EUROPEAN
PLASMA RESEARCH
ACCELERATOR WITH
EXCELLENCE IN
APPLICATIONS

EuPRAXIA
Preparatory Phase

Status of EuPRAXIA_PP

P. Campana (INFN-LNF)

TDR review committee, June 16th 2025

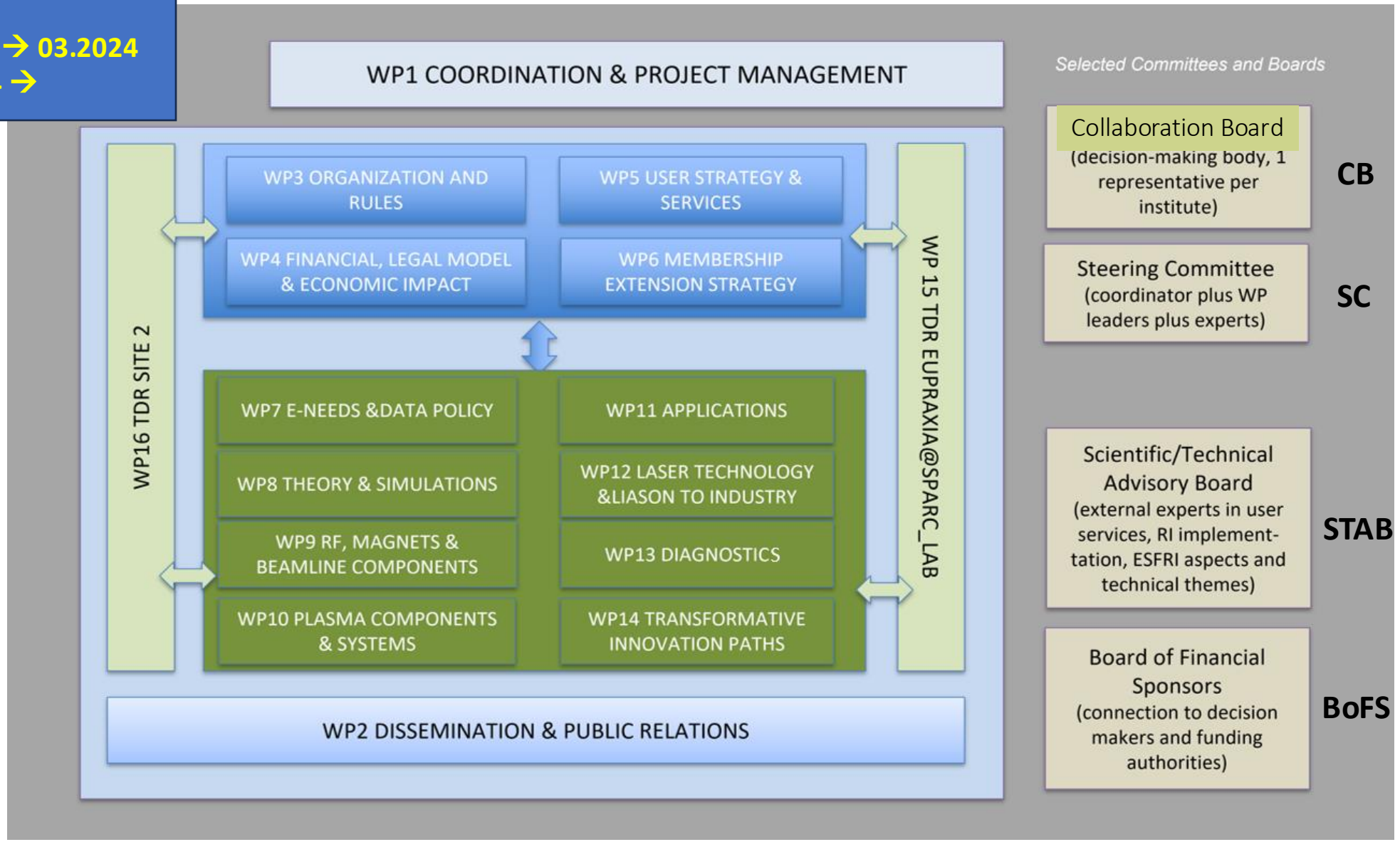
Funded by
the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101079773. It is supported by in-kind contributions by its partners and by additional funding from UK and Switzerland.

EuPRAXIA PP structure

Funded by the European Union

Project coordinators:
R. Assmann (DESY & INFN) → 03.2024
P. Campana (INFN) 03.2024 →



EuPRAXIA_PP Consortium & ancillary EU programs

Funded by the European Union

28 EU institutions, beneficiaries (3.7 M€)
10 ass. partners (CH & UK, w/matching funds)
8 observers

Horizon EU Grant Agreement n. 101079773

Consortium Grant Agreement signed (large overlap with ESFRI applicants)

Direct Involvement of EU Laser Industrial Companies

ANCILLARY SUPPORTING PROGRAMS

- EuPRAXIA Doctoral Network 3.1 M€

This project has received funding from the European Union´s Horizon Europe research ar innovation programme under grant agreement no. 101073480 and the UKRI guarantee fu

- EuAPS 22 M€

R&D on betatron plasma sources, based on IT Next-Gen. EU Recovery Funds (INFN, CNR, Rome TV Univ.)

- PACRI EU Horizon EU Grant 11 M€

NEW !

