



Welcome

School on Plasma Accelerators

Carsten P Welsch

INFN-LNF and U Liverpool/CI



UK Research
and Innovation





Logistics

School on Plasma Accelerators

Minh Cao

University of Liverpool/CI



UK Research
and Innovation

Meeting Venue

Orto Botanico di Roma

- Aranciera & Centro Visite
- Gate opens at 9.00am

WIFI

- Each participant will need a unique password to access the WIFI network

Please wear your name badge at all time during the school.

Overview of Activities

Monday 22nd April, Orto Botanico di Roma

Seminar by Prof Victor Malka 17:00

Welcome Reception from 18:00

Tuesday 23rd April, Orto Botanico di Roma

Seminar by Prof Anne L'Huillier 17:00

Aperitif from 18:00

Wednesday 24th April, INFN-LNF

Coach pick up 7:45

School Start 9:30

Lab Visit from 15:30

Thursday 25th April, Orto Botanico di Roma

Seminar by Dr Edda Gschwendtner 17:00

Formal Dinner at Hotel Forum from 20:30

Friday 25th April, Orto Botanico di Roma

Supervisory Board Meeting 9:00 – 11:00

School Start 10:00

End of School 13:00

EuPRAXIA-DN School on Plasma Accelerators

22nd – 26th April, Rome, Italy



SAPIENZA
UNIVERSITÀ DI ROMA



EuPRAXIA School, INFN, Rome, Italy, 22 – 26 April 2024

Monday	Tuesday	Wednesday (@INFN)	Thursday	Friday	
9:00 – 9:15 Arrival and Registration <i>Gates open at 9:00</i>	<i>Gates open at 9:00</i>	9:00 – 9:30 Arrival and Registration	<i>Gates open at 9:00</i>	<i>Gates open at 9:00</i>	
9:15 – 10:00 Welcome and Logistics <i>Carsten P Welsch et al., INFN/U Liverpool</i>	9:15 – 10:15 Technology of Plasma Sources <i>Angelo Biagioni, INFN</i>	9:30 – 10:30 Betatron Radiation Emission in Plasma <i>Alessandro Curcio, INFN-LNF</i>	9:15 – 10:15 Plasma Diagnostics for Plasma Accelerators <i>Zulfikar Najmudin, Imperial College London</i>	9:00 – 11:00 Supervisory Board (SB) Annual Meeting	
10:00 – 11:00 Introduction to High Power Lasers <i>Leonida Gizzi, CNR</i>	10:15 – 11:15 Introduction to Laser Wakefield Acceleration <i>Gabriele Grittani, ELI ERIC</i>	10:30 – 11:30 Free Electron Lasers <i>Enrica Chiadroni, INFN-LNF</i>	10:15 – 11:15 Extreme Light Infrastructure – a Distributed European Research Infrastructure <i>Gabriele Grittani, ELI ERIC</i>		10:00 – 11:00 Micro Accelerators THz <i>Szabolcs Turnár, U PECS</i>
COFFEE BREAK					
11:30 - 12:30 Introduction to Plasma Physics <i>Pablo San Miguel Claveria, IST</i>	11:45 - 12:45 Introduction to Particle-driven Acceleration <i>Livio Verra, INFN</i>	12:00 – 13:00 Beam Manipulation with a Plasma Accelerator <i>Riccardo Pompili, INFN-LNF</i>	11:45 - 12:45 The Role of Computing in the Development of Plasma Accelerators <i>Jorge Vieira, IST</i>	11:30 – 12:00 Primer on Low Level RF <i>Manuel Cargnelutti, I-TECH</i>	
12:30 - 13:30 Intro to Linacs <i>Marco Bellaveglia, INFN</i>	12:45 - 13:45 Introduction to Laser-driven Heavy Ion Acceleration <i>Josefine Metzkes-Ng, HZDR</i>	13:00 – 13:30 EuPRAXIA <i>Carsten P Welsch, INFN/U Liverpool</i>	12:45 - 13:45 Plasma Simulation for Optimization <i>Andreas Doepp, LMU Munich</i>	12:30 – 13:00 Primer on Integrated Diagnostics <i>Erich Griesmayer, CIVIDEC</i>	
LUNCH					
14:30 - 15:30 Beam Physics of High Quality Beams <i>Massimo Ferrario, INFN</i>	14:45 – 16:30 Study Session	14:30 – 15:30 History of INFN <i>Andrea Ghigo, INFN-LNF</i>	14:45 – 16:30 Poster Session and Industry Display	12:30 – 13:00 Closing Remarks <i>Carsten P Welsch, INFN/U Liverpool</i>	
15:30 - 16:30 Beam Diagnostics for Plasma Accelerators <i>Joseph Wolfenden, U Liverpool</i>		15:30 – 15:40 Introduction of the INFN-LNF		COFFEE BREAK	
COFFEE BREAK					
17:00 - 18:00 Seminar History of plasma accelerators <i>Victor Malka, Weizmann Institute</i>	17:00 - 18:00 Seminar Ultra-short Laser Pulse Generation and Application <i>Anne L'Hullier, U Lund</i>	INFN-LNF Lab Visit <i>EuPRAXIA-DN SC meeting in parallel</i>	17:00 - 18:00 Seminar The AWAKE Experiment at CERN <i>Edda Gschwendtner, CERN</i>		
Reception	Aperitif		20:30 Formal Dinner Roof Garden Restaurant Hotel Forum	End of School	



