EuPRAXIA

Scientific Committee - 04/05/2023

Antonio Falone
On behalf of the EuPRAXIA Team

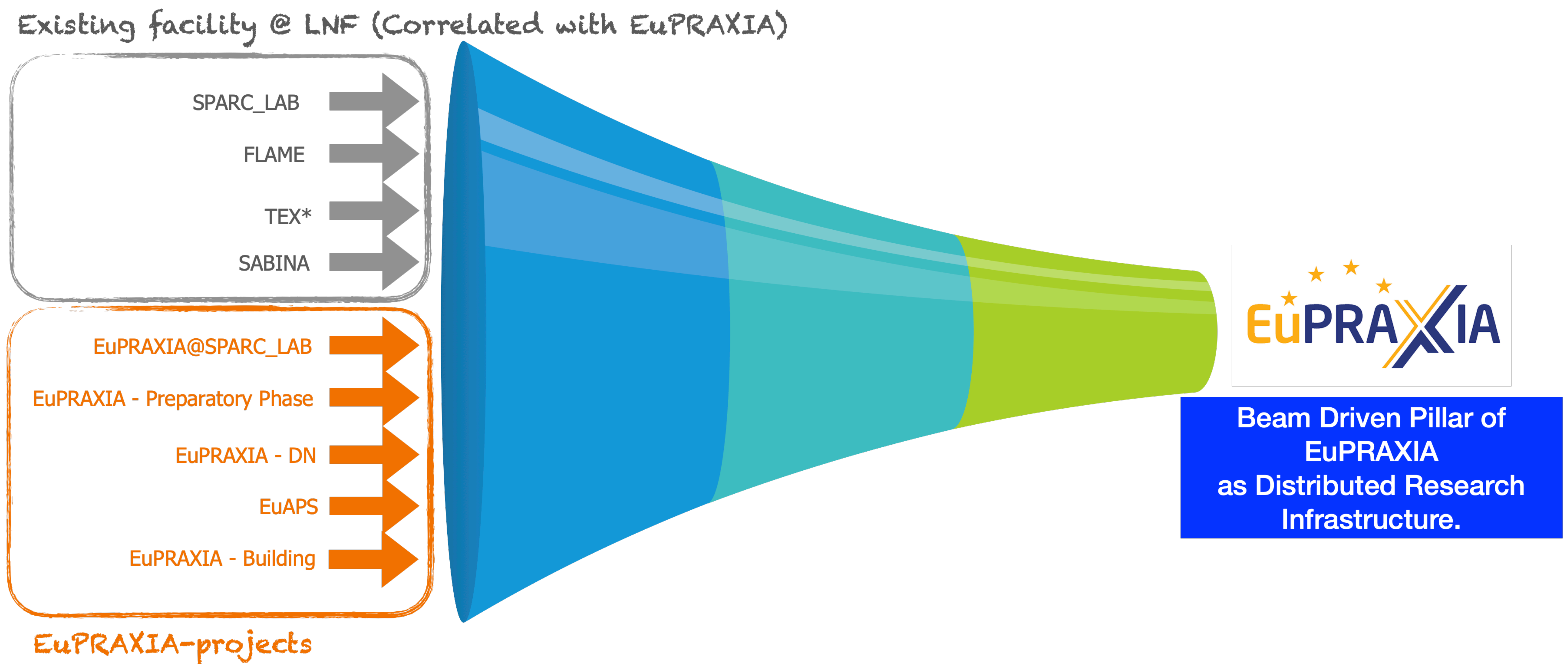
EuPRAXIA Galaxy

EuPRAXIA is naturally evolving from one single project to a program i.e. a set of correlated projects in order to achieve a common goal → Building a Research Infrastructure based on beam driven plasma acceleration and X-Band Linac.

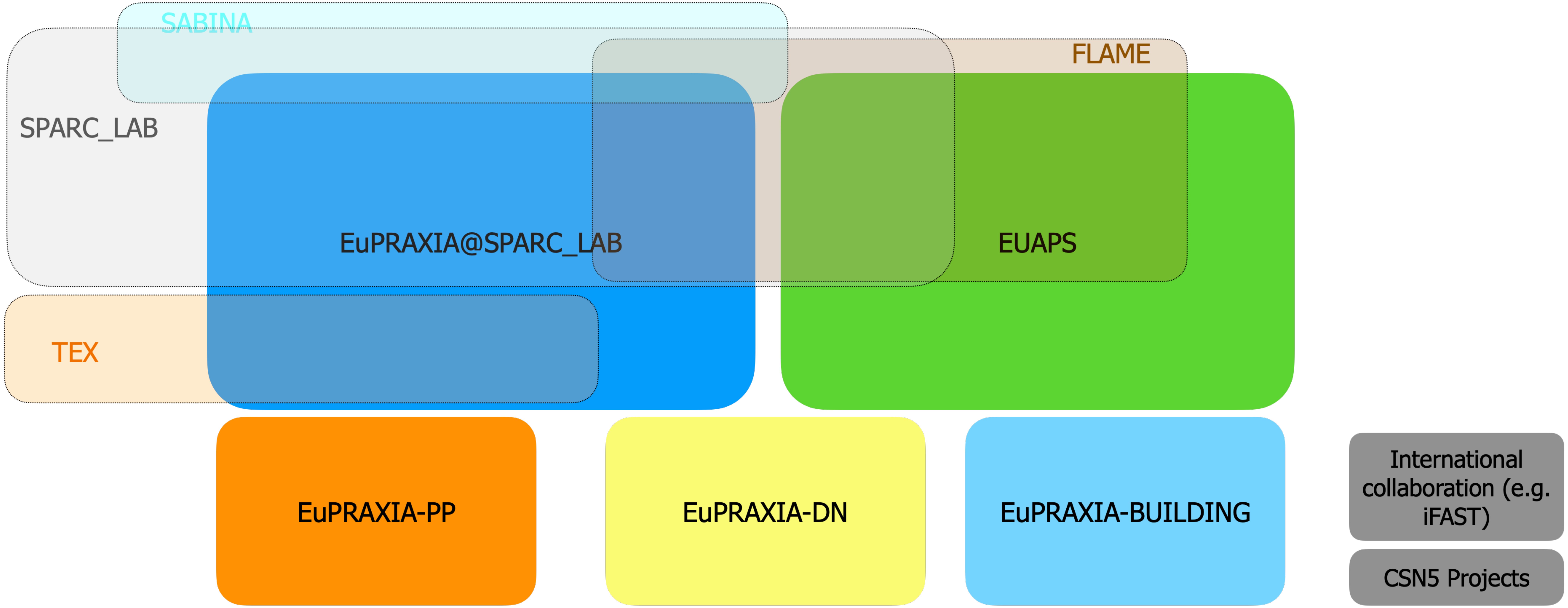
PROJECT → PROGRAM

EuPRAXIA Galaxy

Existing facilities at LNF serve all EuPRAXIA projects



EuPRAXIA Galaxy

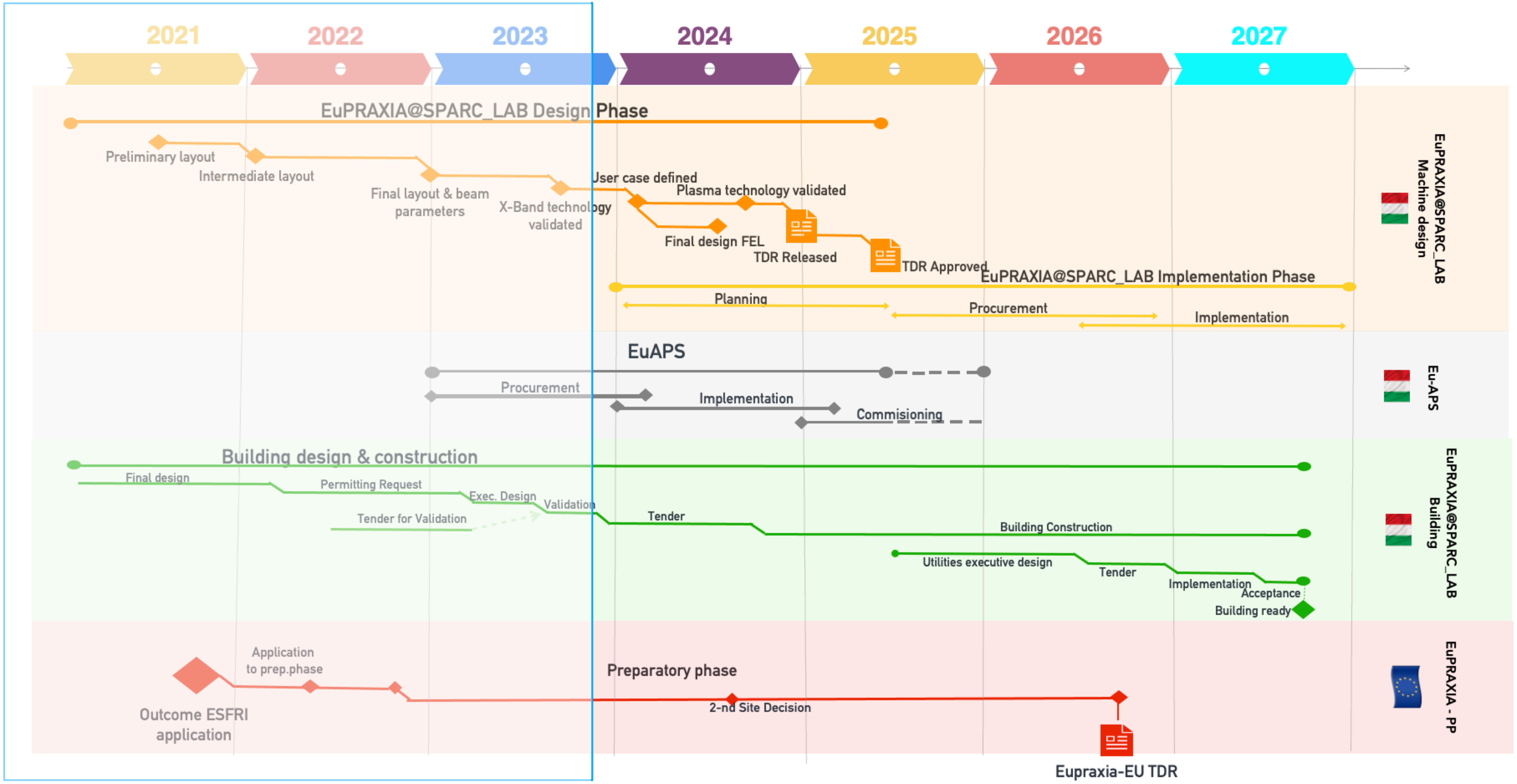


This is just a tentative visualization of the correlation between all EuPRAXIA related activities. The real world is even more complicated, all of them in fact share the same resources and we are not considering here other projects (e.g. STAR, ELI) and of course the activities carried out at the DAFNE Complex (Dafne + Linac + BTF).

EuPRAXIA Galaxy

	EuPRAXIA@SPARC_LAB	EuPRAXIA Building	EuAPS	EuPRAXIA-Preparatory Phase	EuPRAXIA - Doctoral network
Scope	Redaction of the TDR of the Beam Driven Pillar	Design and construction of the building that will house the facility	Betatrone Source High Power Laser High Repetition Rate Laser	Definition and design of EuPRAXIA as distributed RI (legal, governance, financial model)	10 PhD programs across Europe on plasma accelerator science
Duration	TDR is expected at the end of 2025	End of 2027 (approx)	30months (+6) Not later than 31/12/2025	48 months 30/10/2026	48 months 31/12/2026
Budget	9 M€	To be assessed. O(40M€)	22,3 M€	2,7 M€ (+ In kind contribution)	2,5 M€ (+ In kind contribution)
Funding source	Internal funding through GE	Internal funding through GE	PNRR	Horizon Europe	Horizon Europe
R&D required	Yes	NO	Some	NO	NO
Partner	Mainly internal LNF with some partnership with Elettra, ENEA UniTOV, Uniroma1, INFN-MI	Internal LNF	LNF, LNS, INFN-MI (INFN) CNR UniTOV	25 Partner + 9 Associated	23 Partner + 15 Associated

EuPRAXIA Galaxy



EuPRAXIA Galaxy

- Status EuPRAXIA Preparatory Phase

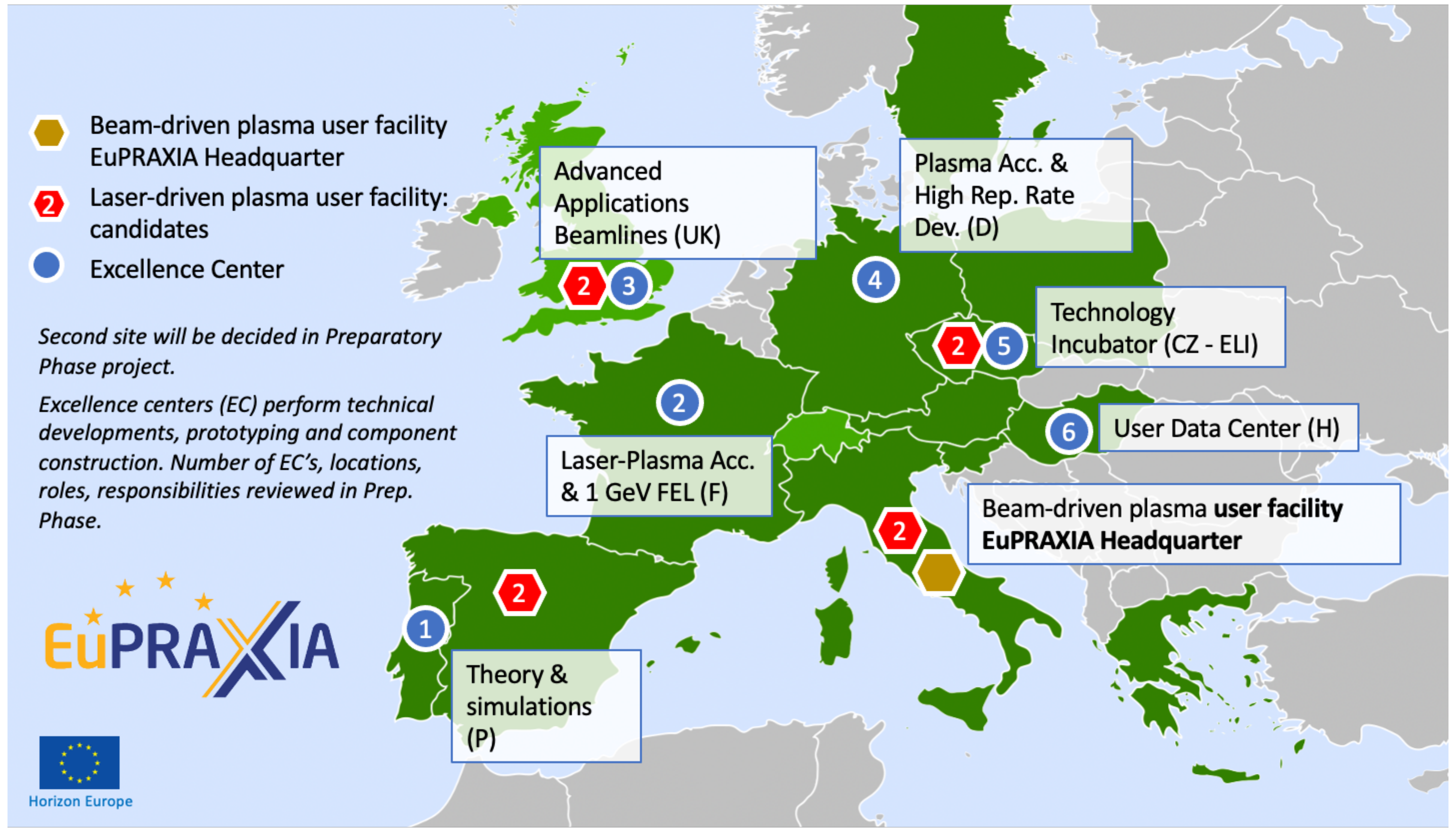
- Status EuPRAXIA Building

- Status EuPRAXIA@SPARC_LAB

- Status EuPRAXIA Advanced Photon Sources, EuAPS

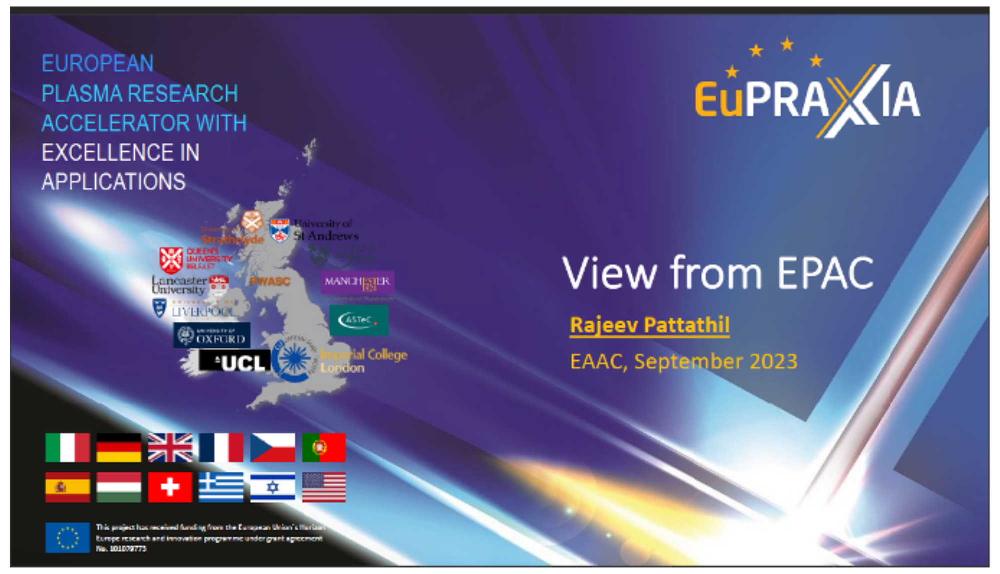
EuPRAXIA Preparatory Phase

- ✓ First year is over —> Technical & Financial Reporting is ongoing
- ✓ First batch of M12 deliverables produced on time and uploaded in the portal
- ✓ A number of dedicated workshops and meeting took place during the year, mostly to discuss the future architecture of the EuPRAXIA European Facility.
- ✓ Survey on possible in-kind contributions has been done.