Program to develop plasma based sources (achieved thanks to EuPRAXIA framework). Starting March 2025

EMPA*	CH
EPFL*	CH
PSI*	**CH**
DESY	DE
FBH Berlin	DE
FHG-ILT Aachen	DE
FZ Julich	DE
HZ Dresden	DE
LMU Muenchen	DE
HHU Dusseldorf	**DE**
GSI-FAIR Darmstadt	**DE**
ELI Beamline ERIC	CZ
CEA	FR
CNRS	FR
THALES	FR
AMPLITUDE	**FR**
IASA Athens	GR
WIGNER	HUN
Uni. Szeged	HUN
Uni. Pecs	HUN

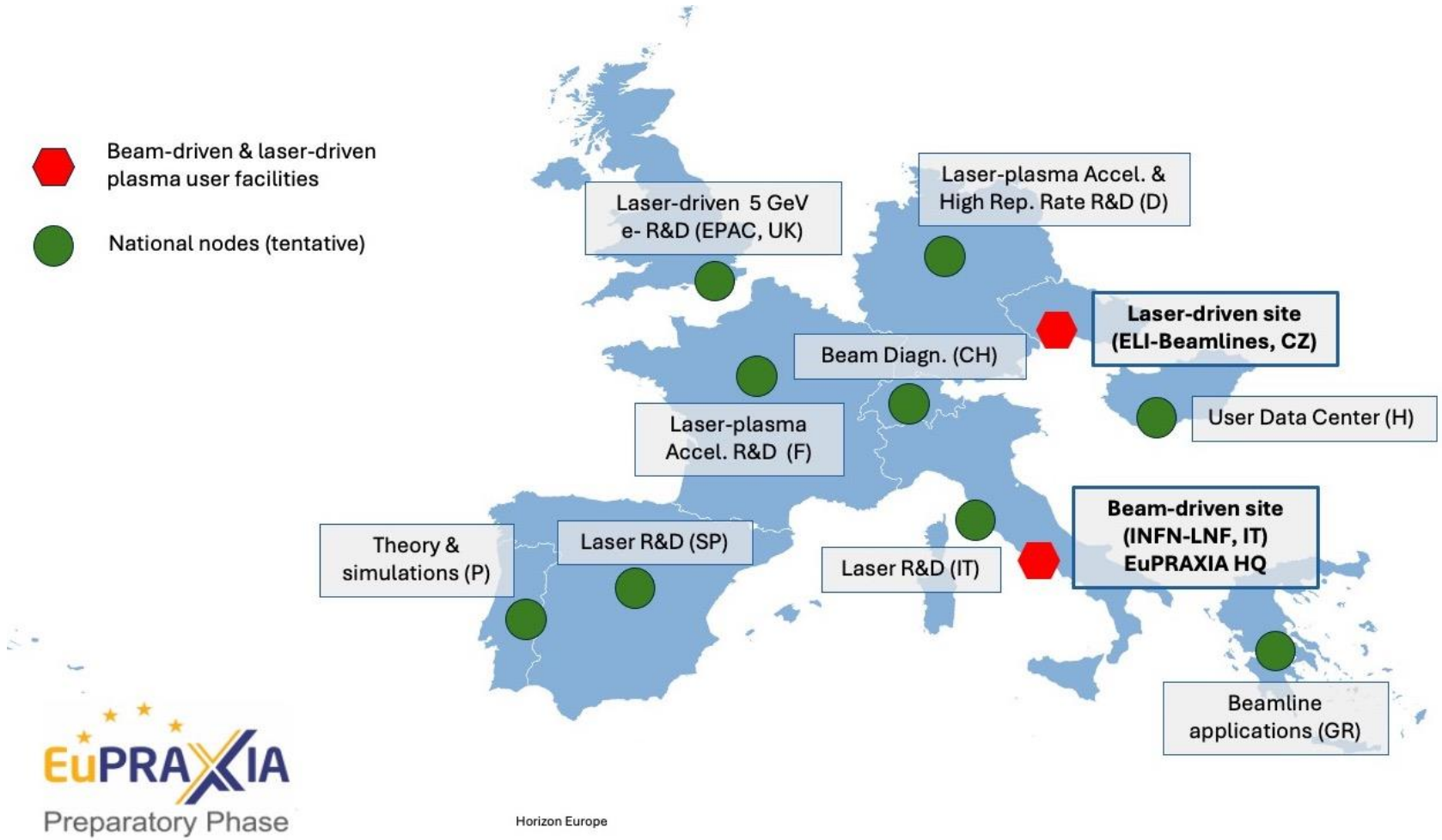
* associate partners

CERN	INT. ORG.
H. Univ. Jerusalem	ISR
CNR	IT
ELETTRA Trieste	IT
ENEA Frascati	IT
INFN	IT
U. Roma Sapienza	IT
U. Roma Tor Vergata	IT
IST Lisbon	P
ALBA Cells	SP
CLPU Salamanca	SP
IC London*	UK
QU Belfast*	UK
STFC*	UK
U. Liverpool*	UK
U. Oxford*	UK
U. Strathclyde*	UK
UCLA*	US

38 members, 8 observers

UJT Shanghai (observer)	CN
HZ Jena (observer)	DE
U. Cote d'Azur Nice (observe	FR
NTUA Athens (observer)	GR
U. Milano Bicocca (observer)	IT
U. Palermo (observer)	IT
NCBJ Otwock (observer)	PL
U. Manchester (observer)	UK

