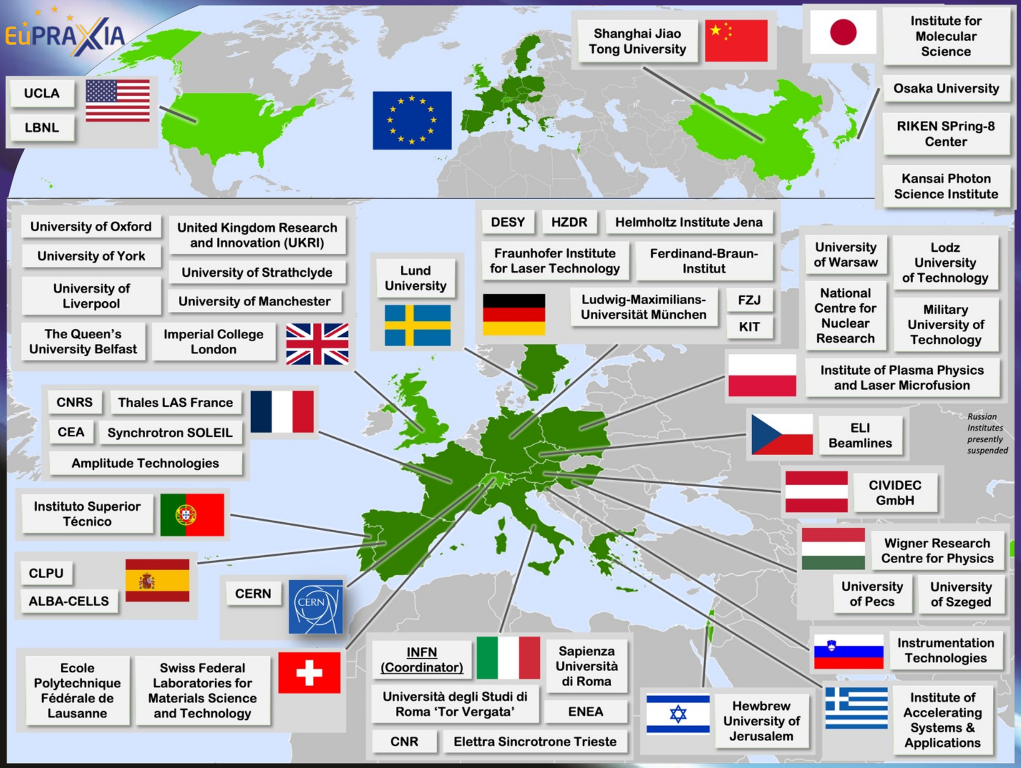
EUROPEAN
PLASMA RESEARCH
ACCELERATOR WITH
EXCELLENCE IN
APPLICATIONS



Status of EuPRAXIA ESFRI Project

R. Assmann, DESY & INFN

EuPRAXIA@SPARClab Review

15 June 2023

This project has received funding from the European Union´s Horizon Europe research and innovation programme under grant agreement No. 101079773

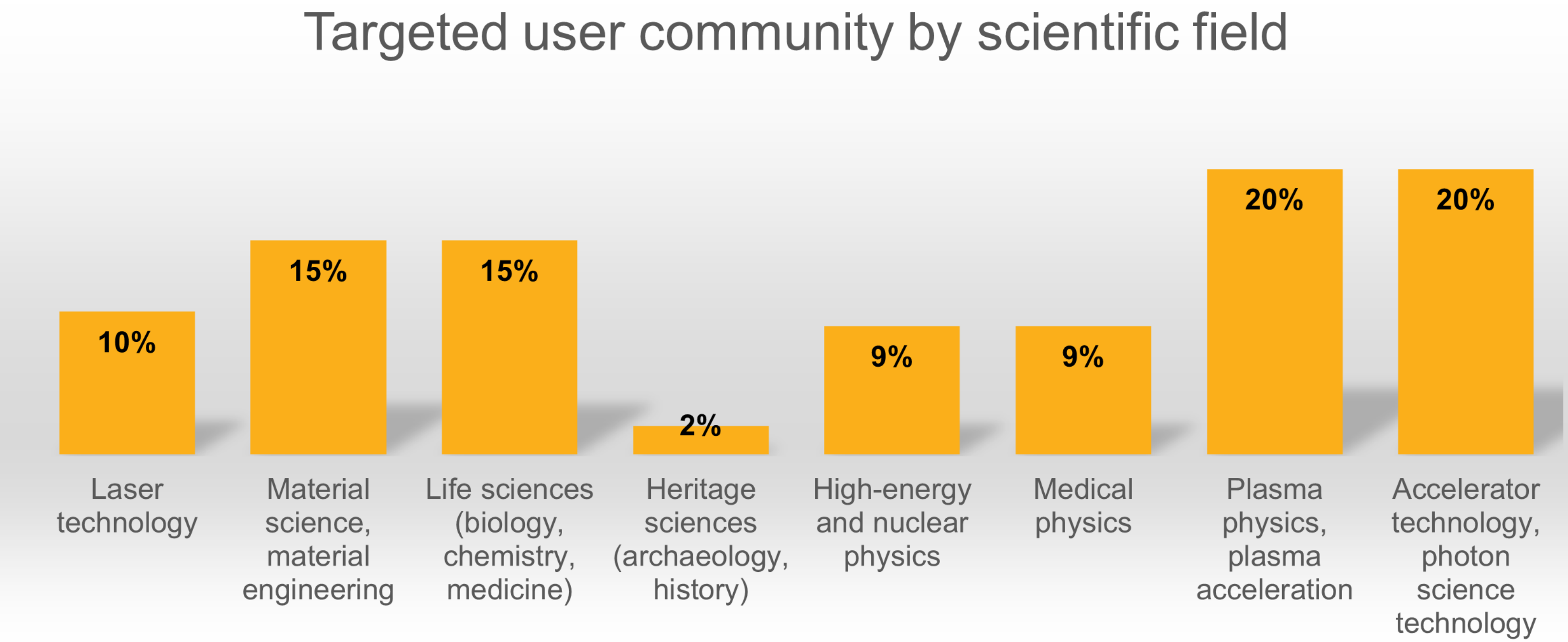
Compact EuPRAXIA Facility Will Deliver to Users

Funded by the European Union

Ultra-short pulses with 10-100 Hz of*

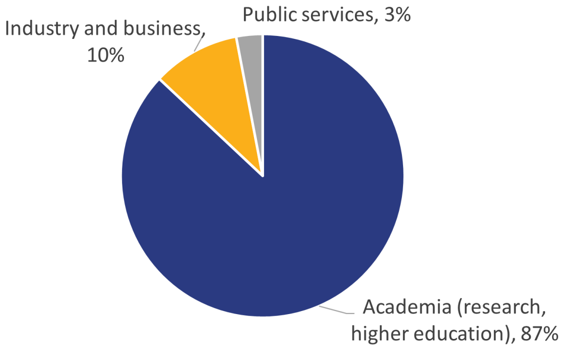
- Electrons (0.1-5 GeV, 30 pC)
- Positrons (0.5-10 MeV, 10^6)
- Positrons (GeV source)
- Lasers (100 J, 50 fs, 10-100 Hz)
- Betatron X rays (1-110 keV, 10^{10})
- FEL light (0.2-36 nm, 10^9-10^{13})

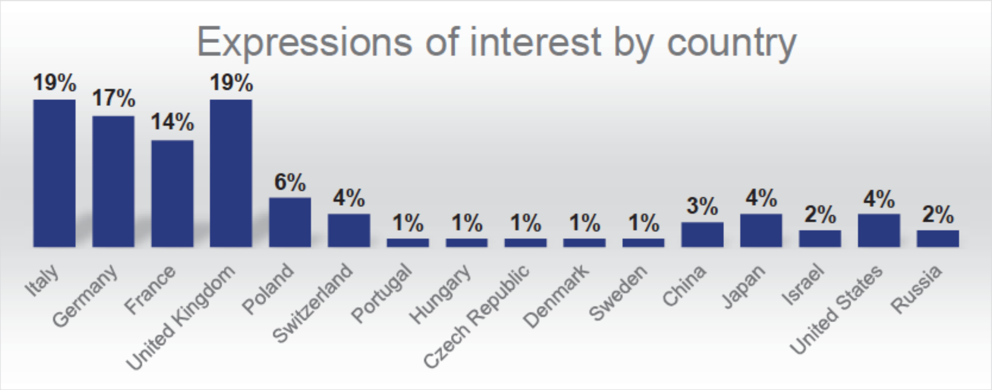
** Parameter ranges are application- / user-driven and still have flexibility in the current design*



Expressions of interest from **95 research groups** received, representing several thousand scientists in total.

Form basis of **user demand analysis**.





Socioeconomic Impact from Miniaturization
EuPRAXIA Approach Based on Plasma Technology

