EUROPEAN
PLASMA RESEARCH
ACCELERATOR WITH
EXCELLENCE IN
APPLICATIONS

EuPRAXIA

Status of EuPRAXIA (ESFRI & PP)

P. Campana (INFN-LNF)

EuPRAXIA@SPARC_LAB Review Committee, June 26-28, 2024

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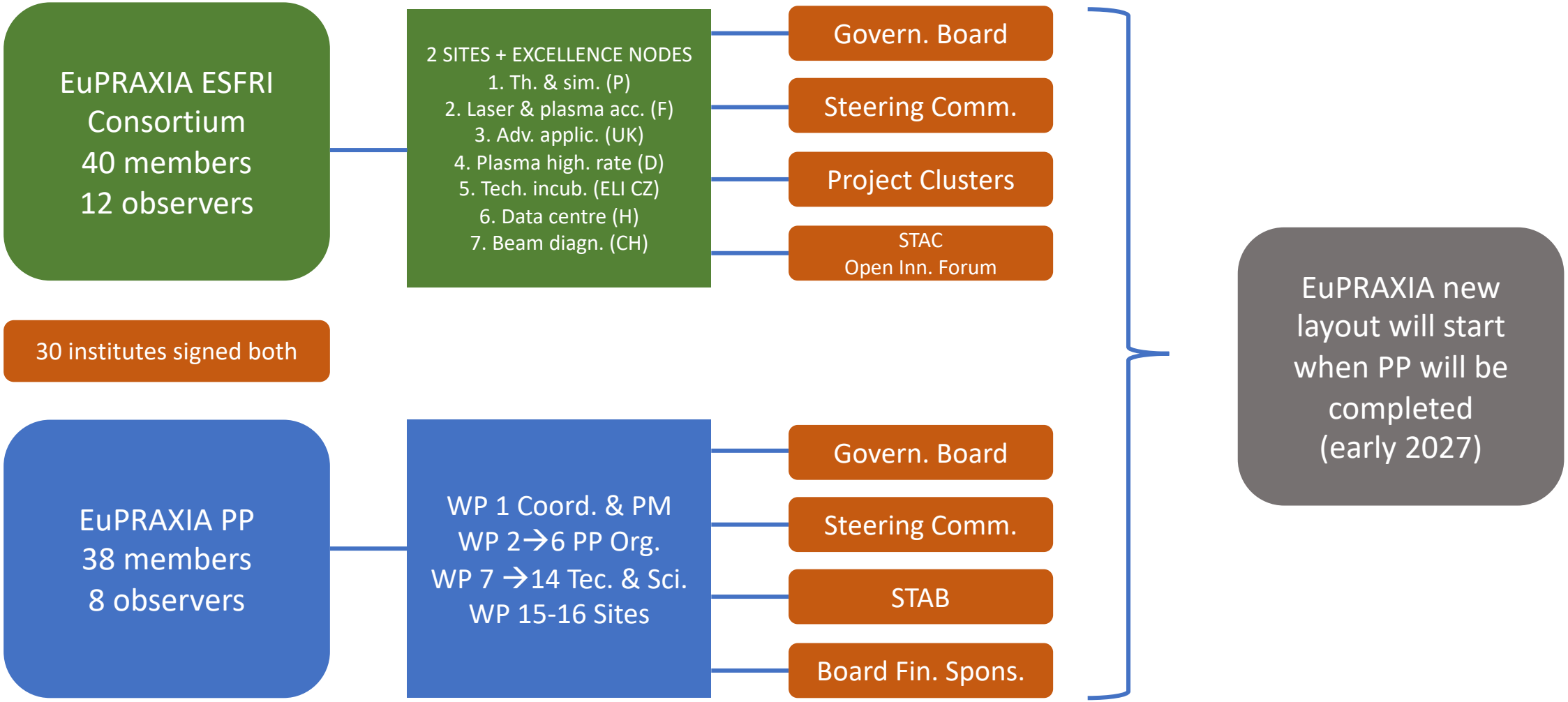
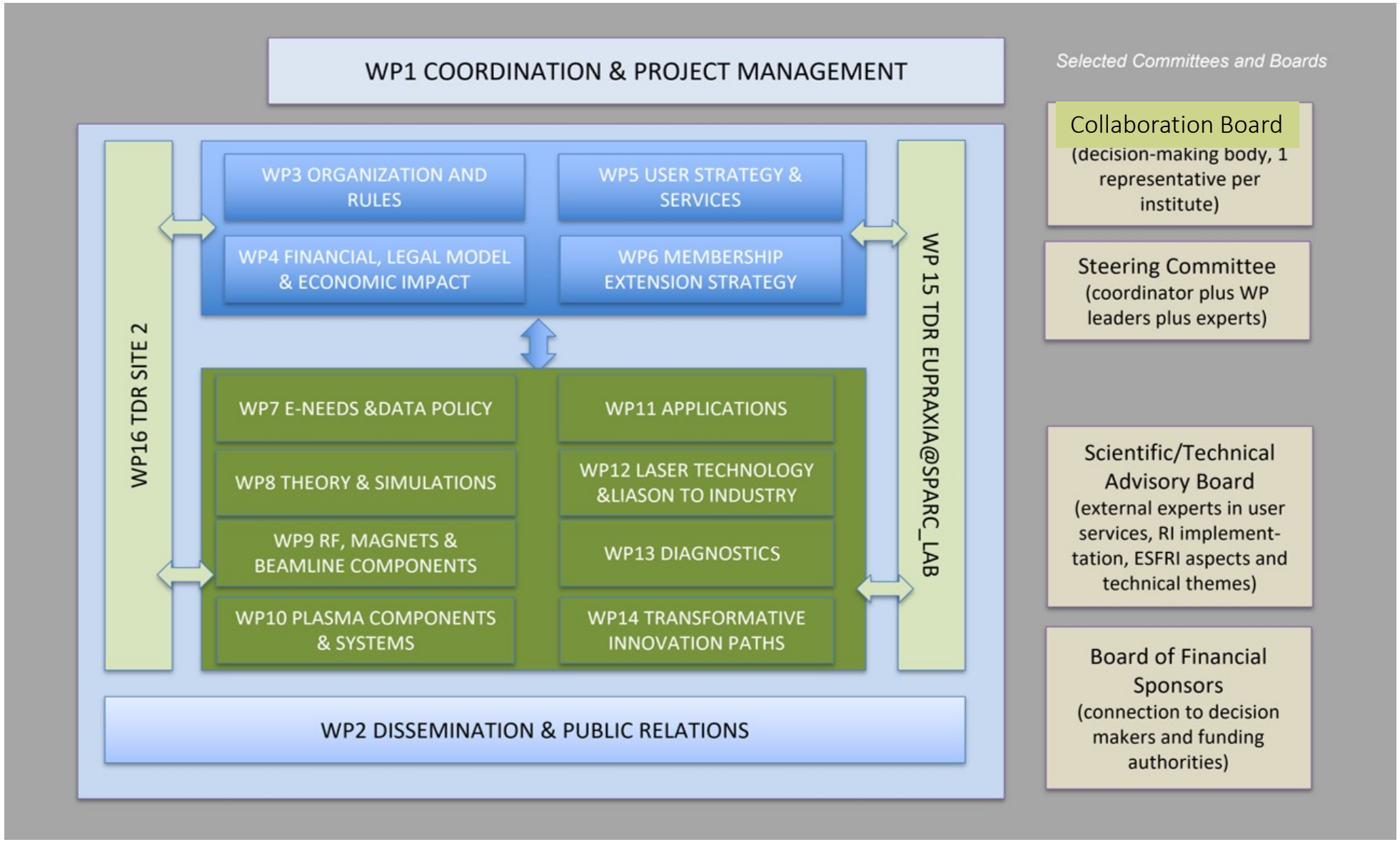
EuPRAXIA storyboard