EuPRAXIA Consortium Networking



EuPRAXIA Preparatory Phase

Horizon Europe

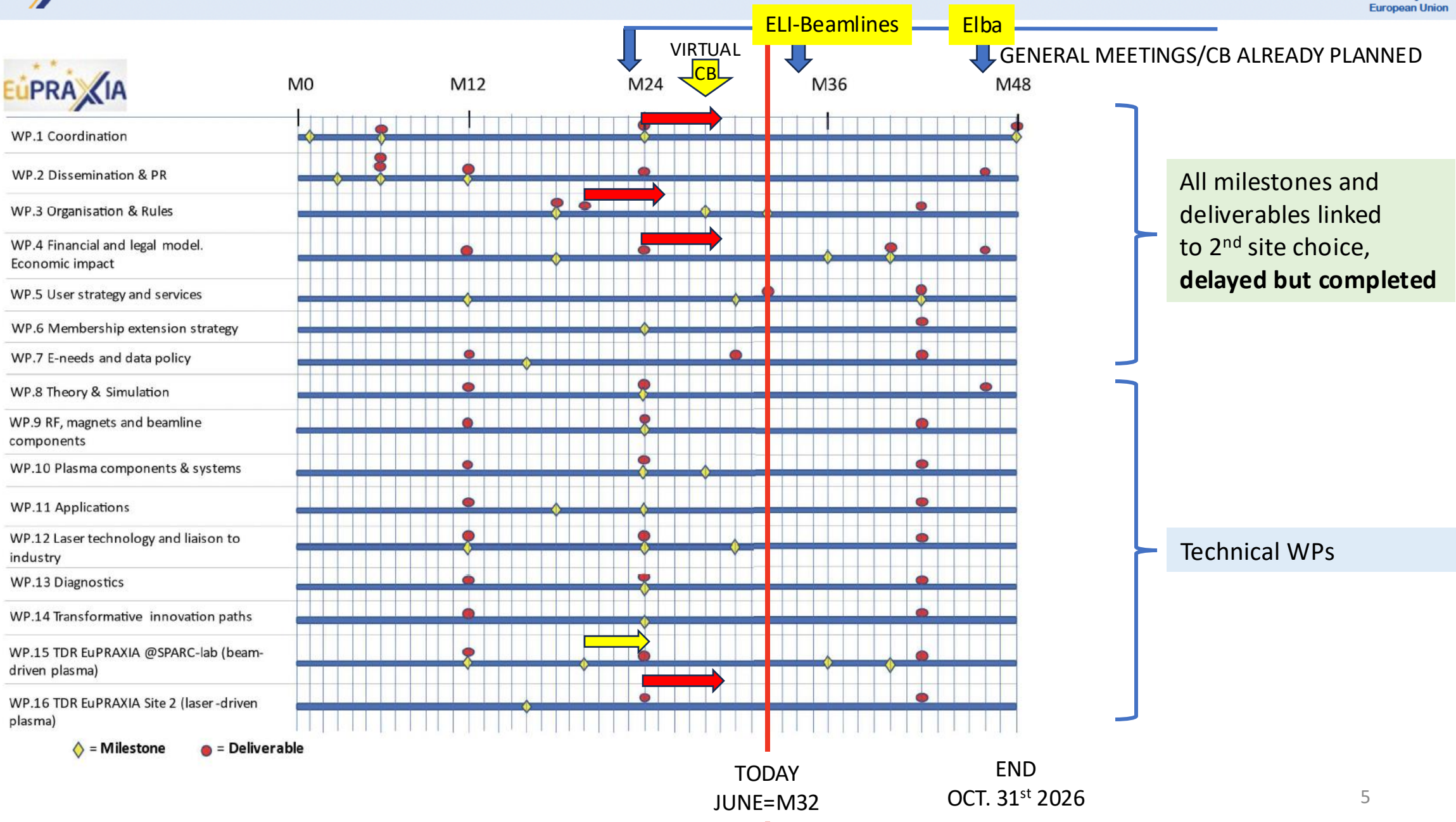
A large collection of the best European know-hows in accelerators, lasers and plasma technologies

Network organization
- **Sites (PWFA/LWFA)**
- **National nodes**
- **Technology clusters**

LWFA site chosen:
- ELI ERIC, Prague

+ Two national nodes:
- CNR-INO, Pisa
- EPAC-RAL, UK

Status of Milestones & Deliverables



All milestones and deliverables linked to 2nd site choice, **delayed but completed**

Technical WPs

ESFRI PP evolution

April has seen the preparation by the EuPRAXIA Project Management of two very important documents:

- **Policy brief** (mid-term review, requested by EU Project Office, a 4-pages status of the PP grant)
- **Reporting period no. 2 to EU**, due by June ~ 50 pages
- **Monitoring report to ESFRI** (~ 60 pages document which is part of RI ESFRI monitoring process held on the about 70 Landmarks and Roadmap projects). This document will be read by 4 rapporteurs (2 scientific, 2 for the implementation). A written report will be sent to ESFRI Forum and approved by the end of 2025 (it will contain marks !)
  The next monitoring (deeper, with oral interview) will be held in 2030-31 and will be **decisive** for the passage of EuPRAXIA from Roadmap to Landmark.

EU will launch soon **HORIZON-INFRA-2025-01-DEV-02** targeting the research infrastructure projects that entered the ESFRI Roadmap in 2021, due to their scientific excellence and organisational maturity as well as to their strategic importance for the European Research Area and the structuring of the European research infrastructure ecosystem.

EuPRAXIA can access this opportunity to support its Pre-Implementation Phase, especially concerning **establishing governance, securing funds, finalisation of architecture, ICT and data management, development of access policies, internalization**, etc…
Timing: ~ Q3-2026 → Q3-2030 (4 y grant, ~ 1.7 ME) → *more info from Antonio F.*

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- **October 2025**

M 4.2 Approval by the Collaboration Board of drafts for the legal and financial packages
M 15.3 Report on R&D achievements supporting EuPRAXIA@SPARC_LAB technical design

- **February 2026**

D 4.3 **EuPRAXIA Socio-economic Impact assessment**
M 4.3 **Approval by the Board of Financial Sponsors of the legal and financial packages**

- **April 2026**

D 3.3 **Report on the distributed RI concept including organization and rules**
D 5.2 Report (R) on EuPRAXIA-RI terms of services
M 5.3 Service Catalog & Organizational requirements for user services
D 15.3 Report on TDR status for EuPRAXIA@SPARC_LAB
D 16.2 Report on TDR status for EuPRAXIA@Site 2, laser driven

- **August 2026**

D 4.4 Report (R) on final EuPRAXIA financial and legal model incl. RI governance and management

- **October 2026**

D 1.3 **EuPRAXIA-RI Implementation Plan**
M 1.4 **Agreement on legal and financial packages**

Funded by the European Union

Recommendations, Meeting #2, 6.2.2025

After reviewing and discussing the progress of the EuPRAXIA PP project, the STAB unanimously agreed that the overall organization is advancing well, with the responsible institutions demonstrating outstanding performance.

Significant progress has been demonstrated in the design and analysis of the beam driven accelerator case since the last meeting, which is very impressive. Continued development at this pace will ensure with a high probability the success of the PP phase and the achievement of the project goals also due to sufficient funding availability.

The laser driven case on the other hand is still in the development stage. According to the brief presentation of the site proposals, which were quite diverse in terms of goals and perspectives, more effort needs to be invested in the elaboration of a sustainable roadmap in order to fulfill the expectations of the EuPRAXIA project, also aiming to reach the status of user facility. This is in order to avoid serious delays in the completion at least of phase one with LWFA.

