EuPRAXIA Doctoral Network

Newsletter

Latest developments in plasma accelerator research and training.

Highlights

sCVD Diamond Detector Offers Excellent Energy Resolution in Radiation Measurement

EuPRAXIA-DN Camp II on Science held in Lisbon

EuPRAXIA at IPAC'25

Welcome

A September full of opportunities

Only a few more days until the 14th International Beam Instrumentation Conference (IBIC 2025), which will take place in Liverpool from 7–11 September 2025. This flagship event will bring together experts from across the globe to discuss the latest developments in beam diagnostics. I look forward to colleagues and friends joining us for a week of stimulating talks, networking, and collaboration.

Following our two successful Camps in Pisa and Lisbon, our focus now turns to EuPRAXIA Camp III, which will take place at the University of Pécs in Hungary on 6–7 October 2025.

The workshop will highlight innovations enabled by plasma accelerators across medicine, chemistry and materials science.

The abstract submission and scholarship application deadline is 7 September, so please make sure you submit your contribution now to secure a place!

Enjoy this newsletter!

Prof Carsten P. Welsch
Coordinator

»» Research Highlights

sCVD Diamond Detector Offers Excellent Energy Resolution in Radiation Measurement

Photo credit: https://cividec.at/detectors-B7-HT.html

A recent study published in *Nuclear Instruments and Methods* in Physics Research A, led by EuPRAXIA fellow Divya, demonstrates excellent energy resolution in alpha spectroscopy using single-crystal chemical vapor deposition (sCVD) diamond detectors.

Radiations emitted by radioactive sources play a crucial role in fields such as nuclear safety, dosimetry, space missions, and radiation monitoring in conventional and plasma accelerators, as well as radiation therapy. Precise measurement of their energy allows for the identification of radiation and the monitoring of radiation exposure with high accuracy.

Diamond, known for its outstanding thermal conductivity and radiation hardness, is especially suited to harsh environments where conventional detectors degrade or fail. The sCVD sensor, grown by chemical vapor deposition, forms an almost defect-free crystal. The detector used in this study, developed by [CIVIDEC Instrumentation GmbH](), featured a 4.5 × 4.5 mm² active area with a thickness of 500 μm. In the study, the experts from CIVIDEC tested sCVD diamond detectors in vacuum using a *241Am* alpha source. The results showed an energy resolution of (16.7 ± 0.2) keV FWHM for 5.485 MeV alpha particles, achievable without peak fitting or offline analysis.

Unlike many existing systems requiring cooling or bulky shielding, these compact diamond detectors are reliable at room and elevated temperatures, exhibit low electronic noise, and can be deployed for extended durations.

They represent a fusion of advanced materials science and practical engineering, delivering a novel tool to measure the invisible but powerful forces of radiation. Their potential applications are wide-ranging and include nuclear safety, space missions, radiation monitoring in conventional and plasma accelerators.

The full paper can be found here

Further reading:
Divya D., et al., 'High-precision alpha spectroscopy using sCVD diamond detectors', Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, Volume **1080**, 2025. https://doi.org/10.1016/j.nima.2025.170664

New Study Reveals Exceptional Laser Performance in Thulium-doped Ceramics

A team of scientists at the Intense Laser Irradiation Laboratory (ILIL) at The National Institute of Options (CNRINO) in Pisa, Italy, including EuPRAXIA members Dr Luca Labate and Dr Leonida Gizzi and EuPRAXIA Doctoral Network Fellow Alex Whitehead, have published a paper outlining their work developing a new type of laser medium that works at a wavelength of 2 μm. This is an important range for medical, industrial, and scientific technologies. Their work, recently published in High Power Laser Science and Engineering, shows that using a ceramic material infused with the rare-earth element thulium can make lasers more powerful and efficient.

The researchers used a ceramic called Tm: Lu_2O_3, which contains thulium atoms. When they shine a laser diode into it, the thulium atoms absorb the energy and emits it in the mid-infrared regime. What makes this special is how efficiently this process works in the ceramic.