EuPRAXIA Preparatory Phase

- ✓ Discussions on 2nd site decision are ongoing.
- ✓ So far 4 potential (outstanding candidates):
  - ELI-ERIC (Cz)
  - EPAC (UK)
  - CNR-INO (IT)
  - CLPU (ES)
- ✓ A first round of visit and discussion will be finalized at beginning of 2024.
- ✓ Afterwards requirements will be formalized and a bid-book will be prepared to formalize the commitment.



Building Status

- Final design finalized
- Formal authorization from permitting authorities received
- Tender for the validation of the executive design issued
- Executive design kick-off meeting on the 18th October 2023.

DONE

- Executive design in progress

On Going

Courtesy S.Incremona, U.Rotundo

Building Status - rendering

694

APPROVED

MINISTERO DELLE INFRASTRUTTURE E DEI TRASPORTI

PROVVEDITORATO INTERREGIONALE PER LE OO.PP. PER IL LAZIO, L'ABRUZZO, LA SARDEGNA

* * * * *

VIA MONZAMBANO, 10 – ROMA

AVVISO

ai sensi dell'art. 29 del D.Lgs. 18 aprile 2016, n. 50

O[illegible]: C.[illegible] n. [illegible]4 - Realizzazione [illegible] un nuovo complesso edilizio EuSPARC per ospitare la facility EuPRAXIA presso i Laboratori Nazionali di Frascati INFN.

Amministrazione Proponente: [illegible]N Istituto Nazionale di Fisica Nucleare

Si comunica [illegible] ai sensi dell'art. 14-bis comma 5 della L. 241/90 e ss.mm. e ii., è da considerarsi acquisito l'assenso sul progetto in argomento da parte delle Amministrazioni invitate alla Conferenza. Si **DICHIARA**, pertanto, sulla scorta degli atti acquisiti, perfezionata l'intesa per la localizzazione e realizzazione dell'opera indicata in oggetto e, di conseguenza, AUTORIZZATO il relativo progetto definitivo.

Gli atti del procedimento sono in visione presso la Segreteria dell'Ufficio Conferenze di Servizi di questo Provveditorato

IL DIRIGENTE	IL RESPONSABILE DEL PROCEDIMENTO	IL PROVVEDITORE
Dott. Ing. Carlo Guglielmi	Dott. Arch. Alessia Costa	Dott. Ing. Vittorio Rapisarda Federico

Firmato digitalmente da CARLO GUGLIELMI O = MIMS C = IT

Alessia Costa MIMS 19.05.2023 13:22:39 GMT+00:00

VITTORIO RAPISARDA FEDERICO Ministero delle Infrastrutture e dei Trasporti 23.05.2023 11:37:37 GMT+01:00

Roma, li ____________

PUBBLICATO ____________

RITIRATO ____________

ISO 9001 BUREAU VERITAS Certification

Courtesy S.Incremona, U.Rotundo

Building Status - rendering

Vista del nuovo complesso da Via Isaac Newton

Vista aerea del nuovo complesso dalla parte del nuovo parcheggio

Courtesy S.Incremona, U.Rotundo

EuPRAXIA@SPARC_LAB

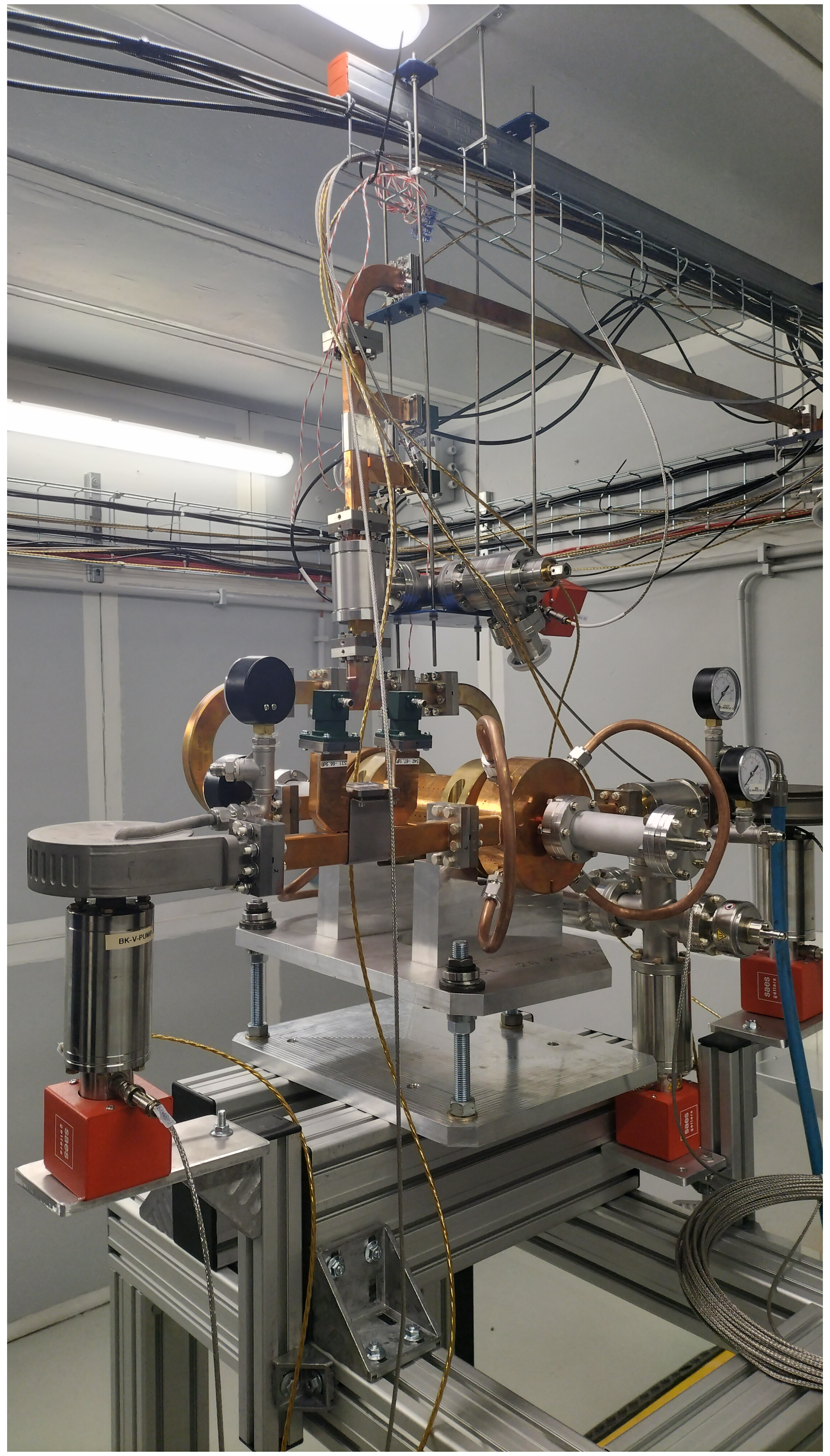
RF Power Source

- ✓ RF design of X-Band waveguide components is completed (e.g. mode converter and pumping port)
- ✓ Procurement High Efficiency High Power CPI Klystron (50MW) – Concluded. Preliminary design review completed (09/23), final design review scheduled on the 25th of November - ON TIME
- ✓ Procurement High Repetition Rate Canon Klystron through Scandinova is almost finished - FAT scheduled on the 14th November 2023.
- ✓ TEX Facility – Operating. Test on CERN/ PSI X-Band section. Test on Circular Waveguide & mode converter.
- ✓ Optimization of the RF Distribution on going (Choice on RF system for linearizer and deflector - dedicated RF station or distributed waveguide system)

Courtesy F.Cardelli / S.Pioli

RF Power Source

✓ TEX Facility – Operating. Test on CERN/ PSI X-Band section (WG system already conditioned)

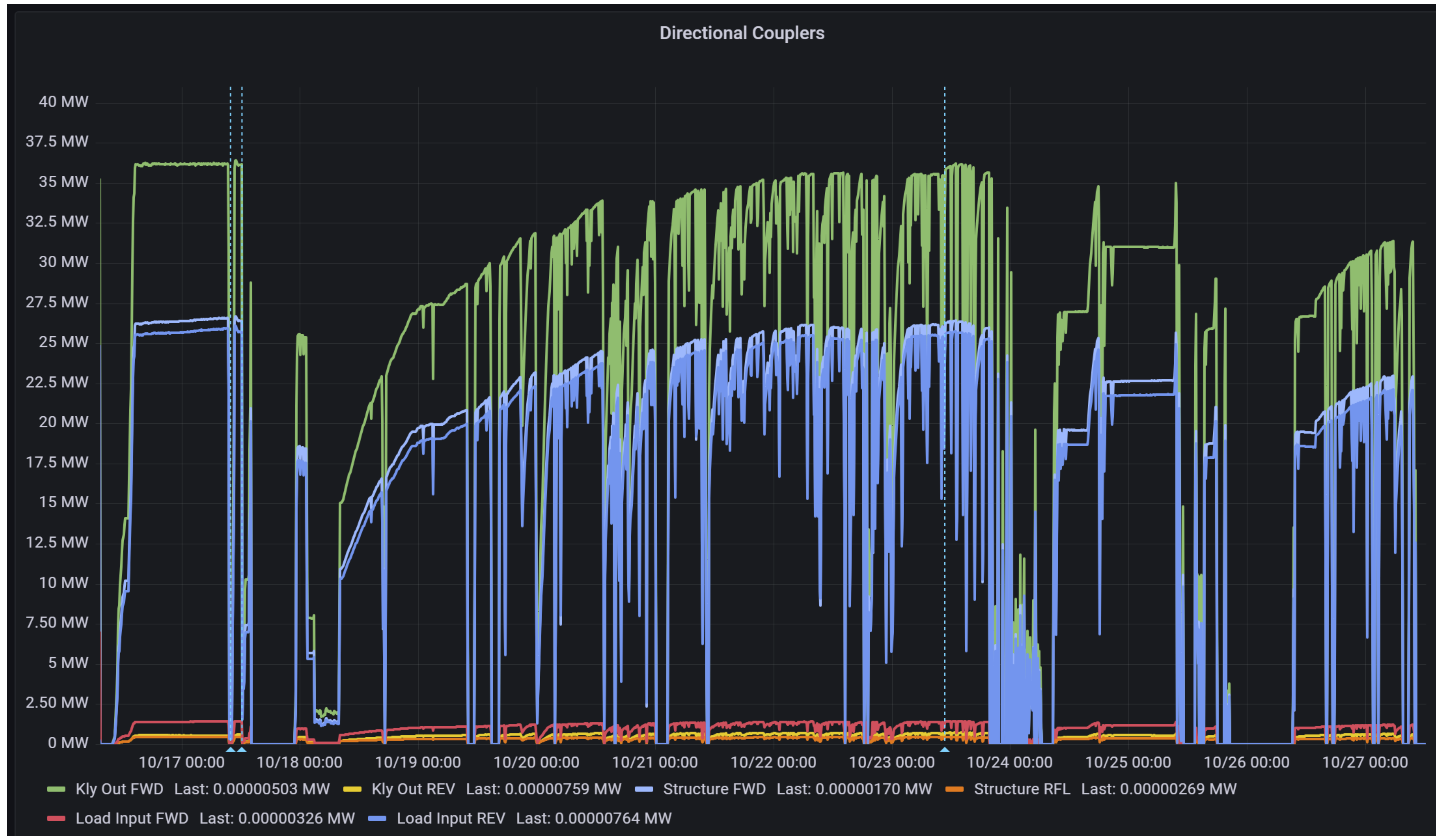


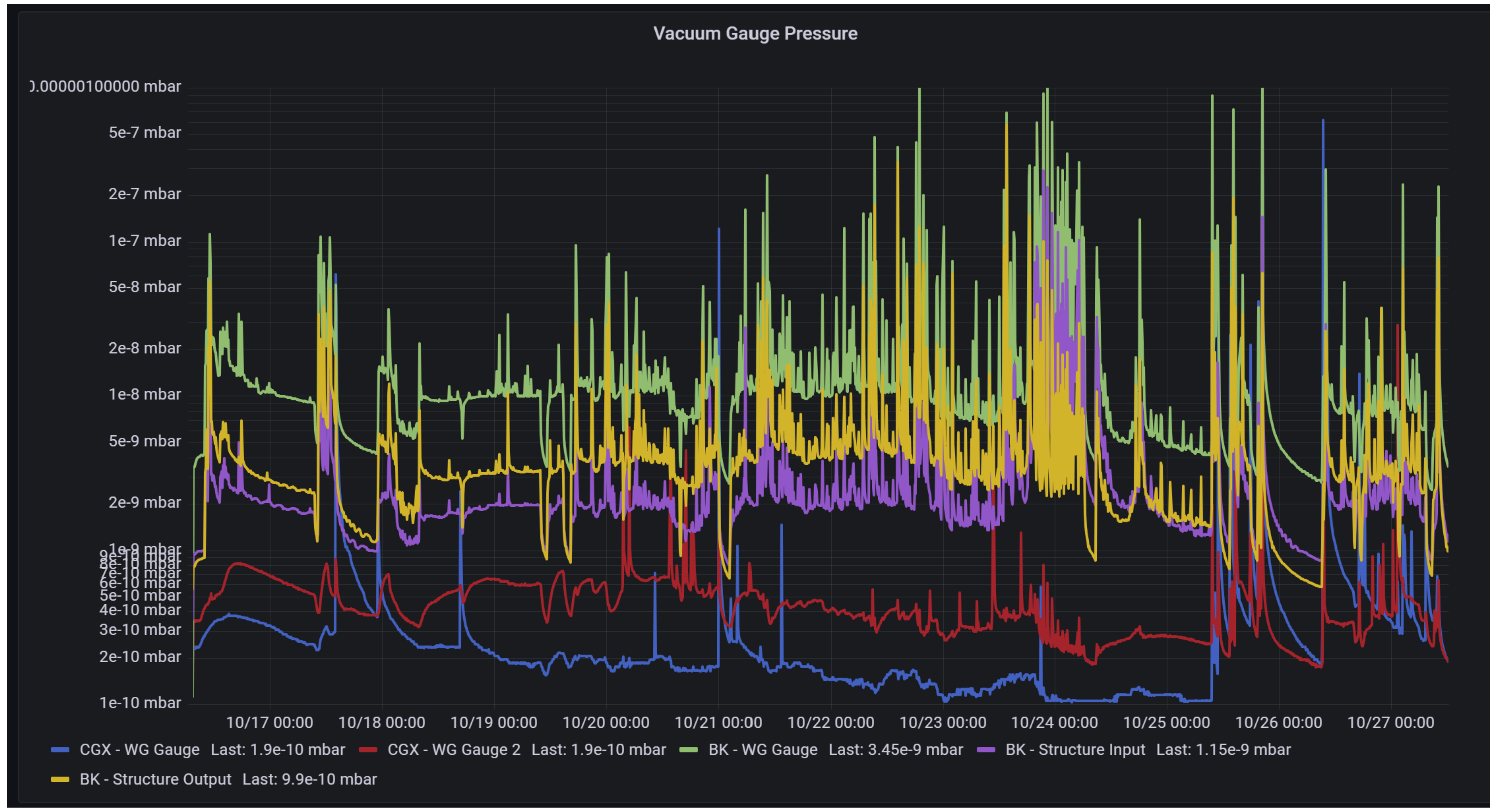
RF Power Source

✓ TEX Facility – Operating. Test on waveguide circular mode converter successfully completed.