The STAB is concerned that the 'EuPRAXIA Configuration', as presented by Antonio Falone, is not appropriate for a distributed ESFRI Research Infrastructure that EuPRAXIA aspires to become. The very loose connection of the two sites and the underdefined linking to the National nodes and further clusters in these countries, as the figures seems to indicate, does not appear to match the requirements a governance of this distributed infrastructure would need. Neither it is clear if the AISBL, now suggested to become the legal format, would align with this model. The STAB suggests that the EuPRAXIA management identifies the major processes the distributed research infrastructures needs to perform, and identifies further how the different partners (the two main sites, as well the other sites) shall contribute to these processes. Such an analysis could guide the type of governance needed as well as the structure of the organization to be chosen.

An additional complication in the process of establishing the AISBL might have to do with the fact that the second site could belong to an ERIC. The relations between the AISBL and the ELI-ERIC should find an optimal legal solution. The STAB considers it urgent to establish a realistic timeline for the setting up of the AISBL legal entity.

Concerns about the definition of relationship among sites, nodes and clusters.
Required better understanding of role and operation of possible AISBL legal entity

>> main message:
PUT IN OPERATION NATIONAL NODES/CLUSTERS AND LINK THEM TO SITES !

Board of Financial Sponsors

FROM EU GRANT AGREEMENT: *Within the EuPRAXIA-PP project, a Board of Financial Sponsors will be created to meet regularly with potential sponsors of the research infrastructure. This Board will be composed of representatives of research funding bodies and other potential sponsors.*

BoFS is expected to endorse 2nd site choice, legal framework, governance, funding scheme (in-kind & cash), together with general EuPRAXIA layout and operation (sites + national nodes + technical clusters). Heterogeneous composition: National Institutes, Universities, Ministries, Int. Org., ERIC, etc.

Country	Name	other info
CERN	Steinar Stapnes	CERN, Linear Collider Study Leader, Accelerator and Technology Sector
Czech Rep	Radka Wildova	Director General for Higher Education, Science and Research section
	Marek Vysinka	Head of Research Infrastructures Unit
France	Antoine Rousse	CNRS, Research Director
	Catalin Miron	CEA, Director - Research Infrastructures, European & International Affairs
Germany	Andreas Maier	DESY, lead scientist
Greece	Emmanuel Varvarigos	Vice-Rector of NTUA
Hungary	Péter Stefán	National Research, Development and Innovation Office
Italy	Sandra Malvezzi	INFN Executive Board
	Roberto Cimino	MUR, Ministry of University and Research
Portugal	Marta Fajardo	Instituto Superior Técnico, Physics Department
Spain	To be nominated	
Swiss	To be nominated	
UK	John Collier	CLF Director and Executive Director of Laserlab Europe

Board of Financial Sponsors

Funded by the European Union

First informative meeting (17.3.2025)

Attending: representatives from CERN, Czech Rep., France (CEA, CNRS), Germany, Greece, Hungary, Italy (MUR, INFN), Portugal, UK (STFC).

Spain and Switzerland so far not yet represented

Prof. **Radka Wildova** (DG for Higher Education Czech Min.) was nominated Chair of the Board

Questions about second site, funding supporting strategy, AISBL option.

Request to define a **Term of Reference** for the Board (scope, composition, operation, etc.).

So far not existing in ESFRI or EU agreements

At the next meeting (planned at ELI-Beamlines) we plan to identify and invite to the meeting also the EuPRAXIA National Representatives to support the discussion, once National Nodes will be identified

2nd site decision procedure (as approved by CB, Sept. 2024)

Funded by the European Union

- Preparation of templates for 2nd site bid-books (3 applicants: ELI, STFC-EPAC, CNR-INO)
- Deadline for bid-books (December 22nd, 2024)
- Setup of panel for 2nd site choice: striving at consensus, focusing the selection on site(s) ready to met EuPRAXIA Phase 1 requirements within ESFRI timeline requirements

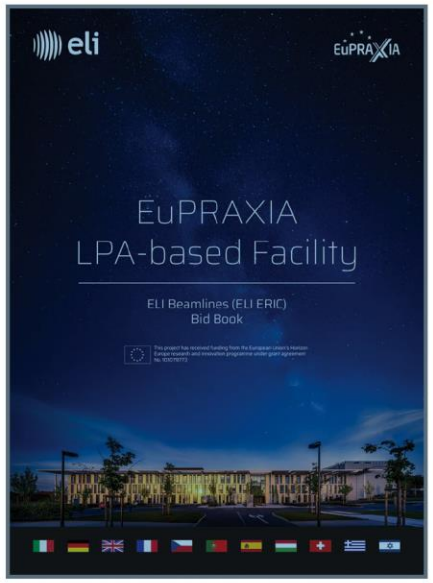
Panel composition: R. Assmann (Chair, GSI), P. Campana (INFN), A. Falone (INFN), M. Ferrario (INFN), G. Gatti (CLPU), A. Ghigo (INFN), L. Gizzi (CNR), A. Molodozhentsev (ELI), R. Pattatill (STFC), A. Specka (CNRS), C. Pelliccione (sec.)

Panel meetings:
January 17, Bid-books presentations and discussion;
January 29, Proponents answers to written question and discussion; draft of procedure to prepare the resolution proposal to CB;
February 21, Discussion and approval of the resolution proposal to CB
March 21, Finalization of resolution proposal to CB

March 25, CB meeting – approved with nearly unanimous consensus (36 yes - 1 abstain - 1 no)

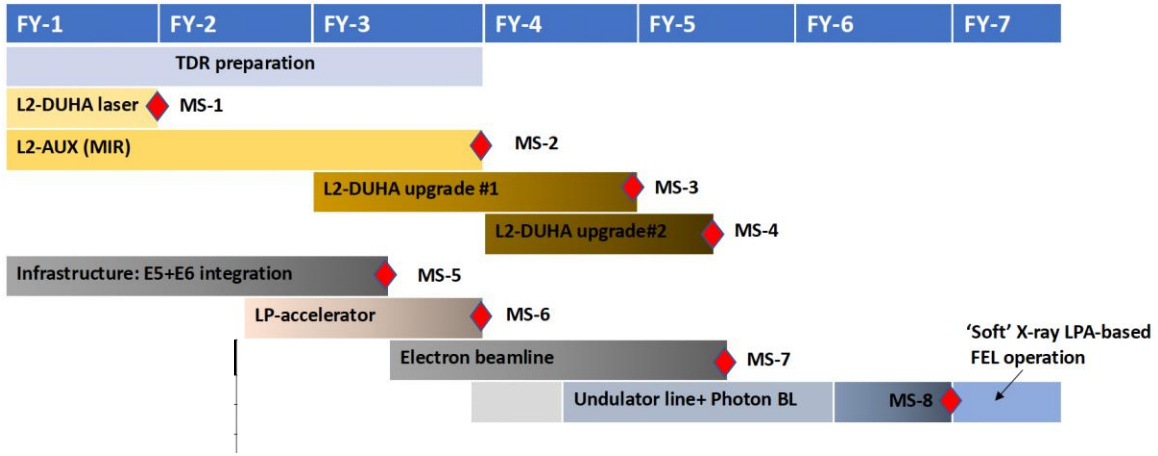
ELI Beamlines, Prague (CZ)