EuPRAXIA-DN School on Plasma Accelerators

22nd – 26th April, Rome, Italy



SAPIENZA
UNIVERSITÀ DI ROMA

EuPRAXIA
Doctoral Network

INFN-LNF

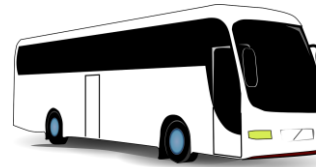
On **Wednesday 24th April**, the school will be held at INFN-LNF, followed by a tour of the labs in the afternoon.

Bus transfer for school participants

Rome to INFN-LNF

Pick up: 7:45 at Lungotevere Farnesina, 7

<https://maps.app.goo.gl/W7bi2aXwEejMcnEc9>



INFN-LNF to Rome

Return after lab tour: 18:00

Entry and exit from the LNF area will only be possible through the **secondary gate** (via Enrico Fermi, 60), near the Tor Vergata train station. The gate will be open from 8:30 am until 6:30 pm.

All arriving participants must wear their conference badge with their name and surname for identification by the Security staff.

WIFI @ INFN-LNF

An eduroam wifi network will be available in all meeting areas.

Participants who don't have an INFN account, will need to register in the INFN identity database before coming to INFN-LNF!

Please follow the procedure on the event's indico website to register:
<https://agenda.infn.it/event/38913/page/8682-infn-lnf-wifi-internet-access>



EuPRAXIA-DN School on Plasma Accelerators

22nd – 26th April, Rome, Italy



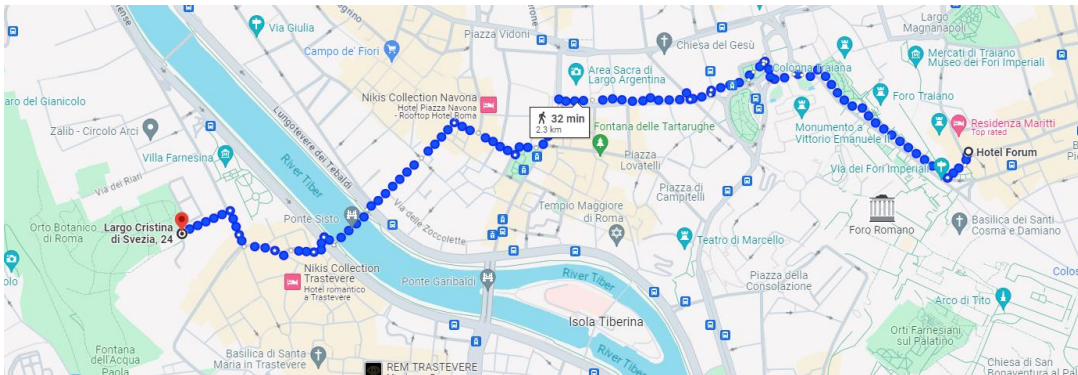
Thursday 25th April: Formal Dinner

Roof Garden Restaurant - Hotel Forum

Via Tor de' Conti 25

00184 Rome

- Training finishes 18:00
- Dinner from 20:30



Beautiful location in the heart of Imperial Fora

approx. 30 min walk from Orto Botanico.