Funded by the European Union

RF Accelerators

> 30,000 operational – many serve for Health

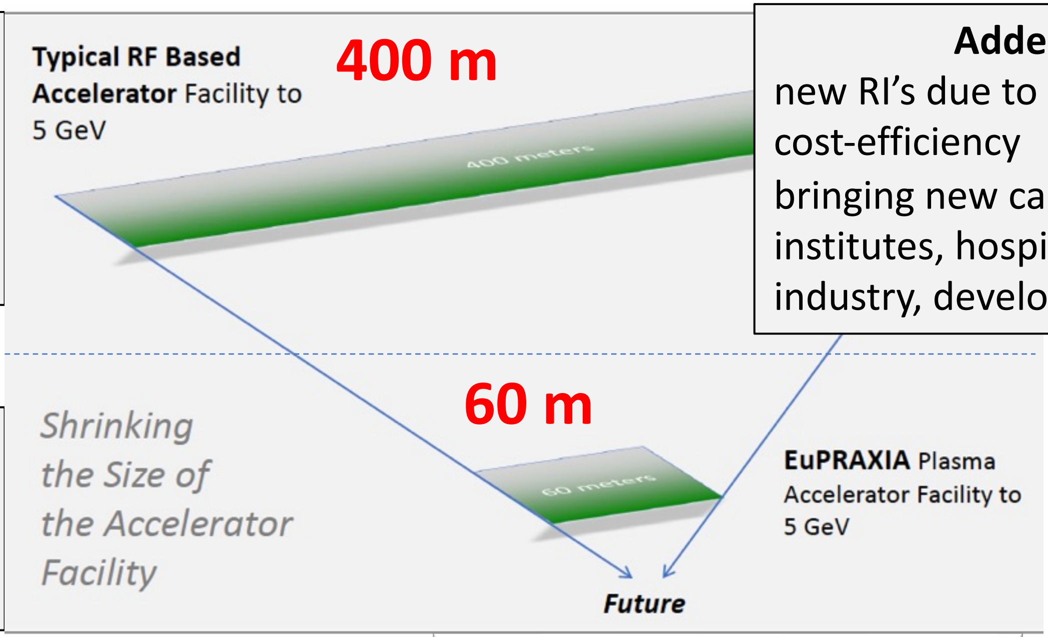
30 million Volt **per meter**

RF: 90 years of success story for society

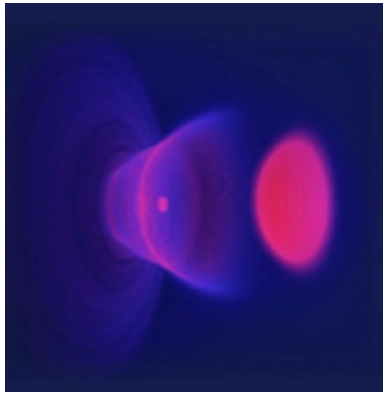
Plasma Accelerators

first user facility to be realized

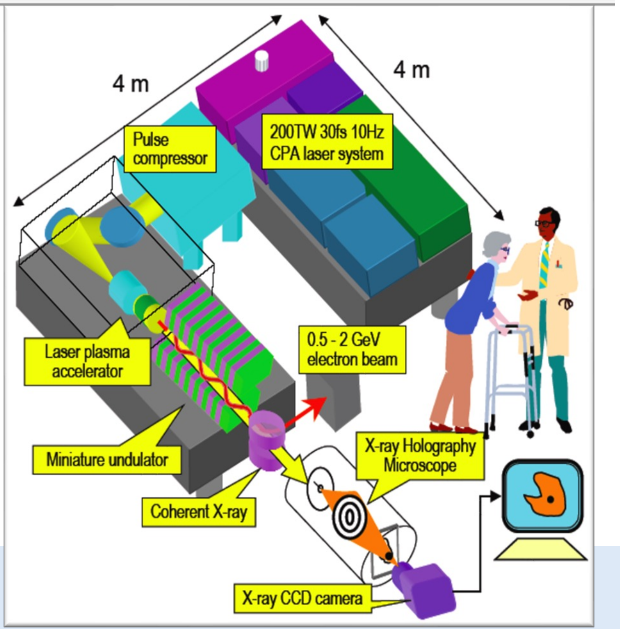
100,000 million Volt **per meter**



Added value
new RI's due to compactness and cost-efficiency
bringing new capabilities to institutes, hospitals, universities, industry, developing countries.



"Think about the quite realistic possibility of having the machine in the same physical area where medical faculties and hospitals are operating."
Prof. S. Morante, Tor Vergata University
Future user of EuPRAXIA

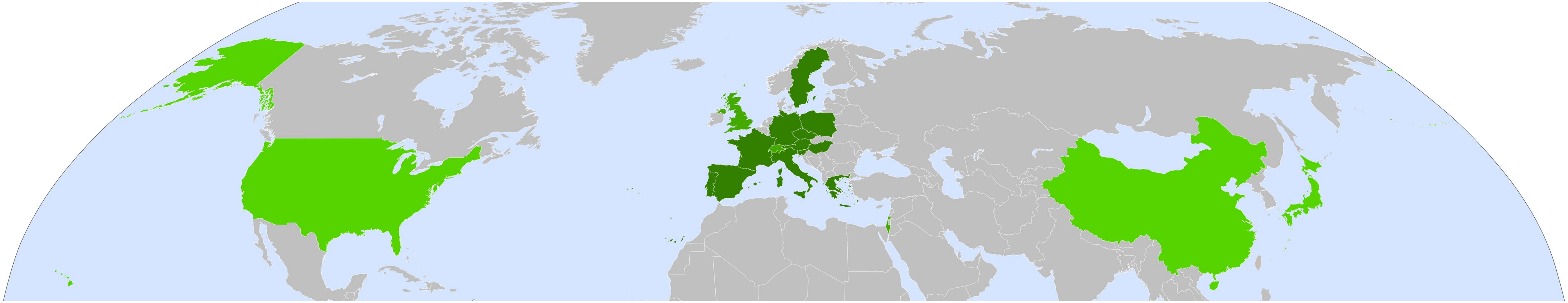


8 m x 4 m
Hospitals
(as industrial product)

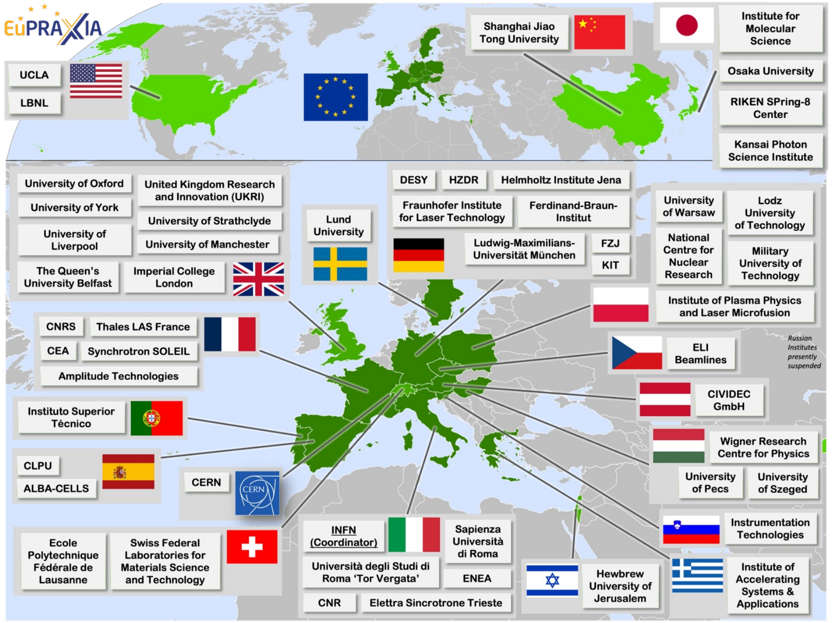
T. Tajima 2010

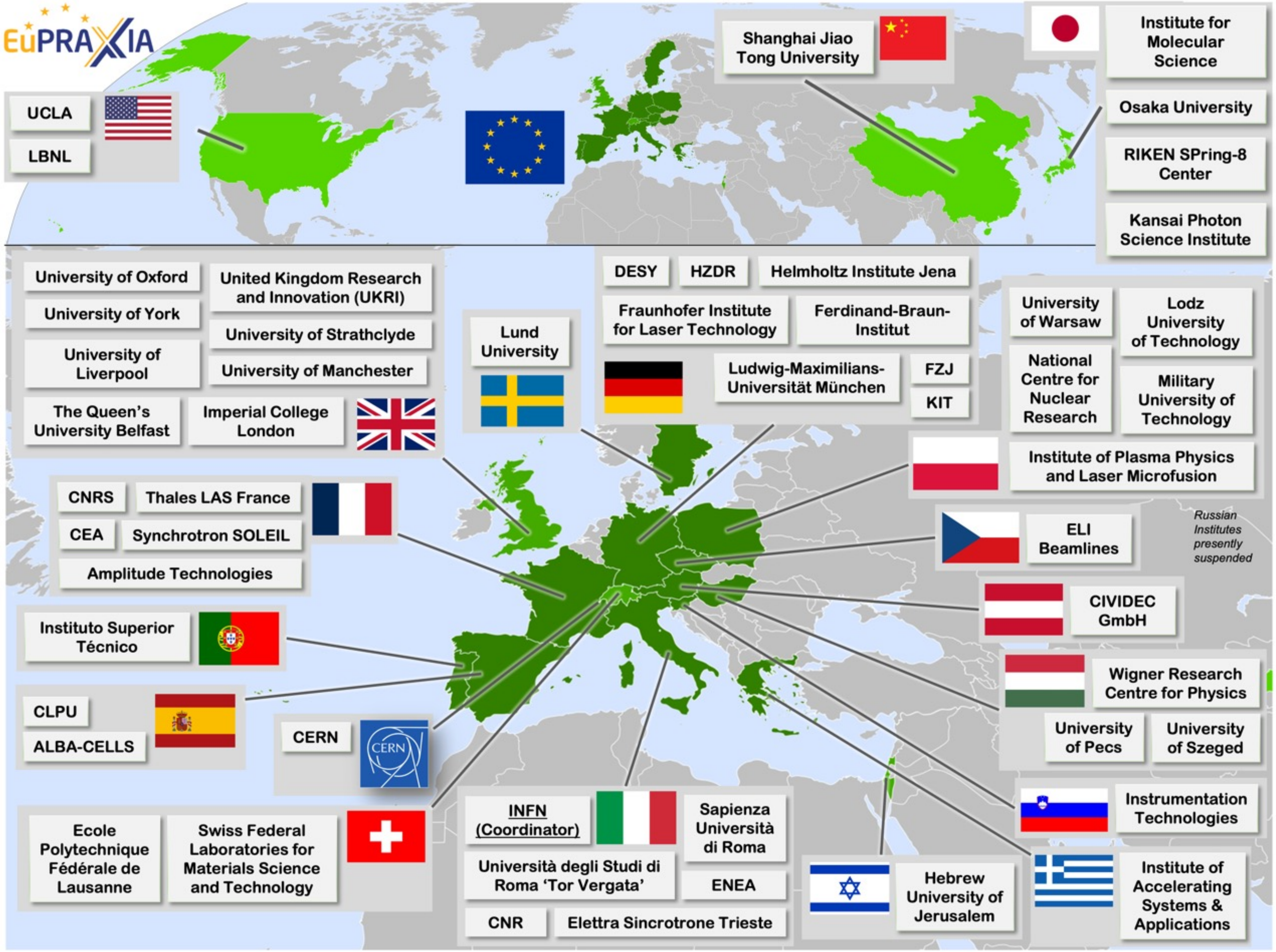
The EuPRAXIA Consortium Today

Funded by the European Union



- **54 institutes** *(in addition 3 waiting to join: Düsseldorf, Nice, PSI)*
- from **18 countries** plus CERN
- signed on one or several presently **active EuPRAXIA consortia**:
  - **ESFRI** consortium (funding in-kind)
  - **Preparatory Phase** consortium (funding EU, UK, Switzerland, in-kind)
  - **Doctoral Network** (funding EU, UK, in-kind)

