M. Ferrario, INFN-LNF, WP6 Leader

18 April 2024

WP6
Novel Particle Accelerators Concepts and Technologies

- **Ralph Assmann left DESY end of August 23**, now in charge of GSI „Accelerator Operation and Development" area. Focus work back on RF accelerator infrastructure, possibly staying connected through Frankfurt Goethe University research group.

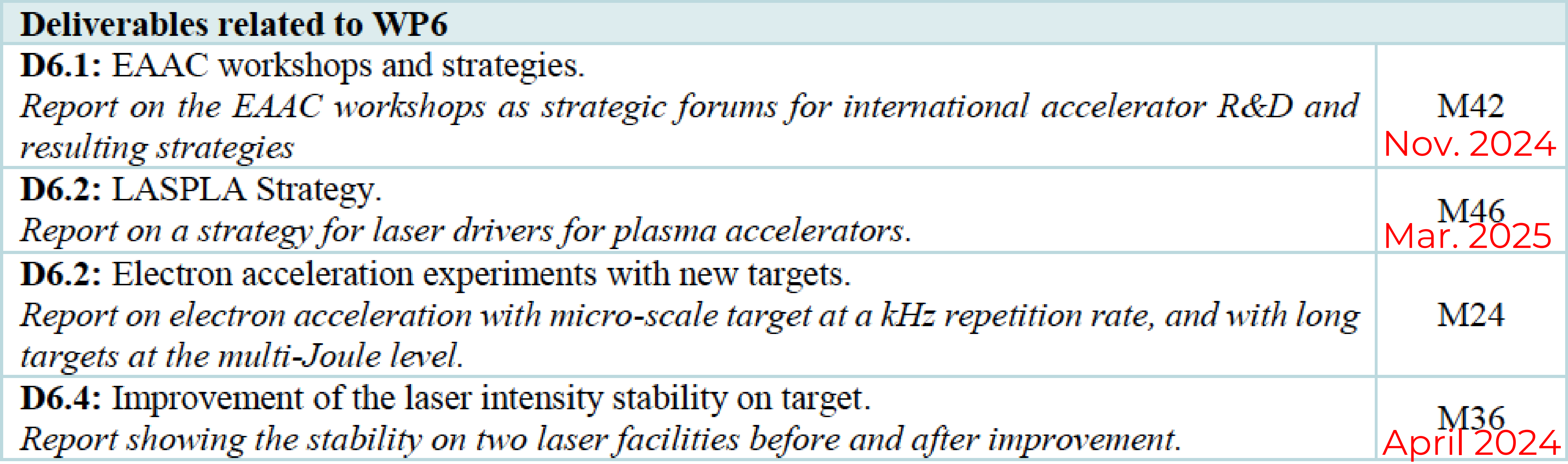
- Task 1 (R.A. + M. Ferrario): **Novel Particle Accelerators Concepts and Technologies** (NPACT – **EuroNNAc4**) M1 – M48
  Sub-task leaders: ***B. Holzer*** *(CERN),* ***D. Minenna*** *(CEA),* ***A. Specka*** *(CNRS),* ***R. Walczak*** *(Oxford)*

- Task 2 (Leo Gizzi): **Lasers for Plasma Acceleration** (LASPLA) M1 – M48

- Task 3 (Cedric Thaury): **Multi-scale Innovative targets for laser-plasma accelerators** (MILPAT) M1 – M32

- Task 4 (Francois Mathieu): **Laser focal Spot Stabilization Systems** (L3S) M1 – M36

EAAC is an iFAST/EuroNNAc Deliverable



Deliverables related to WP6	
D6.1: EAAC workshops and strategies. *Report on the EAAC workshops as strategic forums for international accelerator R&D and resulting strategies*	M42 Nov. 2024
D6.2: LASPLA Strategy. *Report on a strategy for laser drivers for plasma accelerators.*	M46 Mar. 2025
D6.2: Electron acceleration experiments with new targets. *Report on electron acceleration with micro-scale target at a kHz repetition rate, and with long targets at the multi-Joule level.*	M24
D6.4: Improvement of the laser intensity stability on target. *Report showing the stability on two laser facilities before and after improvement.*	M36 April 2024

EAAC 2023

Ralph Assmann (GSI)
Massimo Ferrario (INFN)

198 Participants

163 Delegates

35 Student Grants

We provide funding to the EAAC workshop, in particular rooms, proceedings, student grants, van der Meer prize award, (about **350,000 € since 2013**, the first EAAC)

17–22 Sept. 2023 Hotel Hermitage, La Biodola Bay, Isola d'Elba, Italy

Changes for EAAC Ahead

- EAAC 2023 is the **last EAAC that is sponsored by EuroNNAc/iFAST**, which will end its project lifespan by Spring 2025.
- So far we financed the European Network for Novel Accelerators (EuroNNAc) through the CERN coordinated EuCARD, EuCARD2, ARIES, iFAST projects with EU funding
- EuroNNAc future beyond 2025 to be defined (founded in 2011 at CERN by RA), including **EU sponsoring for EAAC → EAAC 2025** !?

EUROPEAN
PLASMA RESEARCH
ACCELERATOR WITH
EXCELLENCE IN
APPLICATIONS

EuPRAXIA
Preparatory Phase

The EuPRAXIA project

a plasma-based accelerator user facility for the next decade

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

A New European High-Tech User Facility

Funded by the European Union

1

Building a facility with very high field plasma accelerators, driven by lasers or beams
1 – 100 GV/m accelerating field

Shrink down the facility size
Improve Sustainability

2

Producing particles and photons to support several urgent and timely science cases

Drive short wavelength FEL
Pave the way for future Linear Colliders

FEATURE EuPRAXIA

A Martinez de la Ossa/DESY

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.*

https://www.eupraxia-facility.org/

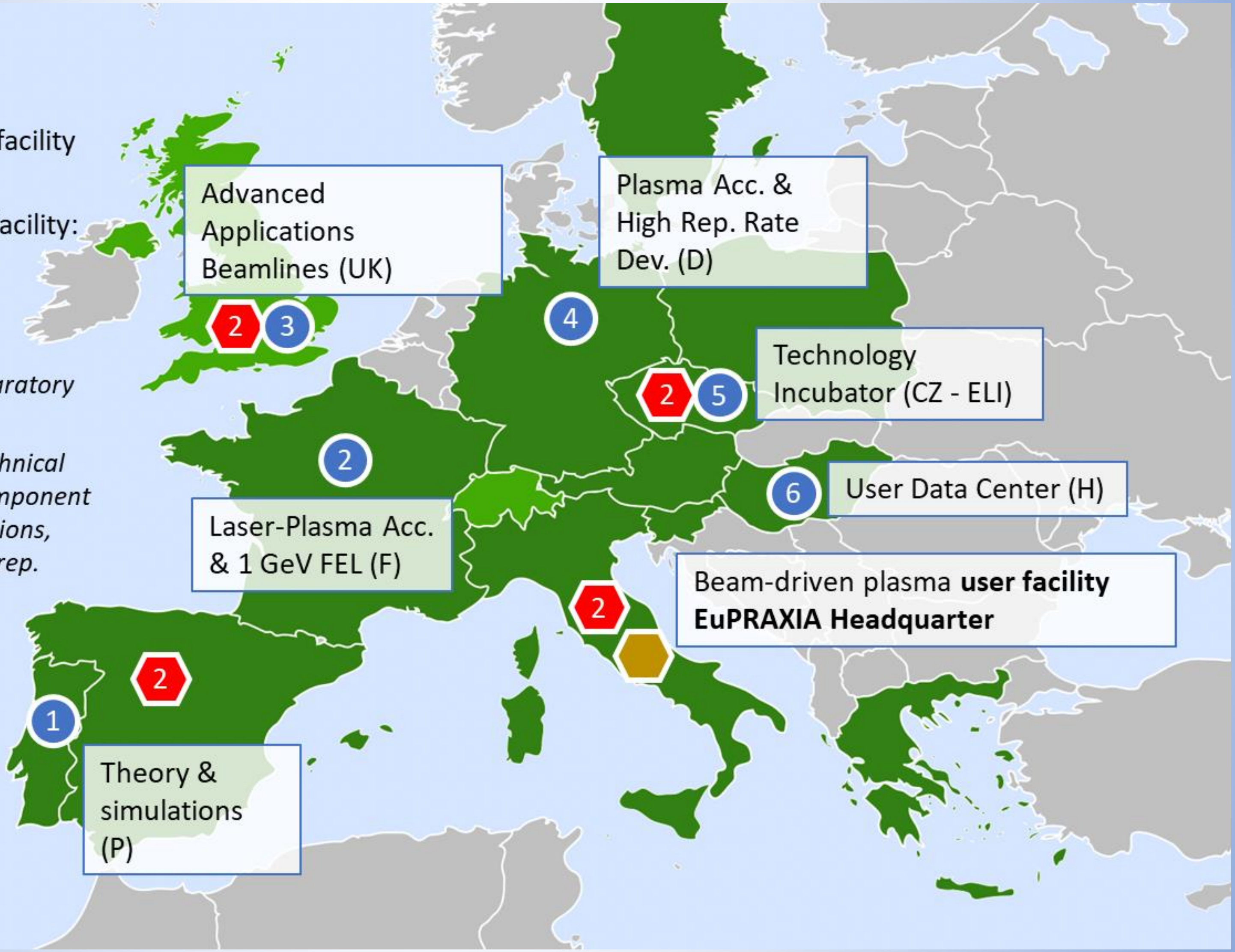
Distributed Research Infrastructure

Funded by the European Union

- ⬢ Beam-driven plasma user facility EuPRAXIA Headquarter
- ⬢ 2 Laser-driven plasma user facility: candidates
- ● Excellence Center

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.



