and developing opportunities for time frames between 2-5 years and are an ideal platform for those who have already demonstrated their potential as outstanding researchers. We can provide access to world-class research infrastructure at the Cockcroft Institute University of Liverpool and help you develop your proposal into a competitive bid. The stimulating environment within the QUASAR Group will be the perfect basis to turn your research ideas into reality.

Please contact Prof Carsten P Welsch for more information c.p.welsch@liverpool.ac.uk

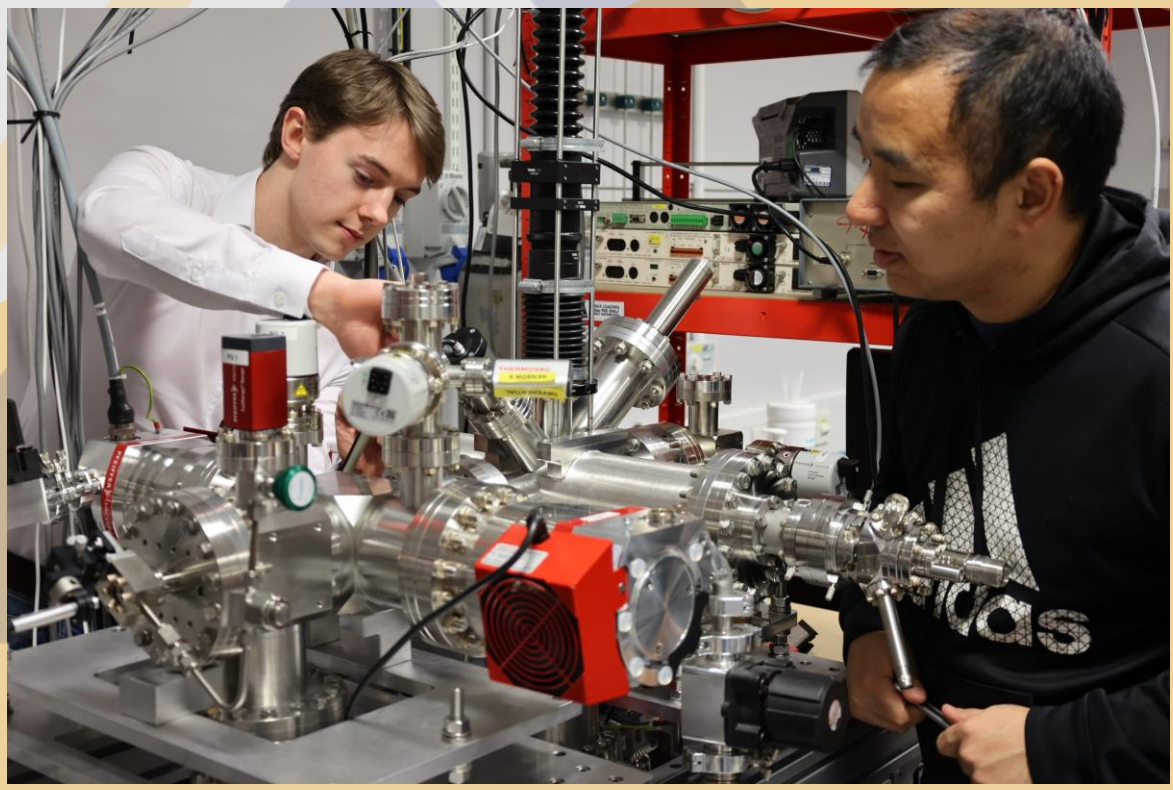

Image credit: QUASAR Group

>>> Notice Board

EuPRAXIA Doctoral Network

Selection of Events	
9 January 2026	EuPRAXIA monthly seminar- Dr Luca Labate delivering his seminar "An application of compact laser-driven electron accelerators: Toward novel approaches to radiotherapy", online
10 July 2026	Symposium - Innovations for a Sustainable Tomorrow, Liverpool, UK
21 – 25 September 2026	EuPRAXIA Final Conference, Elba, Italy

Wishing all our readers a peaceful Holiday Season and a very happy New Year 2026!

EuPRAXIA-DN Project Coordinator

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