Grand design (*R. Assmann et al.*): make EuPRAXIA similar to a HEP-style collaboration, able to setup and manage a Large European Network on advanced particle acceleration technologies (plasma et al.), on lasers and on their industrial and societal applications, thought for academic and industrial users, with two physical sites, and several clusters, *valueing in-kind and cash national contributions*.
Entering ESFRI Roadmap could provide an opportunity to access specific national and EU-based calls for funds.
This design is being throughly pursued from the early Design Phase (2015) to the current Preparatory Phase.

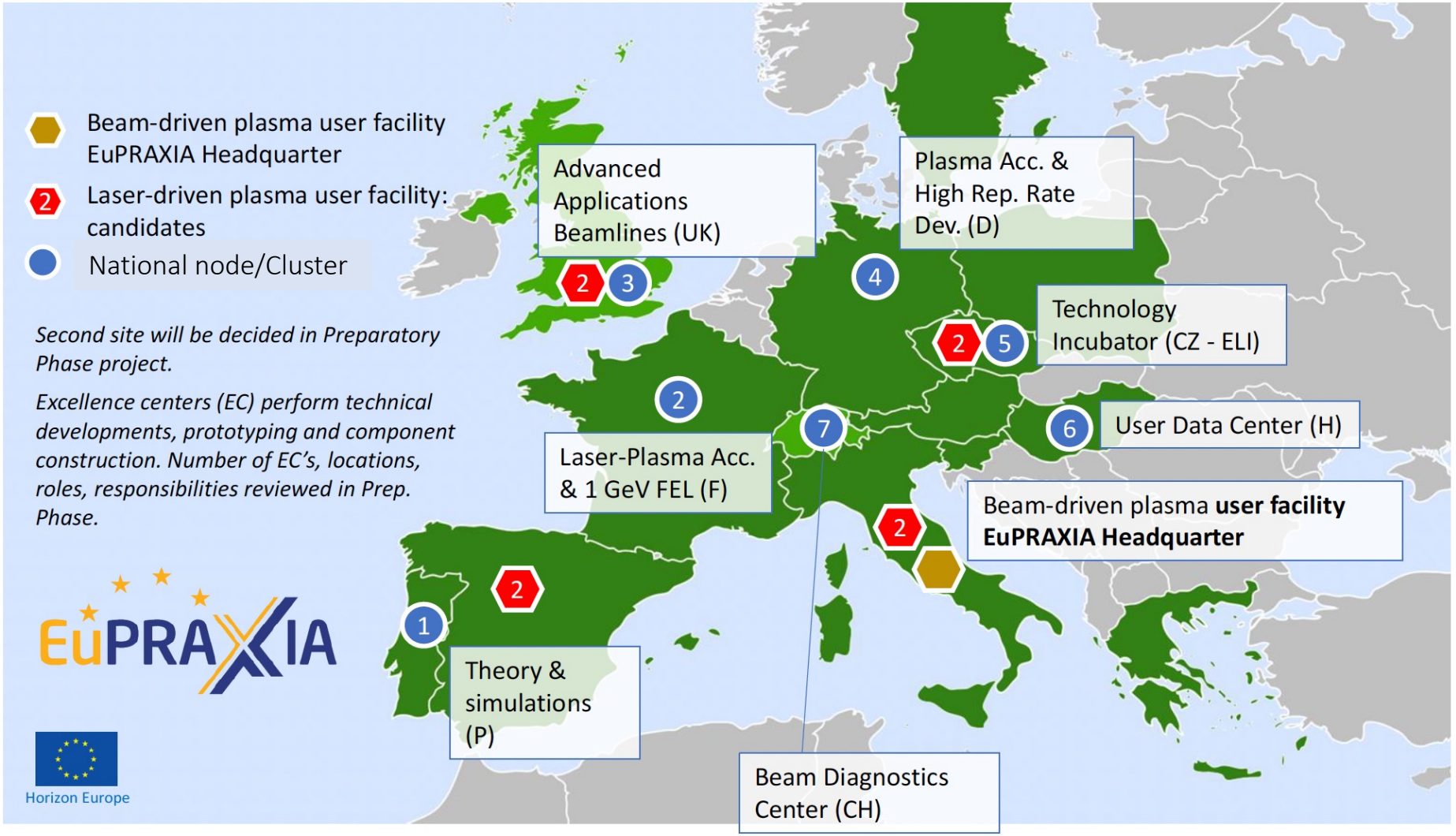
EuPRAXIA ecosystem



EuPRAXIA PP structure



EuPRAXIA Consortium Networking

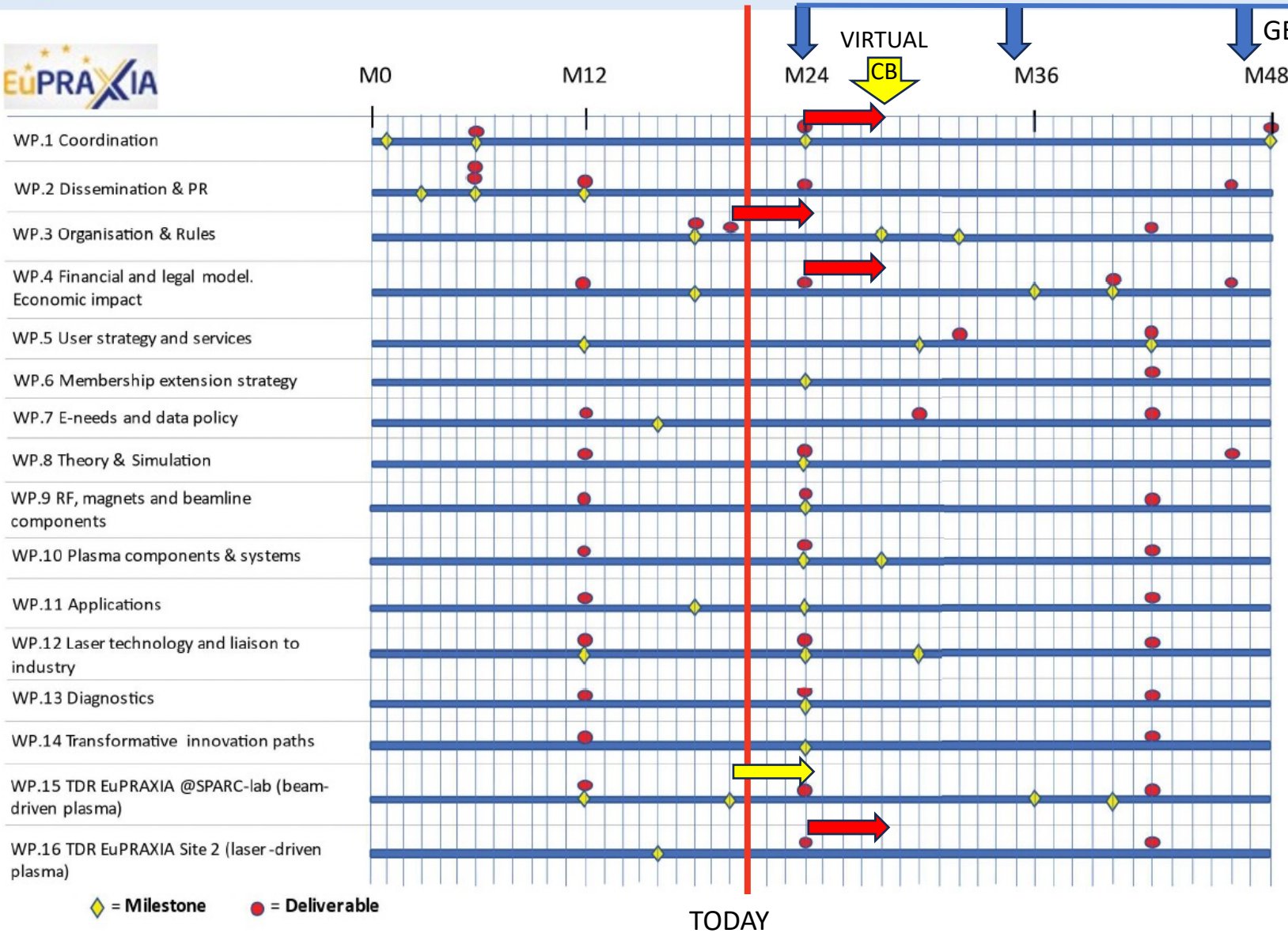


A large collection of the best European know-hows in accelerators, lasers and plasma technologies

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

4 candidates for LWFA
- CLPU, Salamanca
- CNR-INO, Pisa
- ELI ERIC, Prague
- EPAC-RAL, UK

The defiance of the Preparatory Phase



Some of the milestone and deliverables are challenging:
site choice, governance, membership, finance model, sustainability

Well motivated teams are working in technical WPs to proceed towards sites and centers setup

Status of Milestones & Deliverables

- Milestones: fo far, quite good achievements, 1-2 months delay on some, not problematic