- Institutional Capability to Host the Site
- Technical Overview of the Laser-Driven Site Proposal
- Required and Available Resources
- Project Phases and Budget Timeline
- Support from EuPRAXIA Partners
- Political Endorsement
- Alignment with EuPRAXIA Governance
- Additional Considerations



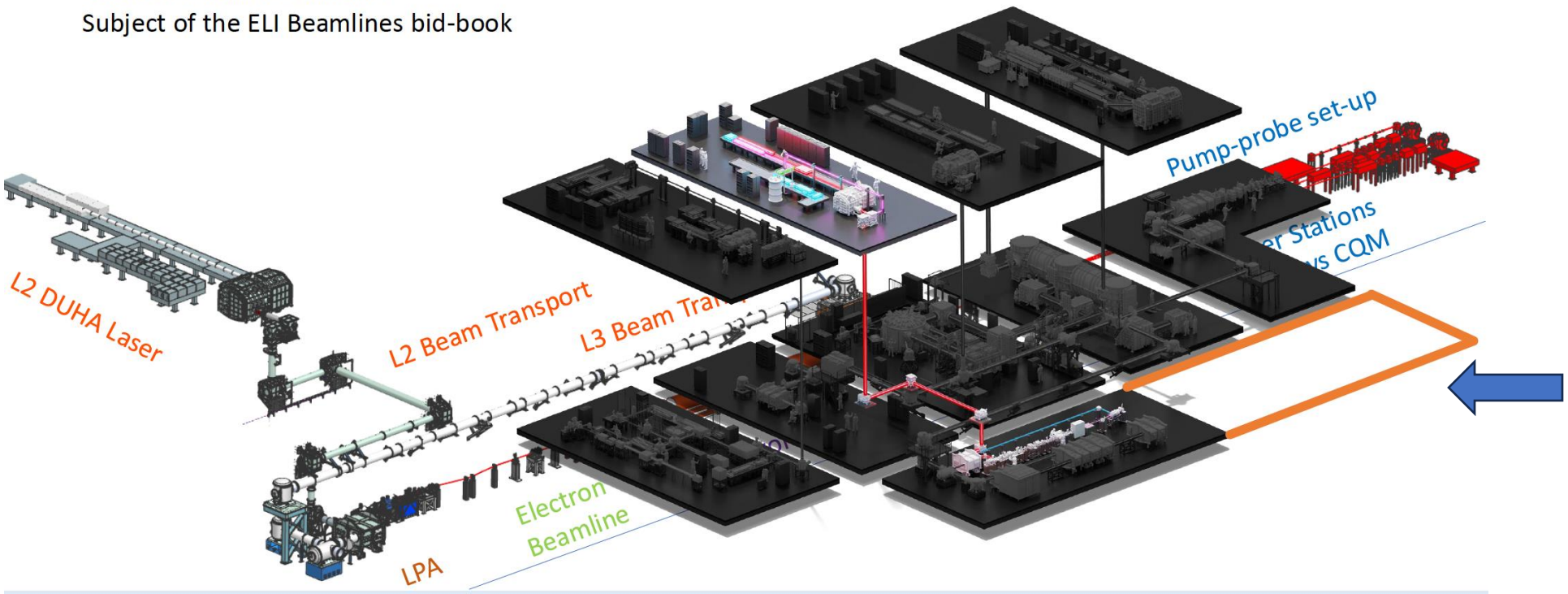
- **Government Endorsement**
  - Backed by the Czech Government's ESFRI Roadmap support and a financial commitment to support the implementation of EuPRAXIA within the established funding framework of ELI Beamlines.
- **ELI General Assembly Support**
  - Members endorse ELI's application to host EuPRAXIA's second site.
- **Framework Readiness**
  - Adaptable financial and governance models to be tailored to meet the specific requirements of EuPRAXIA's construction and operation phases.

Timeline for EuPRAXIA – PHASE 1



Eli Beamlines, Prague (CZ)