Flower Photo Contest

The rules:

- Upload your entry (no larger than 20mb)
- Give your photo a 'Title'
- Enter your name in the 'Caption'
- Voting to take place between 2.00pm - 8.00pm Thursday 25th April
- Voters to vote for their most favourite photos (up to 3)
- Photo that receives the highest number of votes will win the prize
- Prize winner will be announced at the school dinner



Entry Deadline: 12.00 pm Thursday 25th April

EuPRAXIA-DN School on Plasma Accelerators

22nd – 26th April, Rome, Italy



Have a great time!

Contact in case of Emergency

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The school is hosted in partnership with INFN and Sapienza University of Rome with strong support from University of Liverpool/Cockcroft Institute





Overview

EuPRAXIA Doctoral Network

Carsten P Welsch

INFN-LNF and U Liverpool/CI



UK Research
and Innovation

A bit of history...



(Beam Diagnostics, Physics)

4.2 M€, 22 Fellows, 32 partners



(Laser Applications, Engineering)

4.6 M€, 22 Fellows, 38 partners



(Accelerator Optimization, Physics)

6 M€, 23 Fellows, 35 partners



(Medical Applications, Life Sciences)

3.9 M€, 15 Fellows, 31 partners



(Antimatter R&D, Physics)

4.0 M€, 15 Fellows, 24 partners



(Plasma Accelerator R&D, Physics)

3.2 M€, 12 Fellows, 23 partners



Largest portfolio of MSCA networks in any scientific area; around 25M€ of funding and more than 100 Fellows!
Also: Chair of STFC ETCC, member of UKRI TSAG and Director of two CDTs.

The 2021 MSCA-DN Call

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sources: Unsplash / iStockphoto.com

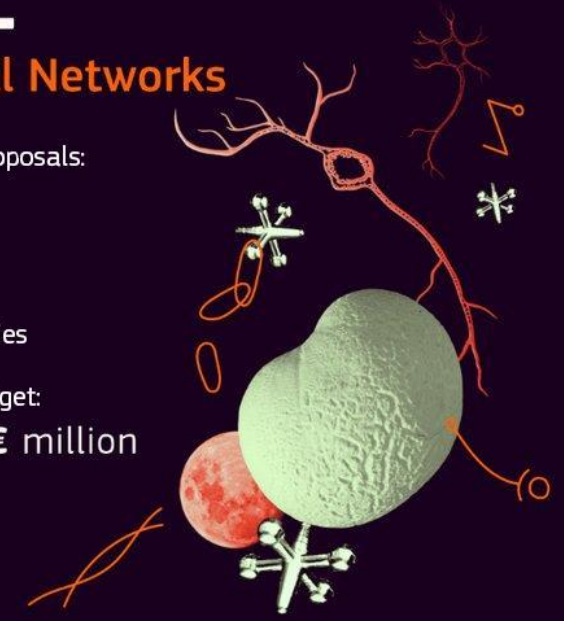
CALL

Doctoral Networks


Submitted proposals:
1077

From:
56 countries

Available budget:
402.95 € million



MSCA
Marie Skłodowska-Curie **Actions**
Developing talents, advancing research



- 897 proposals for standard doctoral networks
- In PHY: 83 proposals – only 10 networks were selected! Success rate was only 12 %.
- Complicated start...but we got there!
- With 3.2M€ we now have one of the largest networks, training 12 Fellows.

What is EuPRAXIA-DN?



- MSCA Doctoral Network with a budget of 3.2M€;
- 12 high-level Fellowships (*10 Fellows will be funded by the EU, another two by the UKRI Guarantee Funds*);
- Interdisciplinary and cross-sector plasma accelerator research and training program carried out between universities, research centres and industry;
- Allows for organizing (large) number of events;
- Recognized importance of plasma accelerator R&D at European level!