- Deliverables: recently implemented (jun 24) D3.1 on *Criteria and methodology for 2nd site selection*
  Four more crucial ones in the next few months:
  - D3.2 *Report on the decision on the second site* (jun 24 → oct 24)
  - D16.1 *Update on EuPRAXIA plans for selected site 2* (oct 24→ feb 25)
  - D1.2 *Description of updated implementation scheme after site decision* (oct 24 → feb 25)
  - D4.2 *Cost implementation and service preliminary assessment* (oct 24 → feb 25)

  The implementation of these deliverables will need intense interactions between the EuPRAXIA management, the sites, the Collaboration Board (CB) and the Funding Agencies (Board of Sponsors)
  Current attitude (agreed with EU-PO): do not re-program deliverables, shift them informing Brussels PO (with justification)

- Next EuPRAXIA in person General Meeting (September, Elba)

EuPRAXIA Consortium & ancillary EU programs

Recent membership entries (CB decision in March):
- PSI (associate)
- GSI-FAIR (Assmann)
- AMPLITUDE
- Uni. Dusseldorf

Acceptance of observers on-going. No further members foreseen.

Complemented by few institutes present in EuPRAXIA ESFRI consortium which did not sign the EuPRAXIA PP Grant Agreement: from France, Germany, Poland, Sweden, United Kingdom, China, Japan, United States

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

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 Doctoral Network