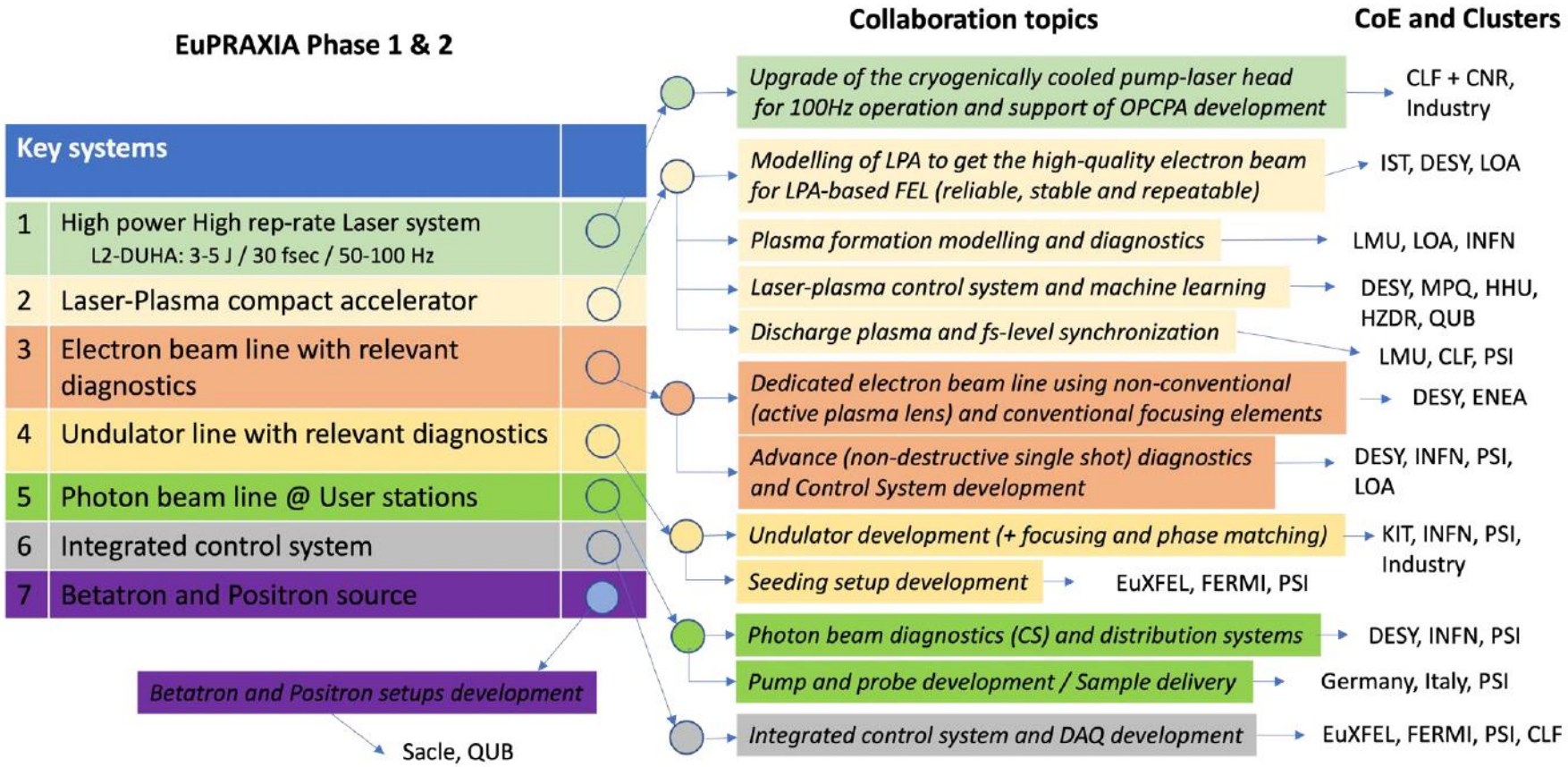
Conceptual model of the EuPRAXIA Phase-1
1GeV electron LPA scheme
Subject of the ELI Beamlines bid-book



Area available for 1 GeV FEL (Phase 1)

Prep + Phase 1 + Phase 2	mEUR	In-kind
Total Cost of Existing Infrastructure	54	54
Total Budget to Complete Phase 1 Scope	58	23
Total Estimated Budget for Phase 2	112	67
Total additional cost	**224/170**	**144/90**

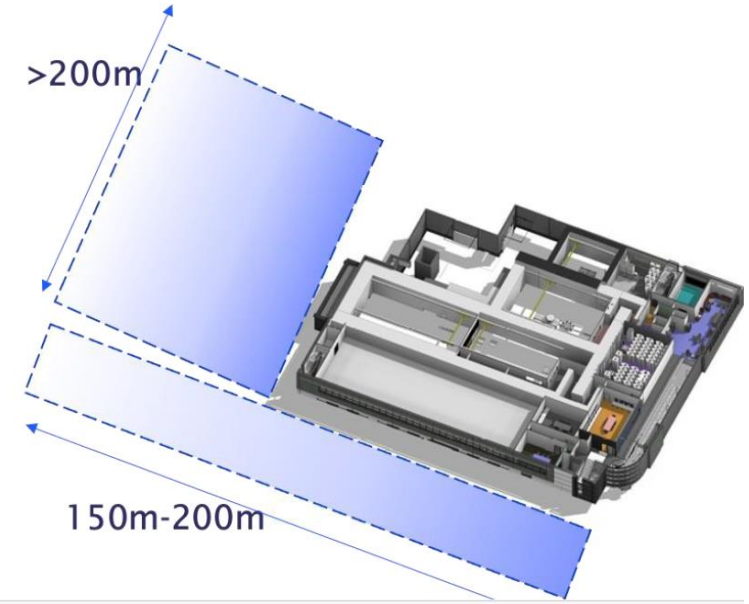
Eli Beamlines, Prague (CZ)



STFC EPAC, Harwell (UK)

- EPAC's operations to start in 2026 – EuPRAXIA can be built on this – EPAC will be a plasma accelerator facility (not just a laser facility)
- Propose to start with 10Hz PW beam with 100Hz upgrade option (under development)
- Strong expertise within STFC (lasers, accelerators, detectors, targetry, data…) and the academic community (plasma accelerators)
- EPAC's applications-oriented program and industry links would help EuPRAXIA
- STFC has long history and all the infrastructures required to run a successful user programme
- Joining EuPRAXIA is in PWASC Roadmap
- STFC's Accelerator Strategy now includes development of plasma accelerators
- UK has re-joined Horizon EU – qualifies for EU funding

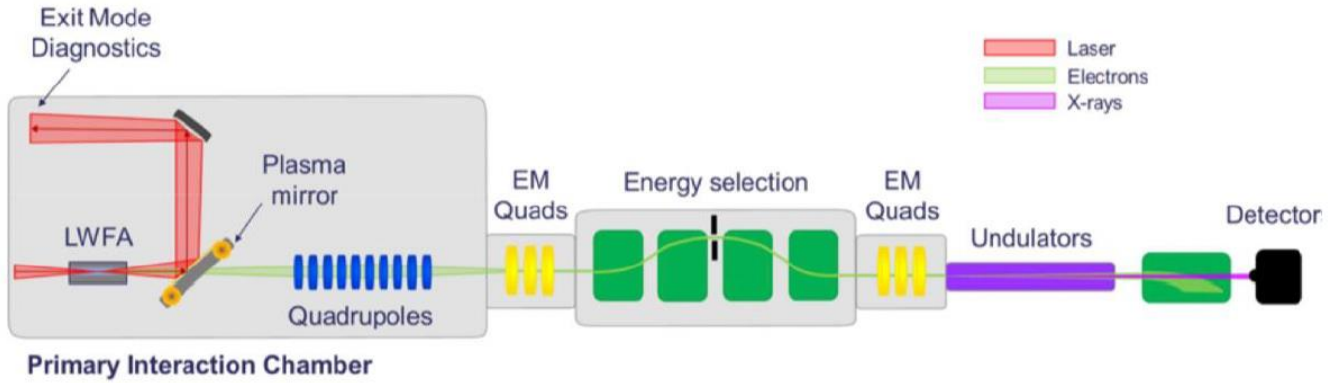
Not enough space in current EA1 hall.
Significant building extension required