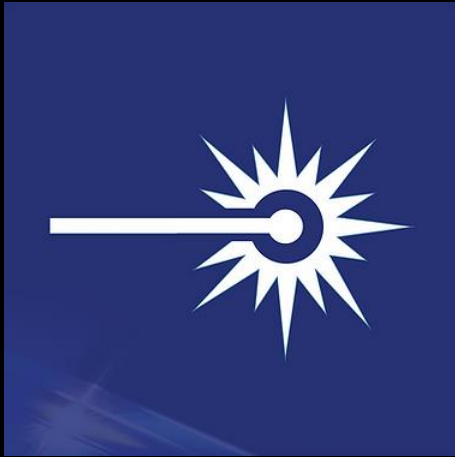
Beneficiaries



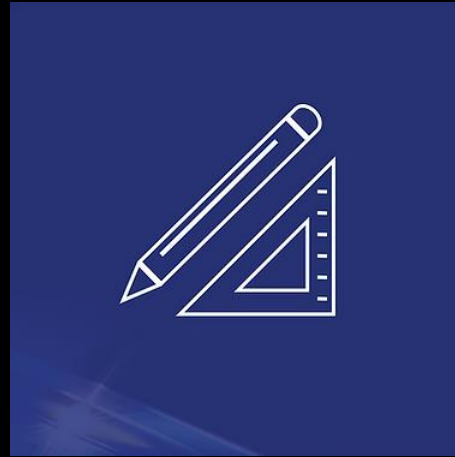
Partner Organizations



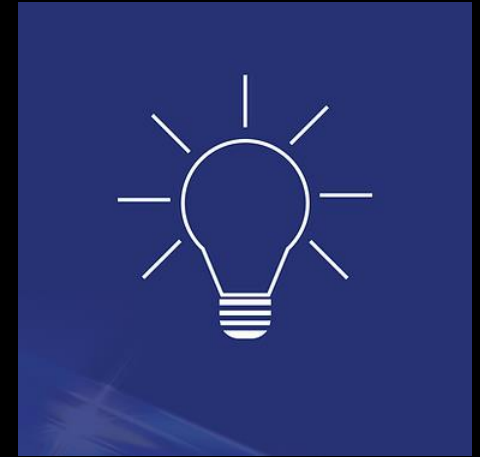
Research



Laser & Plasma



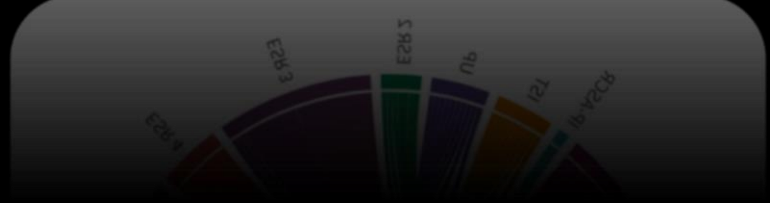
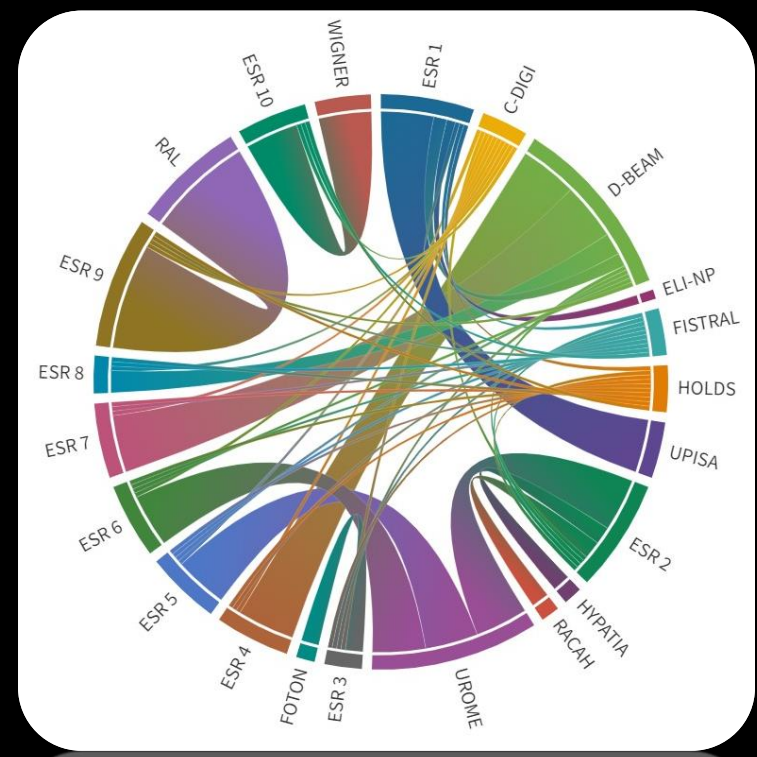
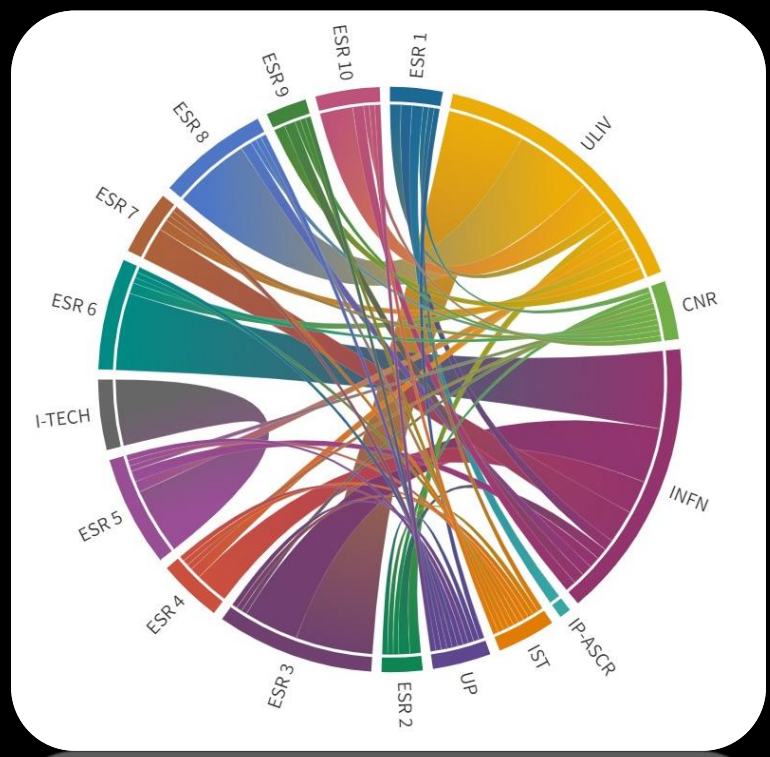
Facility Design &
Optimization