Courtesy F.Cardelli & S.Pioli

RF Power Source





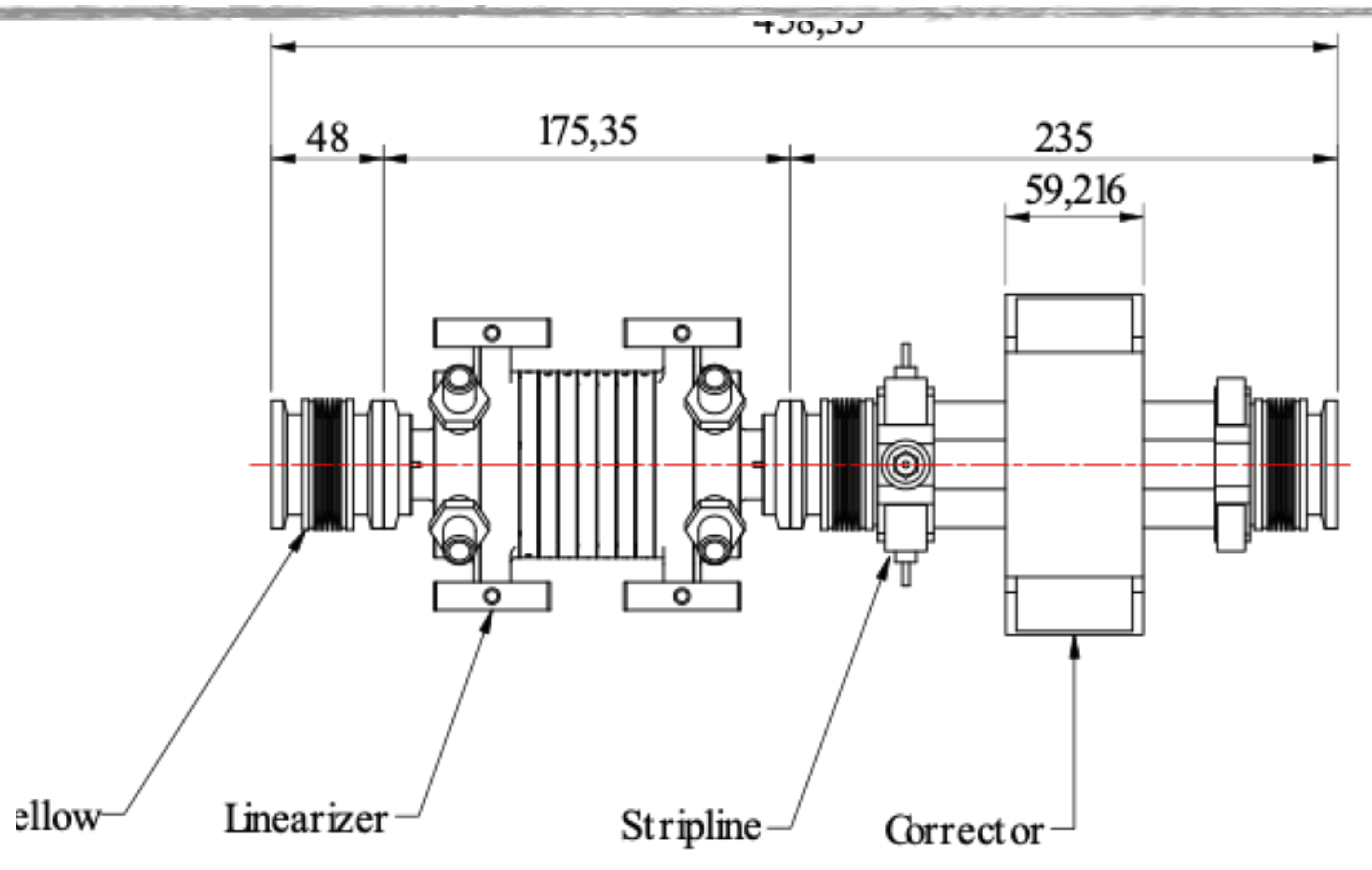
Courtesy F.Cardelli & S.Pioli

Injector

Injector study is now frozen and approved

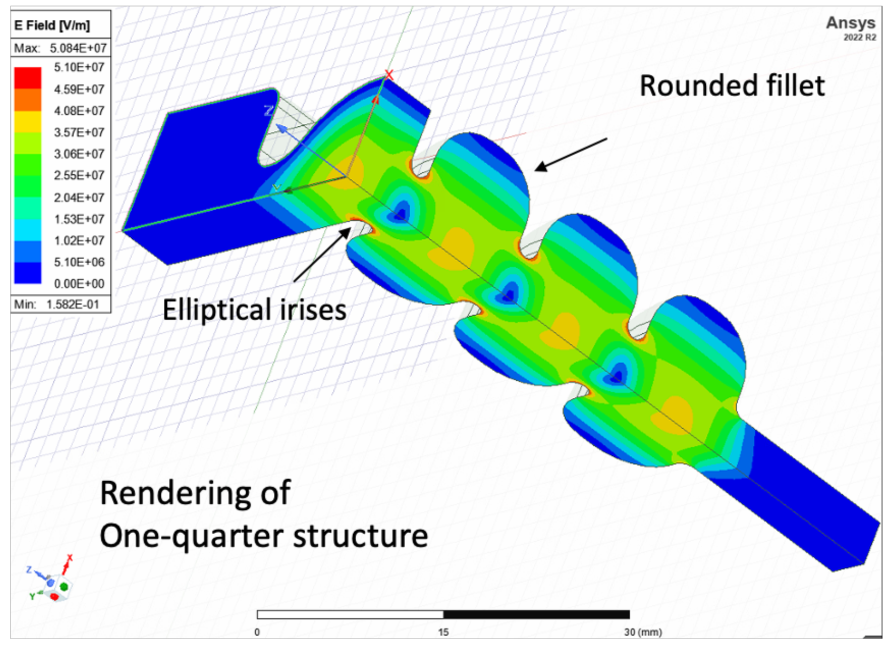
Optimization of the RF distribution taking into account the X-Band linearizer and the 4 S-Band sections are ongoing

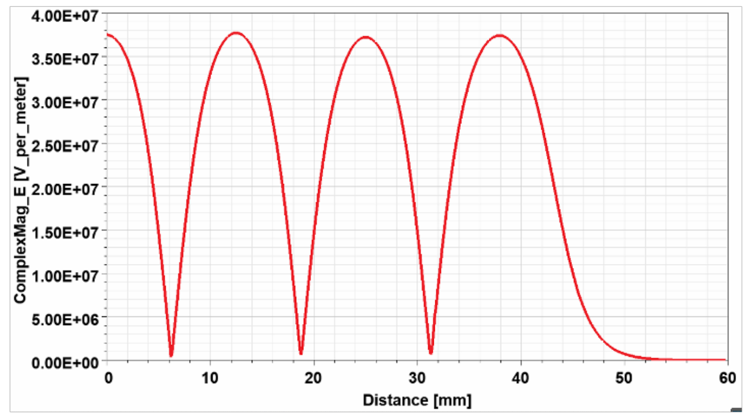
- ✓ Injector layout
- ✓ High charge working point
- ✓ RF distribution for the S-Band system
- ✓ Jitter and sensitivity studies ongoing
- ✓ Comb Beam and S-Band optimization (3+2+2+2)



- iris aperture radius a = 4 mm
- Number of cells = 7
- Cavity Length (from rendering) = 12 cm
- pi mode
- Accelerating Gradient = 20 MV/m

a = 4 mm	
Resonant frequency, f	11.9942 GHz
Quality factor, Q	9,900
Eff. Shunt Impedance, r	83.5 MΩ/m
Eacc	20 MV/m
Epeak	38 MV/m
Number of cells	7
Coupling coefficient, β	1.23
Field build-up, τ	117 ns
Pin	400 kW

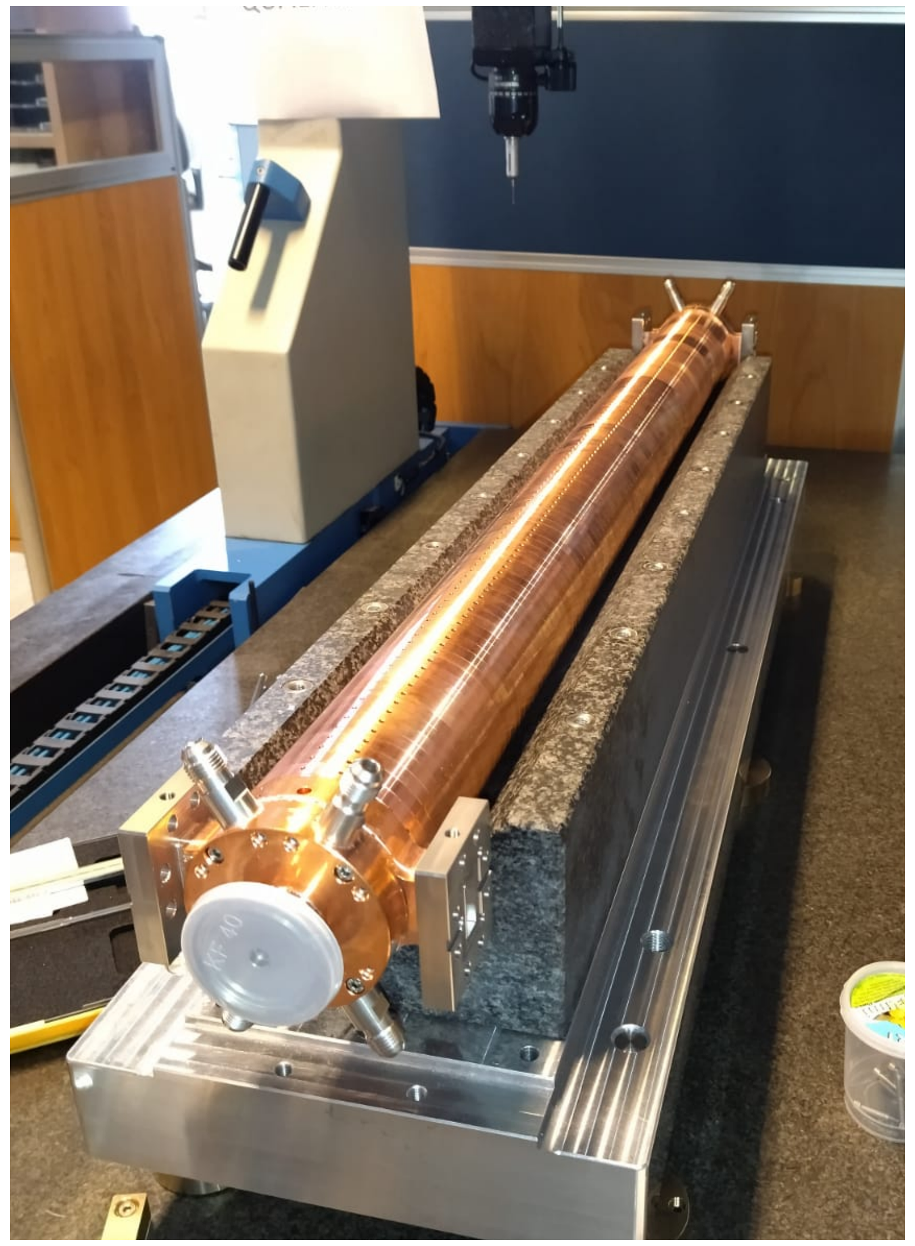


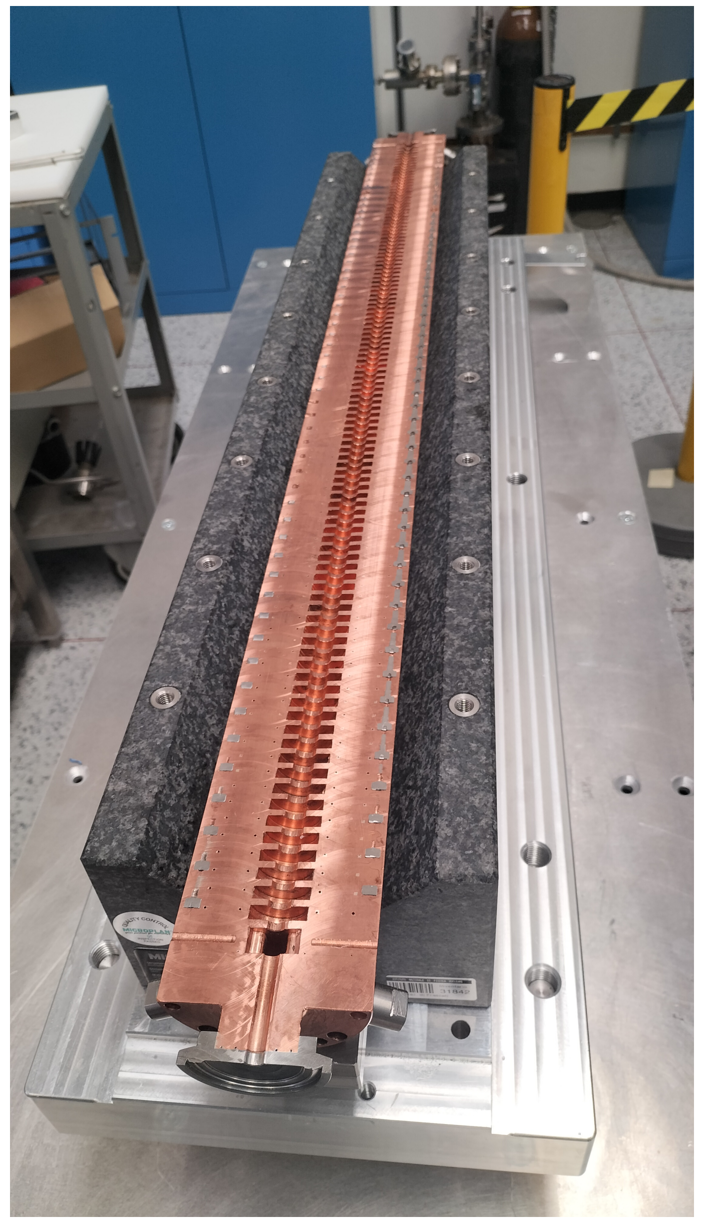


Courtesy E.Chiadroni

LINAC

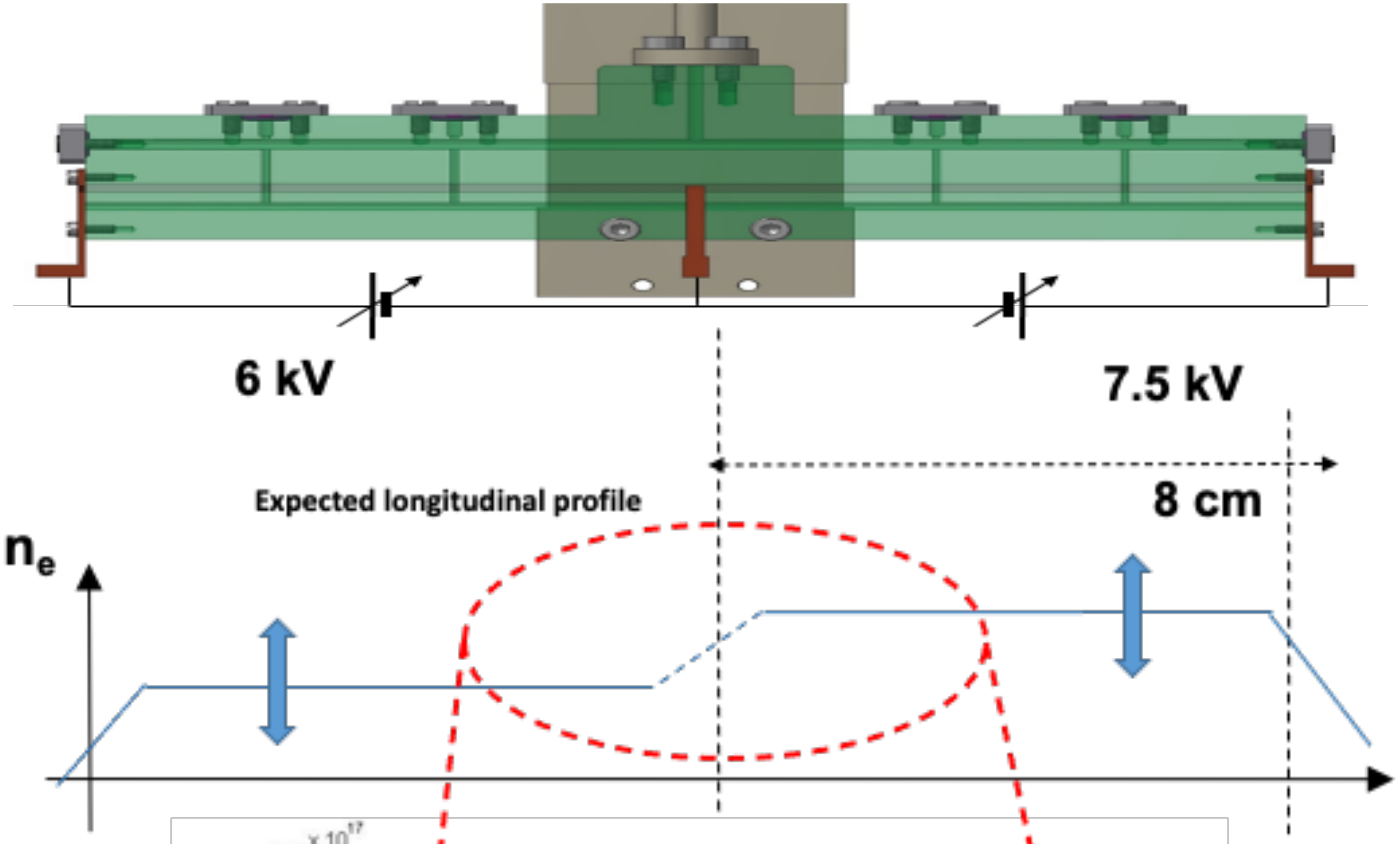
- ✓ Mechanical Prototype X-Band section successfully validated. No significant deformation after brazing and vacuum tightness.
- ✓ RF prototype produced - Brazing is expected at the end of November.