External funding (capital and/or operational) is essential for us – without this, no business case for investment is feasible.
Bidding for 1GeV option is not really in our interest with timescales involved in operating EA1
Instead, we would like to bid for **EPAC to be the 5GeV R&D centre of EuPRAXIA**
The focus will be in getting FEL-quality 5GeV electron beams, which is also in EPAC's strategy
No need for (full-scale) undulator or building – no capital required in the interim
EPAC operations can carry-on uninterrupted

STFC EPAC, Harwell (UK)

Funded by the European Union



Simulations show high-quality 5GeV beams are possible

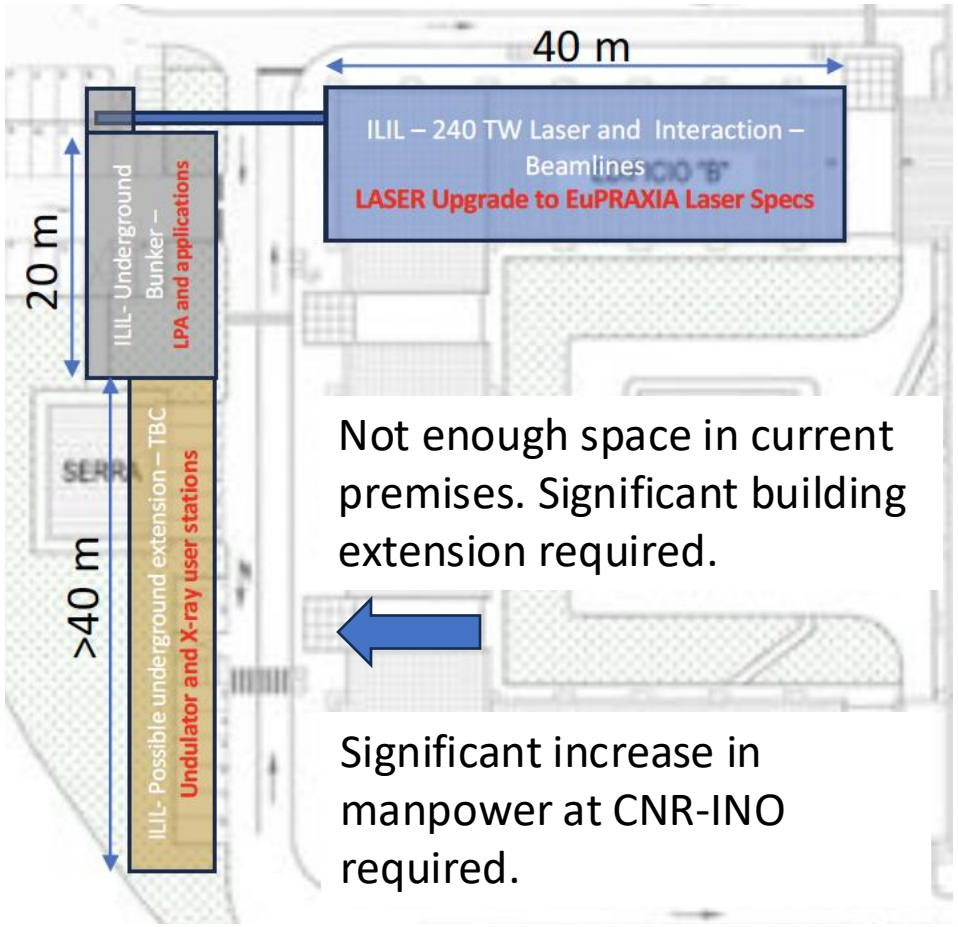
- Will have electron transport optics
- Space for dedicated R&D beamlne setup, if required
- Will have diagnostic options for testing electron beam quality

HW for 5 GeV facility ~ already available as in-kind contrib.

Areas of collaboration	CoE's
Solutions for wavefront and pointing corrections	France, Germany, ...
Diagnostics, Targets, Gas flow control, feedback systems, ML control, plasma lens	France, Germany, Italy
Optimization of FEL quality laser-driven electrons, electron beam transport	France, Germany, Switzerland
Design and delivery of undulators and o diagnostics	Germany, Italy, Switzerland
Physics simulations of LWFA and end-to-end simulations	Germany, Portugal
Advanced Accelerator and injection schemes	Germany, Italy

Timeline:
2023: Chambers and large equipment delivered
2024: Commissioning with internal laser
2026: Pulsed beam and LWFA commissioning
2027: Operational user facility

CNR INO, Pisa (IT)



- Discussion has been ongoing mainly at an institutional (CNR headquarters) level: *significant interest with no show stoppers*
- Active involvement of the CNR Department of Physics (DSFTM) for operational strategy: *synergy with ELI is acknowledge and well received*
- Ongoing discussion on the future development of National (PNRR) RI (IPHOQS and EUAPS) in progress: *may open funding opportunities*
- Higher level (ministerial) engagement on hold for discussion on another high priority ESFRI infrastructure (ET).

High repetition rate High power Ti:Sa amplifier module — PACRI WP10

High repetition rate pump sources for laser drivers — PACRI WP12

Prototype of High average power optical compressor — PACRI WP

Laser driver System Architecture, transport and engineering — PACRI WP11

Strong engagement of CNR INO with other partners (ELI/EPAC) and Laser Companies

2nd site: discussion output

Funded by the European Union

ELI Beamlines proposal

Proposal – Officially adopt ELI Beamlines as EuPRAXIA`s second user site: pillar for a laser driven, plasma-based Free-Electron Laser for users (Phase 1 at 1 GeV beam energy). Europe's most compact, most high tech and most Eastern FEL!