Advanced Applications Beamlines (UK)

Plasma Acc. & High Rep. Rate Dev. (D)

Technology Incubator (CZ - ELI)

User Data Center (H)

Laser-Plasma Acc. & 1 GeV FEL (F)

Beam-driven plasma **user facility EuPRAXIA Headquarter**

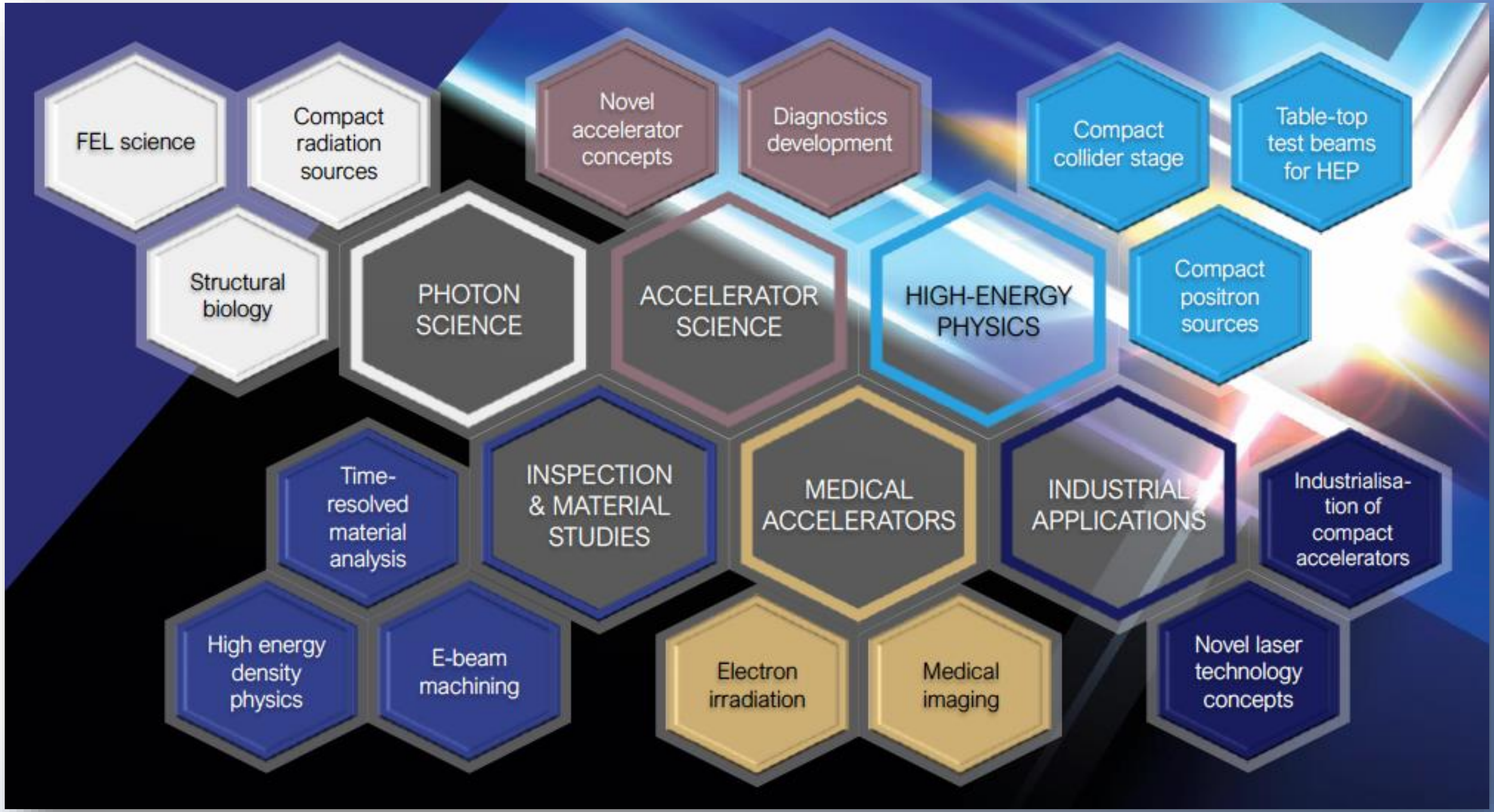
Theory & simulations (P)

Horizon Europe

Intense R&D Program on critical components

Funded by the European Union

- **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)
- **X-band RF Linac**
  (60 MV/m , up to 400 Hz)
- **Plasma Targets**
- **Betatron X rays**
  (1-10 keV, 10^{10})
- **FEL light**
  (0.2-36 nm, 10^9-10^{13})

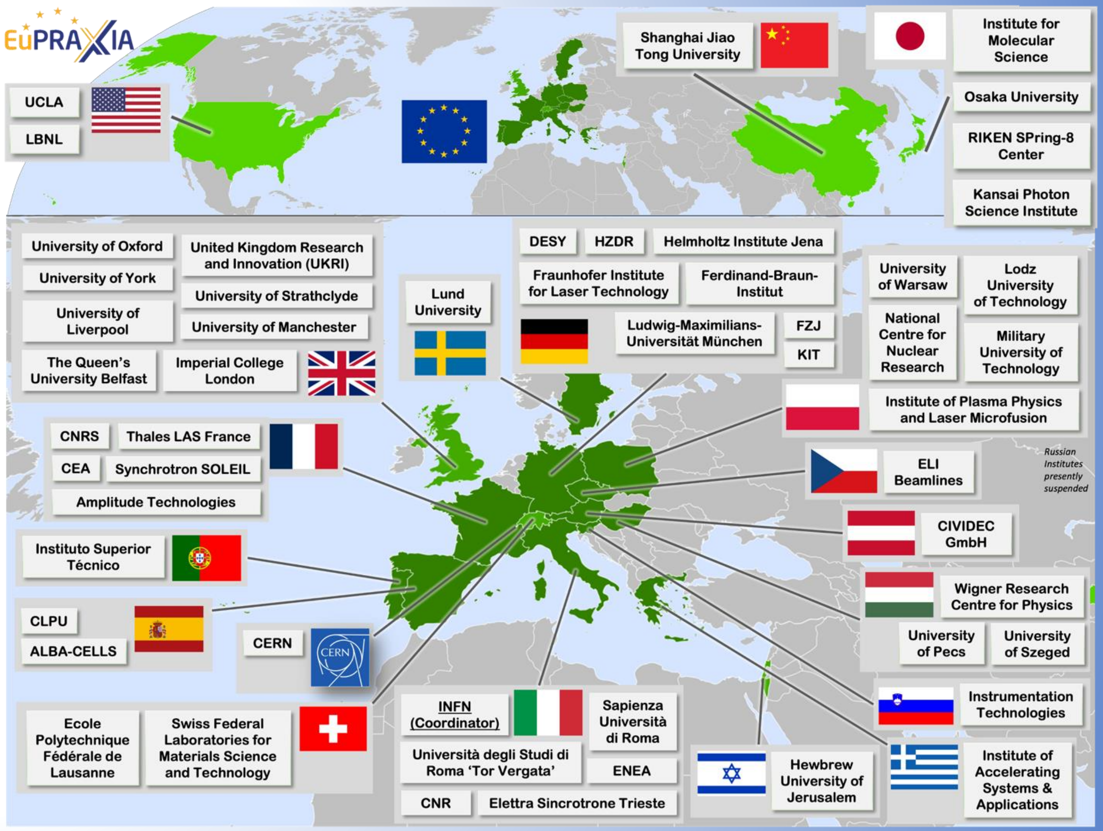


FEL science
Compact radiation sources
Structural biology
PHOTON SCIENCE
Novel accelerator concepts
Diagnostics development
ACCELERATOR SCIENCE
Compact collider stage
Table-top test beams for HEP
HIGH-ENERGY PHYSICS
Compact positron sources
Time-resolved material analysis
INSPECTION & MATERIAL STUDIES
MEDICAL ACCELERATORS
INDUSTRIAL APPLICATIONS
Industrialisa-tion of compact accelerators
High energy density physics
E-beam machining
Electron irradiation
Medical imaging
Novel laser technology concepts

Wide International Collaboration

Funded by the European Union

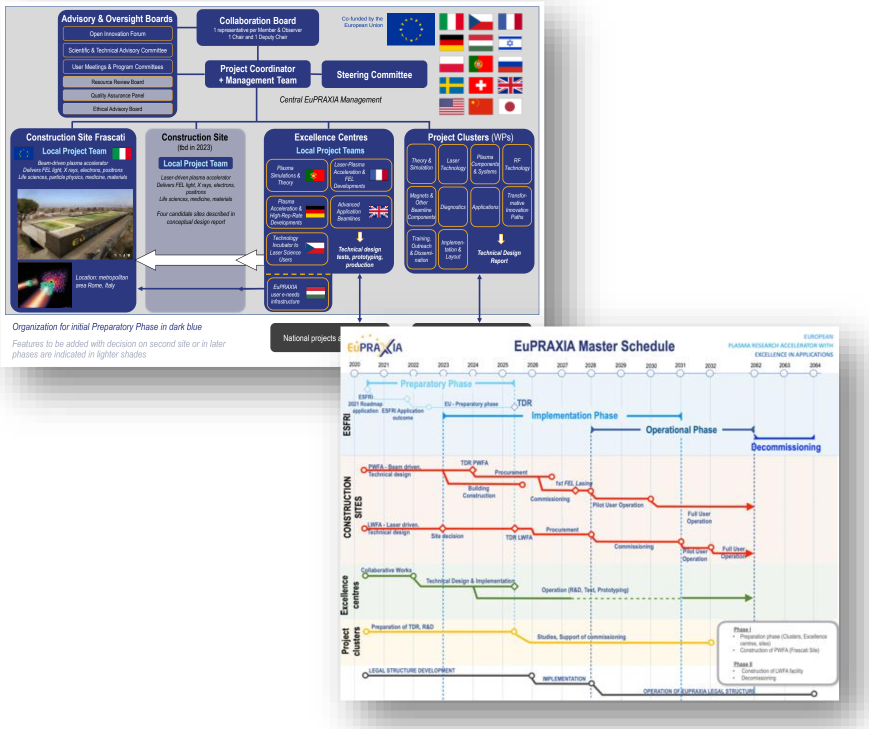
- The EuPRAXIA Consortium today: **54 institutes** from **18 countries** plus CERN
- Included in the **ESFRI** Road Map
- Efficient fund raising:
  - **Preparatory Phase** consortium (funding EU, UK, Switzerland, in-kind)
  - **Doctoral Network** (funding EU, UK, in-kind)
  - **EuPRAXIA@SPARC_LAB** (Italy, in-kind)
  - **EuAPS Project** (Next Generation EU)
  - **What Next? => PACRI** (funding EU)

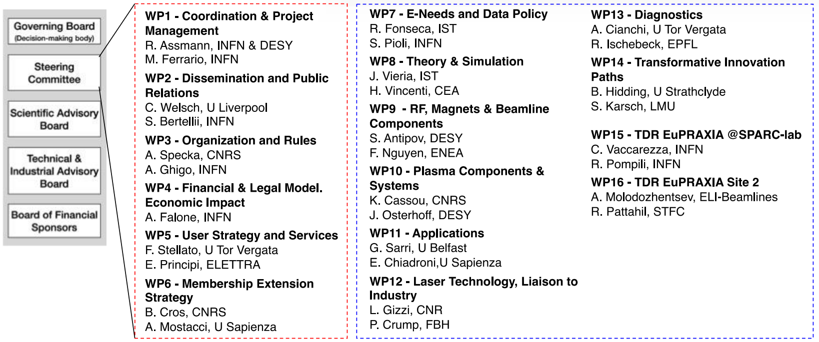


Preparatory Phase Main Goals

Funded by the European Union

- 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





Governing Board (Decision-making body)
Steering Committee
Scientific Advisory Board
Technical & Industrial Advisory Board
Board of Financial Sponsors