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

- EuAPS

This publication has been made with the co-funding of European Union Next Generation EU.

Progressing toward objectives

- Strenghtening the Collaboration activities (at least 1 General Meeting/year + 3 “All WPs Meeting"/year), visiting collaborating Institutes (“team forming”) → **EuPRAXIA Week in September at Elba Island**
- “Tour de table” (video) with individual WPs to understand status and advancements (done)

- Implementation of changes in deliverables/milestones (presented in October ’23 CB)

- Define procedures toward 2nd site identification (see later)
- Define procedures toward governance model (see later)
- Work on realization/start-up of National Nodes/Technical Clusters (to the benefit of PWFA/LWFA sites)

- Activation of Scientific Technical Advisory Board (1st meeting in September)
- Activation of Board of Sponsors (identification of stakeholders, ongoing, 1st meeting in Autumn)

- Simplify management duality between EuPRAXIA-ESFRI and EuPRAXIA-PP Consortia

- *Lobbying activities at EuPRAXIA Institutes Countries, Bruxelles, stimulate interest from industrial partners*

Second site choice (WP1, WP3, WP4)

- 4 very useful visits to site candidates: CNR Pisa, ELI-ERIC Prague, CLPU Salamanca, EPAC RAL
- Strong candidacies, very nice laboratories ! Quite different levels of organisations/structures