Motivation

- The ELI facility today provides sufficient room for installing a 1 GeV FEL (phase 1) including undulators and a user station, without requiring building extensions or new buildings. The other sites require more invests.
- The ELI Beamlines bid provides an in-kind contribution which, in a relatively short time scale, represents a decisive asset for the construction of the EuPRAXIA 2nd site.
- To achieve this goal, some more resources are needed, both from ELI Beamlines and supporting institutions.
- ELI Beamlines organizational structure is fit to provide support to the 2nd site installations, to operation and management of the infrastructure and to users. Formal support from ELI-ERIC management is present.

2nd site: discussion output

Funded by the European Union

STFC EPAC proposal

Proposal – Officially support EPAC as EuPRAXIA Facility for R&D on a 5 GeV electron beam that is produced in a compact laser-plasma accelerator and that has sufficient beam quality for the FEL application.

CNR INO proposal

Proposal – Officially support CNR-INO as the EuPRAXIA National Node in Italy for Laser R&D and as an additional formal link between the two EuPRAXIA pillars in Italy and Czech Republic.

Status of national node/clusters network

Funded by the European Union

National nodes represent the National efforts (in-kind and cash). They participate in the study and the construction of site facilities, develop technologies for further future constructions of these instruments. Furthermore, there are **technological clusters** of participating Laboratories and Universities that work together on specific research and development topics of interest for sites. The current effort is in starting this system.

Country	Site-Item	status	Rank
CERN	Site 1 X-band	Historical support to LNF: to be revamped	
Czech Rep	**ELI Beamline-Laser Driven Site (LPWA)**		
France	R&D on laser plasma acceleration	Mainly CNRS - lack of coherence/funds - LPA Roadmap ongoing ?	
Germany		? - some interest on LPWA (Univ.) - DESY ?	
Greece	Athens NTU	Vague interest on medical applications	
Hungary	Data Storage	Potential interest from IT Wigner group - collab. with PT	
Italy	**LNF - Beam driven site & HUB**		
	CNR Pisa - Industrial Laser R&D	Candidate for IT Laser Technology Node - collab. with ELI	
Portugal	IST Lisbon - Computing & Simulation	Good collaboration (so far, lack of funding)	
Spain	CLPU Salamanca - R&D on Lasers	? - waiting new Director at CLPU - entering ELI ?	
Switzerland	PSI - Beam diagnostics	Good collaboration & perspectives - collab. with Roma2	
UK	EPAC RAL - R&D on 5 GeV (no FEL)	Node for coordinated UK group activities	
	Liverpool - Outreach & dissemination	Clear role	

Agreements/MoU for implementation of sites/nodes

Funded by the European Union

INFN – ENEA
agreement (2024) for:
- collaboration in the area of undulators, and their diagnostics,
- participation of ENEA scientists (3 – 4 people) to EuPRAXIA, SPARC_LAB and SABINA activities

INFN – PSI
Framework agreement (2024) in the area of:
- Exchange of knowledge and know-how, personnel, including students,
- Joint workshops, seminars and hands-on courses,
- Collaborative projects and grants, and,
- Loan of equipment

A prerequisite needed to start a more specific collaboration on EuPRAXIA LNF site (diagnostics)

Several visits/contacts with ELETTRA for support on FEL science (photon beamlines)

Discussions with CERN should be restarted (previous agreement supported X-band facility)

Summary

A selection procedure for 2nd site choice has been setup in Sept. 2024, which led to decision in March 2025 CB

Together with ELI-Beamlines, STFC-EPAC and CNR-INO will play a well identified role in EuPRAXIA Network, allowing, possibly, the bidding for new resources
All sites agreed with foreseen EuPRAXIA governance (AISBL ?) and for providing access to EuPRAXIA users

ELI Beamline site will be required to provide TDR timely, and to setup an Int. Review Committee for it.
Needed fresh resources for 2nd site will have to be negotiated with Czech Rep., ELI ERIC, EuPRAXIA partners, and possibly from EU funding, etc… with the support of EuPRAXIA management.
Operation costs remain still an issue, as currently proposed scheme does not fit EuPRAXIA Consortium agreement (each site/node takes care of its operation costs)

Relevant bodies (BOFS, STAB) started their activities; STAB representations not completely filled (**CH, D, ES**)

National node network preparation is ongoing with some difficulties due to funding access: promising cases (CH, CZ, PT, UK), some other highly unclear (F, ES, D)

Governance model sketched, not clear who could join AISBL (differentiation of roles as in KM3net AISBL ? founding members vs the others ? Fees ?). When mature, discussion will be initiated

Acknowledgements

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EuAPS

Co-funded by the European Union

This project has received funding with the co-funding of European Union Next Generation EU.

PACRI

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement n. 101188004

EuPRAXIA-PP Consortium

Coordinator

INFN
Istituto Nazionale di Fisica Nucleare

Consiglio Nazionale delle Ricerche

Elettra Sincrotrone Trieste

ENEA
Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile

SAPIENZA Università di Roma

Università di Roma Tor Vergata

Imperial College London

QUEEN'S UNIVERSITY BELFAST

UKRI UK Research and Innovation

UNIVERSITY OF LIVERPOOL

UNIVERSITY OF OXFORD

University of Strathclyde Glasgow

CERN

DESY.

Leibniz Ferdinand Braun Institut

Fraunhofer ILT

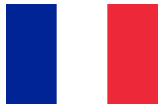
GSI

hhu Heinrich Heine Universität Düsseldorf

HZDR Helmholtz Zentrum Dresden Rossendorf

JÜLICH Forschungszentrum

LMU Ludwig-Maximilians-Universität München



Amplitude

cea

cnrs

THALES

eli

TÉCNICO LISBOA

ALBA

CLPU Centro de Láseres Pulsados

Empa Materials Science and Technology

EPFL

PAUL SCHERRER INSTITUT PSI

THE HEBREW UNIVERSITY OF JERUSALEM

IASA

PÉCSI TUDOMÁNYEGYETEM UNIVERSITY OF PÉCS

SZTE University of Szeged

Wigner