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

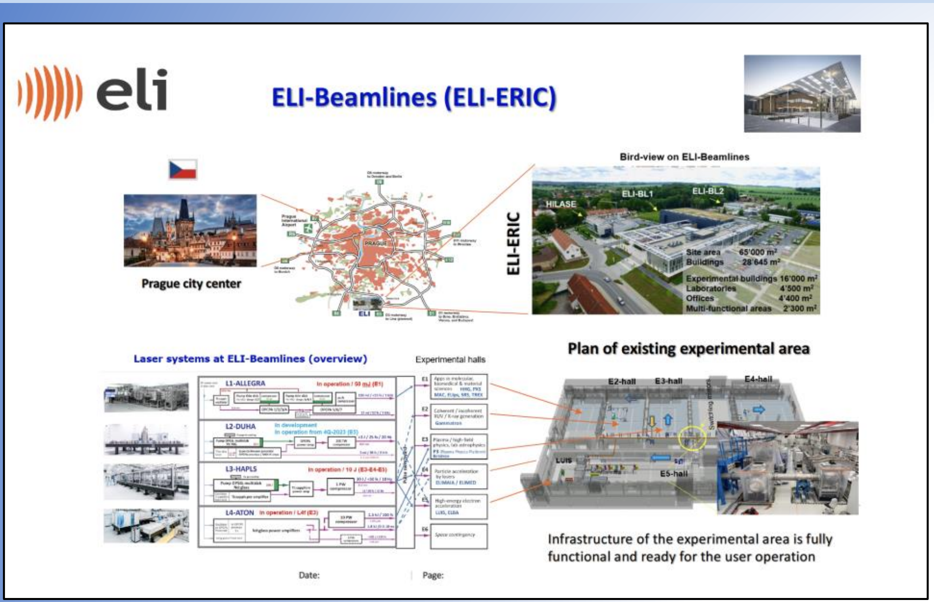
WP13 - Diagnostics
A. Cianchi, U Tor Vergata
R. Ischebeck, EPFL

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

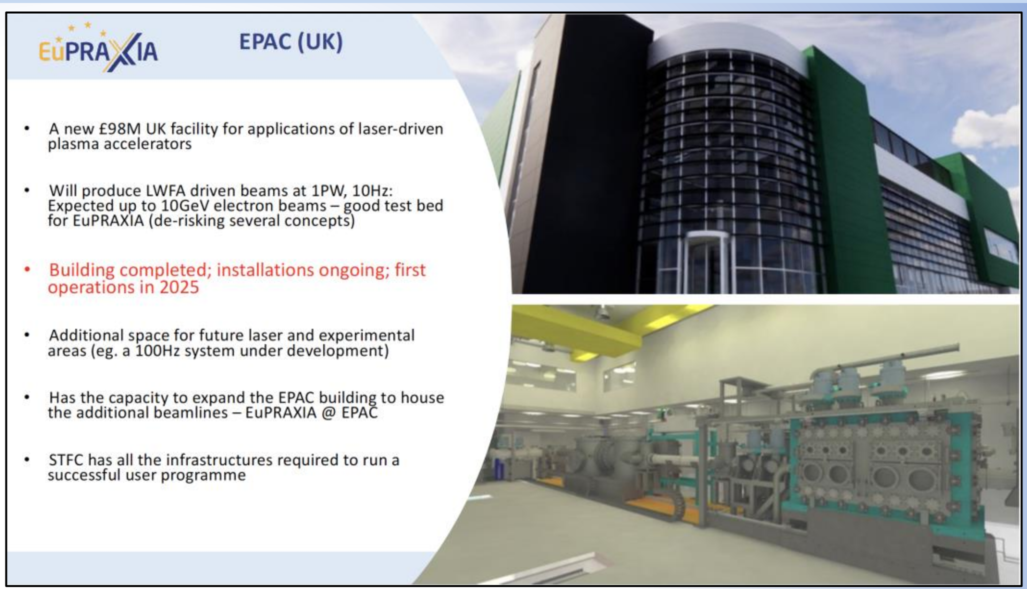
Current Candidates for EuPRAXIA Laser Site



ELI-Beamlines (ELI-ERIC)

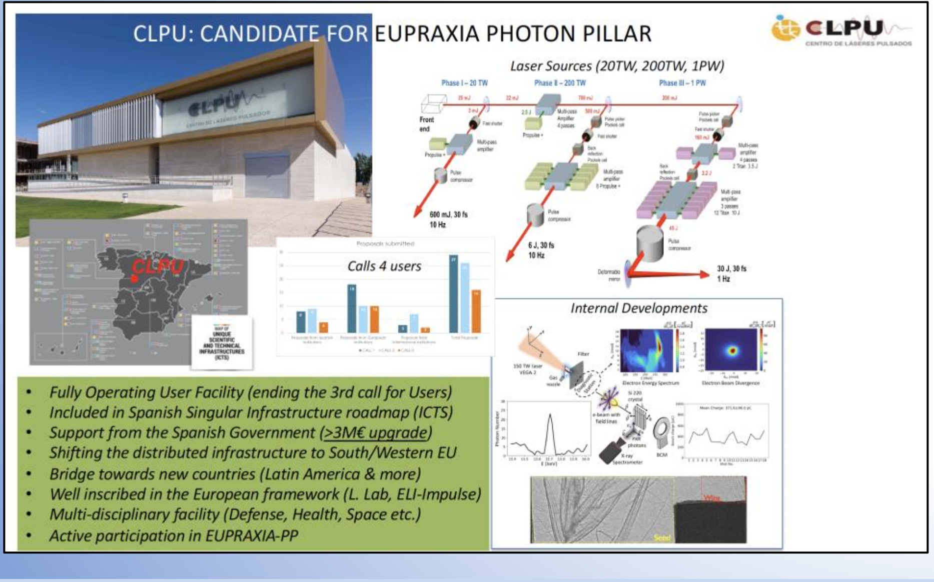
Infrastructure of the experimental area is fully functional and ready for the user operation

Date: | Page:



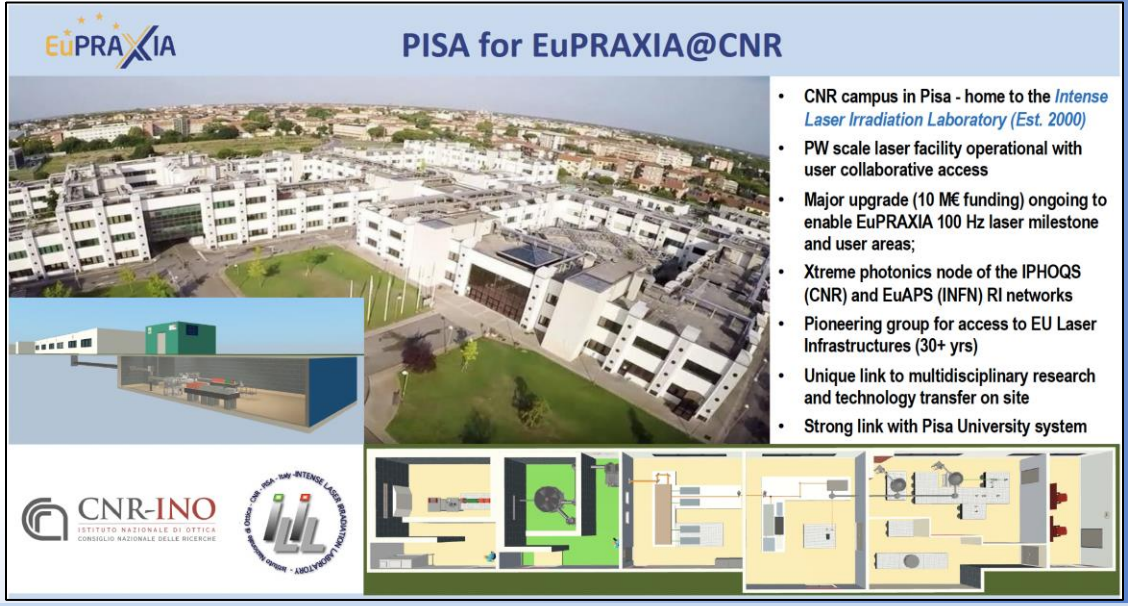
EPAC (UK)

- A new £98M UK facility for applications of laser-driven plasma accelerators
- Will produce LWFA driven beams at 1PW, 10Hz: Expected up to 10GeV electron beams – good test bed for EuPRAXIA (de-risking several concepts)
- Building completed; installations ongoing; first operations in 2025
- Additional space for future laser and experimental areas (eg. a 100Hz system under development)
- Has the capacity to expand the EPAC building to house the additional beamlines – EuPRAXIA @ EPAC
- STFC has all the infrastructures required to run a successful user programme



CLPU: CANDIDATE FOR EUPRAXIA PHOTON PILLAR

- *Fully Operating User Facility (ending the 3rd call for Users)*
- *Included in Spanish Singular Infrastructure roadmap (ICTS)*
- *Support from the Spanish Government (>3M€ upgrade)*
- *Shifting the distributed infrastructure to South/Western EU*
- *Bridge towards new countries (Latin America & more)*
- *Well inscribed in the European framework (L. Lab, ELI-Impulse)*
- *Multi-disciplinary facility (Defense, Health, Space etc.)*
- *Active participation in EUPRAXIA-PP*