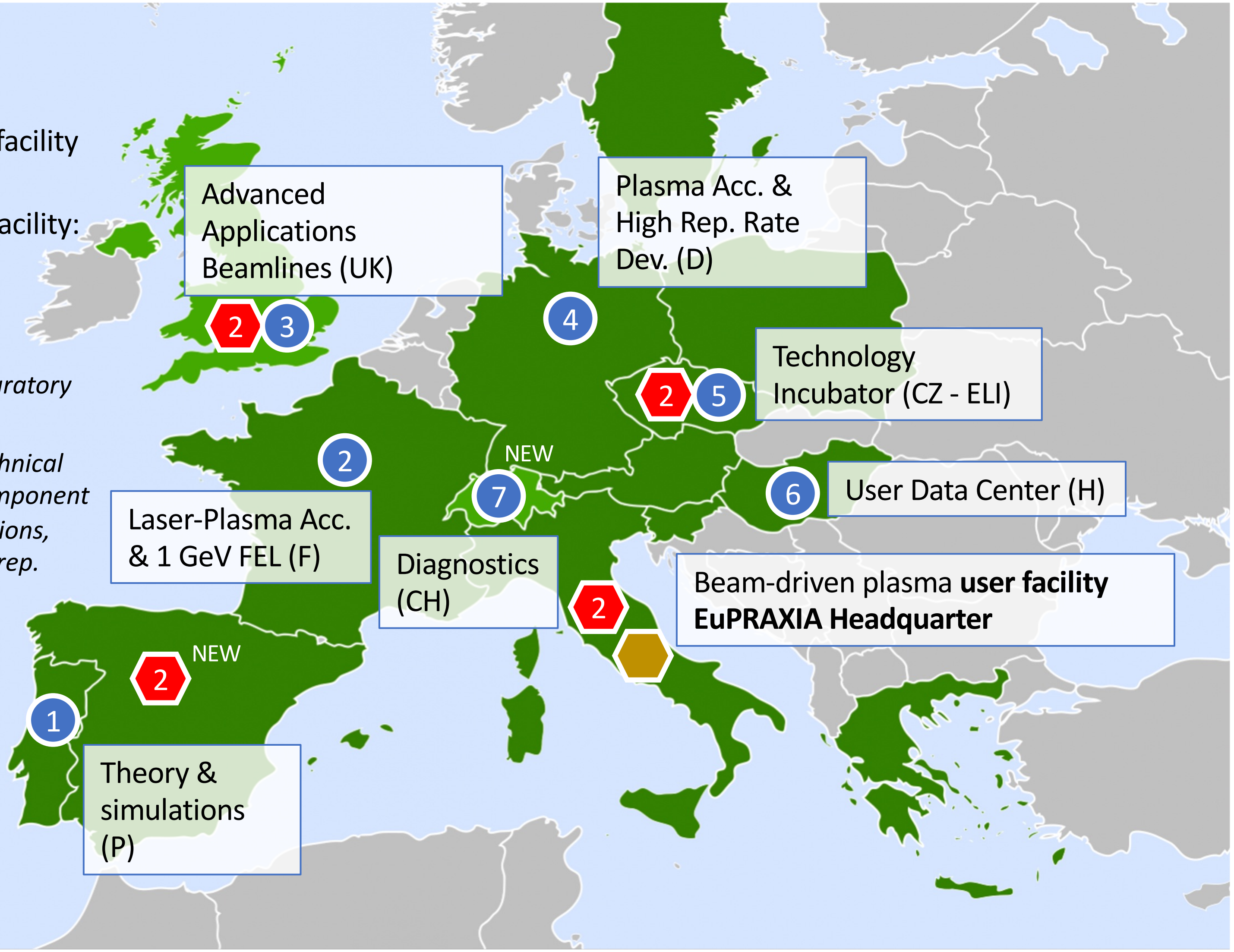




Funded by the European Union

EuPRAXIA Distributed Research Infrastructure *(Status June 23)*

Funded by the European Union



Second site will be decided in Preparatory Phase project.

Excellence centers (EC) perform technical developments, prototyping and component construction. Number of EC's, locations, roles, responsibilities reviewed in Prep. Phase.

Horizon Europe

Today`s status

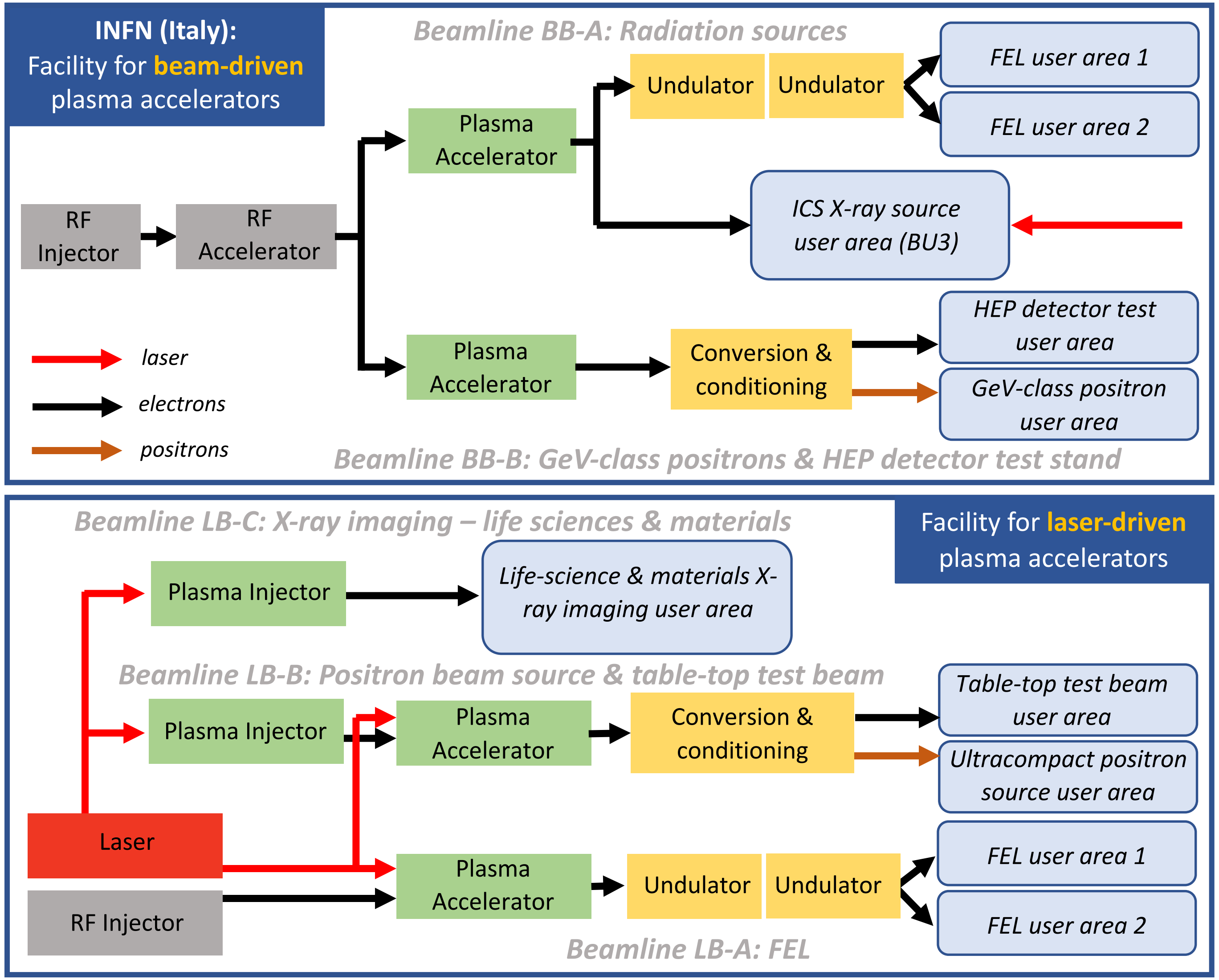
Excellence centers: **several** (6 – 10) assumed to be realized

Second site: **one** to be selected

Connect with WP´s to Horizon Europe and national funding lines

Phased Implementation of Construction Sites

	Laser-driven	Beam-driven
Phase 1	✓ FEL beamline to 1 GeV + user area 1 ✓ Ultracompact positron source beamline + positron user area	✓ FEL beamline to 1 GeV + user area 1 ✓ GeV-class positrons beamline + positron user area
Phase 2	✓ X-ray imaging beamline + user area ✓ Table-top test beams user area ✓ FEL user area 2 ✓ FEL to 5 GeV	✓ ICS source beamline + user area ✓ HEP detector tests user area ✓ FEL user area 2 ✓ FEL to 5 GeV
Phase 3	✓ High-field physics beamline / user area ✓ Other future developments	✓ Medical imaging beamline / user area ✓ Other future developments



EuPRAXIA Implementation Advancing along Several Projects and Agreements

Funded by the European Union

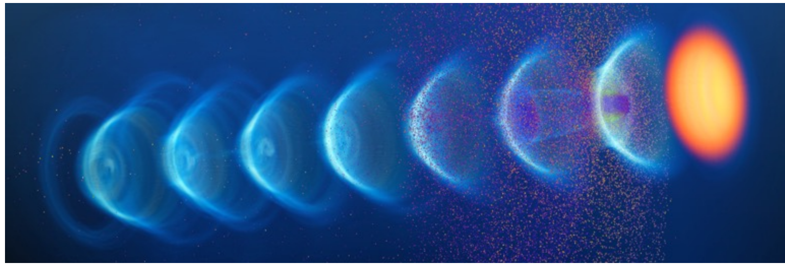
1. **EuPRAXIA@SPARClab** project (Site 1)
   - Includes several bilateral agreements with EuPRAXIA partners – bilateral agreements used to ensure reliable contributions
2. **ESFRI consortium** (funding in-kind)
   - Prepares a European user facility according to ESFRI standards: defines also EuPRAXIA@SPARClab access and user services
   - ESFRI status very important for access to funding (see below)
3. **EU Preparatory Phase** consortium and work contract (funding EU, UK, Switzerland, in-kind)
4. **EU Doctoral Network** (funding EU, UK, in-kind)
5. **PNRR project**, as obtained with ESFRI status as pre-condition
   - Preparatory betatron X ray user facility at SPAClab
6. **PALLAS** contribution from CNRS (defined as EuPRAXIA contribution)