The team measured a 73% slope efficiency, meaning nearly three-quarters of the input energy gets turned into laser light, a very high number for this kind of solid-state laser. One important element for this efficiency is a process called cross-relaxation. In simple terms, one excited thulium atom can "share" its energy with a nearby thulium atom, so both become excited and ready to emit laser light. This double-pumping effect means more energy gets turned into useful light, with less waste.
The lasing was demonstrated experimentally, and the laser power was measured at different temperatures. They also developed an analytical model to simulate the laser dynamics and presented a strong correlation with the experimental data.

Lasers at 2 microns are useful in many fields such as in medicine for surgery and imaging, in industry for cutting and welding and in science for driving next-generation laser systems and even particle accelerators. This ceramic laser design is also cheaper and easier to manufacture than traditional crystal lasers, making it a promising option for future high-power laser systems.

This research shows that thulium-doped ceramics can be a powerful and efficient material for next-generation lasers. This shows great promise for offering high performance at lower cost.

The full paper can be found here.

Further reading:

Fregosi A, Brandi F, Labate L, et al., ‘Cross-relaxation and temporal dynamics of lasing at 2 μm in thulium-doped ceramic material’. High Power Laser Science and Engineering, Volume **13**:e51, 2025. doi:10.1017/hpl.2025.37

»»Network News

EuPRAXIA-DN Camp on Science held in Lisbon

On the 14th and 15th July 2025, the EuPRAXIA Doctoral Network held a two-day Camp at Instituto Superior Técnico (IST) in Lisbon, Portugal. The camp looked at the breakthrough science that the EuPRAXIA facility will enable, exploring how advanced accelerator technologies are paving the way for more compact and versatile particle accelerators.

Camp participants during the Welcome Reception. (Credit: QUASAR Group)

Participants were able to make the most of a wide array of talks. These talks were split into five sessions, with each session being introduced by a key-note talk. On day one, network coordinator Professor Carsten P Welsch and IST President Professor Rogério Colaço welcomed the 35 camp participants. Participants were made up of Fellows from the Doctoral Network, invited key-note speakers and external participants from institutions across Europe.

IST President Professor Rogério Colaço welcomed the delegates. (Credit: QUASAR Group)

Kicking off the key-note talks, Dr Ricardo Fonseca and Prof. Marco Piccardo from IST introduced the topic of HPC and meta surfaces for laser plasma accelerators. Camp participants were then taken on a tour of several IST labs, giving them an insight into their current research and allowing them to discuss with IST experts.

Dr Marie Emmanuelle Couprie from Synchrotron Soleil in France spoke about Free Electron Lasers driven by LWFA. These talks were complemented by numerous contributions from EuPRAXIA-DN Fellows and external participants. Following on from the day's academic activities, a poster session was held, facilitating discussion and interaction between early career researchers and those with more experience, sparking new professional relationships and possible future collaborations.

Participants following the presentations. (Credit: QUASAR Group)

Day two also had a full programme, getting started with an invited talk on Betatron Radiation Theory from Dr Alessandro Curcio from INFN. Dr Marija Vranic from IST then spoke about direct laser acceleration. After taking the opportunity to enjoy lunch in the beautiful Lisbon sunshine, delegates had the chance to hear Dr Raoul Trines from the Rutherford Appleton Laboratory talk about laser-induced plasma science. Similarly to day one, these sessions were complemented by a wealth of contributed talks.

Prof Welsch said: "The wide range of scientific breakthrough studies that are possible at next generation plasma accelerators such as EuPRAXIA was extremely impressive."

Group photograph of the attendees at the EuPRAXIA-DN Camp II.
(Credit: QUASAR Group)

“The Camp was an ideal way to discuss the opportunities and challenges between participants and gave everyone a platform to present their own research. I already look forward to our next workshop in Hungary this October!”

The EuPRAXIA Doctoral Network would like to express its thanks to all invited speakers for their valuable contributions. Special thanks to our colleagues Jorge Vieira, Claudia Romao and the fantastic team at IST for their help in organising the camp.