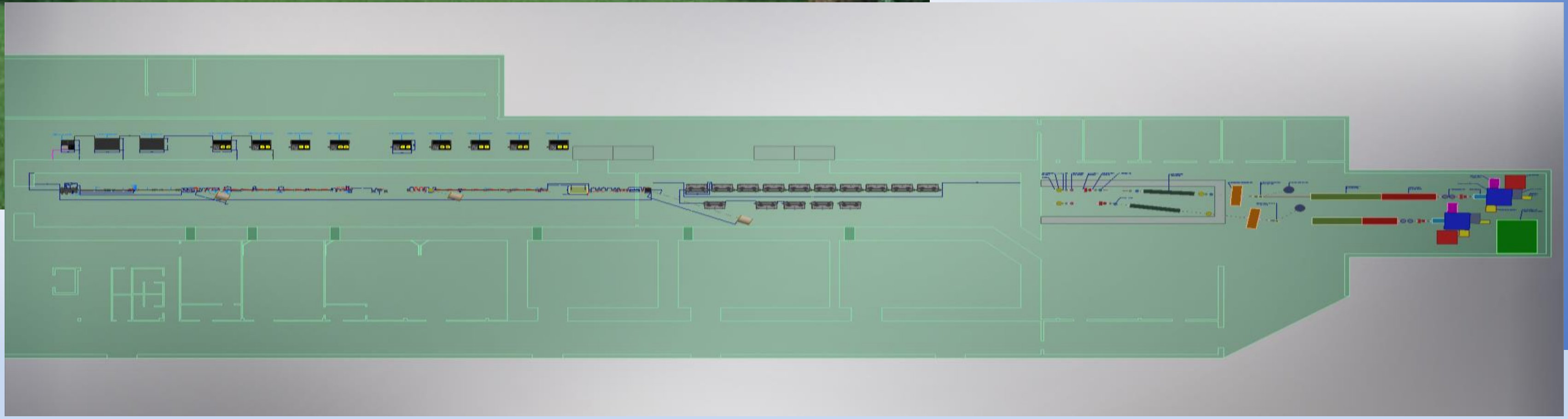


PISA for EuPRAXIA@CNR

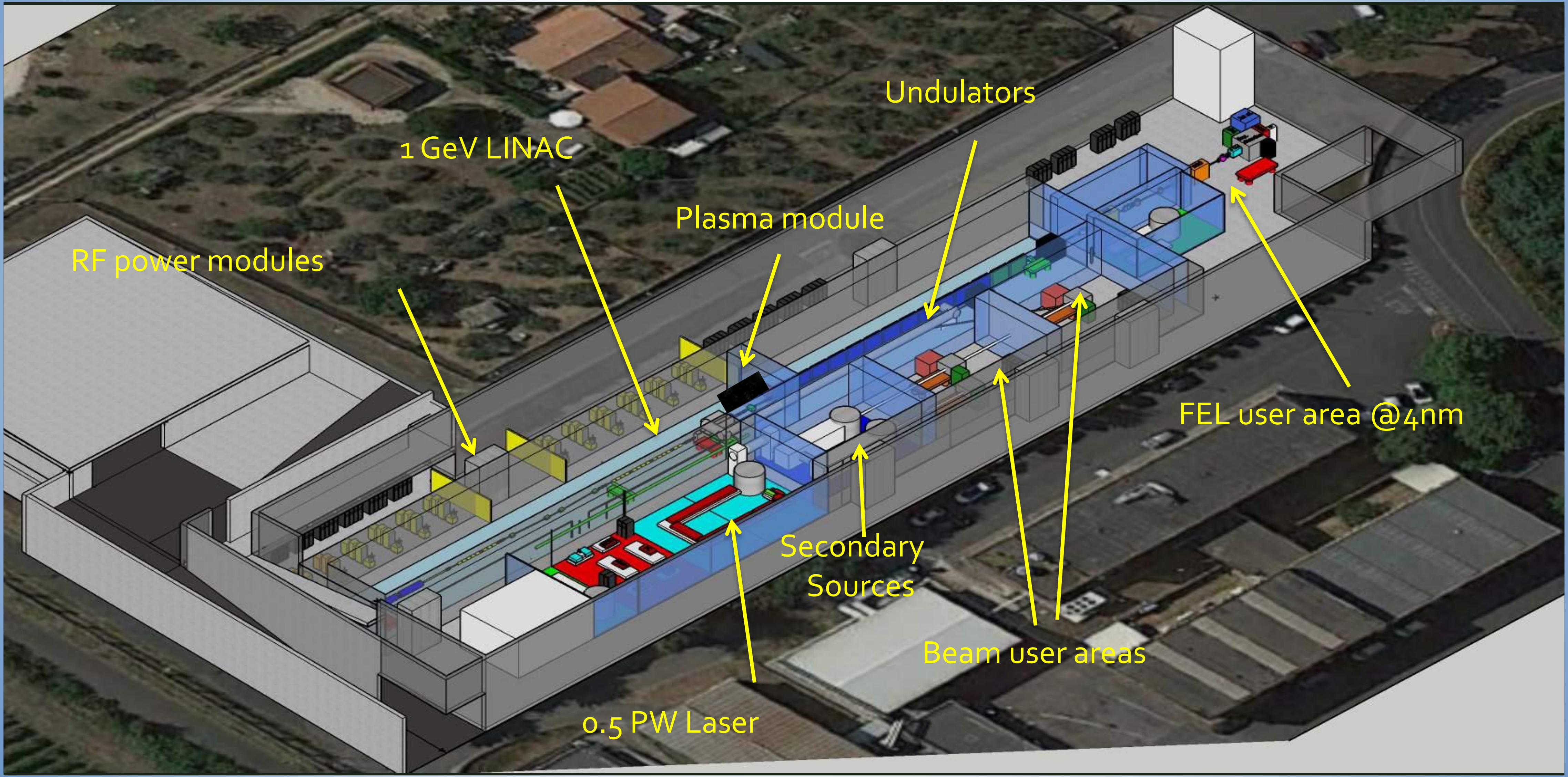
- CNR campus in Pisa - home to the *Intense Laser Irradiation Laboratory (Est. 2000)*
- PW scale laser facility operational with user collaborative access
- Major upgrade (10 M€ funding) ongoing to enable EuPRAXIA 100 Hz laser milestone and user areas;
- Xtreme photonics node of the IPHOQS (CNR) and EuAPS (INFN) RI networks
- Pioneering group for access to EU Laser Infrastructures (30+ yrs)
- Unique link to multidisciplinary research and technology transfer on site
- Strong link with Pisa University system

Headquarter and Site 1: EuPRAXIA@SPARC_LAB

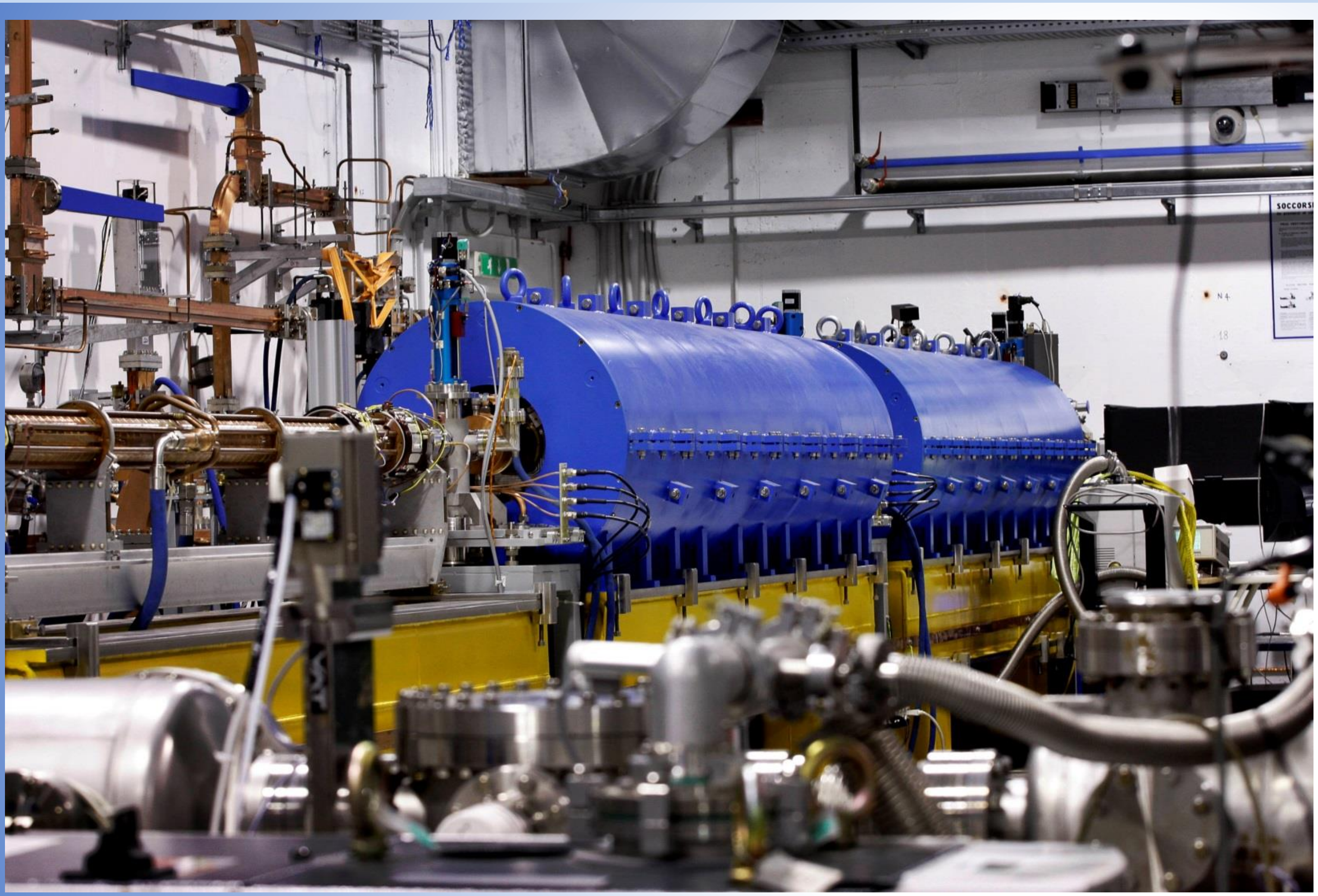
- Frascati`s future facility
- > 130 M€ invest funding
- Beam-driven plasma accelerator
- Europe`s most compact and most southern FEL
- The world`s most compact RF accelerator (X band with CERN)

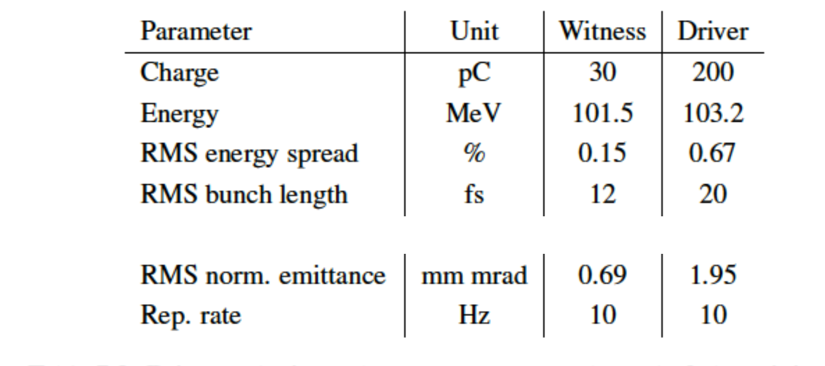


EuPRAXIA@SPARC_LAB



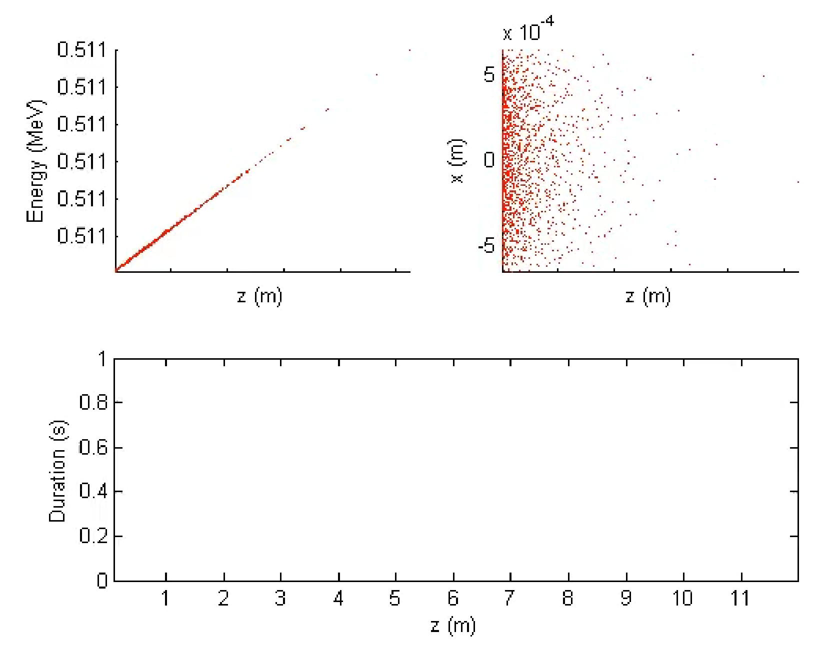
High Quality Electron Beams





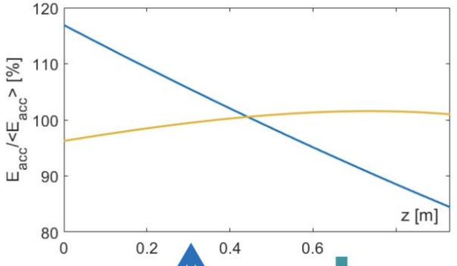
Parameter	Unit	Witness	Driver
Charge	pC	30	200
Energy	MeV	101.5	103.2
RMS energy spread	%	0.15	0.67
RMS bunch length	fs	12	20
RMS norm. emittance	mm mrad	0.69	1.95
Rep. rate	Hz	10	10

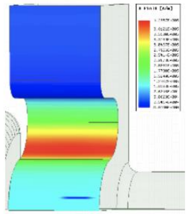
Table 7.2: Driver and witness beam parameters at the end of photo-injector.