- Milestone 16.1 finalized: candidacy overview (text provided by sites, according to structure template):

  - *Existing infrastructure towards delivering the LPA-based EuPRAXIA pillar (Phase1)*
  - *Technology readiness for LPA-based EuPRAXIA pillar (Phase1)*
  - *Existing Safety and Control Systems*
  - *Teaming and Management*
  - *User-oriented operation experience*
  - *Identification of pre-investment relevant for the EuPRAXIA development*
  - *Identification of required funding to accomplish EuPRAXIA LPA-pillar Phase1*
  - *Strategy to implement the EuPRAXIA LPA-pillar Phase-2*
  - *Collaboration needed (wish-list from each candidate)*

- Internal Panel set-up. Preparation of template for site bid-book. Decision by Feb/Mar ’25 (dedicated CB)
- Collaborative approach: try to come to an agreed decision (sites must collaborate among them)
- Site choice & EuPRAXIA governance must be aligned

Governance (WP1, WP4)

- Several models under scrutiny: IGO, ERIC, AISBL, “ELIXIR-type”, Consortium agreement (MoU), etc…
  - IGO and ERIC considered too complex and politically difficult to achieve. Many drawbacks
  - AISBL offers quite a good number of “pros” with little or no- administrative complexity (e.g. KM3-net)

- A legal entity would be beneficial to apply “as EuPRAXIA” to EU grants, although maintaining for each institution, “properties” of in-kind hardware, and responsibility of personnel

- **Governance** based on *Council (FAs), Collaboration Board, Exec (Technical Board), Advisory Board*
  - Consortium Agreement will define: membership, operation of sites/nodes, Headquarters location, centralised users access to facilities, economic sustainabilities of sites/nodes (FA commitments), country contributions for common fund (at reasonable level)
  - Operating coherently as a Network (2 sites + national nodes/technology clusters)

- Two step approach:
  - During Preparatory Phase & beginning of Implementation Phase: MoU agreement
  - During Implementation Phase: legal entity (submitted to a non-negligeable political negotiation)

Funding schemes, sustainibility and collaborative approach

Funded by the European Union

- Sites funding: based on in-kind contributions from institutes/country + regional funding + EU calls
- Operational costs: basically relying on hosting Institution (other schemes possible, although difficult)
- National nodes/ technology clusters: based on in-kind contributions from institutes/country + regional funding + EU calls. They are expected to contribute to specific technical parts of sites

- Funding opportunities (non-exaustive list):
  - ESFRI can trigger national support: Italy (PNRR+Lazio Region), France (CNRS, PALLAS project), Portugal (fund request submitted for HPC centre), … + other tools to be investigated
  - ESFRI can trigger EU support: PP+DN grants (~ # ME), future Implementation grant (~ 5 ME), current or future participation to specific calls (recent PACRI)
  - Long term sustainability of facilities relying on institutes (part of ESFRI commitment)

- Collaborative approach: supporting sites through specific funding (as above) or point2point agreements (e.g. INFN-ENEA on undulators, INFN-CERN on X-band, INFN-PSI on diagnostics, INFN-ELETTRA under discussion, etc…), to be replicated possibly in other sites/nodes