All presentations can be found at the event website

The next EuPRAXIA Camp will be held in Pécs, Hungary on 6th - 7th October 2025 and will cover the innovations that EuPRAXIA will enable.

Registration is now open, and anyone interested can register via the following link

EuPRAXIA at IPAC'25

From the 1st – 6th June 2025, the 16th International Particle Accelerator Conference (IPAC'25) took place between the International Convention Centre and the Taipei World Trade Centre in the vibrant city of Taipei, Taiwan.

The event was hosted by the National Synchrotron Radiation Research Centre and attracted around 1,000 delegates and 70 industrial exhibitors from across the globe. The rich scientific programme covered worldwide advancements in accelerator research and development, provided insights into new projects, and allowed participants to discuss the latest developments in accelerator facilities globally. In addition to the stimulating scientific programme, participants had the valuable opportunity to connect with peers and to establish new business contacts.

EuPRAXIA-DN Coordinator Prof Carsten P Welsch (middle) and four of the Fellows (left to right: Mihail Miceski, Phani Deep Meruga, Alex Whitehead and Romain Demitra).

EuPRAXIA-DN Coordinator Professor Carsten P Welsch contributed a poster to the scientific programme which gave an insight into selected research results from within the Doctoral Network. This led to many insightful conversations.

Alongside Professor Welsch, four of the network's Fellows also presented posters at the conference, showcasing their latest research and developments.

Phani Deep Meruga presented a poster entitled 'Evaluation of an X-band LLRF Prototype for the EuPRAXIA@SPARC_LAB LINAC' which focussed on the performance analysis of the X-band Low-Level RF system. It highlighted both front-end and back-end evaluations, and emphasized its readiness for integration into the high-gradient linac for the upcoming EuPRAXIA@SPARC_LAB machine.
His poster sparked interesting discussions, particularly with researchers working on compact accelerator designs and advanced LLRF control techniques for X-band systems.

Phani Deep Meruga in front of his poster.

Phani had an overwhelmingly positive experience at IPAC. He said that "beyond my own presentation, it was inspiring to attend talks and posters from fellow researchers, showcasing a broad spectrum of advancements from beam dynamics and injector optimization to machine learning applications in beam diagnostics and control. The depth and diversity of topics underscored the accelerating pace of innovation within the field".

As well as representing his research as a EuPRAXIA Fellow, Phani was able to participate as an exhibitor, representing Instrumentation Technologies. In the exchanges that he had, he reported that "what stood out[…] was the global convergence of ideas, the shared drive toward compact and high-performance accelerators, and the increasing importance of precision diagnostics in the broader accelerator community".

Romain Demitra presented a poster on ‘Transverse Plasma-Density Measurements Within Capillary Discharge Channels’, which allowed him to share his experimental set-up and data with leading experts in the field. He said that “presenting my capillary plasma-density measurements at IPAC was a highlight of my career. Engaging with the community, answering probing questions, and envisioning new directions for our research reminded me how exciting collaborative science can be”.

Romain Demitra listening to a talk at IPAC'25.

Mihail Miceski’s poster on the ‘Design of Beam Transport System with Active Plasma Lens for LPA-Driven EUV FEL’ showcased his work on novel accelerator technologies. It highlighted recent advancements and discussed the most promising prospects of laser-plasma accelerators. Mihail found the possibility to connect with experts from around the world particularly motivating, he said that "it was an incredible opportunity to share my research and to represent ELI Beamlines at IPAC, the largest conference in the field of particle accelerators. Engaging in meaningful technical discussions and receiving valuable feedback made the experience especially rewarding”.

Finally, **Alex Whitehead** presented a poster on the ’Study of Electron Density in Capillary Discharge Plasma for Laser Plasma Accelerators’.

Mihail Miceski and Alex Whithead during the conference dinner.

He said that ‘’IPAC’25 was an amazing platform to discuss innovative ideas and breakthroughs in the field of particle acceleration”. He also enjoyed taking the opportunity to explore the city of Taipei, from its rich culture to its delicious cuisine.