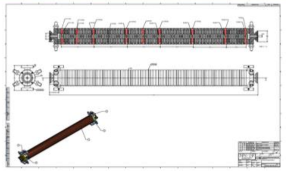
Courtesy E. Chiadroni

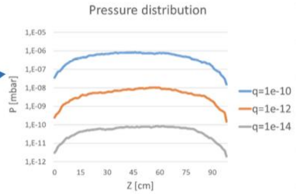
World`s Most Compact RF Linac: X Band

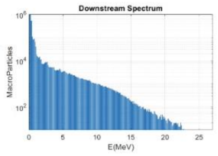




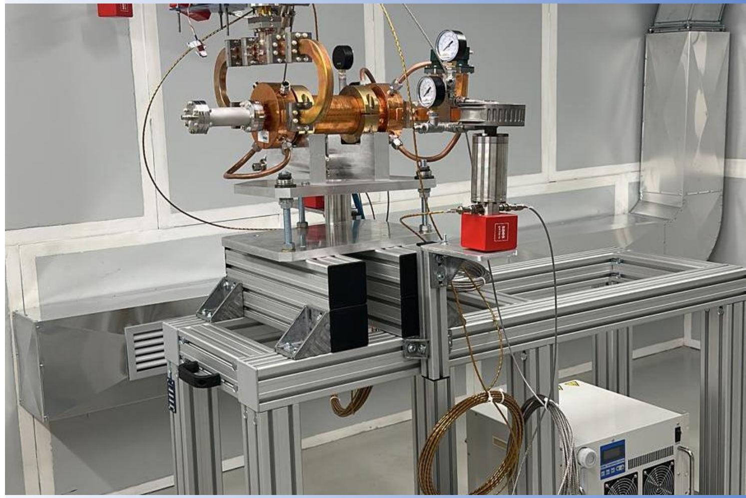
1. **E.m. design**: *done*
2. **Thermo-mechanical analysis**: *done*
3. **Mechanical design**: *done*
4. **Vacuum calculations**: *done*
5. **Dark current simulations**: *done*
6. **Waveguide distribution simulation with attenuation calculations**: *done*

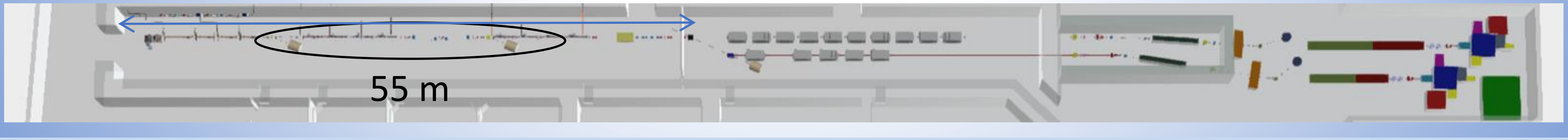






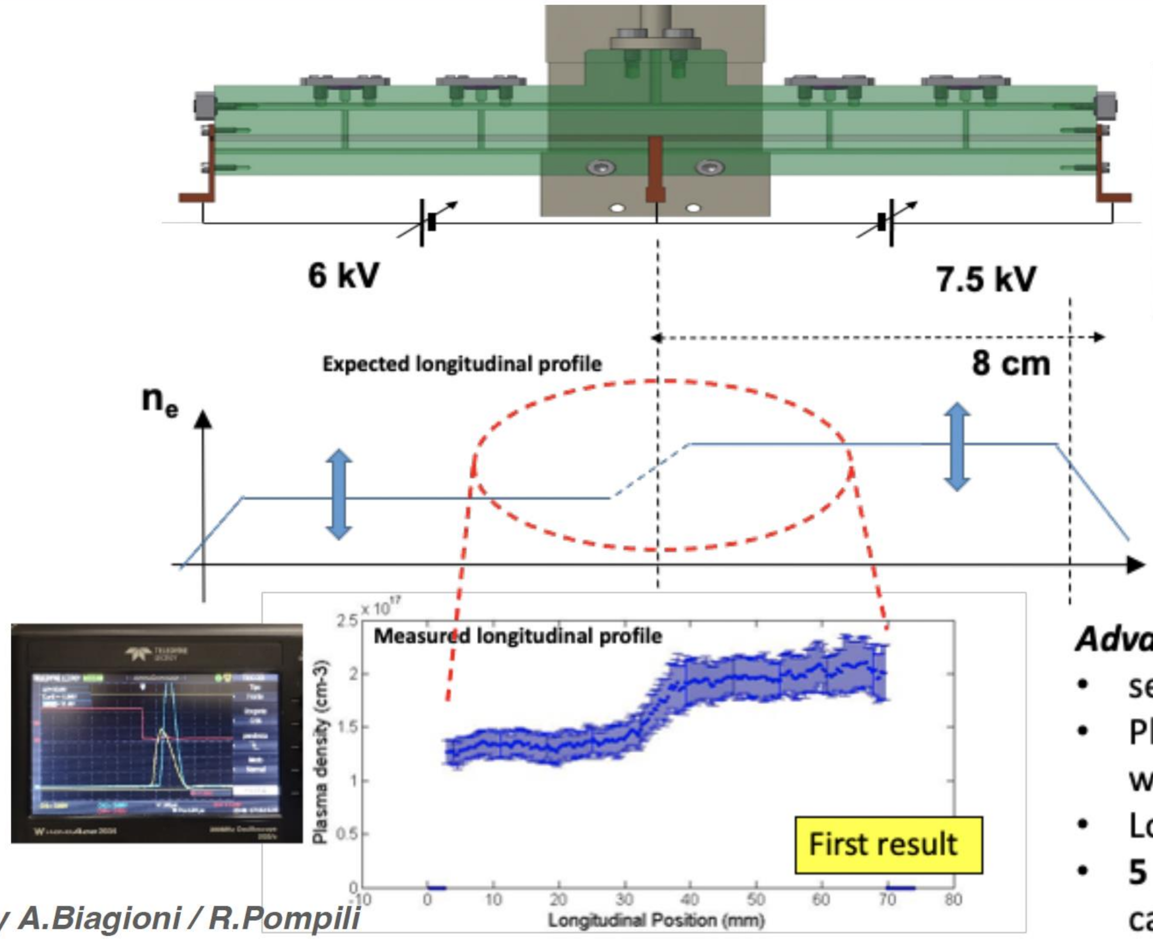
PARAMETER	Value	
	with linear tapering	w/o tapering
Frequency [GHz]	11.9942	
Average acc. gradient [MV/m]	**60**	
Structures per module	2	
Iris radius a [mm]	**3.85-3.15**	**3.5**
Tapering angle [deg]	0.04	0
Struct. length L_s act. Length (flange-to-flange) [m]	**0.94 (1.05)**	
No. of cells	112	
Shunt impedance R [MΩ/m]	93-107	100
Effective shunt Imp. $R_{sh\ eff}$ [MΩ/m]	350	347
Peak input power per structure [MW]	70	
Input power averaged over the pulse [MW]	51	
Average dissipated power [kW]	1	
P_{out}/P_{in} [%]	25	
Filling time [ns]	130	
Peak Modified Poynting Vector [W/µm^2]	3.6	4.3
Peak surface electric field [MV/m]	160	190
Unloaded SLED/BOC Q-factor Q_0	150000	
External SLED/BOC Q-factor Q_E	21300	20700
Required Kly power per module [MW]	**20**	
RF pulse [µs]	**1.5**	
Rep. Rate [Hz]	**100**	

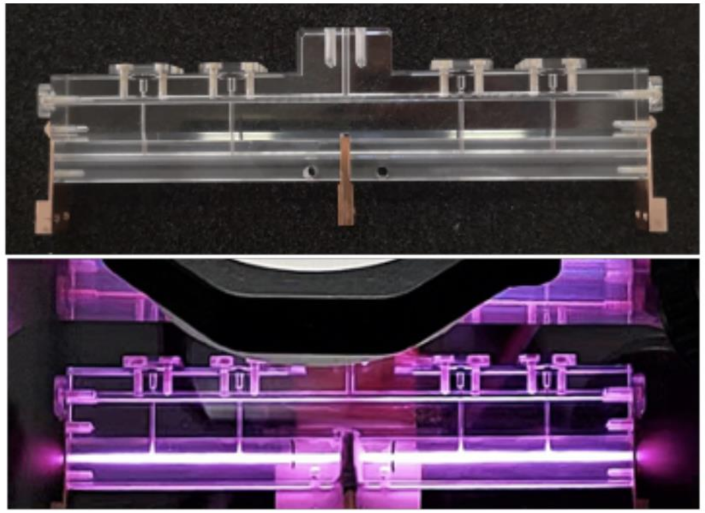




Courtesy D. Alesini

Plasma Module

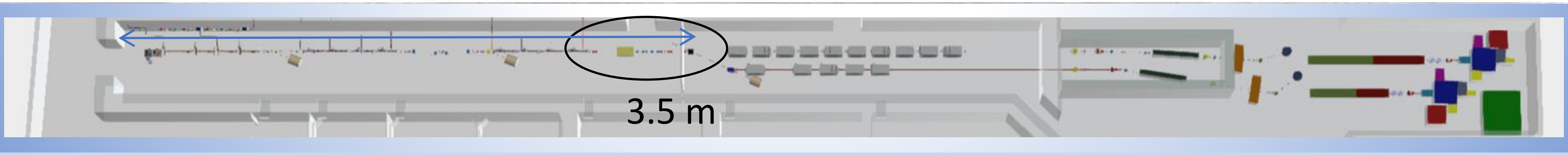




Advantages:

- several independently controllable sections
- Plasma sources larger than 40 cm (m-scale) with HV pulses less than 10 kV
- Longitudinal density modulation
- **5 GeV** case for EuPRAXIA (1.5 GV/m m-scale capillary - density 10^{16} cm-3)

Courtesy A.Biagioni / R.Pompili

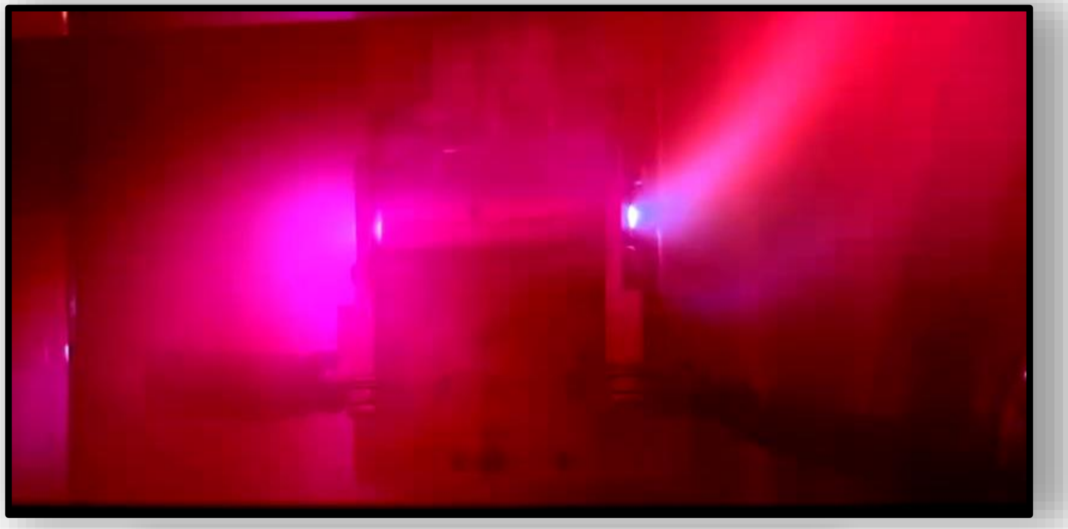


Courtesy A. Biagioni, R. Pompili

High repetition Rate capillary for EuPRAXIA

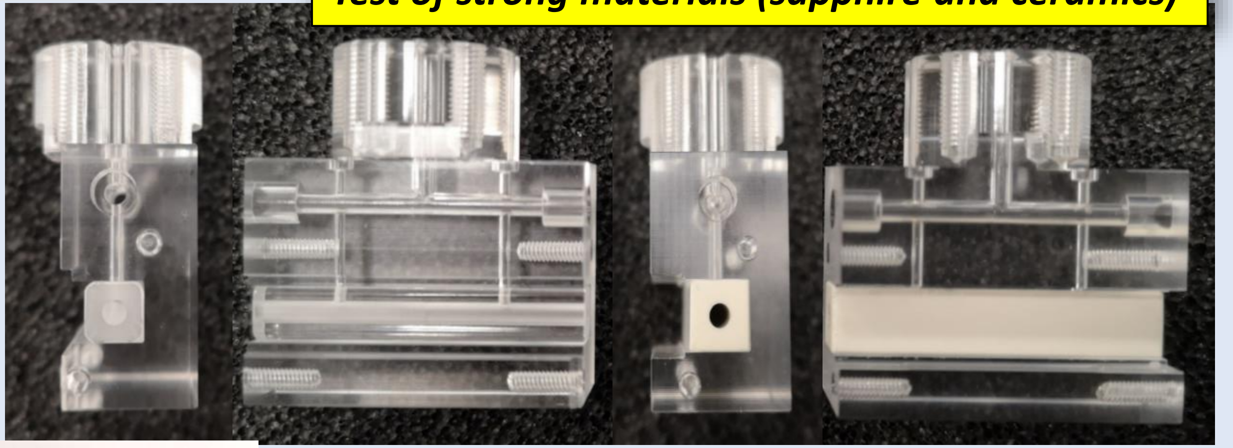
To operate at high repetition rate the key point is the thermal dissipation

1. Solid-state high repetition-rate discharge system
2. Strong materials capable of dissipating thermal energy
3. Vacuum systems suitable for continuous flow gas injection (turbo and primary pumps cooling system)

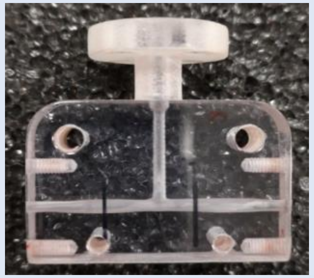


50 Hz repetition rate discharges

Test of strong materials (sapphire and ceramics)

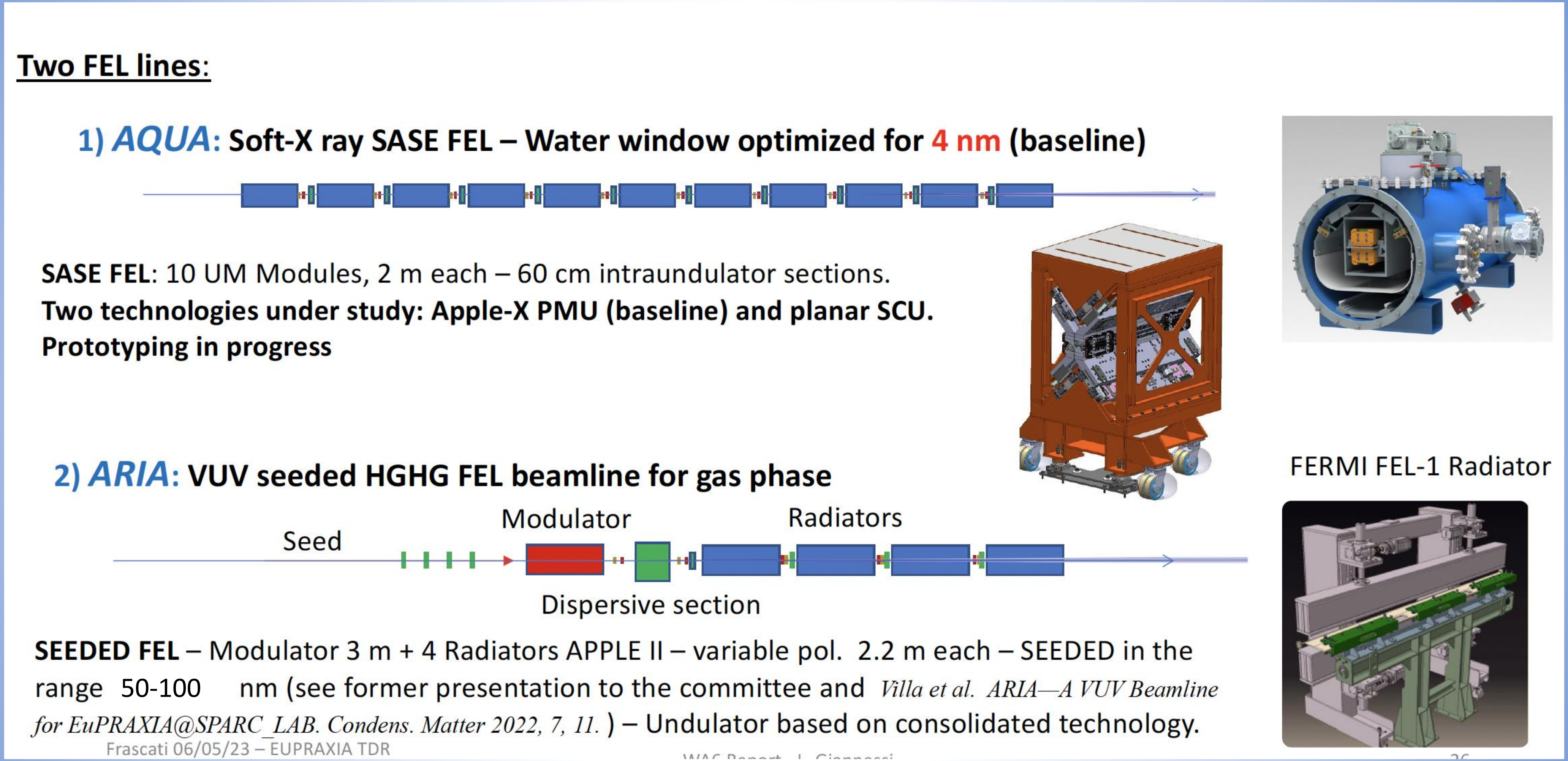


High repRATE can cause a rapid degradation of unsuitable soft materials



Courtesy A. Biagioni, L. Crincoli

Radiation Generation: FEL



Two FEL lines:

1) ***AQUA*****: Soft-X ray SASE FEL – Water window optimized for 4 nm (baseline)**

SASE FEL: 10 UM Modules, 2 m each – 60 cm intraundulator sections.
Two technologies under study: Apple-X PMU (baseline) and planar SCU.
Prototyping in progress

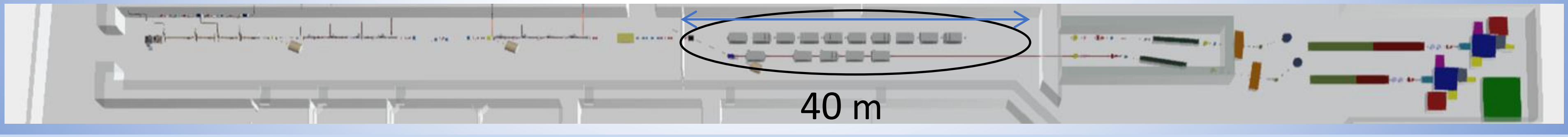
2) ***ARIA*****: VUV seeded HGHG FEL beamline for gas phase**