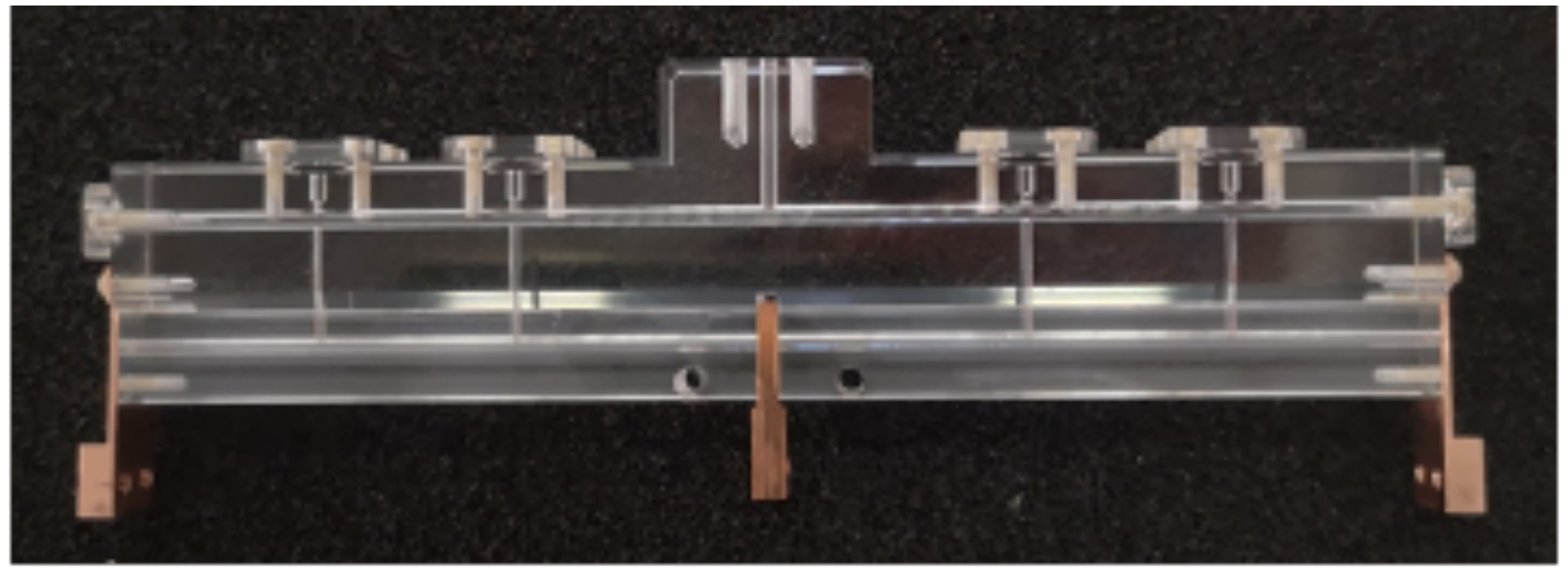


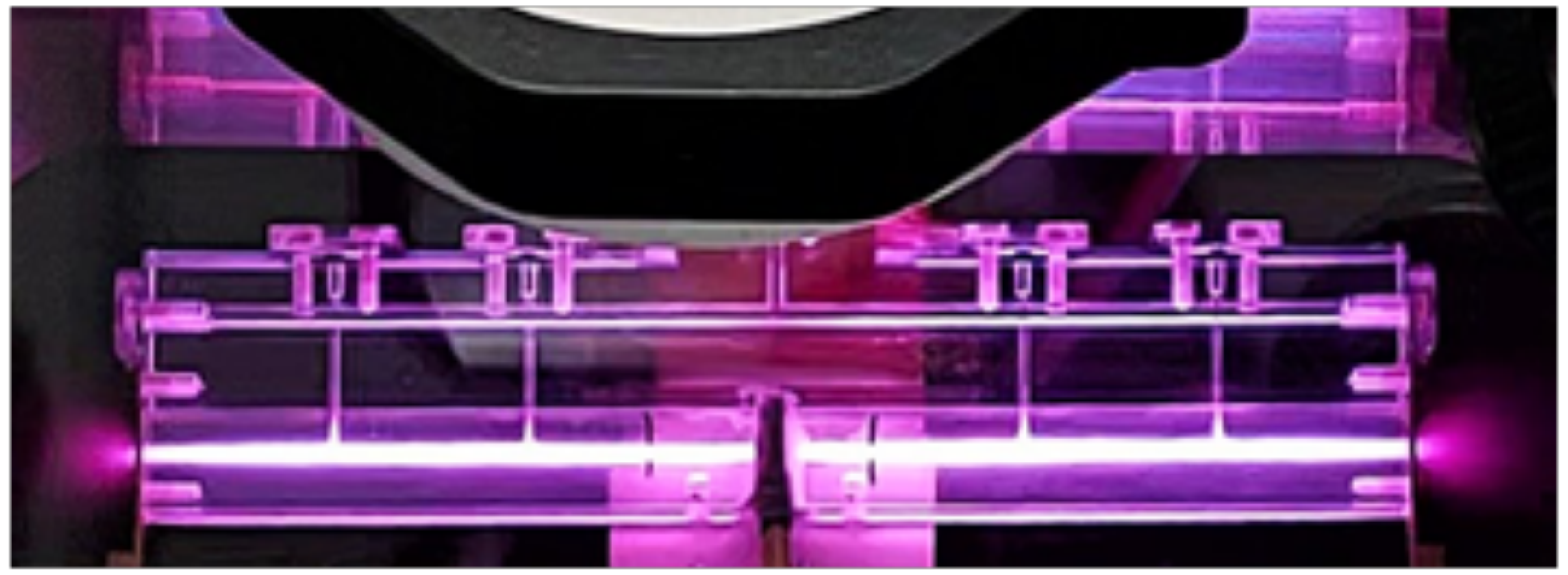


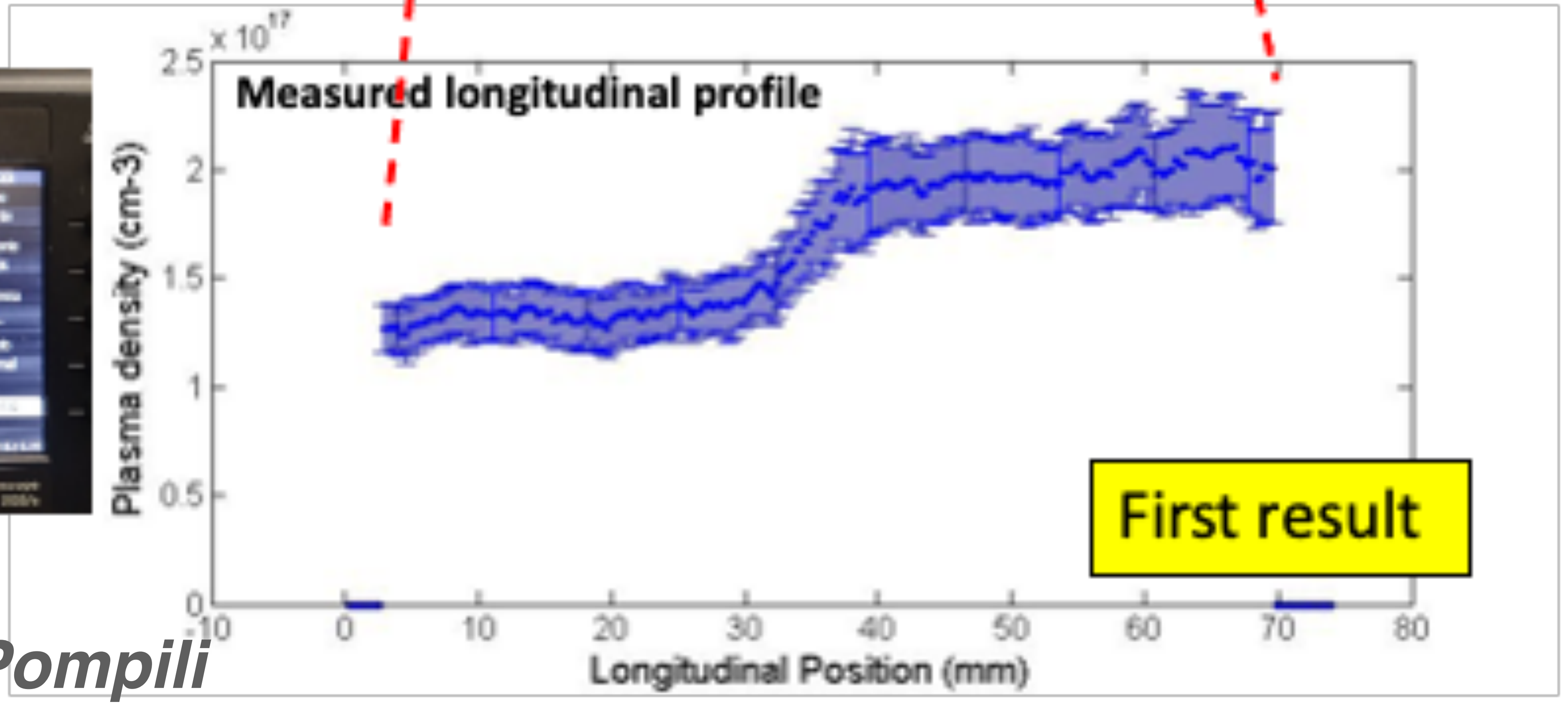
Courtesy D.Alesini

Plasma module









Courtesy A.Biagioni / R.Pompili

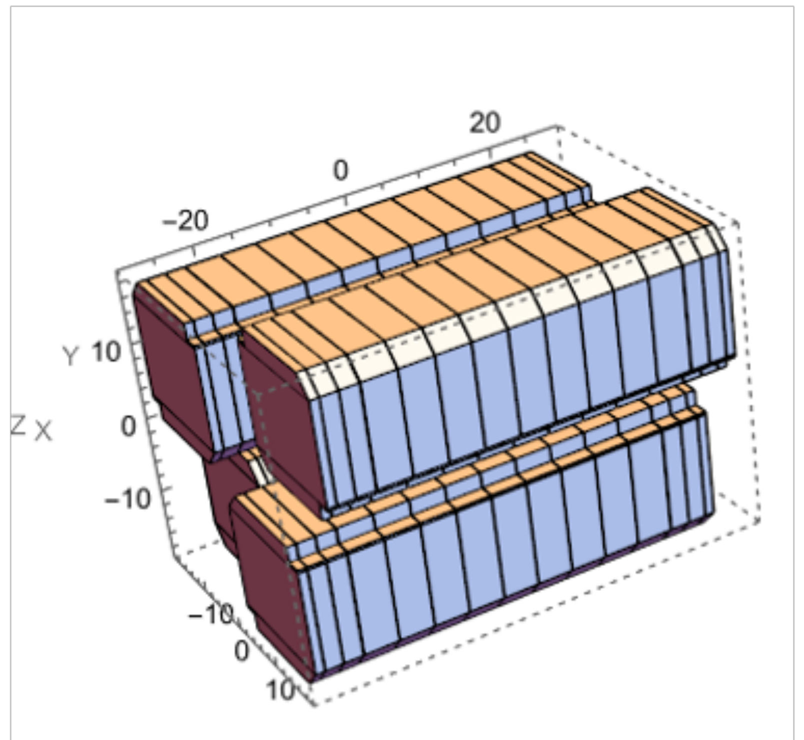
Advantages:

- 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)

Undulator design and prototyping for AQUA: Apple-X

Defining critical design aspects:
Minimum vacuum chamber size / vacuum - wake-fields (F. Bosco Un. Roma 3 – F. Nguyen, ENEA)
Magnetic field tolerances from prototype of Apple-X module (M. Opromolla, LNF)

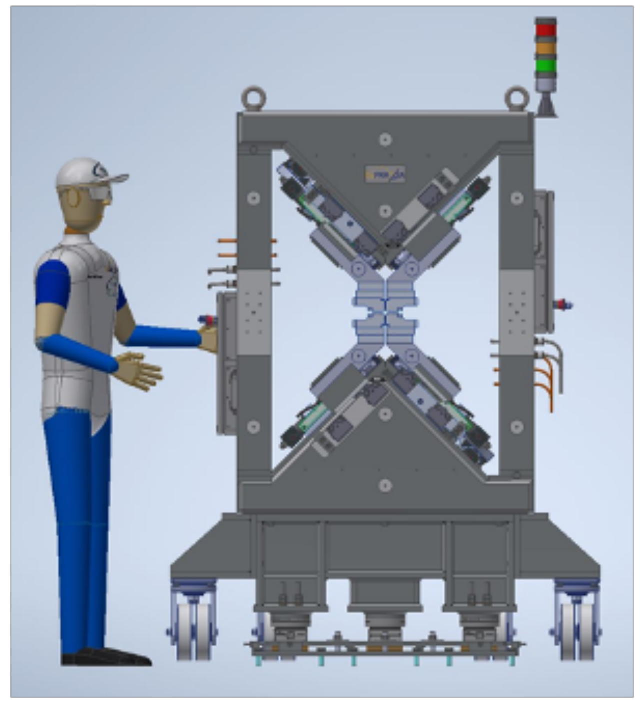
Apple-X undulator for ***SABINA*** (ref. L. Sabbatini) is a first prototype for ***AQUA*** FEL line



Magnetic design A. Petralia (ENEA)

LNF observer in LEAPS-INNOV:
setting up magnetic measurement bench (ref. L. Sabatini A. Vannozzi) in contact with M. Calvi / S. Karabekyan small size Hall probe and Hall probe bench.

Undulator mech. design adapted from **KYMA**- ***SABINA*** by M. Del Franco (LNF)



First ***SABINA*** undulator in FRASCATI March 29, 2023

Courtesy L.Giannessi

Undulator design and prototyping for AQUA 2: SCU

Prototype construction at FNAL (C. Boffo)

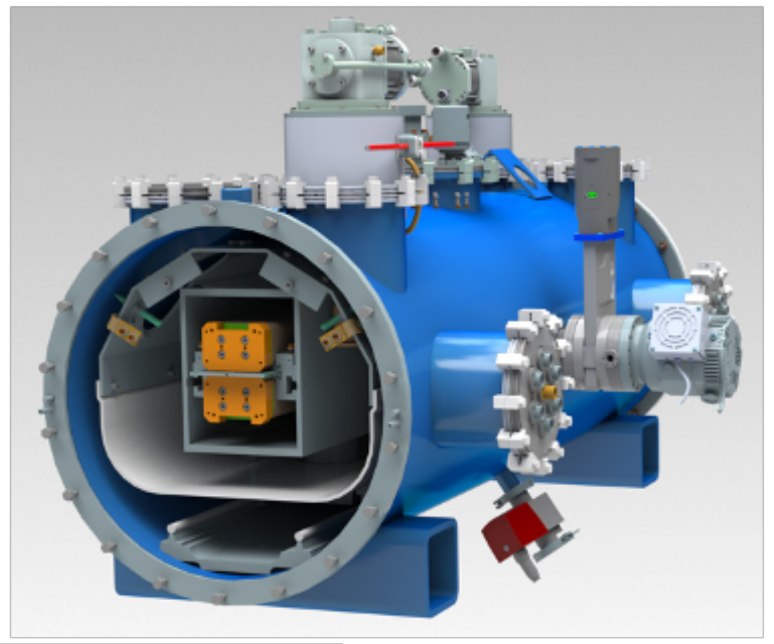
MODULAR DESIGN
Cooling: 2+2 1.8 W GM coolers

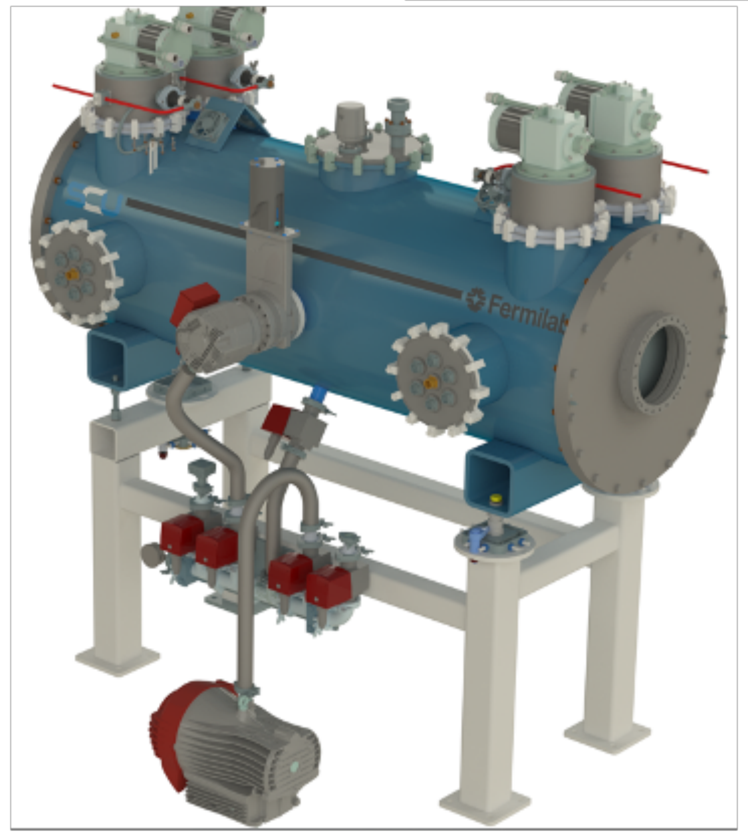
Reduced vessel diameter to minimize: costs, used space and radiation input at 50K

Current leads optimized for higher current/heat load. Hybrid HTS phosphor bronze system

Integrated G11 support posts as in LHC magnets combined with railing system as PIP-II cryomodules

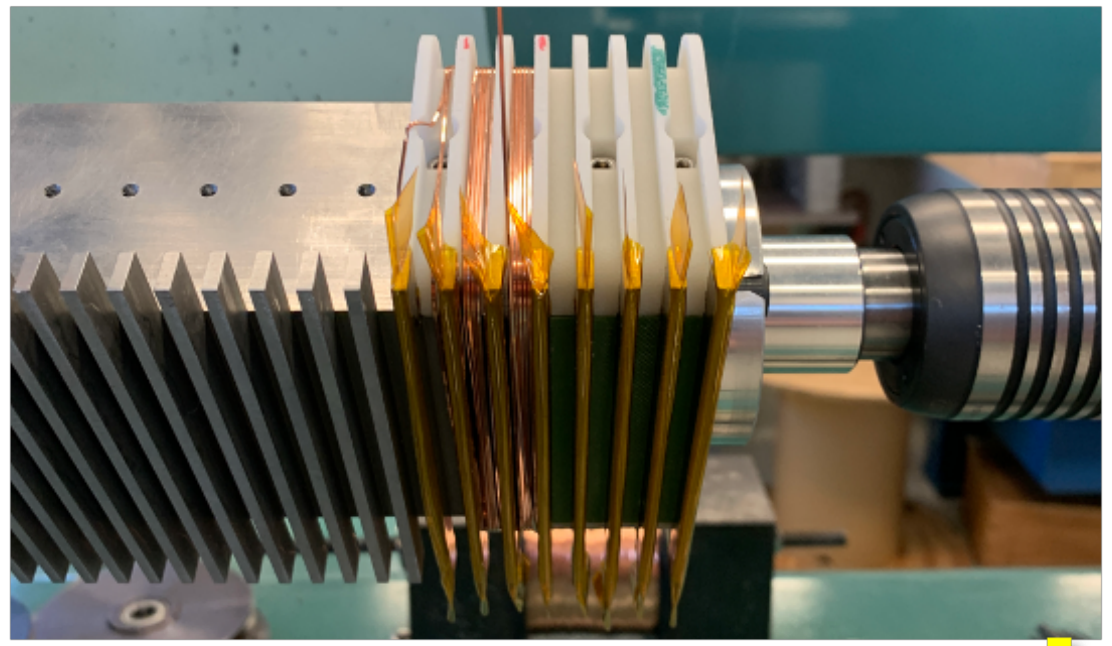
Parameter	Value	Unit
Period	< 16	Mm
Beam stay clear	5	mm
FEL wavelength	~3	Nm
K-value	>1.2	-
Beam heat load	TBD	W
Ramp to operating field	<600	s
Cooling	Cryocoolers	-
Operating temperature	4.2	K
Magnet length	1.5-1.6	m
Flange to flange length	2.0-2.5	m
Beam height	TBD	m
Vacuum vessel diameter	<1	m
Insulation vacuum	$1*10^{-5}$	mbar
Cooldown time	<7	days