The next IPAC will take place in Deauville, France between 17^{th} – 22^{nd} May 2026. Information can be found on the conference website www.ipac26.org

EuPRAXIA Doctoral Network Extension

We are delighted to announce that the EuPRAXIA Doctoral Network was granted an exceptional extension.

Several of the network’s Fellows had to start their projects later than originally planned due to unforeseen visa issues. This was formally acknowledged by the Research Executive Agency which officially approved a 7-month extension. This will allow all Fellows to benefit from the full 36 months of training on their projects.

»» Upcoming Events

EuPRAXIA-DN Camp III - Registration now open!

The third EuPRAXIA Camp will explore how plasma accelerators can pave the way for innovative applications across fields including medicine, chemistry, material science and much more.

This 2-day science workshop will be held at University of Pécs in Hungary. It will be split into sessions led by invited keynote speakers who will first present the state-of-the-art research in a particular area which will then be followed by selected presentations from other workshop participants of either 12- or 25-minute durations.

Generous discussion time will be included in each session and there will also be more general discussions at the end of each day linking between different areas. A poster session will complement the challenge-driven program.

The EuPRAXIA Camps are open to everyone interested in the latest R&D results in plasma accelerators and not limited to members of EuPRAXIA. Participants are asked to suggest their contribution during registration and indicate if they would like to contribute a talk or a poster. Several scholarships will be offered to encourage the participation of early-stage researchers.

For more information and how to register please visit the event homepage:

EuPRAXIA-DN Camp III: Innovation

Abstract submission and scholarship application deadline: 7th September 2025

Registration deadline: 12th September 2025

»» Fellows News

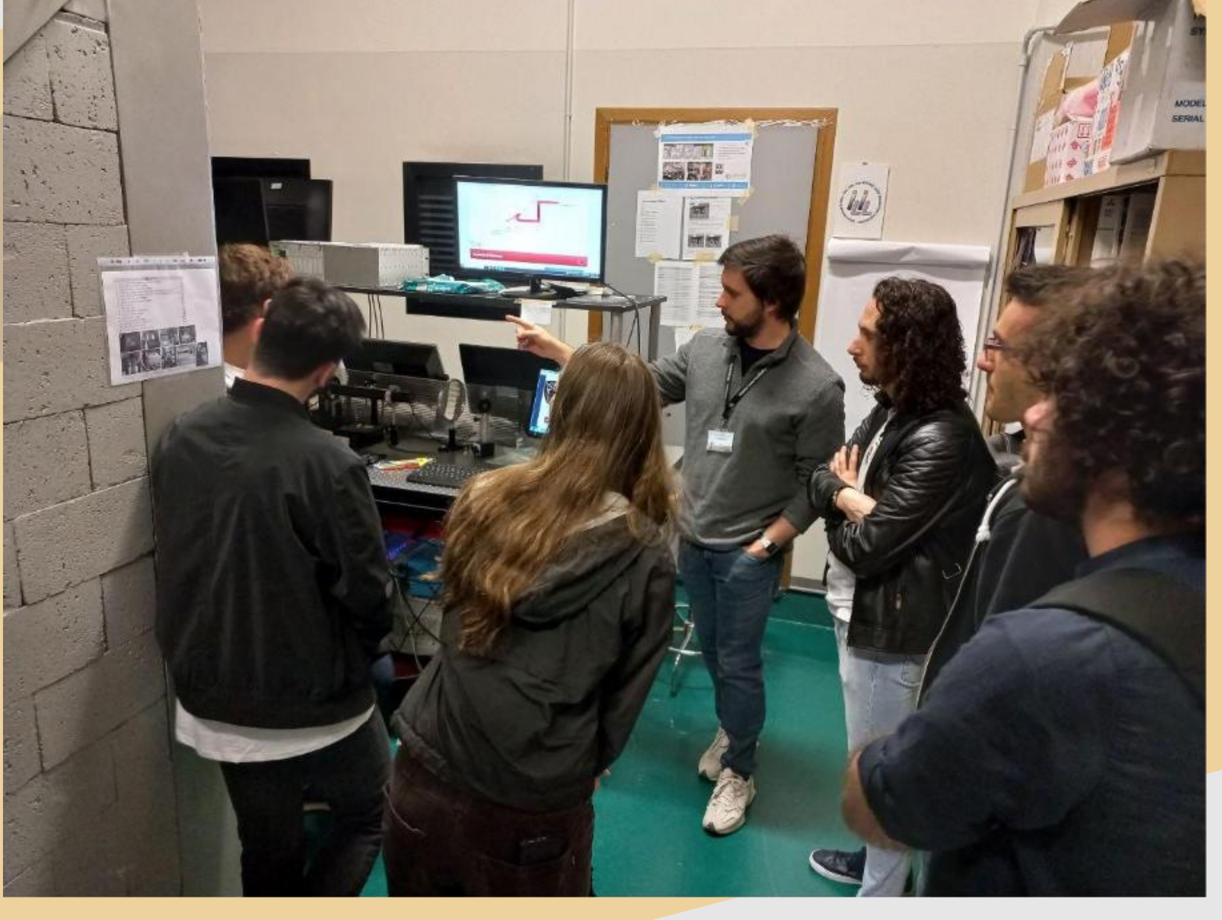
David Gregocki Participates in The Light of Tuscany