… LIFE IS NOT EASY and THERE'S NO FREE CAKE …

PALLAS: an example of funding a national node

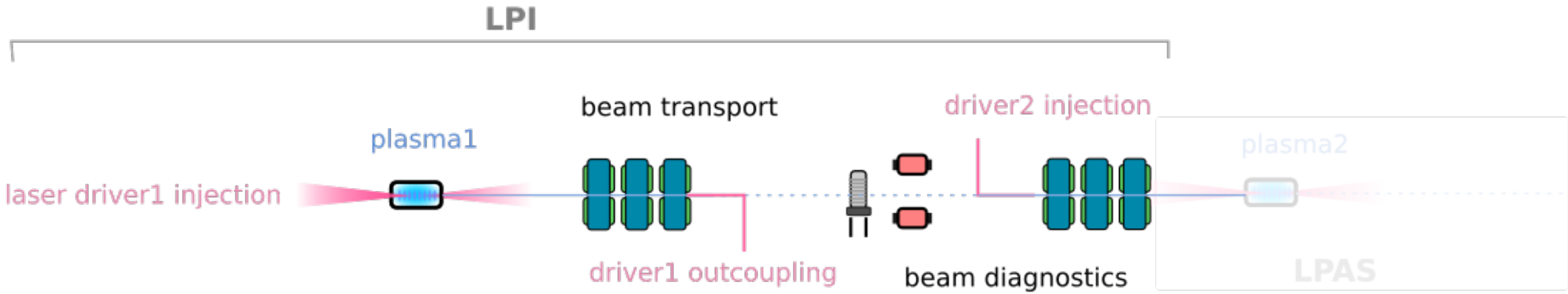
Funded by the European Union

PALLAS

IJCLab (Orsay) test facility for laser-plasma injector optimisation towards RF control reliability

In the context of advanced accelerator high quality beam laser plasma injector (LPI) for **EuPRAXIA** [1] preparatory technical design phase and future high gradient accelerator R&D at IJClab [2]: **10 Hz -150-250MeV** LPI test facility to improve **quality and stability of e- beam generated by laser-plasma accelerator**.

Funded by **PIA3-ANR, CNRS-IN2P3, Université Paris Saclay, EuPRAXIA-PP** and **CPER**
~ 2.3 M€ budget



ESFRI proposed funding structure (2021)

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

(*) 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

AVERAGE ANNUAL OPERATION COSTS: 30

Capital investment for upgrades every 5 years are not included here. The operational costs of all EuPRAXIA sites (beam-driven site at INFN-LNF, Frascati, Italy: 11.6 M€, laser-driven site: 11.3 M€), excellence centres (6.3 M€) and the central RI management (0.8 M€) are included(estimated costs), these costs will be covered by the local host institutes.

Phase I (1 GeV) + Phase II (5 GeV)
Costs (70% - 30%)

Real costs still to be revised:
- for EuPRAXIA@Sparc_LAB
- for site 2 (strongly dep. on choice)
- for 2 site operations
- for nodes & clusters

Mostly based on in-kind contributions to be “certified” within the Consortium (hardware & personnel)

Governance (… stakeholders, … resources, … access, … etc)

- Analysing of various models (~~IGO~~, ERIC, AISBL, Consortium, …), also looking to other RIs:
  the "*perfect one*" does not exist

- Inputs to the choice:
  - Cooperative-oriented consortium
  - Accepted by Funding Agencies & ESFRI
  - Flexible (minimal bureaucracy) and based on MoUs
  - Capable of accounting in-kind contributions and fresh resources (assets remains to stakeholder)
  - Operating coherently as a Network + 2 sites + several Centres (specific techologies)
  - Coordinated external user access to EuPRAXIA facilities
  - Centralized capability to participate to EU calls (issue of legal entity) as "EuPRAXIA"
  - … (plus any further input from partners)

Summary

- EuPRAXIA is a challenging and fascinating ESFRI European Research Infrastructure with several “non standards” aspects:
  - Effort to merge three very different communities: accelerators, plasma, lasers experts
  - Network with real sites, nodes and clusters: HEP-like collaboration guidance
  - Effort to have nodes/clusters contributing to sites
  - Un-conventional way of funding (multi-actors: EU, FA, Universities, etc…), large use of in-kind (HW and personnel)

- A little more than 2 years to conclude EuPRAXIA_PP and several challenging tasks ahead of us: 2nd site choice, governance, legal model, interacctions with FAs

- First tour of WPs shows many extremely well advanced conditions of cooperstion. Some others needs tuning *“… collaborative work encounters difficulty to overcome competitive spirit …” one WP leader said*

EuPRAXIA-PP Consortium