Seed
Modulator
Radiators
Dispersive section

FERMI FEL-1 Radiator

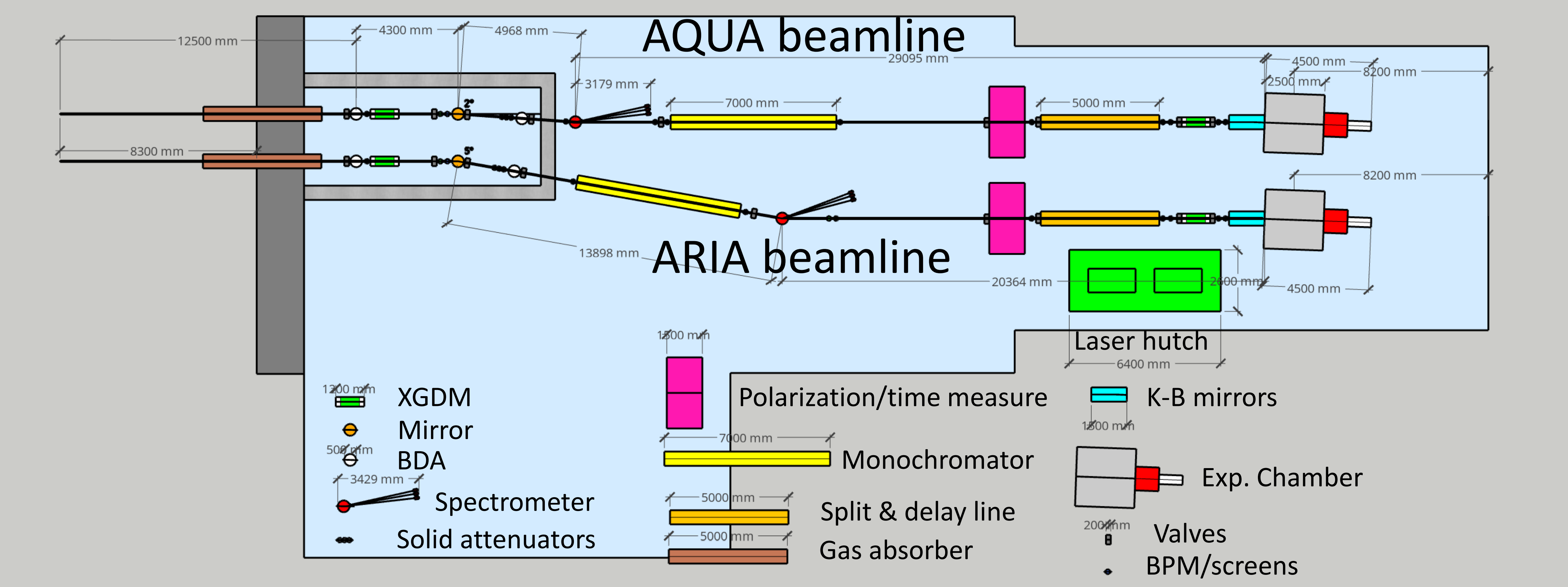
SEEDED FEL – Modulator 3 m + 4 Radiators APPLE II – variable pol. 2.2 m each – SEEDED in the range 50-100 nm (see former presentation to the committee and *Villa et al. ARIA—A VUV Beamline for EuPRAXIA@SPARC_LAB. Condens. Matter 2022, 7, 11.*) – Undulator based on consolidated technology.

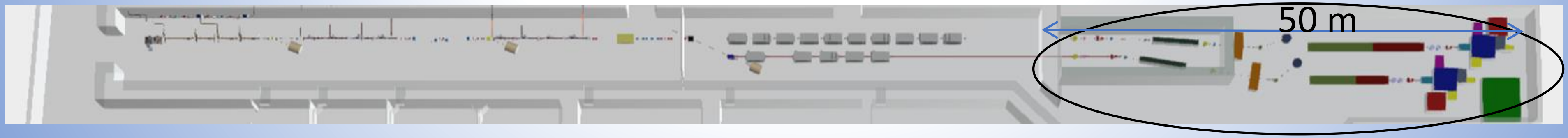
Frascati 06/05/23 – EUPRAXIA TDR



Courtesy L. Giannessi

FEL Beamlines



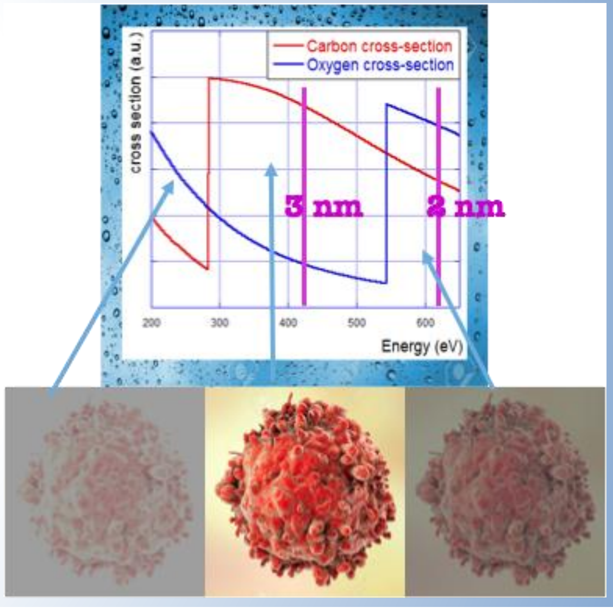


Expected SASE FEL performances

Parameter	**Unit**	PWFA	Full X-band
Electron Energy	GeV	**1**-*1.2*	1
Bunch Charge	pC	**30**-***50***	**200**-***500***
Peak Current	kA	1-2	1-2
RMS Energy Spread	%	**0.1**	0.1
RMS Bunch Length	μm	6-3	24-20
RMS norm. Emittance	μm	1	1
Slice Energy Spread	%	≤0.05	≤0.05
Slice norm Emittance	mm-mrad	0.5	0.5

Parameter	**Unit**	PWFA	Full X-band
Radiation Wavelength	nm	**3-4**	**4**
Photons per Pulse	$\times 10^{12}$	**0.1- 0.25**	1
Photon Bandwith	%	**0.1**	0.5
Undulator Area Length	m	30	
ρ(1D/3D)	$\times 10^{-3}$	**2**	2
Photon Brilliance per shot	$s\ mm^2 mrad^2$ $bw(0.1\%)$	$\mathbf{1{-}2\ \times 10^{28}}$	$1\ \times 10^{27}$

In the Energy region between Oxygen and Carbon K-edge 2.34 nm – 4.4 nm (530 eV -280 eV) water is almost transparent to radiation while nitrogen and carbon are absorbing (and scattering)



Coherent Imaging of biological samples protein clusters, VIRUSES and cells living in their native state
Possibility to study dynamics
~10 ^{11} photons/pulse needed

Courtesy F. Stellato, UniToV

Courtesy C. Vaccarezza/L. Giannessi

Finanziato dall'Unione europea
NextGenerationEU

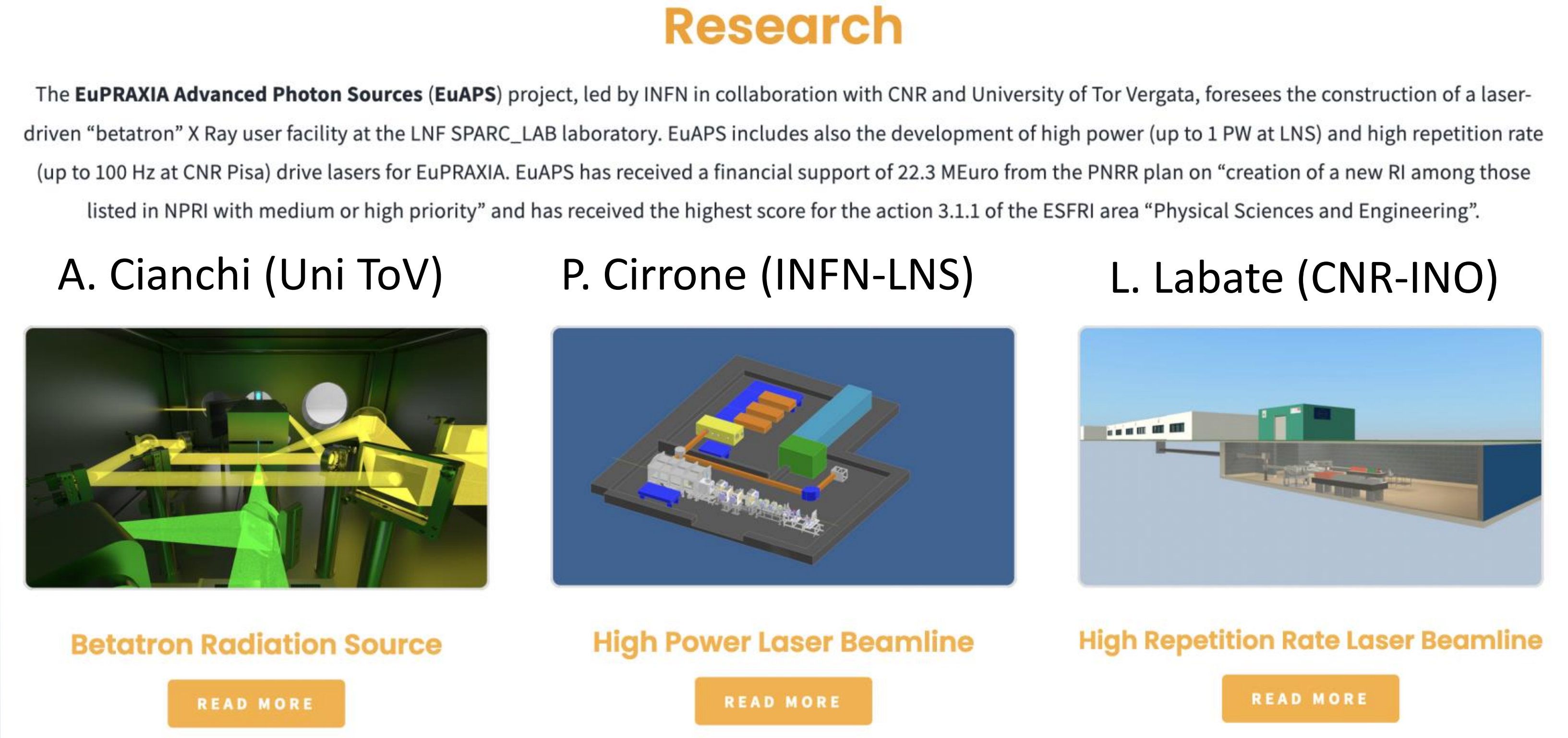
Ministero dell'Università e della Ricerca

Italiadomani
PIANO NAZIONALE DI RIPRESA E RESILIENZA

EuPRAXIA
Advanced Photon Sources

EuAPS: EuPRAXIA Advance Photon Sources

- Principal Investigator: M. Ferrario,
- Infrastructure Manager: C. Bortolin,
- Management and Dissemination: A. Falone