EuPRAXIA Doctoral Network Fellow David Gregocki participated in The Light of Tuscany (LOT25) event, organized by the Associazione Italiana Studenti di Fisica (AISF).

The event led forty students to visit some of the most advanced research facilities in Tuscany, with a focus on photonics and optics and with one key mission in mind: to foster enthusiasm in the minds of young physicists. David took a group of students on a guided tour of the lab he works in at The National Institute of Optics, in Pisa, Italy. This gave visitors an opportunity to see up-close what the daily life and activities of a researcher looks like and understand what challenges David and his colleagues are currently trying to tackle.

The Associazione Italiana Studenti di Fisica is a non-profit association with educational purposes. Its members are the students enrolled in a graduate or undergraduate physics course.

The purpose and intent of AISF is to promote the sciences, particularly physics, amongst students and to develop relationships between students from different parts of the country in an international and global context.



David Gregocki with students during the guided tour. (Image credit: Dr. Martina Salvadori)

»» Partner Updates

ELI Appoints Dr Leonida Antonio Gizzi as Director of Science

The Extreme Light Infrastructure (ELI) in the Czech Republic, the recently selected site for the EuPRAXIA laser-driven plasma accelerator pillar, has announced the appointment of Dr Leonida (Leo) Antonio Gizzi from the National Research Council of Italy (CNR) in Pisa, as its new Director of Science.

In this key position, Dr Gizzi will steer ELI's integrated scientific user programme, working closely with colleagues in management and scientific leadership in order to shape research strategies and to prioritize user access. As a renowned expert in laser–plasma interactions, he brings considerable knowledge in high-intensity lasers, compact particle accelerators, and advanced photon sources

At CNR's Istituto Nazionale di Ottica (INO) in Pisa, Dr Gizzi directs the Intense Laser Irradiation Laboratory (ILIL), advancing plasma-driven radiation sources and ultrafast

phenomena. His work brings together fundamental physics with real-world applications across medicine, energy, and materials science.

Dr Gizzi has been a key member of the EuPRAXIA collaboration since its inception, leading the work package on laser design and optimization for the design study project, and subsequently the laser technology and liaison to industry work package for the preparatory phase. He has also contributed to training events for EuPRAXIA doctoral fellows, giving lectures and seminars about high-power lasers and lasers development roadmaps.

A long-time contributor to ELI, Dr Gizzi has influenced key European laser science projects since ELI's inception. He has championed strategic advancements in laser-driven particle acceleration, X-ray and gamma-ray sources, and novel plasma diagnostics

In his new capacity, as well as coordinating scientific priorities and nurturing multi-disciplinary research across ELI's network, he will serve as ELI's ambassador to international partners and stakeholders to promote this research and to ensure the infrastructure's visibility on an international scale.