EuPRAXIA-PP (Preparatory Phase) Key Facts

Funded by the European Union

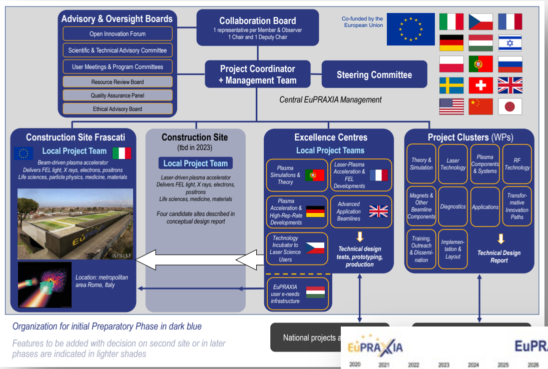
Prepares the implementation of the full RI in Europe

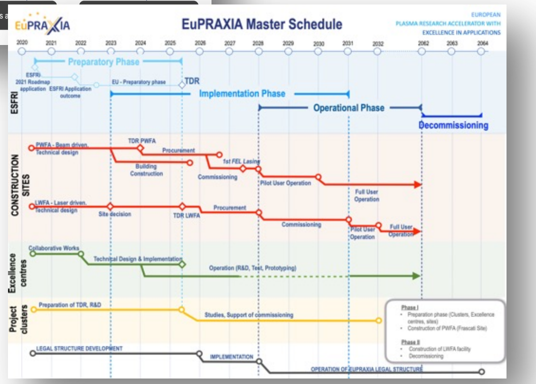
- Total project volume (including in-kind): **8.3 M€**
  - EU funding: **2.49 M€** (EU without in-kind)
  - Outside EU **0.69 M€** (Switzerland)
    0.51 M€ (UK)
- Work organized in 16 Work Packages
- Project dates: **1 Nov 2022 – 31 Oct 2026**
- Coordinator and location of headquarters: **INFN**
- **34** participating organizations from 12 countries
- Will establish a “Board of Financial Sponsors“ with representatives of funding agencies.
- So far **~ 30%** of total M&P funding (**569 M€**) secured. Site 1 is essentially financed.

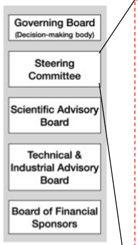


Preparatory Phase Main Goals

- Managerial WP`s
  - **Outreach** to public, users, EU decision makers and industry
  - **Define** legal model (how is EuPRAXIA governed?), financial model, rules, user services and membership extension for full implementation
  - Works with **project bodies and funding agencies** → Board of Financial Sponsors
- Technical WP‘s (correspond to Project Clusters):
  - **Update of CDR** concepts and parameters, towards technical design (full technical design requires more funding)
  - Specify in detail **Excellence Centers and their required funding**: TDR related R&D, prototyping, contributions to construction
  - Help in defining funding applications for various agencies
- Output defined in **milestones & deliverables** with dates







WP1 - Coordination & Project Management
R. Assmann, INFN & DESY
M. Ferrario, INFN

WP2 - Dissemination and Public Relations
C. Welsch, U Liverpool
S. Bertellii, INFN

WP3 - Organization and Rules
A. Specka, CNRS
A. Ghigo, INFN

WP4 - Financial & Legal Model. Economic Impact
A. Falone, INFN

WP5 - User Strategy and Services
F. Stellato, U Tor Vergata
E. Principi, ELETTRA

WP6 - Membership Extension Strategy
B. Cros, CNRS
A. Mostacci, U Sapienza

WP7 - E-Needs and Data Policy
R. Fonseca, IST
S. Pioli, INFN

WP8 - Theory & Simulation
J. Vieria, IST
H. Vincenti, CEA

WP9 - RF, Magnets & Beamline Components
S. Antipov, DESY
F. Nguyen, ENEA

WP10 - Plasma Components & Systems
K. Cassou, CNRS
J. Osterhoff, DESY

WP11 - Applications
G. Sarri, U Belfast
E. Chiadroni,U Sapienza

WP12 - Laser Technology, Liaison to Industry
L. Gizzi, CNR
P. Crump, FBH

WP13 - Diagnostics
A. Cianchi, U Tor Vergata
R. Ischebeck, EPFL

WP14 - Transformative Innovation Paths
B. Hidding, U Strathclyde
S. Karsch, LMU

WP15 - TDR EuPRAXIA @SPARC-lab
C. Vaccarezza, INFN
R. Pompili, INFN

WP16 - TDR EuPRAXIA Site 2
A. Molodozhentsev, ELI-Beamlines
R. Pattahil, STFC

CERN Courier → Raises a Lot of Interest

Funded by the European Union

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FIELD NOTES

who was one of the leaders of the Belle collaboration, looked back at the situation in the early 1980s when B-meson mixing was first observed, and emphasised the role of the accelerator physicists who achieved the 100-fold increase in luminosity that was necessary to measure CP angles. Adrian Bevan (Queen Mary University of London) added a perspective from the BaBar experiment, while the more recent impressive development by the LHCb experiment was summarised by Patrick Koppenburg (Nikhef).

Mixing *Participants of the KM50 event in Tsukuba.*

Theoretical developments remain an integral part of quark-flavour physics. Matthias Neubert (University of Mainz) gave an overview of the theoretical tools developed to understand B-meson decays, which include heavy-quark symmetry, heavy-quark effective field theory, heavy-quark expansion and QCD factorisation, and Zoltan Ligeti (LBNL) summarised concurrent developments of theory and experiment to determine the sides of the CKM triangle. Lattice QCD also played a central role in the determination of the CKM matrix elements by providing precision computation of non-perturbative parameters, as discussed by Aida El-Khadra (University of Illinois).

The B sector is not the only place where CP violation is observed. Indeed, it was first observed in kaon mixings, and important pieces of information have been obtained since then. A number of theoretical ideas dedicated to the study of kaon CP violation were discussed by Andrzej Buras (Technical University of Munich), and experimental projects were overviewed by Taku Yamanaka (Osaka University).

There are still unsolved mysteries around quark-flavour physics. The most notable is the origin of the fermion generations, which may only be understood by accumulating more data to find any discrepancy with the Standard Model. SuperKEKB/Belle II, the successor of KEKB/Belle, plans to accumulate 50 times more data in the coming decades, while LHCb will continue to improve the precision of measurement in hadronic collisions. Nanae Taniguchi (KEK) reported the current status of SuperKEKB/Belle II, which has been in physics operation since 2019 and has already broken peak-luminosity records in e^+e^- collisions. Gino Isidori (University of Zurich) gave his view on the possible shape of physics to come. "There are valuable lessons from the KM paper, which are still valuable today, when applied to the search beyond the Standard Model," he concluded.

As a closing remark, Makoto Kobayashi reminisced about the time when he built the theory as well as the time when the KEKB/Belle experiment was running. "I was able to watch the development of the B factory so closely from the very beginning," he said. "I am grateful to the colleagues who gave me such a great opportunity."

Shoji Hashimoto KEK.

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FEATURE EuPRAXIA

Surf's up *Simulation of electron-driven plasma wakefield acceleration, showing the drive electron beam (orange/purple), the plasma electron wake (grey) and wakefield-ionised electrons forming a witness beam (orange).*

EUROPE TARGETS A USER FACILITY FOR PLASMA ACCELERATION

Ralph Assmann, Massimo Ferrario and Carsten Welsch describe the status of the ESFRI project EuPRAXIA, which aims to develop the first dedicated research infrastructure based on novel plasma-acceleration concepts.

Energetic beams of particles are used to explore the fundamental forces of nature, produce known and unknown particles such as the Higgs boson at the LHC, and generate new forms of matter, for example at the future FAIR facility. Photon science also relies on particle beams: electron beams that emit pulses of intense synchrotron light, including soft and hard X-rays, in either circular or linear machines. Such light sources enable time-resolved measurements of biological, chemical and physical structures on the molecular down to the atomic scale, allowing a diverse global community of users to investigate systems ranging from viruses and bacteria to materials science, planetary science, environmental science, nanotechnology and archaeology. Last but not least, particle beams for industry and health support many societal applications ranging from the X-ray inspection of cargo containers to food sterilisation, and from chip manufacturing to cancer therapy.

This scientific success story has been made possible through a continuous cycle of innovation in the physics and technology of particle accelerators, driven for many decades by exploratory research in nuclear and particle physics. The invention of radio-frequency (RF) technology in the 1920s opened the path to an energy gain of several tens of MeV per metre. Very-high-energy accelerators were constructed with RF technology, entering the GeV and finally the TeV energy scales at the Tevatron and the LHC. New collision schemes were developed, for example the mini "beta squeeze" in the 1970s, advancing luminosity and collision rates by orders of magnitudes. The invention of stochastic cooling at CERN enabled the discovery of the W and Z bosons 40 years ago.

However, intrinsic technological and conceptual limits mean that the size and cost of RF-based particle accelerators are increasing as researchers seek higher beam energies. Colliders for particle physics have reached a

THE AUTHORS
Ralph Assmann DESY and INFN, Massimo Ferrario INFN, Carsten Welsch University of Liverpool/INFN.