Applications

The network's main scientific and technological objectives are split into three closely interlinked work packages.

Secondments



Training & Events



- International **School** on plasma accelerators;
- EuPRAXIA **Camps** on focused research topics – always across the different project work packages;
- Researcher **skills training** designed to prepare all Fellows for their future careers and make them attractive for employers in academia and industry;
- Final **conference** and **outreach symposium** to present project results.

Events are open to all Fellows and wider community !

Kick-off meeting

<https://indico.cern.ch/event/1200106/>



EuPRAXIA-DN Leaflet



Collaboration

The network's main scientific and technological objectives are split into three closely interlinked work packages

- Laser and Plasma,
- Facility Design and Optimization,
- Applications.

EuPRAXIA-DN brings together teams with world-class expertise in an interdisciplinary area of research. To achieve our research objectives, the network requires methods and skills from physics, engineering, optics, IT, materials sciences, electronics and advanced sensor technologies.

Beneficiary Partners

Associated Partners

ACCELERATING RESEARCH AND TRAINING

Project Management

The Steering Committee is responsible for the overall network strategy and takes all the decisions concerning the network. It comprises the scientific coordinator, representative members from universities, research centers and industry, as well as one elected Fellow representative.

The representatives from academia and industry will also act as training coordinators, overseeing the training of all Fellows.

Contact us

EuPRAXIA-DN Coordinator
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- English
- French
- Italian
- German

About EuPRAXIA

EuPRAXIA is the first European project that develops a dedicated particle accelerator research infrastructure based on novel plasma acceleration concepts and laser technology. It focuses on the development of electron accelerators and underlying technologies, their user communities, and the exploitation of existing accelerator infrastructures in Europe. It was accepted onto the ESFRI roadmap for strategically important research infrastructures in June 2021 as a European priority.

Doctoral Network

To fully exploit the potential of this breakthrough facility, advances are urgently required in plasma and laser R&D, studies into facility design and optimization, along a coordinated push for novel applications.

The EuPRAXIA Doctoral Network (EuPRAXIA-DN) is a new Horizon Europe Marie Skłodowska-Curie Actions Doctoral Network (MSCA-DN), offering 12 high level fellowships between universities, research centers and industry that will carry out an interdisciplinary and cross-sector plasma accelerator research and training program for this new research infrastructure

The network focuses on scientific and technical innovations and on boosting the career prospects of its Fellows.