Dr Gizzi giving a presentation at ELI's Summer School ELISS. (Credit: ELI)

Dr Gizzi shared his vision:

"We are entering a new era for laser science, and ELI is uniquely positioned to lead it. This role is both an honour and an opportunity, to guide a scientific programme that is as ambitious as it is essential. My goal is to help ensure ELI delivers not just breakthroughs, but lasting value for science, industry, and society."

He emphasized the importance of interdisciplinary research, with a focus on health, energy, and the environment, and plans to guide ELI toward delivering both fundamental insights and tangible societal benefits.

Allen Weeks, Director General of ELI, said that "Leonida brings a clear vision. He understands that for ELI to reach its full potential, we must accelerate our contributions to challenges with global significance, particularly in areas like radiobiology and fusion… He's the right person to help ELI bridge that gap and make the societal relevance of our work explicit."

The selection of such an influential figure in European laser science once again reinforces Europe's leading position in advanced accelerator technologies. Dr Gizzi will begin transitioning into the role in September, with his full appointment taking effect in December.

The Extreme Light Infrastructure (ELI) in the Czech Republic. (Image credit ELI ERIC)

>>> Selected Publications

TI FEL performance and tolerance studies of the EuPRAXIA@SPARC_LAB beamline

Nguyen, F.; Giannessi, L.; Opromolla, M.; Petralia, A

Nuclear Instruments & Methods in Physics Research Section A-Accelerators Spectrometers Detectors and Associated Equipment Journal 1074, 170291 (MAU 2025)

https://doi/org/10.1016/j.nima.2025.170291

The AQUA beamline of the EuPRAXIA@SPARC_LAB facility is a SASE free-electron laser designed to operate in the water window, in the 3-4 nm wavelength range. The electron beam driving this source is accelerated up to about 1-1.2 GeV by an X-band normal conducting linear accelerator, followed by a plasma wakefield acceleration stage. The main radiator consists of an array often APPLE-X permanent magnet undulator modules, each 2 m long and with a period length of 18 mm. Tolerance analyses against resistive wall wakefields and injection misalignments at undulator entrance are performed, and the related effects on the laser yield performance are evaluated and discussed.

Biological applications at the AQUA beamline of the EuPRAXIA@SPARC_LAB free electron laser

Santis, ED.; André, T.; Alleva, S.; Bean, R.; Ferrario, M.; Marcelli, A.; Minicozzi, V.; Principi, E.; Timneanu, N.; Caleman, C.; Stellato, F

EUROPEAN BIOPHYSICS (JUL 2025)

https://doi.org/10.1007/s00249-025-01778-4

The EuPRAXIA project is a European initiative aimed at developing groundbreaking, ultra-compact accelerator research infrastructures based on novel plasma acceleration concepts. The EuPRAXIA@SPARC_LAB facility, located in the Italian National Institute for Nuclear Physics-Frascati National Laboratory, will be the first operating Free Electron Laser facility of EuPRAXIA, based on an accelerator module driven by an electron bunch driver. The Free Electron Laser will produce ultra-short photon pulses in the soft X-ray region. The photons will be delivered to an endstation, called AQUA, to perform a wide range of experiments in atomic and molecular physics, chemistry, and life sciences for both academic and industrial users. Thanks to its wavelength, which falls within the so-called 'water window', AQUA will be particularly well-suited for coherent imaging and ion spectroscopy measurements on biological samples at room temperature in a fully hydrated environment. This unique capability opens up innovative experimental schemes for studying biological systems in states that closely resemble their physiological conditions. This paper presents numerical simulations of coherent diffraction imaging and Coulomb explosion imaging experiments, anticipating future studies at AQUA on biological samples.

Modeling laser-wakefield accelerators using the time-averaged ponderomotive approximation in a Lorentz boosted frame

Massimo, F.; Benedetti, C.; Terzani, D.; Beck, A.; Cros, B.