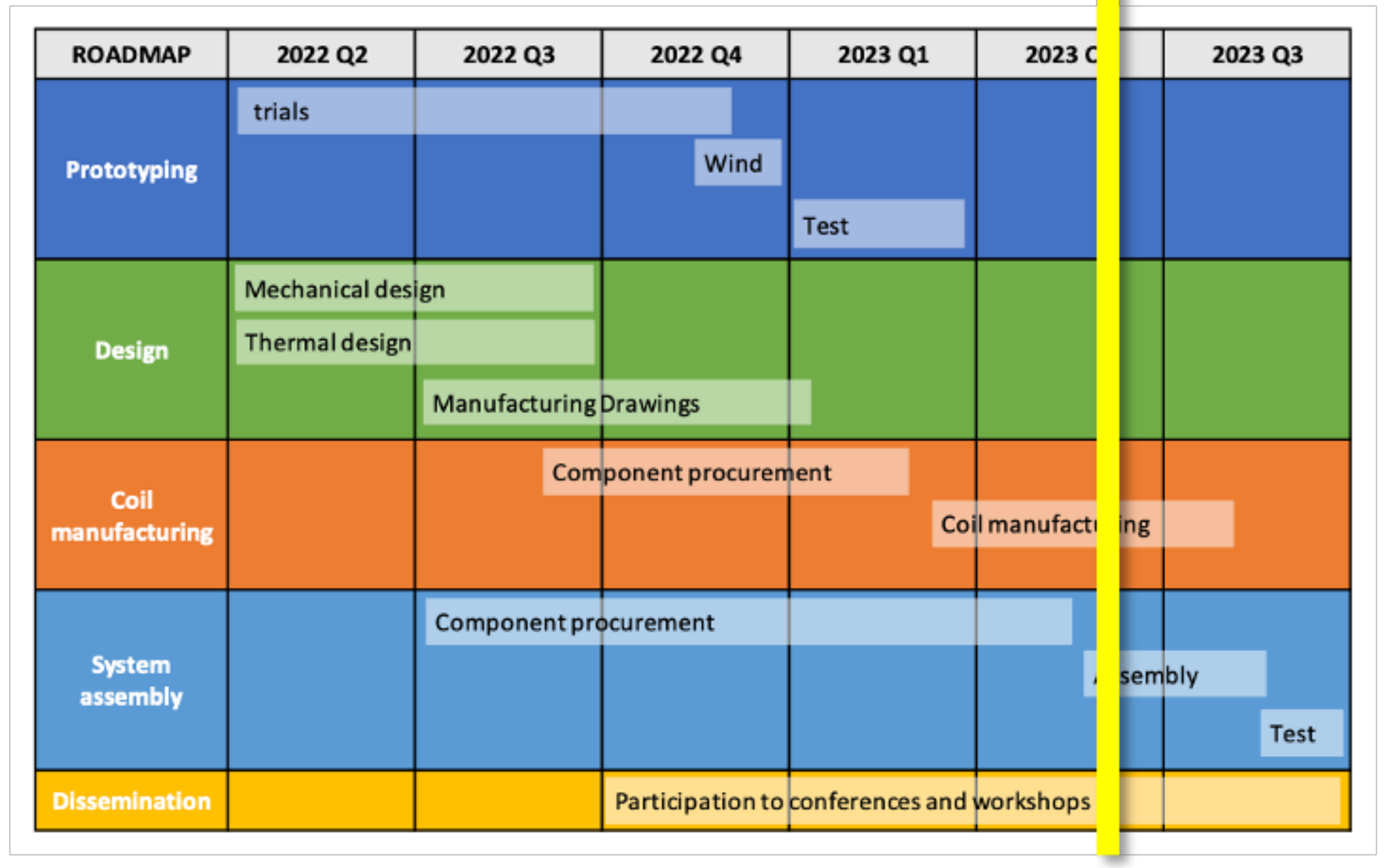




Q3 2023 the prototype undulator should be completed – delivery to LNF in 2024

Fermilab U.S. DEPARTMENT OF ENERGY Office of Science





Courtesy L.Giannessi

System engineering

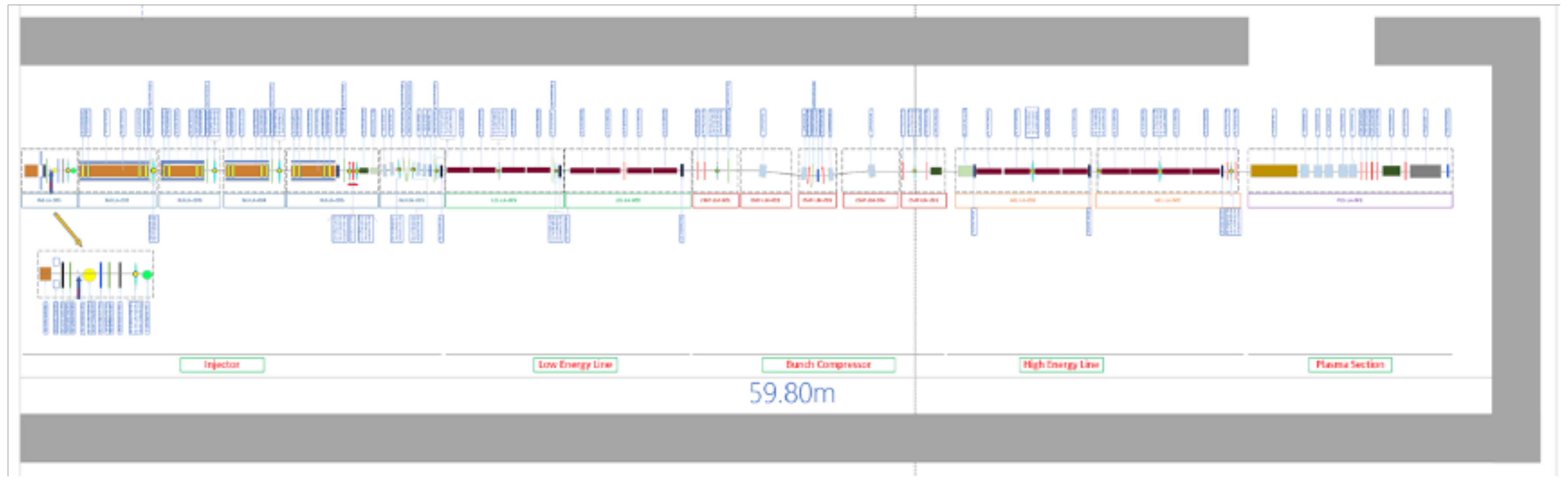
The project is being implemented through a phasing approach, the TDR Phase is the phase dedicated to the full design of the machine. In order to develop the TDR phase, a group of technologists is responsible for coordinating the management of activities related to the project. Within this framework, the project strategy put in place covers the following points:

- Machine configuration management and naming convention;
- Components database management Machine
- Components management related to ancillary elements (power supplies, cabling, controller, DAQ, etc…
- Budget management

Courtesy F.Cioeta

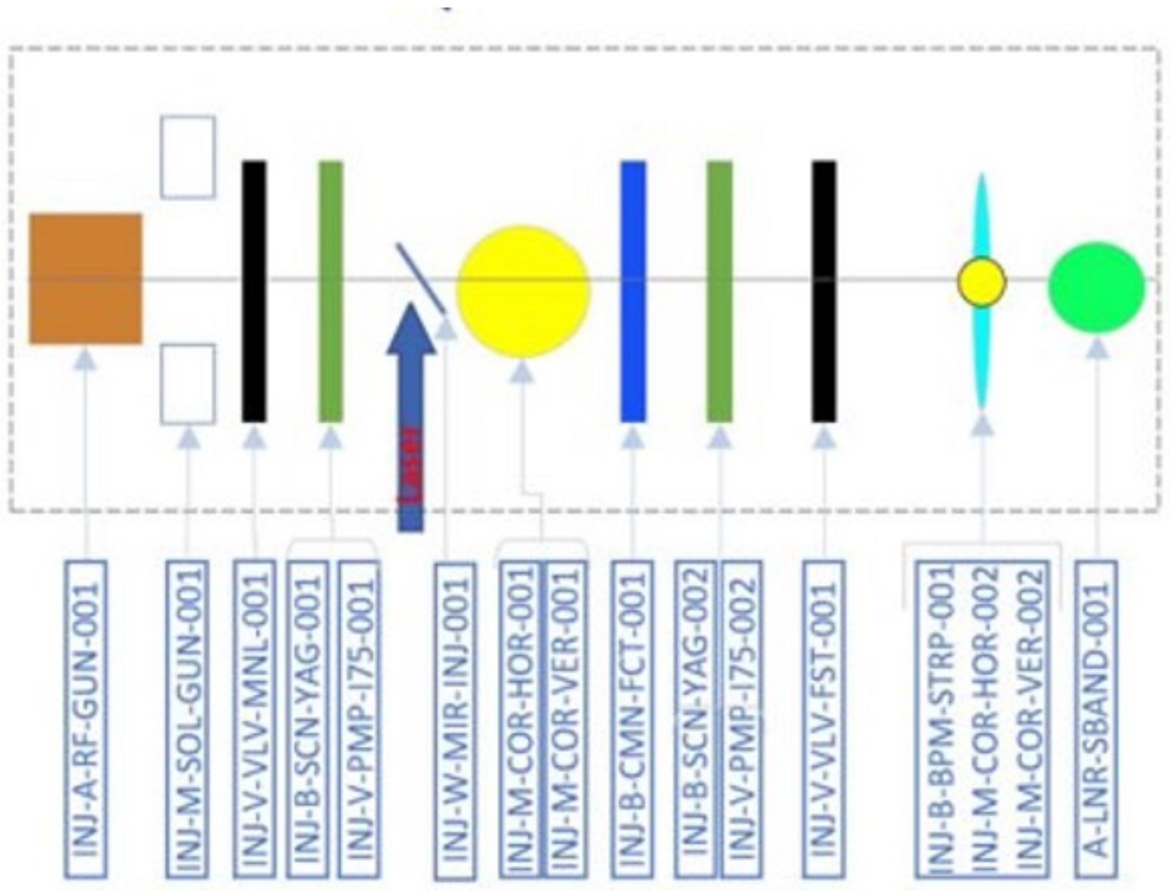
System engineering

The schematic layout was developed using Viso Professional of Microsoft Office 365 as the project software. The purpose of the schematic layout is to give an immediate overview of machine elements in order to help to plan and to implement machine components that will be after listed in a specifics database.



.....and Naming Convention

The need for a hierarchical and arborescent organization of objects for the purpose of efficient and traceable management of configuration machine occurs through the use of a specific ***nomenclature.***



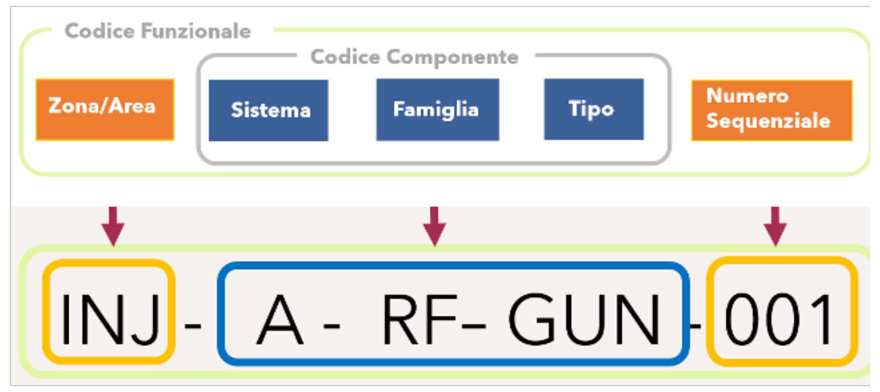
The name of a system is the set of two codes

Component Code:

It identifies the system as such. Identical components may have the same code.

Functional Code:

Additional fields that determine the uniqueness of the component by identifying the zone or area of the machine where it is installed and where the component acquires its functionality.



Courtesy F.Cioeta

System engineering

Using specific software as a database (e.g. Hexagon INFOR-EAM), it is possible to create relationships between the various tables that collect requirements and components related to machine elements, so as to identify for each individual element the auxiliary components necessary at the proper operation and control as well as visualize all the components in the machine through the CAD interface. For each component therefore is possible to identified a specifics codes and attributes such as:

- UUID Code
- PBS Code
- WBS Code
- Moduls
- Longitudinal coordinate
- Type of connectors
- Facility requirements (water flow, electrical power)
- Costs
- Status
- Suppliers

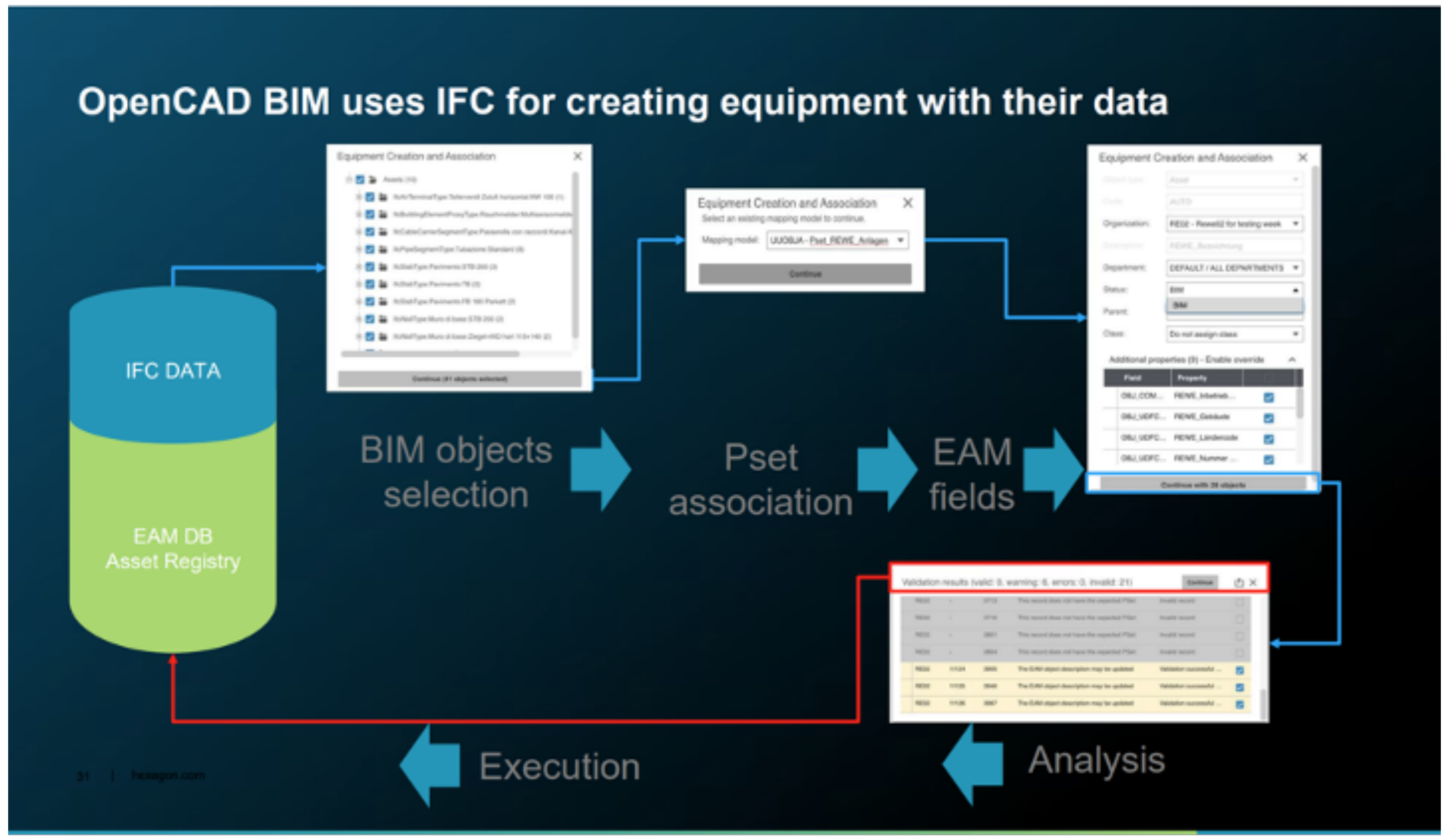
PBS MACHINE | DIAGNOSTIC DEVICE | VACUUM CONNECTED DEVICE | Relazioni