Research Projects

The Fellows will work on the following research projects. Ten Fellows will be funded from the HE-MSCA-DN funds, while two Fellows will be funded by the UKRI guarantee funds:

- Istituto Nazionale di Fisica Nucleare**
Theoretical and Experimental Studies of Plasma Formation in Capillary Discharge Waveguides for Plasma-based Accelerators
- Theoretical and Technological Studies into Femtosecond Synchronization**
- CWIDEC Instrumentation GmbH**
Development of Integrated Diagnostics for Plasma Accelerators
- Consiglio Nazionale delle Ricerche – Istituto Nazionale di Ottica**
Manipulation and Characterization of Ultrashort Laser Pulses for High-quality Electron Bunch Acceleration
- EU Beamlines**
Study laser-plasma interaction in a preformed plasma channel in a high repetition rate regime
- Laser-driven Undulator Coherent Radiation Source**
- Instituto Superior Técnico**
Superradiance from non-linear Thomson Scattering
- Instrumentation Technologies**
Development and Validation of an X-band Low Level Radio Frequency prototype for EuPRAXIA
- Lunds Universitet**
Short-pulse Laser-driven Injector
- University of Pécs**
THz-driven Dielectric Accelerators
- University of Liverpool**
Ultra-short Bunch Length Measurements with Femtosecond Resolution
- Laser-driven Proton Beam Therapy**

Training & Events

The fundamental core of the training is a dedicated cutting-edge research project for each Fellow at their host institution.

The training program is designed to address a wide range of employment skills with the aim to provide all Fellows with the competences required for their future researcher careers in both, academia and industry. All students will be enrolled into a structured PhD program and benefit from a combination of local and network-wide trainings within EuPRAXIA-DN. This includes courses at the different host institutions, alongside network-wide trainings which will be made available to the wider scientific community.

“ Plasma accelerator research is at the cutting edge of technology. ”

Prof Dr Carsten P Welsch

© D. J. Arnold, W. Wang, M. Zepf, L. H. Yu, S. M. S. Loeb, L. H. Yu, S. M. S. Loeb, L. H. Yu, S. M. S. Loeb

Skills School

- PhD project-specific part
 - Presentation skills
 - Scientific writing
 - Project management
- Generic skills through outreach project
 - Team working
 - Proposal writing
 - Peer review
 - Working under (time) pressure



"I hadn't really thought of myself as a project manager until today!"

Skills School



MSCA Info Day 2023



Brussels, 8/9 November 2023: **Exemplary exploitation of synergies!**

Media Skills School



- **CONCEPTING, CREATIVE & PLANNING** materials covering production methodologies, ideas, mood-boards, story-telling in the specific area of scientific communication
- **SCRIPTING & STORYBOARDING** of a scientific communications films. Including script, storyboards, animatic, shot list, look development and 2D animation asset creation to be used as film content.
- **POST-PRODUCTION, MOTION GRAPHICS:** Preparation of assets to be used for titles and selection of audio clips for titles and backdrop for scientific film.
- **DELIVERY, RELEASE & SHARING** training course covering: formats, versioning, outlets and networks, hashtags, metatags, platforms, channels, storage, automated social media and tracking metrics.

Media Skills School



EuPRAXIA-DN Film

Thus far ~20,000 views

Sustainable video production, use of AI



<https://youtu.be/6NPgxCdffrE>



EuPRAXIA-DN Newsletter

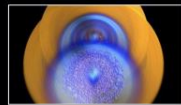


EuPRAXIA >>> Newsletter

Doctoral Network Latest developments in plasma accelerator research and training.



>>> Highlights



Coherence and superradiance from a quasi-particle accelerator



Joint LIV.INNO and EuPRAXIA-DN researcher training hosted in Liverpool



Meet our EuPRAXIA Doctoral Network Fellows - Part 1

>>> Welcome

A new doctoral network is born!

It is my great pleasure to launch this new quarterly newsletter of the EuPRAXIA Doctoral Network. The network officially started on 1 January 2024, but the first of our 12 Fellows started their positions only a few months ago. Now, all but one of the Fellowships have been filled (the last remaining position is advertised [here](#)) and it was fantastic to meet all those who had started their roles last month for their first training events.

The EuPRAXIA Doctoral Network is closely connected with the EuPRAXIA project, on the ESFRI roadmap since 2021, and the EuPRAXIA Preparatory Phase project. All these projects share the vision of a new distributed research infrastructure that provides plasma-accelerated beams with superior quality to a wide range of user. The doctoral network will directly train the next generation of experts in this exciting field and our many events will be

open also to the wider scientific community. This newsletter will keep you up to date with our latest news and research results. I hope you enjoy reading about our "first steps".