CERN COURIER MAY/JUNE 2023 25

IPAC23 Talk, EuPRAXIA Leaflet

Funded by the European Union

INFN Interview of Massimo, … (more in the pipeline)

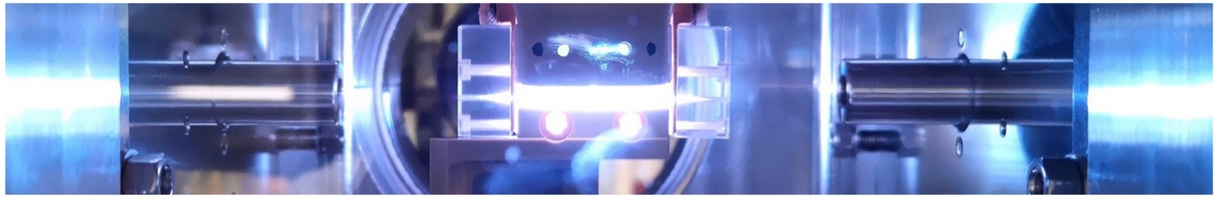
Funded by the European Union

NEWSLETTER 105

Italian National Institute for Nuclear Physics

MAY 2023

Istituto Nazionale di Fisica Nucleare



PEOPLE MAY 2023

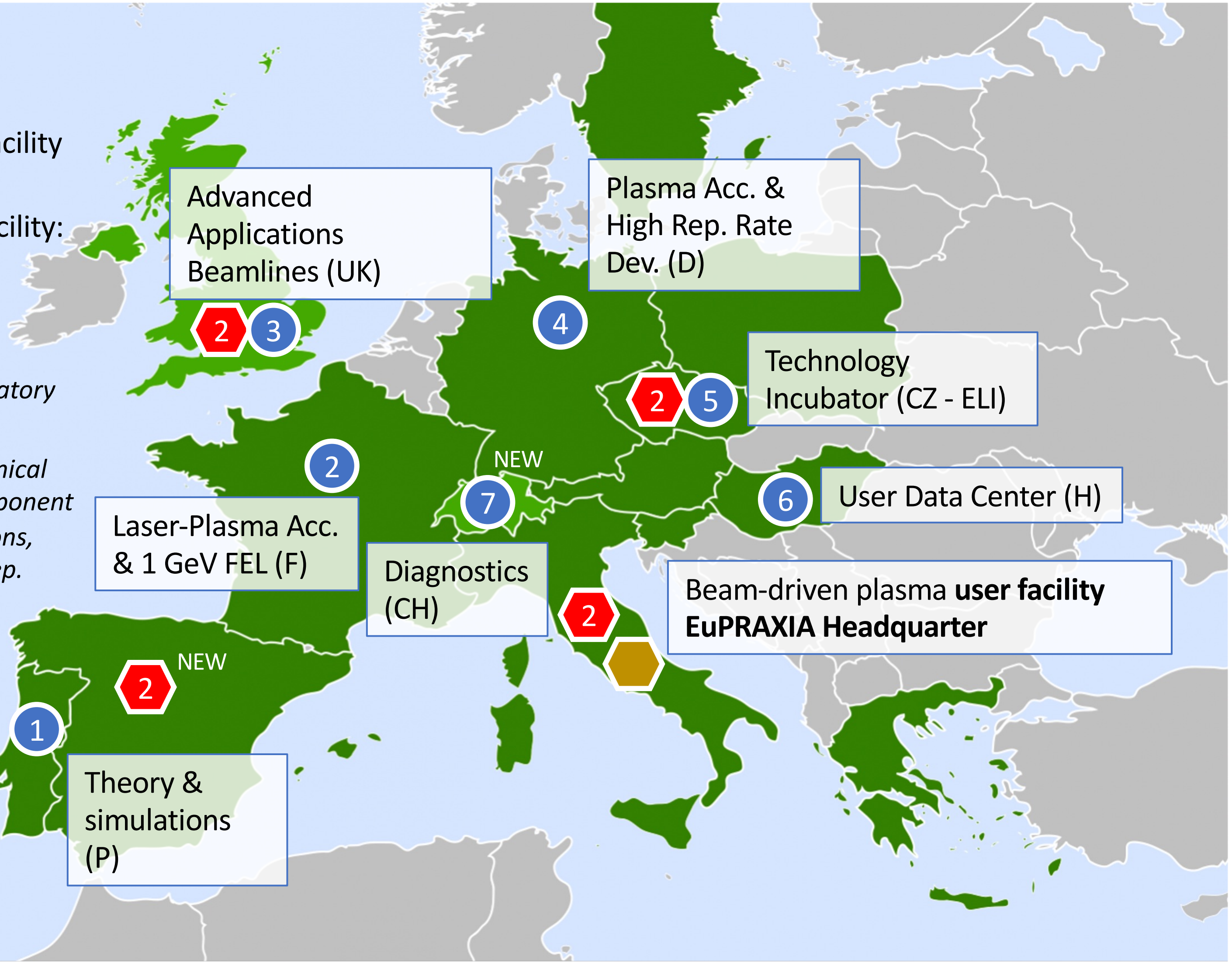
THE FUTURE OF PARTICLE ACCELERATORS ALSO LIES IN PLASMA

Interview with Massimo Ferrario, spokesperson of EuAPS and SPARC_LAB, at Frascati National Laboratories

Among the topics discussed during the annual International Conference on Particle Accelerators (IPAC'23), held last May in Venice Lido, the state of research on plasma accelerators certainly deserves attention: not only for the central role played by Italy, but also for the new and promising scenarios that the advent of this technology seems to shape. A future characterized by the opportunities deriving from easier access to accelerator machines and from an increasingly widespread use of these instruments in different fields. The possibility of realizing a new generation of more compact and cheaper light sources and accelerators, capable of satisfying both the needs of high-energy physics and those of the world of applied research or manufacturing sectors, is in fact the reason for the strong interest in projects that are focusing internationally on the design and development of a plasma particle acceleration technology and its applications. Initiatives like EuPraxia were hence among the themes of IPAC'23 agenda. …

EuPRAXIA Distributed Research Infrastructure *(Status June 23)*

Funded by the European Union



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EuPRAXIA

Horizon Europe

Today`s status

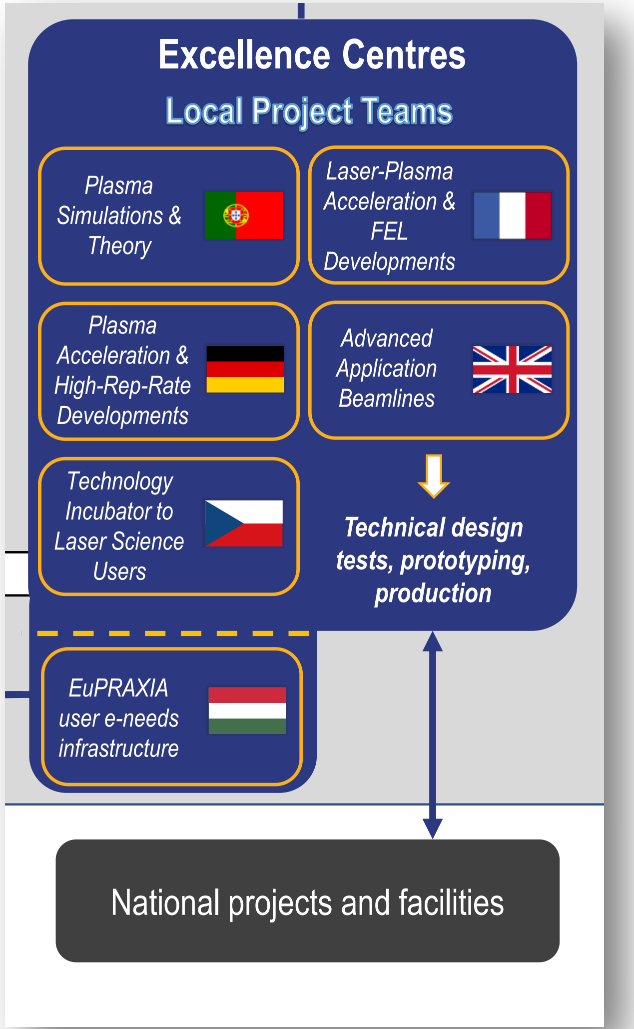
Excellence centers: **several** (6 – 10) assumed to be realized

Second site: **one** to be selected

Connect with WP´s to Horizon Europe and national funding lines

Relevant Questions for Preparatory Phase

- Updates to **CDR concepts – towards a TDR**
- Second **site on LWFA**: Location and definition.
- Excellence centres *(add excellence centre lines to project overview and funding lines)*:
  - Define final number and concepts (single hub, multi hub, connections)
  - Can be cross-WP or single WP → **EuPRAXIA PP workshop last week**
  - Specify R&D, prototyping, testing and possible **deliverables** (baseline or upgrades) to construction sites for each excellence center
  - Determine required budget and discuss implementation possibilities
- **User** services and access models
- **E infrastructure** requirement and integration
- **Legal** and **financial** models. **Open** science and open innovation.
- Rules and **organization**. **Extension** of membership.
- …



EuPRAXIA-PP Workshop, 5 – 7 June

Funded by the European Union

EuPRAXIA-PP and ESFRI Workshop on Excellence Centers and 2nd site (Laser-driven)

5–7 Jun 2023
Rome
Europe/Rome timezone

Enter your search term

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- Participant List
- Meeting Venue
- Travel Information
- Accomodation Information
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Support
eupraxia_pp_excellence...

PLEASE BRING WITH YOU THE HARD COPY OF YOUR TICKET (DOWNLOADABLE FROM YOUR REGISTRATION FORM). THE QR CODE ON IT WILL BE USED FOR THE CHECK IN.

The **EuPRAXIA-PP and ESFRI Workshop on Excellence Centers and 2nd site (Laser-driven)** will be held in Museo Ninfeo, Rome (piazza Vittorio Emanuele II, 78) .

All participants have to register through the website.
NO REGISTRATION FEE is required to attend the meeting.

EuPRAXIA has developed very well and several EU projects plus national activities have started end of last year. In particular we have the EuPRAXIA Preparatory Phase (PP) project, the EuPRAXIA Doctoral Network (DN), the EuPRAXIA Advanced Photon Sources (APS), the EuPRAXIA@SPARC_LAB construction project and the EuPRAXIA ESFRI consortium now all ongoing.

Our signed EuPRAXIA consortia agreements now bring together 54 institutes from 18 countries plus CERN as international organization.

Our Conceptual Design Report (CDR) and the ESFRI application have proposed a distributed implementation with national excellence centers and two construction sites. This was very much liked by the community, consulted governments and ESFRI. Now we need to define in more detail what those are in detail and how much additional resources we would need.

We can and should still adjust and optimize our previous plans: additional excellence centers are possible, we can change topics, we can discuss additional candidates for site 2, we need to define in detail how national excellence centers look like (single institute, multiple centers, distributed) and so on.

https://agenda.infn.it/event/35633/

Alessandro Gallo
Welcome to INFN and Rome

Ralph Assmann
Presentation of excellence center and site approach

Jens Osterhoff
Excellence center Germany

Kevin Cassou
Excellence center France

Rasmus Ischebeck
Excellence center Switzerland

Roman Hvezda
Excellence center Czech Republic

Gianluca Sarri
Excellence center UK

János Hebling et al.
Excellence center Hungary

Massimo Ferrario
Site 1, Short update

Giancarlo Gatti
Site 2, Option CLPU

Alexander Molodozhentsev
Site 2, Option ELI-Beamlines

Rajeev Pattathil
Site 2, Option EPAC

Leonida Antonio Gizzi
Site 2, Option Pisa

Talks and discussions (all in person)

Circulated as written draft:
Excellence center Portugal

Last week: Very good discussions in the museum

Funded by the European Union

2nd Sites: Bids from Czech Rep., Italy, UK, Spain

Funded by the European Union

Budget was Defined in 2019

Funded by the European Union

PRELIMINARY COST ESTIMATE

The full-scale EuPRAXIA project is a strategic investment into accelerator innovation, laser industry, the technical education of young generations, and European collaboration.