Riquadro di spostamento

ID	ID_COM	WA C	WE	AREA,	SYS	FAM	TYPE	SEQUEN	PBS-CODE	DESCRIPTION	Z-C	MODULS
1	RFG	WA2	WP08	INJ	A	RF	GUN	001	INJ-A-RF-GUN-001	RF GUN	0	INJ-LA-001
2	I20			INJ	V	PMP	I20	001	INJ-V-PMP-I20-001	ION PUMP GUN	0	INJ-LA-001
3	I20			INJ	V	PMP	I20	002	INJ-V-PMP-I20-001	ION PUMP GUN	0	INJ-LA-001
4	NEG			INJ	V	PMP	NEG	001	INJ-V-PMP-NEG-001	NEXTOR Z100 GUN	0	INJ-LA-001
5	NEG			INJ	V	PMP	NEG	002	INJ-V-PMP-NEG-002	NEXTOR Z 100 GUN	0	INJ-LA-001
6	SLG			INJ	M	SOL	GUN	001	INJ-M-SOL-GUN-001	SOLENOID GUN	0	INJ-LA-001
7	VMN			INJ	V	VLV	MNL	001	INJ-V-VLV-MNL-001	MANUAL VALVE GUN	0	INJ-LA-001
8	SYA			INJ	B	SCN	YAG	001	INJ-B-SCN-YAG-001	SCREEN GUN	0	INJ-LA-001
9	I75			INJ	V	PMP	I75	001	INJ-V-PMP-I20-001	IONIC PUMP GUN	0	INJ-LA-001
10	MIR			INJ	W	MIR	INJ	001	INJ-W-MIR-INJ-001	MIRROR GUN	0	INJ-LA-001
11	CHO			INJ	M	COR	HOR	001	INJ-M-COR-HOR-001	HORIZONTAL CORRECTOR GUN	0	INJ-LA-001
12	CVE			INJ	M	COR	VER	001	INJ-M-COR-VER.001	VERTICAL CORRECTOR GUN	0	INJ-LA-001
13	CMN			INJ	B	CMN	FCT	001	INJ-B-CMN-FCT-001	CURRENT MONITOR GUN	0	INJ-LA-001
14	SYA			INJ	B	SCN	YAG	002	INJ-B-SCN-YAG-002	SCREEN GUN	0	INJ-LA-001
15	I75			INJ	V	PMP	I75	002	INJ-V-PMP-I75-002	IONIC PUMP GUN	0	INJ-LA-001
16	VFS			INJ	V	VLV	FST	001	INJ-V-VLV-FST-001	FAST VALVE GUN	0	INJ-LA-001
17	LNR			INJ	A	LNR	SBD	001	INJ-A-LNR-SBD-001	LINEARIZER	0	INJ-LA-001
18	BPM			INJ	B	BPM	STP	001	INJ-B-BPM-STP-001	STRIPLINE GUN	0	INJ-LA-001
19	CHO			INJ	M	COR	HOR	002	INJ-M-COR-HOR-002	HORIZONTAL CORRECTOR GUN	0	INJ-LA-001
20	CVE			INJ	M	COR	VER	002	INJ-M-COR-VER-002	VERTICAL CORRECTOR GUN	0	INJ-LA-001
21	XBG			INJ	A	ACC	XBD	001	INJ-A-ACC-XBD-001	XBAND GUN	0	INJ-LA-001
22	CHO			INJ	M	COR	HOR	003	INJ-M-COR-HOR-003	HORIZONTAL CORRECTOR LA002	0	INJ-LA-002
23	CVE			INJ	M	COR	VER	003	INJ-M-COR-VER-003	VERTICAL CORRECTOR LA002	0	INJ-LA-002
24	SOL			INJ	M	SOL	SEC	001	INJ-M-SOL-SEC-001	SOLENOID SBAND	0	INJ-LA-002
25	SBD			INJ	A	ACC	SB3	001	INJ-A-ACC-SB3-001	SBAND 3M LA002	0	INJ-LA-002
26	CHO			INJ	M	COR	HOR	004	INJ-M-COR-HOR-004	HORIZONTAL CORRECTOR SB1	0	INJ-LA-002
27	CVE			INJ	M	COR	VER	004	INJ-M-COR-VER-004	VERTICAL CORRECTOR SB1	0	INJ-LA-002
28	SYA			INJ	B	SCN	YAG	003	INJ-B-SCN-YAG-003	FIRST SCREEN LA002	0	INJ-LA-002
29	I75			INJ	V	PMP	I75	003	INJ-V-PMP-I75-003	ION PUMP SBND1	0	INJ-LA-002
30	BPM			INJ	B	BPM	STP	002	INJ-B-BPM-STP-002	STRIPLINE LA002	0	INJ-LA-002
31	CHO			INJ	M	COR	HOR	005	INJ-M-COR-HOR-005	HORIZONTAL CORRECTOR LA002	0	INJ-LA-002
32	CVE			INJ	M	COR	VER	005	INJ-M-COR-VER-005	VERTICAL CORRECTOR LA002	0	INJ-LA-002
33	CHO			INJ	M	COR	HOR	006	INJ-M-COR-HOR-006	HORIZONTAL CORRECTOR LA003	0	INJ-LA-003
34	CVE			INJ	M	COR	VER	006	INJ-M-COR-VER-006	VERTICAL CORRECTOR LA003	0	INJ-LA-003

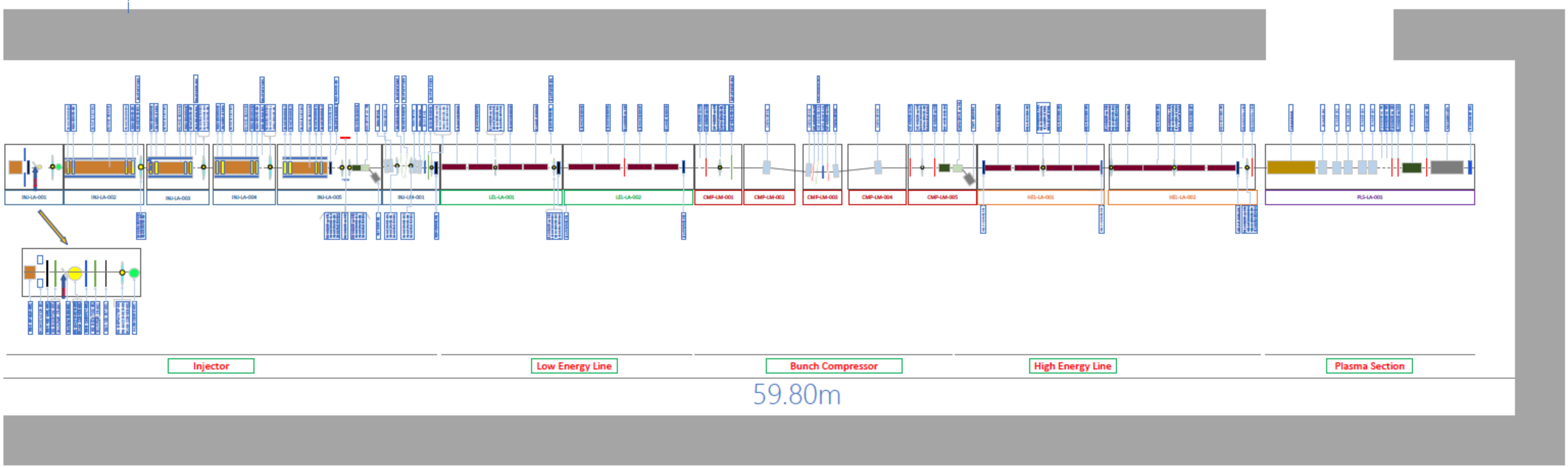
➢ Moreover is possible to link other document such as:

1. Specifications
2. Approved construction drawings
3. Commercial documents (orders, specifications, etc.)
4. Quality documents (calibration certificates, certificates of conformity, etc.)
5. Warranty
6. Manuals



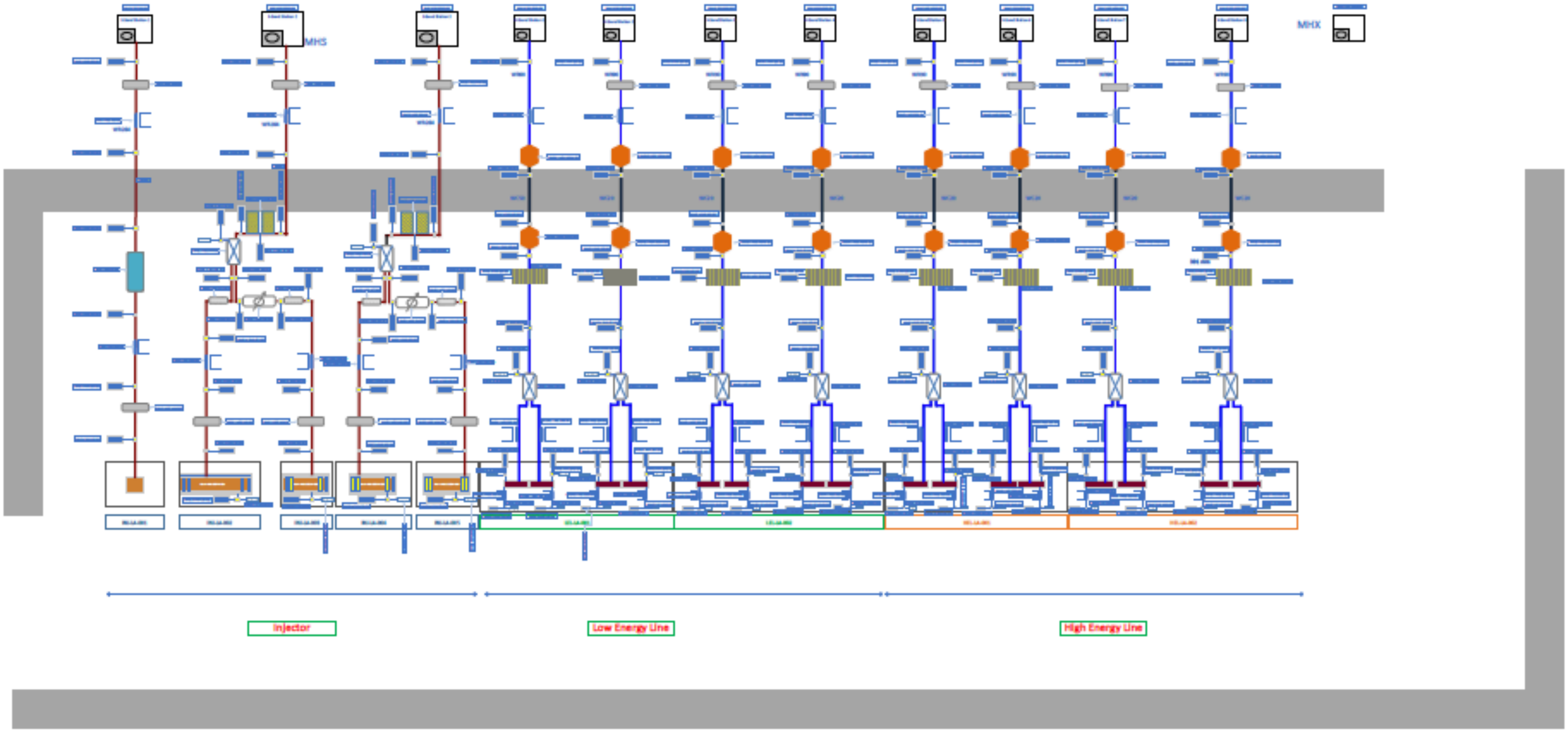
Courtesy F.Cioeta

Machine Layout



Courtesy F.Cioeta & E.Di Pasquale

RF Power Source layout



Courtesy F.Cioeta

General Status / Intermediate milestones

WA ID	Intermediated deliverable expected	Updated Status
WA1	**BEAM PHYSICS**	
M1.1	S2E new layout completed	Done
M1.2	Photon Number optimization	Done
M1.3	Machine intermediate layout	Done
M1.4	RF specifications	Done
M1.5	Magnets specifications	Prelimin.
M1.6	Stability& Jitter studies	Prelimin.
M1.7	Laser heater parameters	Prelimin.
M1.8	Machine final layout	T.B.D.
WA2	**INJECTOR**	
M2.1	Injector preliminary layout	Done
M2.2	Injector Layout	Done
M2.3	Injector components design	Done
M2.4	Injector RF Distribution	Done
M2.5	Photocathode laser design	Prelimin.
WA3	**LINAC**	
M3.1	Linac Design	Consol.
M3.2	Vacuum Design	Consol.
M3.3	Linac RF Distribution	Consol.
M3.4	HP Waveguide Validated	Consol.
M3.5	X-Band section validated	Prelimin.

WA ID	Intermediated deliverable expected	Updated Status
WA.04	**RF & POWER SUPPLIES**	
M4.1	S-Band Waveguide design	Done
M4.2	X-Band Waveguide design	Done
M4.3	Power supply design validated.	Draft
M4.4	X-Band RF power system validation	Draft
M4.5	Timing & Synchronization system designed	Prelimin.
WA.05	**PLASMA**	
M5.1	Capillary plasma characterization	Prelimin.
M5.2	Plasma section final design	T.B.D.
WA.06	**FEL**	
M6.1	FEL Configuration Strategy	Done
M6.2	Final Design Phase 0	Prelimin.
M6.3	AQUA Final Design	Prelimin.
WA.08	**USER**	
WA8.M1	Design optical elements	T.B.D.
WA8.M2	Final design user end station	T.B.D.
WA8.M3	TDR Users	Draft
WA.10	**DIAGNOSTICS**	
M10.1	BPM prototype validation	Done
M10.2	BLM prototype validation	Draft
M10.3	Compact Diag Chamber validation	Done
M10.4	High Precision Charge measurement validation	Done
M10.5	Diagnostic prototyping validation	Prelimin.
M10.5	Final e-beam diagnostic design	Prelimin.
M10.6	ML data taking final design	T.B.D.
BLDG	**Building**	
BLDG.M1	Final design Ready	Done
BLDG.M3	Authorization Ready	Done
BLDG.M4	Executive Design	Prelimin.
BLDG.M5	Validation executive design	Prelimin.
BLDG.M6	Tender Construction finalised	T.B.D.
BLDG.M7	Building & utilities ready	T.B.D.

Transition to Implementation Phase

✓ Starting the planning of the implementation phase

1 additional Working Area - INTEGRATION to help in the definition of the implementation phase:

- Installation and commissioning strategy
- Procurement strategy and planning
- Ancillary systems to be organized (pre-assembly area, alignment, logistics etc…).

✓ TDR Structure is in place (proto-WBS for the implementation phase)

Technical Design Report - Structure

Chapter	
1	executive summary
2	eupraxia in the european context
3	eupraxia@sparc_lab
4	scientific case
5	experience with the LNF test facilities
6	beam physics
7	machine layout
8	photoinjector
9	X-band linac
10	plasma accelerating module
11	Free Electron Laser
12	photon beam lines
13	experimental endstations
14	electron and photon diagnostics
15	laser systems
16	timing and synchronisation
17	control system
18	vacuum system
19	magnets and power supply
20	machine protection system
21	civil infrastructures
22	radiation safety and beam dump
23	integration, implementation and commissioning strategy
24	system engeneering
25	project costs , timeline and management structure

This will be complemented by:

- Scientific Case Report
- Project Management Plan

Overleaf structure is already in place and the population of each single chapter has just started.

Transition to Implementation Phase

✓ A cost Estimation based on the existing layout has been produced and it is now in the phase of a refinement.

✓ Cost Estimation based on the existing layout and grouped in three families.

✓ First Cost&Schedule Review Meeting is scheduled on the 11th December 2023.

Machine

- Linac
- Ondulators
- Photon Beamline
- User End Station
- RF & Power Supplies
- Laser system
- Ancillary System (DAQ, Controls)

Utilities

- Cabling
- Secondary cooling system

Civil Engineer

- Building
- HVAC
- Electrical Distribution

Cost estimation analysis

Cost per functional system

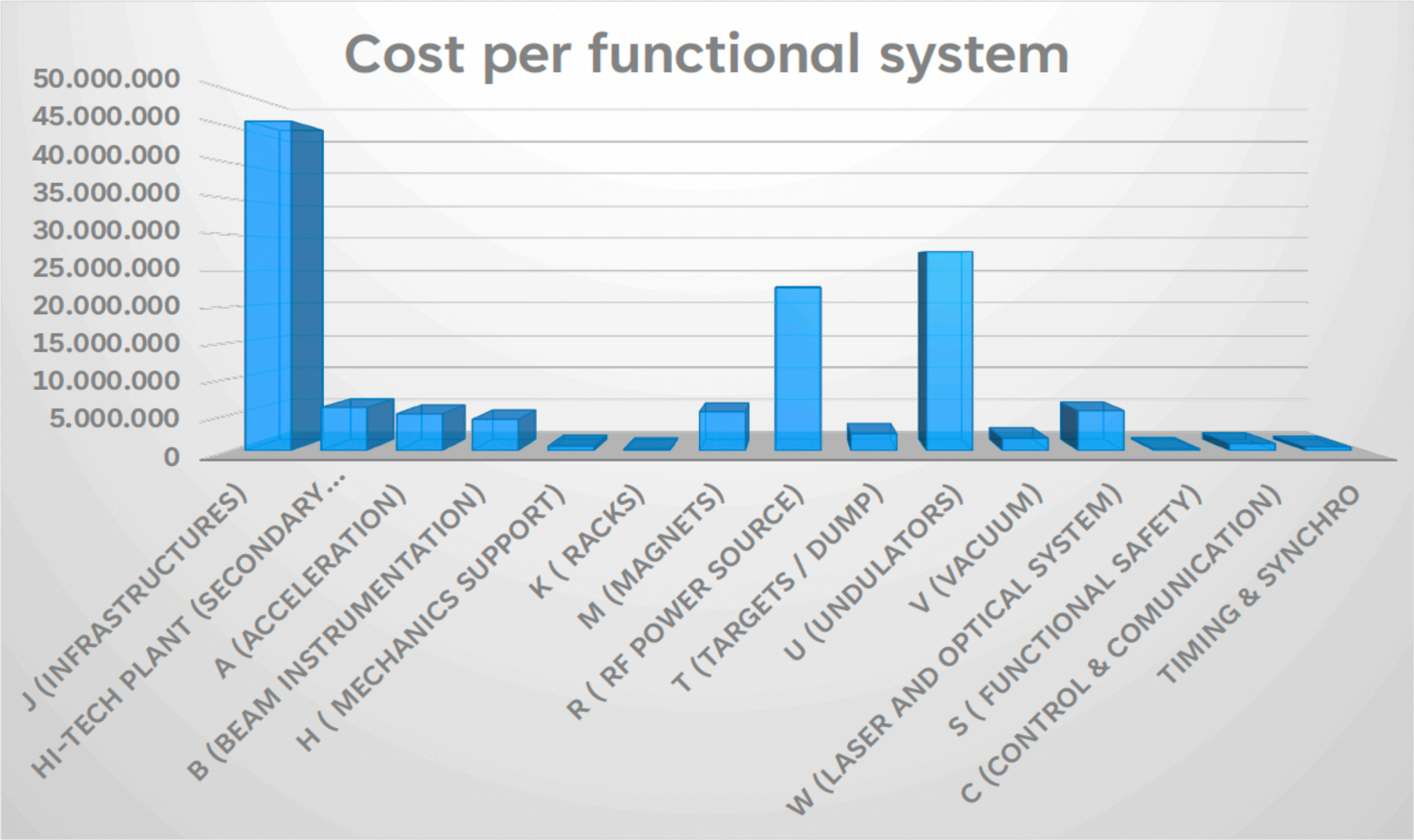
Functional System	Expected cost [€] VAT Included
J (INFRASTRUCTURES)	45.775.000
Hi-Tech Plant (secondary circuit/cabling etc)	6.000.000
A (ACCELERATION)	5.107.000
B (BEAM INSTRUMENTATION)	4.340.000
H (MECHANICS SUPPORT)	637.740
K (RACKS)	200.000
M (MAGNETS)	5.395.000
R (RF POWER SOURCE)	22.631.000
T (TARGETS / DUMP)	2.356.560
U (UNDULATORS)	27.650.000
V (VACUUM)	1.709.000
W (LASER AND OPTICAL SYSTEM)	5.538.000
S (FUNCTIONAL SAFETY)	250.000
C (CONTROL & COMUNICATION)	1.000.000
TIMING & Synchro	500.000
TOT	129.089.300