Research

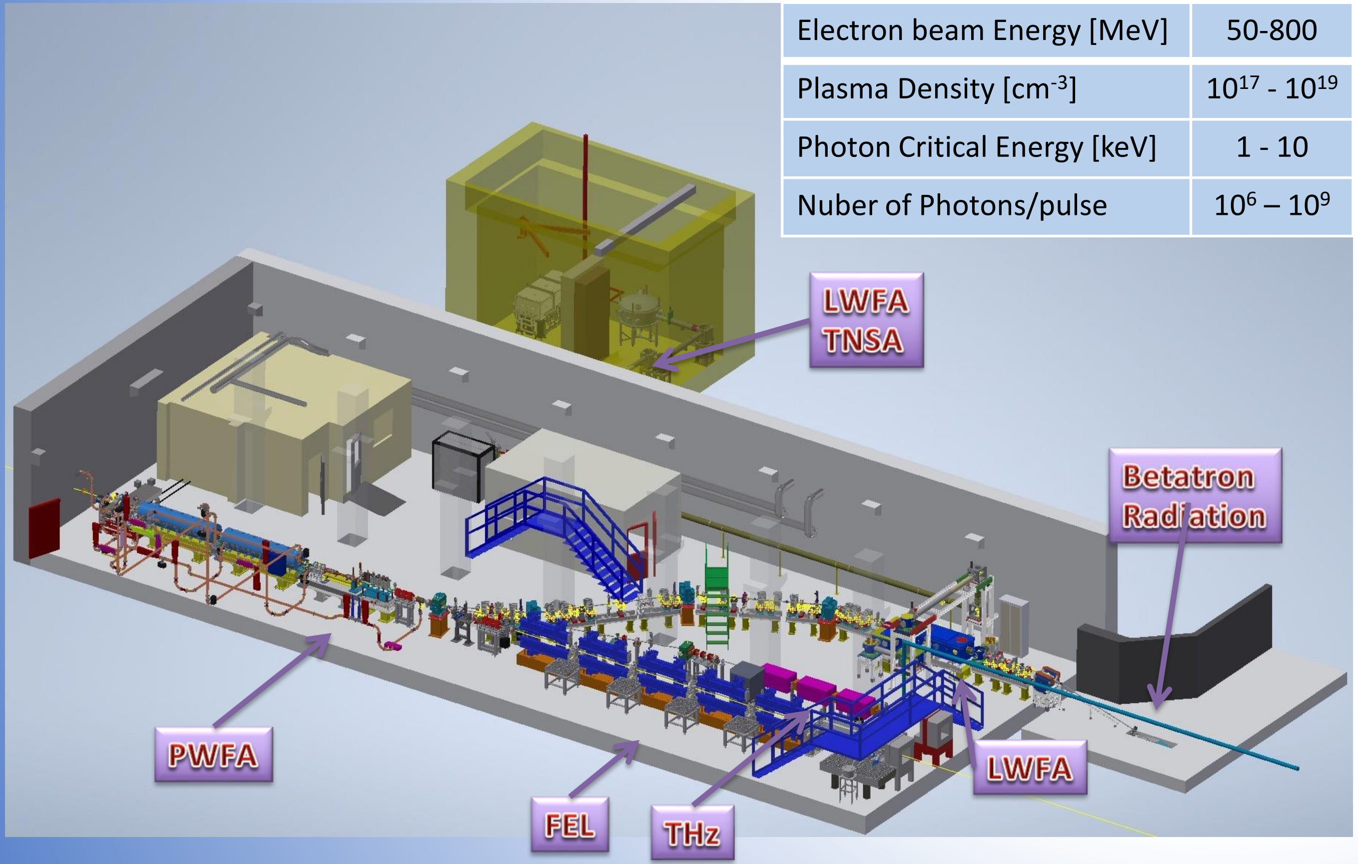
The **EuPRAXIA Advanced Photon Sources** (**EuAPS**) project, led by INFN in collaboration with CNR and University of Tor Vergata, foresees the construction of a laser-driven “betatron” X Ray user facility at the LNF SPARC_LAB laboratory. EuAPS includes also the development of high power (up to 1 PW at LNS) and high repetition rate (up to 100 Hz at CNR Pisa) drive lasers for EuPRAXIA. EuAPS has received a financial support of 22.3 MEuro from the PNRR plan on “creation of a new RI among those listed in NPRI with medium or high priority” and has received the highest score for the action 3.1.1 of the ESFRI area “Physical Sciences and Engineering”.

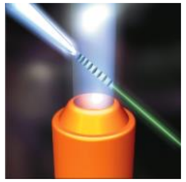
A. Cianchi (Uni ToV)	P. Cirrone (INFN-LNS)	L. Labate (CNR-INO)
Betatron Radiation Source	High Power Laser Beamline	High Repetition Rate Laser Beamline
READ MORE	READ MORE	READ MORE

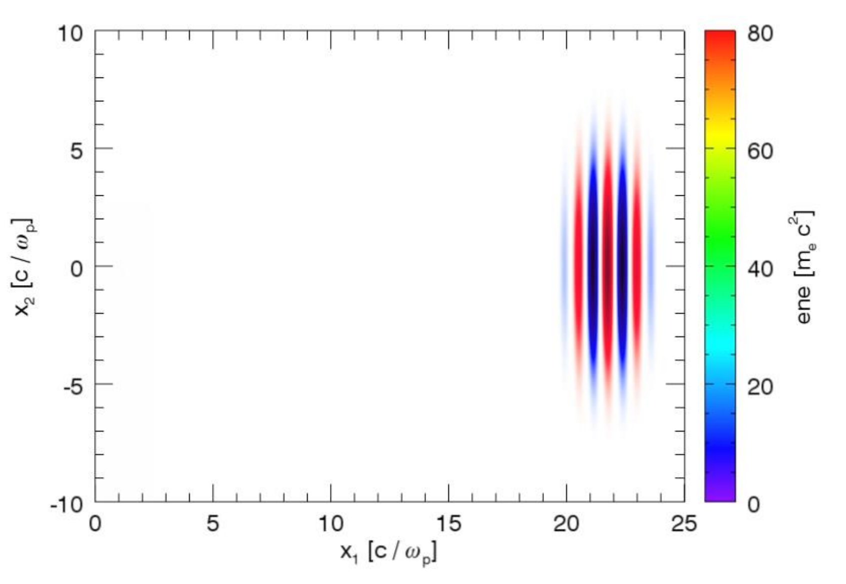
M. Ferrario et al. INFN-23-12-LNF (2023)

Betatron Radiation Source at SPARC_LAB

Electron beam Energy [MeV]	50-800
Plasma Density [cm^{-3}]	10^{17} - 10^{19}
Photon Critical Energy [keV]	1 - 10
Nuber of Photons/pulse	10^6 – 10^9







Courtesy J. Vieira, R. Fonseca/GoLP/IST Lisbon

NEXT STEP: PACRI?

Funded by the European Union

- **HORIZON-INFRA-2024-TECH-01-01: R&D for the next generation of scientific instrumentation, tools, methods, solutions for RI upgrade**

- **Dead line 12 March 2024**

- **Target Budget ~10 MEuro**

25 Members
+
1 Associated partner

19 Universities and Scientific Labs.
+
7 Industries

#	Partner	Acronym
1	Elettra - Sincrotrone Trieste SCpA (Coordinator)	ST
2	European Organization for Nuclear Research	CERN
3	Istituto Nazionale Fisica Nucleare	INFN
4	University of Liverpool	ULIV
5	Thales-MIS	Th-MIS
6	Scandinova Systems AB	SCND
7	VDL ETG Technology & Development BV	VDL
8	COMEB	COMEB
9	United Kingdom Research and Innovation	UKRI
10	Consiglio Nazionale delle Ricerche	CNR
11	Extreme Light Infrastructure ERIC	ELI-ERIC
12	Centre National de la Recherche Scientifique CNRS	CNRS
13	Thales LAS France SAS	Th-LAS
14	Amplitude	Amplitude
15	Centro de LÁSERES Pulsados	CLPU
16	Ferdinand-Braun-Institut gGmbH, Leibniz-Institut für Hoechstfrequenztechnik	FBH
17	Associacao do instituto superior Tecnico para a Investigacao e Desenvolvimento	IST
18	Università degli Studi di Roma La Sapienza	USAP
19	Heinrich-Heine-Universitaet Duesseldorf	UDUS
20	Deutsches Elektronen-Synchrotron DESY	DESY
21	The Chancellor, Masters and Scholars of the Univ. of Oxford	UOX
22	Ludwig-Maximilians-Universitaet Muenchen	LMU
23	GSI Helmholtz Centre for Heavy Ion Research	GSI
24	Università degli Studi di Roma Tor Vergata	UTOR
25	SourceLAB	SourceLAB
26	Paul Scherrer Institut (Associated partner)	PSI

WP No.	Work Package Title	Lead Partic. Short Name
1	Coordination and project management	**ELETTRA**
2	Scientific and industrial exploitation	**ULIV**
3	Plasma accelerator theory and simulations	**IST**
4	High repetition rate plasma structures	**INFN**
5	Plasma acceleration diagnostics and instrumentation	**CNRS**
6	High efficiency RF generator	**Thales-MIS**
7	High repetition rate modulator	**Scandinova**
8	X-band RF Pulse Compressor (BOC)	**INFN**
9	RF tests and validation	**CERN**
10	High repetition rate high power Ti:Sa amplifier module	**UKRI**
11	Efficient kHz laser driver modules for plasma acceleration	**CNR**
12	High-rep rate pump sources for laser drivers	**ELI-ERIC**
13	Prototype of high average power optical compressor	**Thales-LAS**
14	Laser Driver System Architecture,transport and engineering	**CNRS**

Plasma Accelerators for Compact Research Infrastructures (PACRI)

Funded by the European Union

The objective of the **PACRI** project is to develop innovative breakthrough technologies, increasing their Technology Readiness Level (TRL) for electron accelerators while taking energy consumption, resource efficiency, costs, and environmental impact into due account. This includes the following draft non-exclusive goals:

- **developing high rep-rate plasma modules,** as required for the EuPRAXIA project, extending its scientific domain from high average brightness radiation sources up to high energy physics;
- **developing key laser components required to upscale high-power high repetition rate Laser technology** as required by the EuPRAXIA and ELI Research Infrastructure.
- **improving the performance of normal conducting technology for X-band linac drivers,** extending them to the kHz regime, with focus on efficiency and energy consumption;
- **supporting development towards compact linear colliders and nuclear physics facilities;**
- **developing compact advanced undulator modules,** in order to reduce the overall size of the future FEL facilities.
- **supporting the availability of compact X-ray facilities (FELs, ICSs, Betatron)** to serve a larger number of users in many scientific fields, industry and society;

EuPRAXIA Workshop

22-27 September 2024

Elba

- **EuPRAXIA_PP Annual Meeting**
- **M15.2** Workshop on “EuPRAXIA@SPARC_LAB machine upgrade and additional beam lines“ (M20) giugno 2024 [Pompili, Vaccarezza]
- **M6.1** Outreach Workshop (M24) ottobre 2024 [Cros, Mostacci]

A warm thank to the IFAST project for supporting the EuRONNAC -> EAAC-> EuPRAXIA activities that allowed the consoldation of the Plasma Accelerator Community in EuROPE.

Looking forward to seeing you all at EAAC 2025!

Conclusions and Acknowledgemet

Funded by the European Union

- Plasma accelerators have advanced considerably in beam quality, **achieving FEL lasing**.
- EuPRAXIA is a design and an ESFRI project for a distributed European Research Infrastructure, **building two plasma-driven FEL´s in Europe**.
- EuPRAXIA FEL site in Frascati LNF-INFN is sufficiently funded for **first FEL user operation in 2028**.
- Second EuPRAXIA FEL site will be selected in next months, among **4 excellent candidate sites**.

- **A warm thank to the IFAST project for supporting the EuRONNAC -> EAAC-> EuPRAXIA activities that allowed the consoldation of the Plasma Accelerator Community in EuROPE.**

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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.

Operating properties

- Discharges synchronization
  - Lenses synchronized with the beam entrance
  - Central discharge applied 3 µs before for plasma acceleration
- 10 kV voltage resulting in:
  - 500 A on the lenses
  - 250 A in the accelerator