EuPRAXIA is, at full scale, a 320 million euro investment into European compact accelerator innovation and scientific applications, including an 83 million euro investment into laser technology. Depending on budget availability, minimal scenarios include options for a 68 million euro beam-driven and a 75 million euro laser-driven accelerator site.

The EuPRAXIA concept relies heavily on existing R&D facilities at major European laboratories. The institutes operating there today will ensure the availability of the required administrative structures and basic infrastructures. EuPRAXIA can therefore be highly cost-effective and focus on innovation and leadership in technology and science. Using existing large laboratories as hosts guarantees the sustainability of the EuPRAXIA centres and site(s) and opens the possibility of co-funding.

Detailed discussions on funding provisions for the full EuPRAXIA project will only take place after the completion of the Conceptual Design Report (CDR) in October 2019. In Section 4, the CDR provides a preliminary cost estimate for the EuPRAXIA research infrastructure, the required technical design and prototyping. Options start at a cost of 68 million euro for a beam-driven and 75 million euro for a laser-driven EuPRAXIA implementation (minimal systems). It is estimated that the full-scale EuPRAXIA facility with two construction sites requires an investment of 320 million euro and about 1,800 FTE person power integrated over a 8–10 year project duration (technical design, prototyping, and construction). The 320 million euro cost includes about 83 million euro that is invested in laser technology with industry and will be leveraged by co-funding from the EuPRAXIA partners. The full-scale EuPRAXIA implementation is a truly European project that realises the competitive advantage, scientific impact, and societal benefits described above.

It is explicitly acknowledged that the development of a EuPRAXIA funding scenario will require detailed discussions with decision makers at the national and EU levels. Only the support and injection of significant funding from the European Commission can enable an open innovation infrastructure project like EuPRAXIA, a project that is focused on capital-intensive high technology and operates across Europe.

The interim funding from the completion of the conceptual design report in October 2019 to the possible start of (not yet defined) Horizon Europe funding for the technical design at the end of 2022 is an issue of critical importance. The shift of the next roadmap exercise of the European Strategy Forum for Research Infrastructures (ESFRI) by one year creates a likely gap in funding that should be urgently addressed. A funding of 4 million euro would be sufficient to keep the EuPRAXIA collaboration active and advance preparatory work on concepts and implementation details. Additional funding at the level of a former 'Joint Research Activity' (JRA, 15 million euro) would allow the start of urgent R&D work and the performance of critical feasibility demonstrations.

SCHEDULE

EuPRAXIA is a project that requires a technical design phase of four to six years and a construction phase of four years.

The definition of the EuPRAXIA project phases and the correspondence with European decision processes (such as the ESFRI roadmap) are discussed in Section 5.1. We note that the international race towards compact particle accelerators with applications and progress in back-bone technologies (e.g. high-power lasers from industry) require a fast decision process. Fast decisions will make it possible to retain the competitive edge. Once funding is available, the EuPRAXIA R&D can start swiftly, based on the work done in the EuPRAXIA conceptual design study and the reliance on existing research infrastructures. It is acknowledged that the EuPRAXIA project is a highly innovative project with a number of risks in technical challenges and project setup. Therefore, a decision process will need to move in a stepwise fashion, from the approval of the technical design phase to a project readiness review and finally the approval for construction.

Proceeding at full speed, we estimate that the EuPRAXIA research infrastructure would start full operation in 8–10 years. Parts of EuPRAXIA could go into operation at significantly earlier times.

Budget was Refined *(According to EU/ESFRI rules and Reviewed by ESFRI)*

Funded by the European Union

ESFRI MoS

ESFRI Monitoring System

Strategy Report on Research Infrastructures

ROADMAP 2021

Proposal Questionnaire Part A: General Information

Submitted on 2020-09-08

PROPOSAL SUBMISSION THROUGH ESFRI MOS+

PROPOSAL COORDINATOR:
Antonio Falone

RI NAME:
European Plasma Research Accelerator with Excellence In Applications

1

EuPRAXIA: Cost/Budget Status June 2023

Funded by the European Union

Cost item	Invest (M€)	Personnel (M€)	Total cost (M€)	Obtained (M€)	Coverage for full implementation (%)	Rest (§) (M€)
Site 1 (*), Frascati	151,0	23,0	174,0	**138,8**	**80%**	35,2
Site 2 (**), tbd	149,0	29,0	178,0	0,0	0%	**178,0**
Termination	1,0	2,0	3,0	0,0	0%	3,0
CDR	0,2	2,8	3,0	3,0	**100%**	0,0
Preparation, incl. PNNR, clusters & excellence centers	137,0	74,0	211,0	34,6	16%	**176,4**
Total	438,2	130,8	**569,0**	176,4	31%	392,6

(*) includes estimate of 240 FTE-y of personpower from LNF-INFN

(**) cost will be reduced in case of relevant pre-invests (exisiting infrastructure, equipment)

(§) for full implementation, phased EuRAXIA approach allows user operation without full funding

Request from committee: Clarify financial contributions of EuPRAXIA to the project

- EuPRAXIA@SPARClab shall operate as a European Research Infrastructure and user facility: **serving its users, according to ESFRI standards**.
- **EuPRAXIA-PP**: Various work outcomes directly relevant for EuPRAXIA@SPARClab, so complementing TDR work on other required issues (financed by EU):
  - User services and access models
  - E infrastructure requirement and integration
  - Legal and financial models.
  - Open science and open innovation.
- **EuPRAXIA-DN**: PhD positions also on EuPRAXIA@SPARClab funded in- and outside of LNF.
- **EuPRAXIA ESFRI status** opens access to various funding pots for EuPRAXIA@SPARClab:
  - PNRR project EuPRAXIA Advanced Photon Sources: 22 M€. ESFRI project status a pre-condition.
- Work ongoing: define in more detail possible major external contributions (services, hardware components, not financial), start lobbying on obtaining them

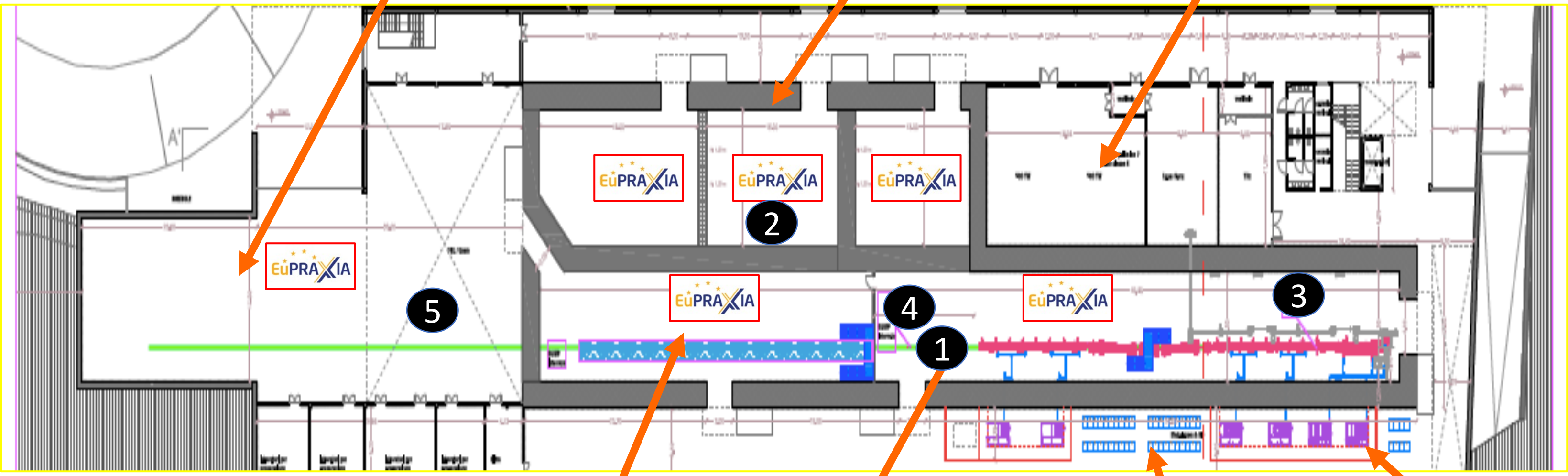
Ongoing in EuPRAXIA-PP

(1) Preparing coherent project proposal for
176.4 M€ EuPRAXIA distributed TDR/excellence center/WP work
(who, what, when)

(2) Four project **proposals for second site with each maximum cost of 178 M€**
(existing infrastructure can reduce cost)

→ *Then ask for this money at EU/ESFRI/national governments (lobby) and iterate on concept with feedback from decision makers*

Opportunities for Collaboration (Site 1)



Need the same for LWFA site

European interests & possible contributions to Frascati site:

1. Plasma structure designs, devices
2. Compact positron source
3. HQ 150 MeV laser plasma injector
4. HQ laser driver
- Hybrid concepts
- Simulations
5. User experiments and lines

To be detailed in TDR phase.