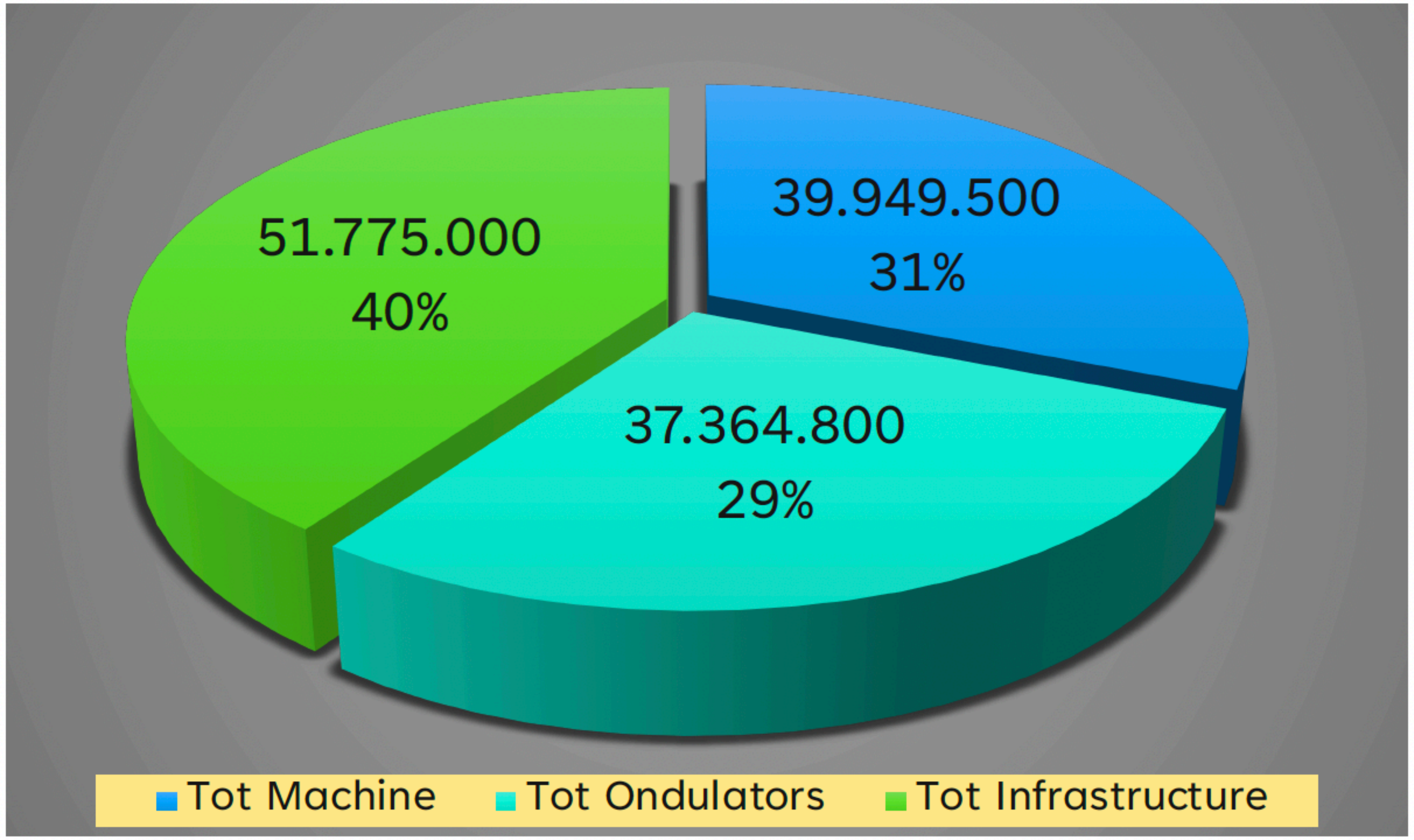
Cost estimation analysis

Cost per functional area

Functional Area	Expected Cost [€] VAT Included
Injector	4.897.100
Low Energy Line	1.918.900
Bunch Compressor	969.500
High Energy Line	2.211.300
Plasma Module	2.137.000
RF Power Station	22.631.000
Control (W/Timing & Synchro)	1.500.000
Photocathode Laser	1.100.000
Tot Machine	37.364.800
ARIA	13.986.800
ARIA BeamLine	5.985.700
AQUA	15.000.000
AQUA BeamLine	4.977.000
Tot Ondulators	39.949.500
Building	45.775.000
Hi-Tech Utilities	6.000.000
Tot Infrastructure	51.775.000
TOTAL	129.089.300

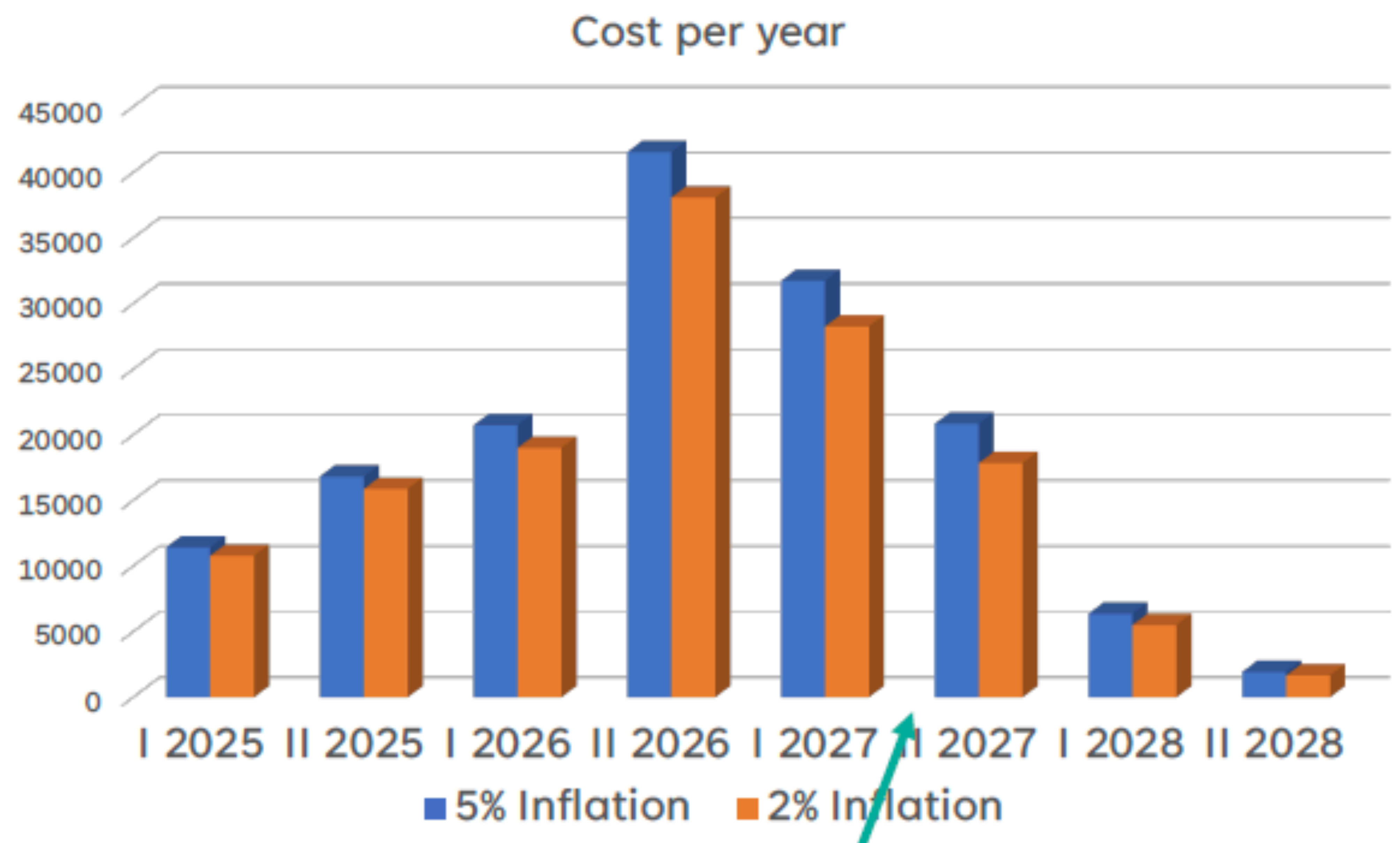
Cost Distribution





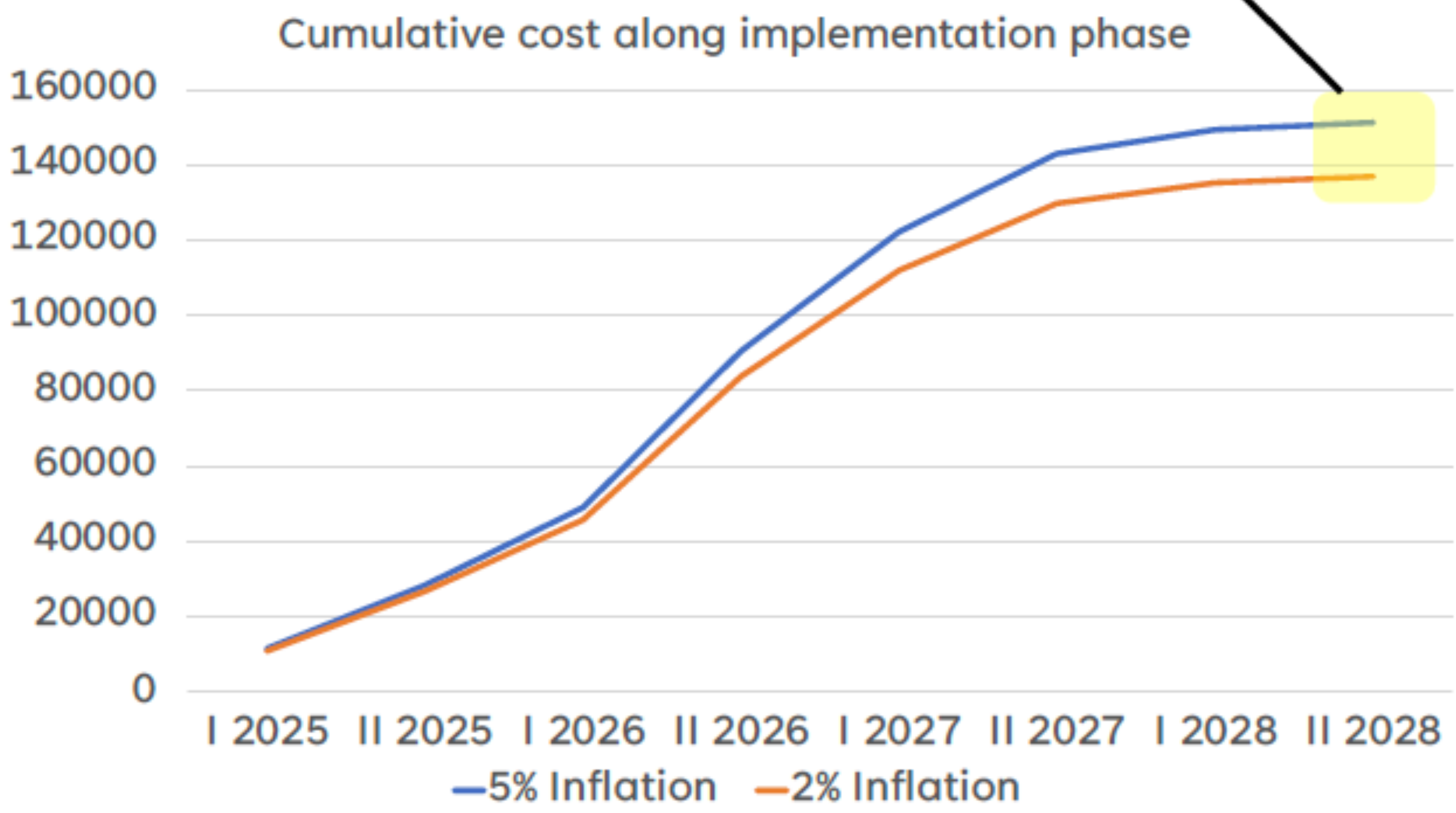
40% Infrastructure and 60% overall machine

Cost estimation analysis



Running costs kick in

136,93M€ < BAC < 151,29 M€



Cost estimation analysis

In 2019 the Italian Government allocated 108M€ until 2030.

In 2021 for the ESFRI Roadmap application we performed a cost estimation (much less accurate though) which is substantially confirmed now.

Considering the current cost estimation as of today the over budget is about 19%, however if we actualize 108M€ to the integrated inflation until today we have that:

108M€ → 125,172 M€* The actual over budget is therefore just 3%.

However, part of the budget is allocated for R&D (9M€) in addition NO contingencies are included. This would mean that all the risks have been mitigated which is not the case at this moment.

Most importantly it includes 2 beamlines instead of just 1 as originally planned.

1st Cost & Schedule review scheduled on the 11th December 2023

EuPRAXIA Advanced Photon Sources

EuPRAXIA

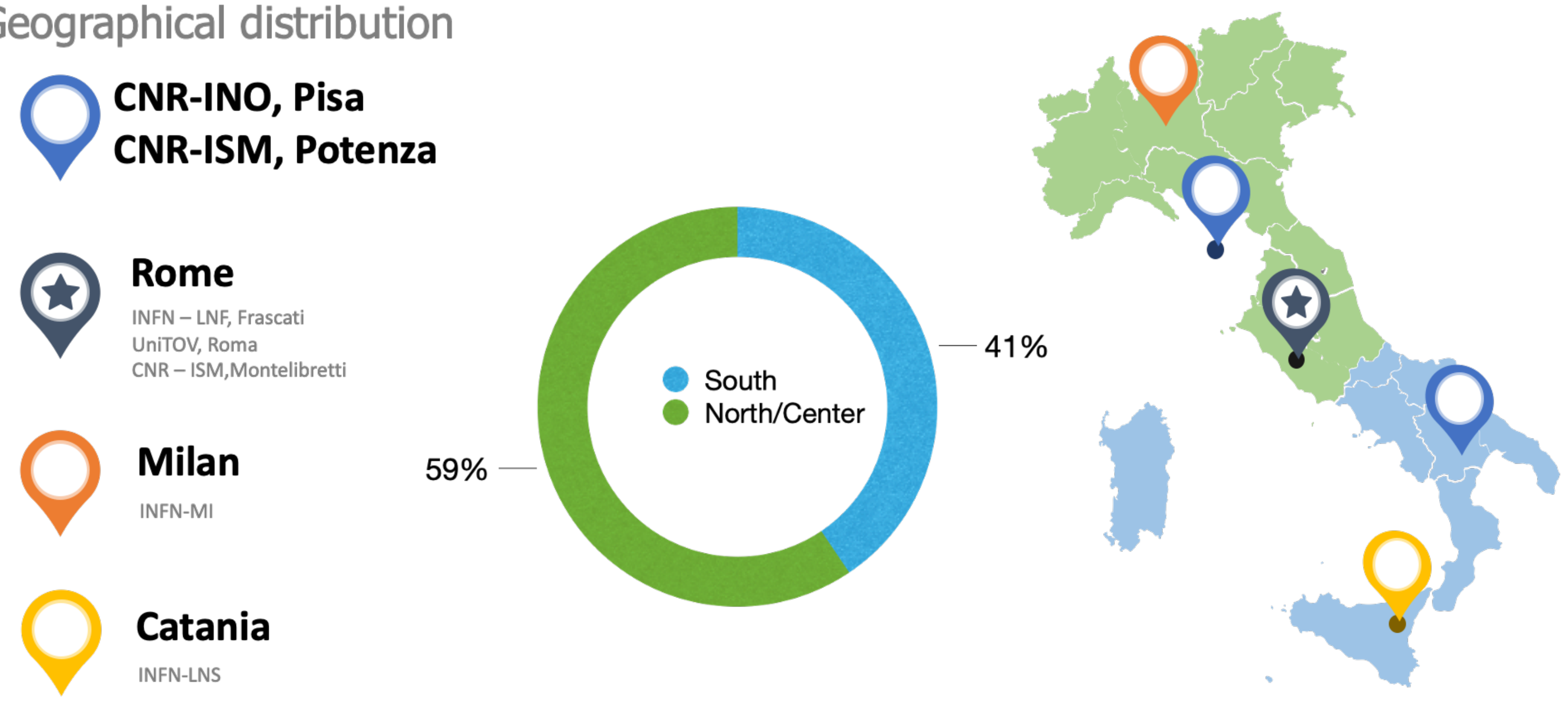
Advanced Photon Sources

EuPRAXIA Advanced Photon Sources

- Ranking 1° in ESFRI Research Infrastructure call for Next Generation EU (PNRR).
- Phase 1 EuPRAXIA Implementation Phase
- Betatron Radiation Source for x-ray imaging (INFN- LNF)
- High Power Laser [1 PW] (INFN-LNS)
- High Repetition Rate Laser [100Hz] (CNR-INO)

Kick off meeting on the 28th Feb. 2023

Geographical distribution



ISTITUTO NAZIONALE DI FISICA NUCLEARE

Laboratori Nazionali di Frascati

INFN-23-12-LNF
6 Aprile 2023

EuPRAXIA Advanced Photon Sources

PNRR_EuAPS Project

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4) INFN, Laboratori Nazionali del Sud, Catania, Italy
5) University of Roma "Tor Vergata", Physics Department, Italy
6) Centro Siciliano di Fisica Nucleare e Struttura della Materia (CSFNSM), Catania, Italy
7) CNR - Istituto Nazionale di Ottica , Pisa, Italy
8) CNR - Istituto Nazionale di Ottica , Firenze, Italy
9) INFN, Sezione di Milano, Milano, Italy

Abstract

The EuPRAXIA Advanced Photon Sources (EuAPS) project, led by INFN in collaboration with CNR and University of Roma "Tor Vergata", foresees the construction of a laser-driven "betatron" X Ray user facility at the LNF SPARC_LAB laboratory. EuAPS also includes 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.