Plasma Physics and Controlled Fusion 67(6), 065032 (JUN 2025)

https://doi.org/10.1088/1361-6587/addc97

Future, high-fidelity simulations of multi-GeV-class laser Wakefield accelerators (LWFAs) will need to model the propagation of high-intensity laser drivers over meter-scale plasmas with high spatial and temporal resolutions, thus requiring high amounts of computational resources. Various techniques have been devised over the years to reduce the computational cost of such simulations, including the time-averaged ponderomotive approximation, and the use of the Lorentz boosted frame technique. In this paper we discuss the combination of these two computational techniques, highlighting the resulting significant reduction in the computational cost of LWFA simulations and the limitations of this approach. The combination of the two techniques can potentially become essential for the modeling of a multi-TeV, LWFA-based collider.

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

CONTENTS

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

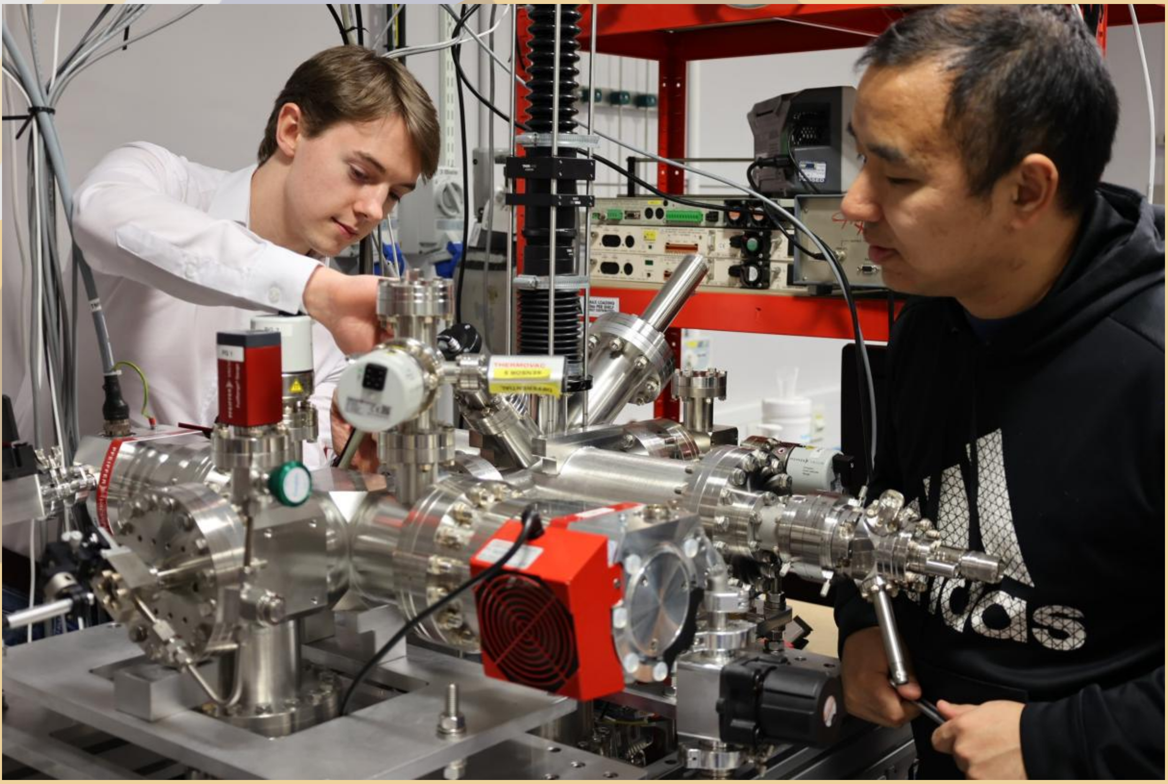


Image credit: QUASAR Group

Notice Board

EuPRAXIA Doctoral Network

Selection of Events	
7 - 11 September 2025	14^{th} International Beam Instrumentation Conference (IBIC), Liverpool
3 October 2025	EuPRAXIA monthly seminar- Dr Riccardo Pompili speaking about EuPRAXIA@SPARC_Lab, online
6 - 7 October 2025	EuPRAXIA DN Camp III - Innovations, Pécs, Hungary

Help us communicate interesting events, updates and latest R&D in plasma accelerator physics and send us your news and updates.

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