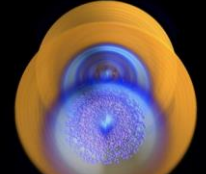
Prof. Carsten P. Welsch
Coordinator

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www.eupraxia-dn.org

>>> Research Highlights

Coherence and superradiance from a quasi-particle accelerator



Representation of super-intense light cones (yellow). These light cones form from a quasi-particle located at the centre of each cone. Quasi-particles are a result of a plasma electron (lighter) accumulation at the back of each plasma wave (blue).
Credits: Bernardo Malacá (IST) (2023) simulation.

"Nothing can move faster than light. Absolutely nothing, except perhaps rumours." This belief comes from the British writer and humourist Douglas Adams, who decided to challenge one of the fundamental ideas in Einstein's theory of relativity. But what if there were tiny particles that could? These super-speedy particles, known as tachyons, were first suggested by a German physicist named Gerald Feinberg back in 1967. Since then, the idea of breaking the speed limit of light has captured the imagination of scientists and thinkers alike.

A group of international scientists led by researchers from EuPRAXIA partner Instituto Superior Técnico (Laser and Plasma Group, Institute of Plasma and Nuclear Fusion) and including experts from the University of Rochester and University of California Los Angeles in the United States and the Applied Optics Laboratory in France, have discovered something fascinating.

If these particles exist, they might be the key to creating a new kind of super-bright light source, just

as powerful as the most advanced ones we have today, but much smaller. This groundbreaking research has been published in a paper in *Nature Photonics* recently.

Instead of focusing on individual particles (which can't go faster than light), they looked at something called "quasi-particles." These quasi-particles are the result of electrons moving together in synchrony to the "Mexican wave that goes around football stadiums even though every person stays put. The fascinating part is that these quasi-particles can travel at any speed, even faster than light, and can withstand intense forces.

According to Jorge Vieira, a professor at the Instituto Superior Técnico, and coordinator of this study, "these special quasi-particles provide an exciting new way to explore and suggest extremely powerful sources of light that nobody had thought of before." This approach is simple enough that it can be tried in dozens or even hundreds of labs around the world, bringing the theoretical concept a step closer to becoming a reality.

Bernardo Malacá, a doctoral student at IST and the study's primary author, said: "The flexibility is enormous. Even though each electron is performing relatively simple movements, the total radiation from all the electrons can mimic that of a particle moving faster than light or an oscillating particle, even though there isn't a single electron locally moving faster than light or an oscillating electron."

Light sources have a huge impact on our lives, from science and technology to everyday applications. For example, they play a crucial role in non-destructive imaging (like scanning for viruses or checking product quality), understanding biological processes (like photosynthesis), manufacturing computer chips, and exploring the behaviour of matter in planets and stars.

Bernardo Malacá added: "We started with the basics - what conditions make multiple particles emit light as if they were one" - and then applied that to the most intense sources of light." The most powerful sources of light like free electron lasers are rare and massive, making them impractical for most laboratories, hospitals, and businesses. But with the

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>>> Fellows News

Meet our EuPRAXIA-DN Fellows - Part 1

EuPRAXIA-DN will train a cohort of 12 Fellows (ten Fellows will be funded from the HE-MSCA-DN funds, while two Fellows will be funded by the UKRI Guarantee Funds) between universities, research centers and industry who will carry out an interdisciplinary and cross-sector plasma accelerator research and training program for this new research infrastructure. The network focuses on scientific and technical innovations and on boosting the career prospects of its Fellows.

11 Fellows have already been recruited to the EuPRAXIA Doctoral Network. Below we present those who recently started work in their host institutions, with other Fellows to be introduced in the upcoming issues.

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Andrés Leiva Gendre

Andrés is an Argentinian applied physicist. He studied at the National University of Córdoba (UNC), where he became interested in Medical Physics. His bachelor's thesis was on "Online Dosimetry by Electron-positron Annihilation Detection using Nanoparticles for Tumour Targeting."

Andrés' interest in nuclear medicine prompted him to enrol in the ERASMUS MUNDUS Joint Master's Degree in Nuclear Physics. In this international program, he studied at several European Universities, namely, the University of Seville, the University of Catania, and the University of Caen Normandy, located in Spain, Italy, and France, respectively.