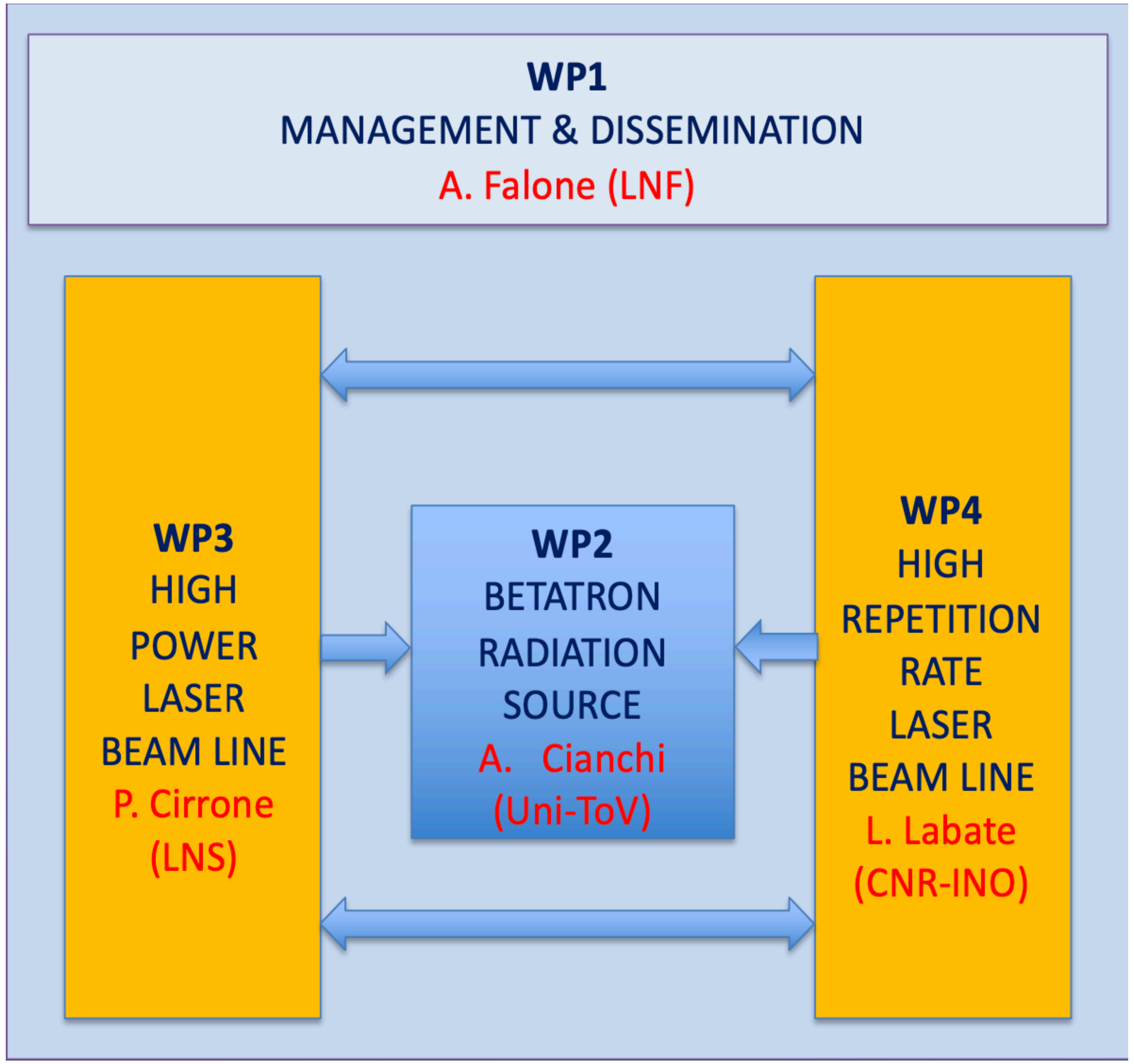
EuAPS has received a financial support of 22.3 M€ from the PNRR plan, Mission 4 "Education and Research", Action 3.1.1 "Creation of new research infrastructures strengthening of existing ones and their networking for Scientific Excellence under Horizon Europe" and has received the highest score among the submitted projects of the ESFRI area "Physical Sciences and Engineering".

The EuAPS project starting date has been fixed on December 1st, 2022 and will last 30 months (with a possible extension of additional 6 months).

In this paper we report the introductory part of the submitted proposal.

EuPRAXIA Advanced Photon Sources

EuAPS Scientific Coordinator: M. Ferrario (INFN-LNF)
EuPRAXIA/EuAPS Integration: R. Assmann (DESY & INFN)



Scientific Advisory Committee

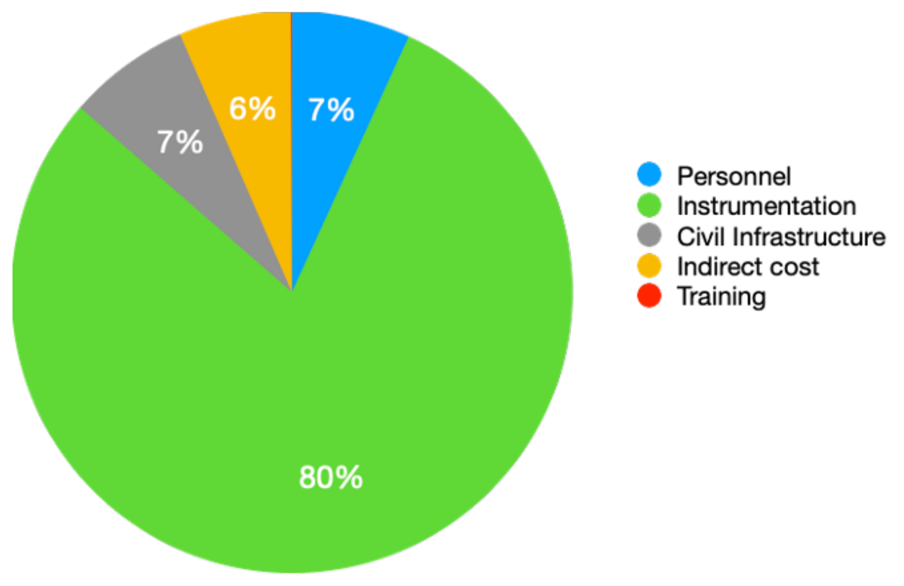
Operating Units Board

Scientific and Technical Board

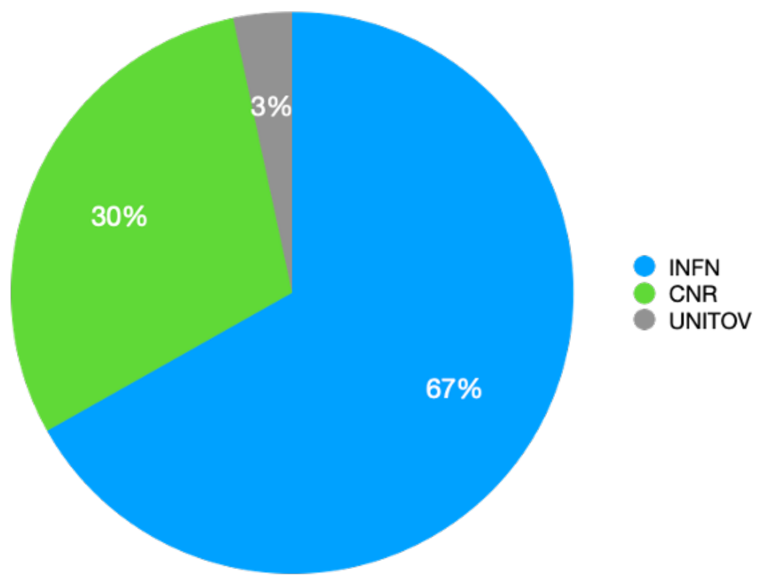
EuPRAXIA Advanced Photon Sources

Costs included in the request for funding (€)			
	To be located within the eight southern regions	To be located outside the eight southern Regions	Total requested grant
Fixed term personnel specifically hired for the project	270.000,00	1.258.000,00	1.528.000,00
Scientific instrumentation and technological equipment,software licenses and patent	6.917.812,47	10.865.386,00	17.783.198,47
Open Access,Trans National Access, FAIR principle implementation	0,00	0,00	0,00
Civil infrastructures and related systems	1.300.006,38	280.000,00	1.580.006,38
Indirect costs, including running costs	575.081,15	869.302,00	1.444.383,15
Training activities	0,00	15.000,00	15.000,00
Total	**9.062.900,00**	**13.287.688,00**	**22.350.588,00**

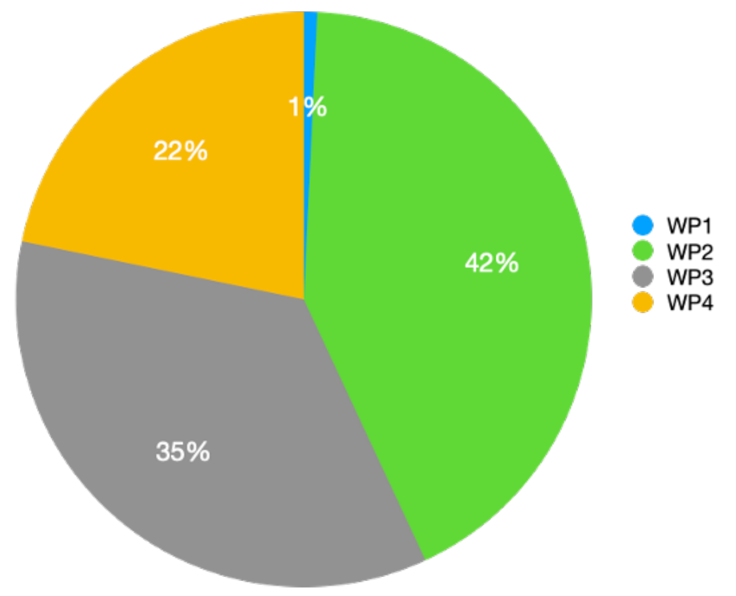
Distribution per item



Distribution per institution



Distribution per WP



EuPRAXIA Advanced Photon Sources

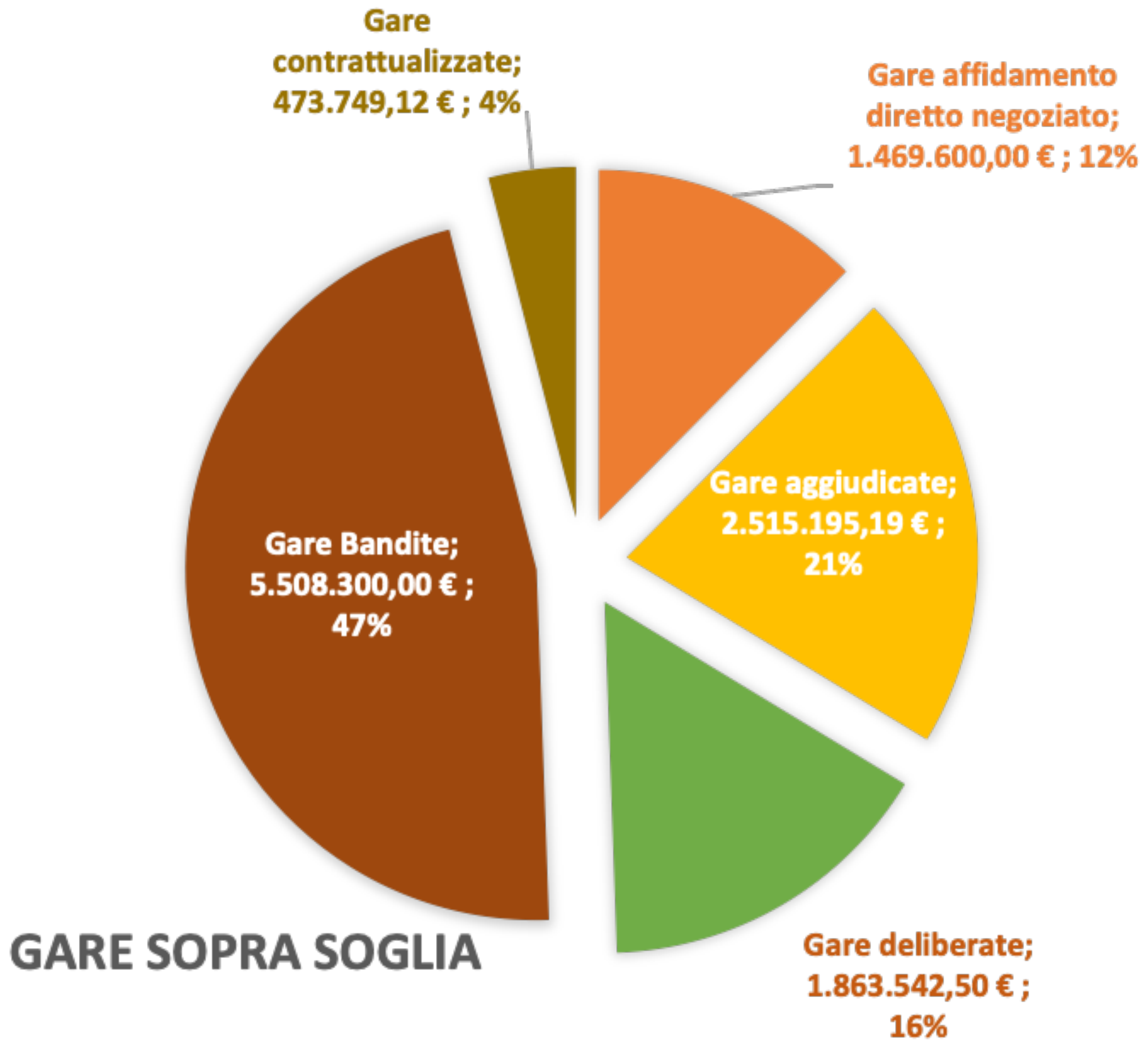
All foreseen recruitment has been completed:

1 Infrastructure Manager
7 technologists + 1 to be hired soon

Tot pre-committed/committed/paid (INFN SIDE):
11.830.386 +2.621.810+870.320= 15.322.516 € (93.3%)
TO BE DONE= 1.033.702€ (6.7%)

The first milestone to adjudicate all the tenders before 31st Dec.2023 is practically accomplished (only 1 exception concerning CNR).

Baseline for installation and commissioning will start soon as consequence of the procurement process.



Comments & Recommendation - Follow up

- *Keep the focus on the key strategic goal of EuPRAXIA@SPARC_LAB, namely validation of beam driven plasma acceleration as an appropriate technology for a successful photon science user facility at LNF!*
- *Build-up of* EuPRAXIA@SPARC_LAB *workforce, in particular for RF systems, accelerator physics and operation needs more momentum.*

- Recently additional manpower joined the Accelerator Division within the EuPRAXIA program and different funding.

- The cost estimation of the implementation phase will take into account also the personnel requirements for the period 2025-2028.

- An integrated planning of the DA activities is being carried out in order to ensure an effective resource allocation to the EuPRAXIA initiatives, although this activity is not yet formalized.

Conclusions

- EuPRAXIA transition to single project to multiple correlated projects (Program)

- EuPRAXIA@SPARC_LAB is gradually converging to solid conclusions- on time w.r.t. original baseline. TDR is expected to be written in 2025, framework already in place.
    - X-Band Sections development is ongoing
    - TEX facility is now operating. 2 additional RF station will upgrade the facility by 2024.
    - Ondulators prototype SABINA ready.
    - Plasma R&D is proceeding towards high performances solutions
    - Transition to the implementation phase is taking momentum.

- EuAPS is a new challenge that will complete the EuPRAXIA phase 1
    - Very demanding project from management perspectives (all tenders to be adjudicated by Dec23).
    - Additional manpower was possible (including an infrastructure manager).
    - Opportunity to laser upgrade
    - Synergy with EuPRAXIA@SPARC_LAB for beam line and user end station.

- EuPRAXIA Building has now passed the authorization phase and executive design is ongoing. The building construction tender can be likely issued during 2024.