Conclusion

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- EuPRAXIA advancing well with **several EU funded projects** and the EuPRAXIA@SPARClab project in full steam
- High interest and **support from our communities** – also conventional RF accelerator specialists believe in it more and more
- EuPRAXIA consortia are growing, new and strong partners, new second site candidate, doctoral network providing **EU fellows** for EuPRAXIA, …
- **Preparatory phase** started:
  - defining crucial **user facility** aspects at **ESFRI standards** → EuPRAXIA@SPARClab
  - working on **obtaining additional funding** for clusters (European TDR work) and excellence centers (European contributions of services or hardware to construction sites) → would further support EuPRAXIA@SPARClab efforts
- We came a long way, still some hills to conquer but steadily climbing

Thank You

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European Union

Reserve Slides

Reference Documents EuPRAXIA-PP

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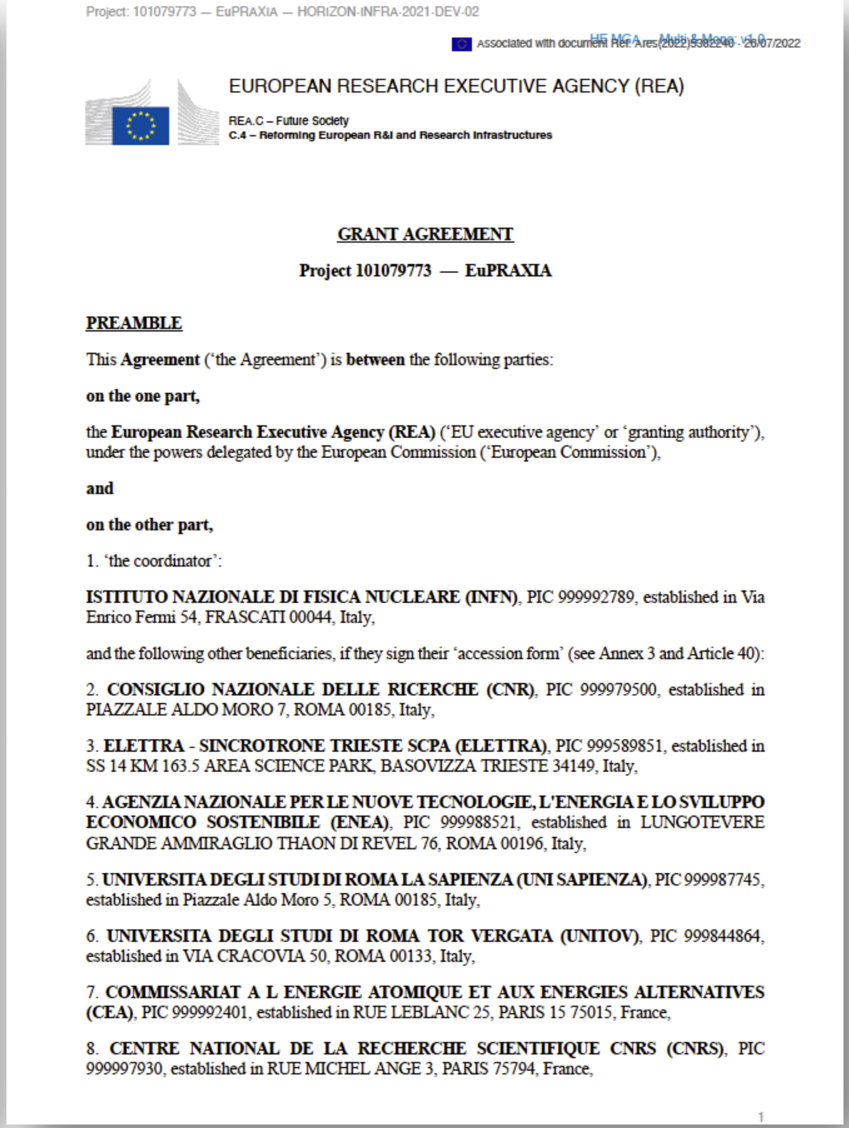

Project: 101079773 — EuPRAXIA — HORIZON-INFRA-2021-DEV-02

Associated with document Ref. Ares(2022)5382240 - 26/07/2022

EUROPEAN RESEARCH EXECUTIVE AGENCY (REA)

REA.C – Future Society
C.4 – Reforming European R&I and Research Infrastructures

GRANT AGREEMENT

Project 101079773 — EuPRAXIA

PREAMBLE

This **Agreement** ('the Agreement') is **between** the following parties:

on the one part,

the **European Research Executive Agency (REA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and

on the other part,

1. 'the coordinator':

ISTITUTO NAZIONALE DI FISICA NUCLEARE (INFN), PIC 999992789, established in Via Enrico Fermi 54, FRASCATI 00044, Italy,

and the following other beneficiaries, if they sign their 'accession form' (see Annex 3 and Article 40):

2. **CONSIGLIO NAZIONALE DELLE RICERCHE (CNR)**, PIC 999979500, established in PIAZZALE ALDO MORO 7, ROMA 00185, Italy,

3. **ELETTRA - SINCROTRONE TRIESTE SCPA (ELETTRA)**, PIC 999589851, established in SS 14 KM 163.5 AREA SCIENCE PARK, BASOVIZZA TRIESTE 34149, Italy,

4. **AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE, L'ENERGIA E LO SVILUPPO ECONOMICO SOSTENIBILE (ENEA)**, PIC 999988521, established in LUNGOTEVERE GRANDE AMMIRAGLIO THAON DI REVEL 76, ROMA 00196, Italy,

5. **UNIVERSITA DEGLI STUDI DI ROMA LA SAPIENZA (UNI SAPIENZA)**, PIC 999987745, established in Piazzale Aldo Moro 5, ROMA 00185, Italy,

6. **UNIVERSITA DEGLI STUDI DI ROMA TOR VERGATA (UNITOV)**, PIC 999844864, established in VIA CRACOVIA 50, ROMA 00133, Italy,

7. **COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES (CEA)**, PIC 999992401, established in RUE LEBLANC 25, PARIS 15 75015, France,

8. **CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS (CNRS)**, PIC 999997930, established in RUE MICHEL ANGE 3, PARIS 75794, France,

1

EuPRAXIA Consortium Agreement, final version date 15.11.2022

Consortium Agreement

HORIZON EUROPE GRANT AGREEMENT N. 101079773

Final Version – Date 15/11/2022

Based on DESCA – Model Consortium Agreement for Horizon Europe

AP Version 1

July 2022

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DESCA AP Version 1

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Reference Documents EuPRAXIA-ESFRI

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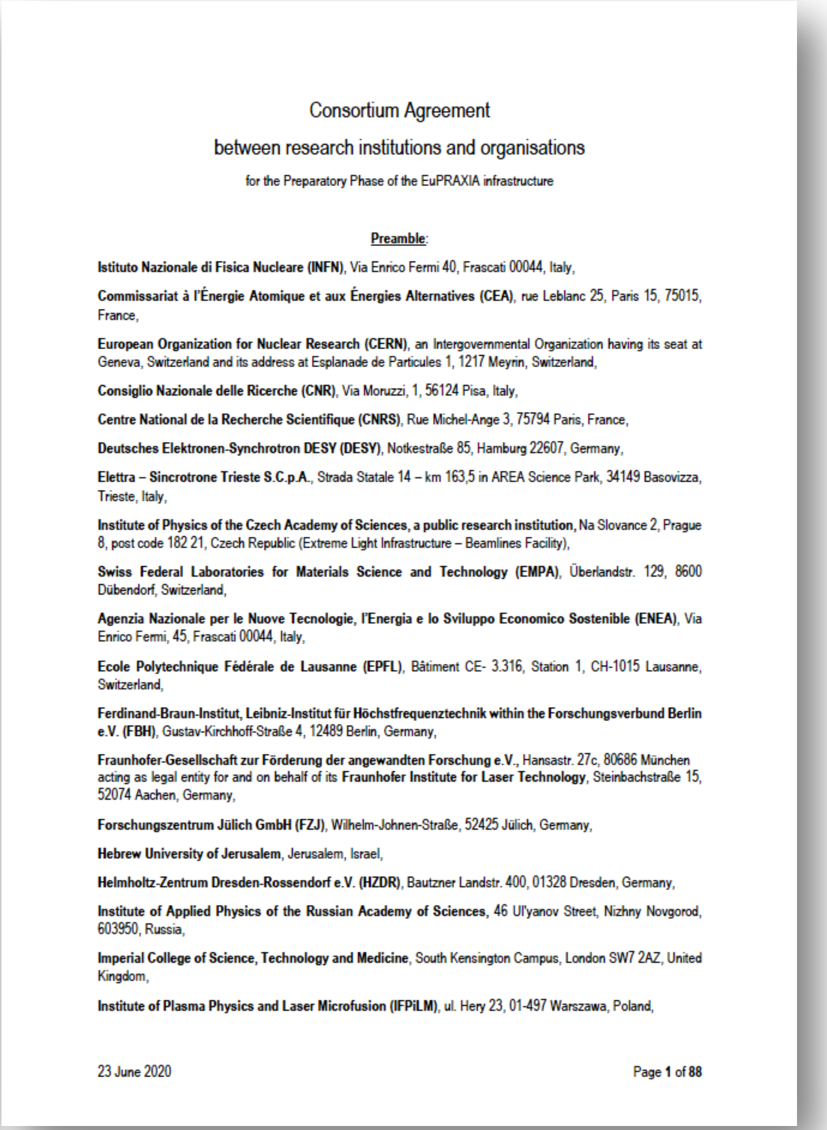

Consortium Agreement

between research institutions and organisations

for the Preparatory Phase of the EuPRAXIA infrastructure

Preamble:

Istituto Nazionale di Fisica Nucleare (INFN), Via Enrico Fermi 40, Frascati 00044, Italy,

Commissariat à l'Énergie Atomique et aux Énergies Alternatives (CEA), rue Leblanc 25, Paris 15, 75015, France,

European Organization for Nuclear Research (CERN), an Intergovernmental Organization having its seat at Geneva, Switzerland and its address at Esplanade de Particules 1, 1217 Meyrin, Switzerland,

Consiglio Nazionale delle Ricerche (CNR), Via Moruzzi, 1, 56124 Pisa, Italy,

Centre National de la Recherche Scientifique (CNRS), Rue Michel-Ange 3, 75794 Paris, France,

Deutsches Elektronen-Synchrotron DESY (DESY), Notkestraße 85, Hamburg 22607, Germany,

Elettra – Sincrotrone Trieste S.C.p.A., Strada Statale 14 – km 163,5 in AREA Science Park, 34149 Basovizza, Trieste, Italy,

Institute of Physics of the Czech Academy of Sciences, a public research institution, Na Slovance 2, Prague 8, post code 182 21, Czech Republic (Extreme Light Infrastructure – Beamlines Facility),

Swiss Federal Laboratories for Materials Science and Technology (EMPA), Überlandstr. 129, 8600 Dübendorf, Switzerland,

Agenzia Nazionale per le Nuove Tecnologie, l'Energia e lo Sviluppo Economico Sostenible (ENEA), Via Enrico Fermi, 45, Frascati 00044, Italy,

Ecole Polytechnique Fédérale de Lausanne (EPFL), Bâtiment CE- 3.316, Station 1, CH-1015 Lausanne, Switzerland,

Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik within the Forschungsverbund Berlin e.V. (FBH), Gustav-Kirchhoff-Straße 4, 12489 Berlin, Germany,

Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V., Hansastr. 27c, 80686 München acting as legal entity for and on behalf of its **Fraunhofer Institute for Laser Technology**, Steinbachstraße 15, 52074 Aachen, Germany,

Forschungszentrum Jülich GmbH (FZJ), Wilhelm-Johnen-Straße, 52425 Jülich, Germany,

Hebrew University of Jerusalem, Jerusalem, Israel,

Helmholtz-Zentrum Dresden-Rossendorf e.V. (HZDR), Bautzner Landstr. 400, 01328 Dresden, Germany,

Institute of Applied Physics of the Russian Academy of Sciences, 46 Ul'yanov Street, Nizhny Novgorod, 603950, Russia,

Imperial College of Science, Technology and Medicine, South Kensington Campus, London SW7 2AZ, United Kingdom,

Institute of Plasma Physics and Laser Microfusion (IFPiLM), ul. Hery 23, 01-497 Warszawa, Poland,

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PP Steering Committee: Leaders Behind EuPRAXIA

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WP1 - Coordination & Project Management
R. Assmann, INFN & DESY
M. Ferrario, INFN

WP2 - Dissemination and Public Relations
C. Welsch, U Liverpool
S. Bertellii, INFN

WP3 - Organization and Rules
A. Specka, CNRS
A. Ghigo, INFN

WP4 - Financial & Legal Model. Economic Impact
A. Falone, INFN

WP5 - User Strategy and Services
F. Stellato, U Tor Vergata
E. Principi, ELETTRA

WP6 - Membership Extension Strategy
B. Cros, CNRS
A. Mostacci, U Sapienza

WP's on coordination & implementation as ESFRI RI (organization, legal model, financing, users)

WP7 - E-Needs and Data Policy
R. Fonseca, IST
S. Pioli, INFN

WP8 - Theory & Simulation
J. Vieria, IST
H. Vincenti, CEA

WP9 - RF, Magnets & Beamline Components
S. Antipov, DESY
F. Nguyen, ENEA

WP10 - Plasma Components & Systems
K. Cassou, CNRS
J. Osterhoff, DESY

WP11 - Applications
G. Sarri, U Belfast
E. Chiadroni,U Sapienza

WP12 - Laser Technology, Liaison to Industry
L. Gizzi, CNR
P. Crump, FBH

WP13 - Diagnostics
A. Cianchi, U Tor Vergata
R. Ischebeck, EPFL

WP14 - Transformative Innovation Paths
B. Hidding, U Strathclyde
S. Karsch, LMU

WP15 - TDR EuPRAXIA @SPARC-lab
C. Vaccarezza, INFN
R. Pompili, INFN

WP16 - TDR EuPRAXIA Site 2
A. Molodozhentsev, ELI-Beamlines
R. Pattahil, STFC

WPs on technical implementation and sites

Deliverables & Milestones WP1

Deliverable No	Deliverable Name	Work Package No	Lead Beneficiary	Type	Dissemination Level	Due Date (month)
D1.1	Data Management Plan (WP1)	WP1	1 - INFN	R — Document, report	PU - Public	6
D1.2	Description of updated implementation scheme after site decision	WP1	1 - INFN	R — Document, report	PU - Public	24
D1.3	EuPRAXIA-RI Implementation Plan	WP1	1 - INFN	R — Document, report	PU - Public	48

Milestone No	Milestone Name	Work Package No	Lead Beneficiary	Means of Verification	Due Date (month)
1	Kick off Meeting	WP1	1-INFN	Meeting website	1
2	Formation of project boards	WP1	1-INFN	Report	6
3	Decision on ranking of legal models for RI	WP1	1-INFN	Report	24
4	Agreement on legal and financial packages	WP1	1-INFN	Report	48

EuPRAXIA

Selection Criteria 2nd EuPRAXIA Site

(from CDR, fulfilled by 1st Site LNF/INFN)

Reviewed and finalized by WP3

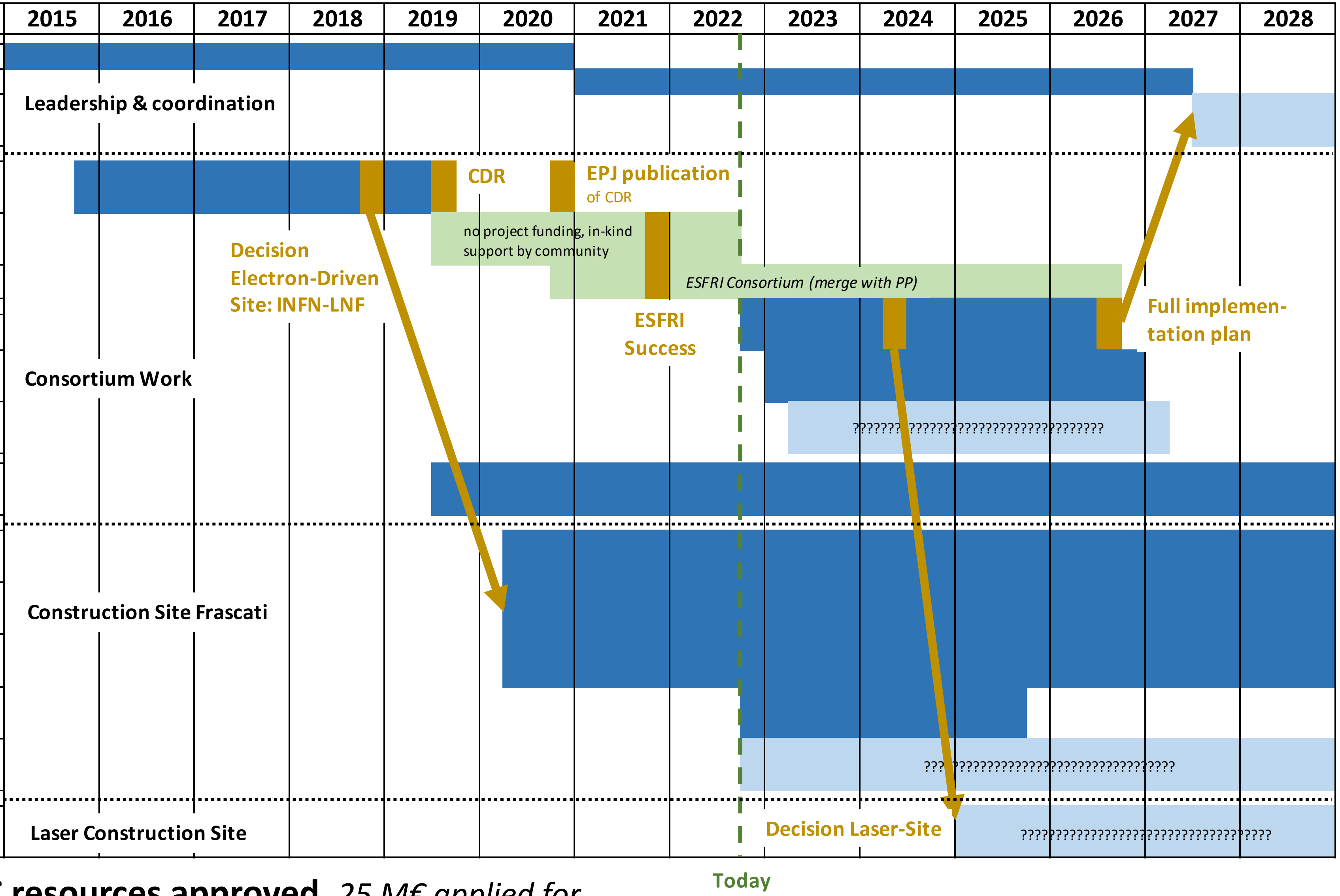
Legal/Political	Technical	Financial
Compliance of host institution with **EuPRAXIA Access** Policy	Site provides sufficient **space** (about 175 m x 35 m)	Commitment to **sustainability** of EuPRAXIA (host lab covers site operation costs)
Compliance of host institution with **EuPRAXIA Open Innovation** and **Open Science** Policy	Laboratory has **infrastructures** in one or several of RF accelerators, laser installations, user access.	**Previous investments** into local infrastructures of relevance for EuPRAXIA (leverage effect)
Agreement of host institution with the **long-term scientific agenda** of EuPRAXIA	Site provides required **services** and facilities for support of external users, including E infrastructure	Existence of one or a mix of **funding sources** able to finance implementation of the site
Laboratory has existing groups in place to guarantee **safety** requirements (laser, radio-protection, access control) and rules		

Note: approach reduces cost (pre-invest) and risks of cost-overun.

EuPRAXIA Project Overview & Funding Lines

Funded by the European Union

Activity	Resources	Origin
Headquarter Hamburg/DESY	0 €	In-kind DESY
Headquarter Frascati INFN-LNF	0 €	In-kind INFN and DESY
*EuPRAXIA **Legal Structure of European RI***		*Defined in Preparatory Phase*
Conceptual Design Project	6.000.000 €	EU + in-kind (included here)
Application ESFRI Roadmap, Funding applications	0 €	In-kind DESY, INFN and EuPRAXIA consortium
ESFRI Consortium		
Preparatory Phase Project	8.310.000 €	EU, UK,Switzerland + in-kind (included here)
EuPRAXIA Doctoral Network	2.600.000 €	EU
CREATE (includes EuPRAXIA R&D) - proposed - reserve list	*15.000.000 €*	EU INFRATECH
CNRS project PALLAS (letter J.L. Biarrotte 30.3.2021)	1.670.000 €	CNRS France
EuPRAXIA **Construction in Frascati LNF-INFN** (EuPRAXIA@SPARClab)	108.000.000 €	Italian government invest (plus personnel)
Local EuPRAXIA support projects	7.000.000 €	Regional Lazio funding
Confinancing Regional Funds, preparation building project	7.000.000 €	INFN direct funds
EuPRAXIA Advanced Photon Source (EuAPS)	22.000.000 €	PNRR (EU/Italian recovery funding)
EuPRAXIA beamline support - in discussion	*10.000.000 €*	Regional Lazio funding
Site 2 (laser site) implementation		Defined in Preparatory Phase
Total (available)	162.580.000 €	
Total (applied)	25.000.000 €	



162.6 M€ resources approved, *25 M€ applied for*