During his Master's Degree, he learned about novel concepts in accelerator physics and became passionate about it. In the last semester, he worked on "Modelling of Tapered Co-propagating Structures for Dielectric Laser-driven Accelerators" in collaboration with the Italian research institute INFN.

He joined EuPRAXIA-DN at the University of Pécs within the High-Field Teraherz Research Group on THz-based Dielectric Laser-driven Accelerators. His research project will focus on THz-driven dielectric accelerators.

In his free time, Andrés balances his activities between training, meeting with friends, dancing Tango, and traveling. He likes engaging in different physical activities like hiking or combat sports. On the other hand, he never misses the chance to play chess with other players. Andrés is very open to talking, learning, and discussing any topic. He likes to spend high-quality time in any social meeting. He considers making people smile and laugh very important. For Andrés, experience teaches life, and travel is a part of education.

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>>> Upcoming Events

EuPRAXIA-DN School on Plasma Accelerators 22 - 26 April 2024, Rome, Italy

Several tens of thousands of particle accelerators are in use today with varied applications in research, industry, medicine and other fields. Yet accelerator usage could be much more widespread, were it not limited by cost and size constraints, especially in hospitals, universities, and small and medium size companies. This would enable ground-breaking applications and innovations on a much larger scale.

A possible solution to this bottleneck is the development of more compact - and consequently more cost-efficient - accelerator technologies, a strategy that has been investigated in the past two decades bringing forth plasma accelerators as one of its most promising candidates.

This interdisciplinary school will bring together all research areas within EuPRAXIA-DN and will be held in the Eternal City Rome in Italy from 22-26 April 2024. Lectures and topical talks will be presented by research leaders from academia and industry.

The school will be organized in partnership with INFN and introduce the basic principles of plasma accelerators, including basic plasma physics, laser- and beam-driven acceleration, plasma injection schemes, plasma and beam diagnostics, particle-in-cell codes, as well as specific high impact projects, including EuPRAXIA and AWAKE.

Tutorial sessions in smaller problem classes will reinforce content and promote discussion. All participants will be given the opportunity to present their own research in a poster session.

Social events, an excursion to INFN-LNF, and a public talk on plasma accelerator science and technology will complement the diverse and interesting programme.

Several scholarships for early-stage researchers from outside of the EuPRAXIA Doctoral Network will be available.

For more information and to register please visit:
<https://agenda.infn.it/eupraxia-school-on-plasma-accelerators>

Registration deadline: 29th February 2024



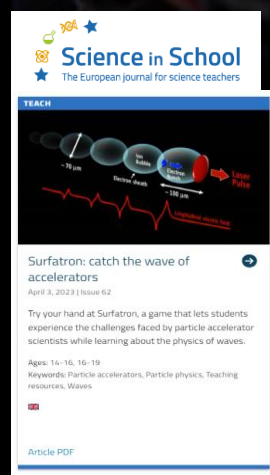
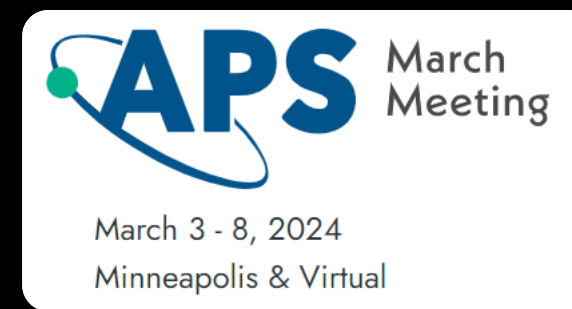
The EuPRAXIA-DN School will take place at the Botanical Garden of Rome.

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<https://www.eupraxia-dn.org/newsletter>

Outreach



International successes:

- Physics of Star Wars
- Surfatron

This week

- Every aspect of plasma accelerators will be presented by leading experts – tutorial will dive deep into specific areas.
- Opportunities to discuss your own research throughout the week, in particular the poster session.
- Outing to Frascati Lab on Wednesday to see the future (EuPRAXIA).
- Get to know other participants and lecturers – network, become part of the EuPRAXIA family.

Enjoy the week!



EuPRA XIA

Doctoral Network



This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement no. 101073480.



**UK Research
and Innovation**