

WELCOME



A new European Laboratory.



NUCLÉAIRE
& PARTICULES
You know as IN2P3 !

BIENVENU(E)S

Formed on 2020 by the merging of 5 Laboratories in Orsay-France

CSNSM	<i>Centre de Sciences Nucléaires et de Sciences de la Matière</i>
IPN	<i>Institut de Physique Nucléaire</i>
IMNC	<i>Imagerie et Modélisation en Neurobiologie et Cancérologie</i>
LAL	<i>Laboratoire de l'Accélérateur Linéaire</i>
LPT	<i>Laboratoire de Physique Théorique</i>



IJCLab : Located in Orsay Campus, 30 Km South-Paris, Campus Paris-Saclay

IJCLab is occupying a large part of the Orsay Campus ($\sim 50000\text{m}^2$)



RER B
Bures

IRFU/CEA in the same Campus



RER B
Orsay



The Orsay Campus

Irène Joliot-Curie.

Her vision was instrumental in the creation of the Orsay campus and the establishment of its first scientific laboratory (in 1955).

IJCLab follows her heritage and vision.

Extension Virtual Data
bâtiment 206



Ateliers bâtiment 100



PSI-Silicon



Ateliers bâtiment 200



Some News from IJClab

A lot of activities are going on ...



Cafeteria – Bât.102



Entrée du laboratoire – Bâtiment 100

Extension bâtiment 108

MOSAIC



Hall D3-D4 Bâtiments 201



ThomX and PERLE



du Hall D1-D2, de l'IGLOO, bat 201

Vacuum & Surfaces





...et voilà IJClab !

7 Research Poles

31 research teams and 2 Departments

1 Engineering pole

4 Departments with 10 Services

1 Administration Pole

3 Divisions + 1 Service

6 support Services

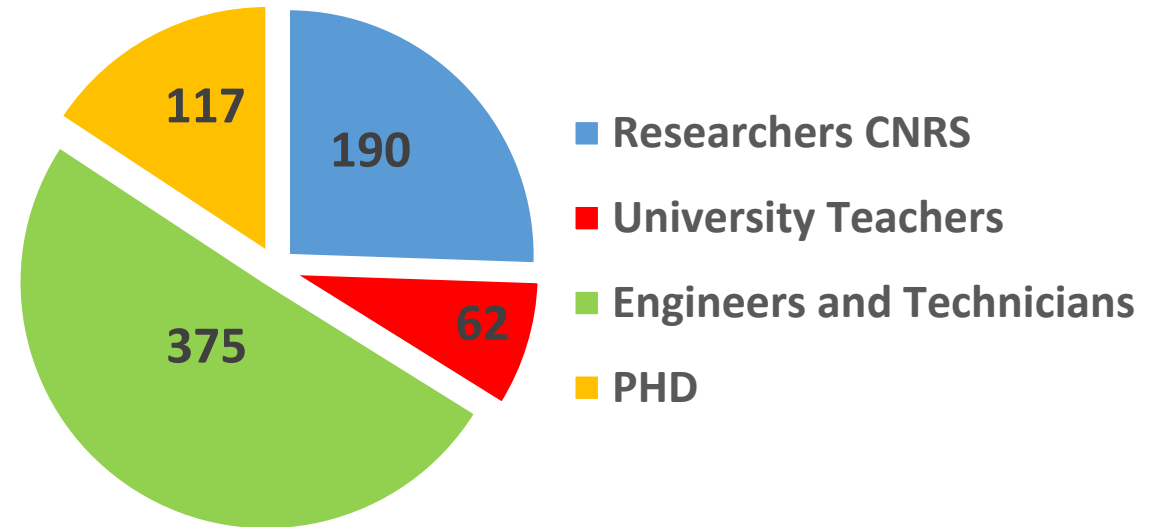
5 Platforms

(with external users)

+ several technical platforms

~750 people (~530 permanents)

The largest laboratories of the CNRS and Paris Saclay
In the network of the major European laboratories (LDG)



120+ internships/year
>800 people present in the laboratory

New and different organization compared to the former laboratories + new “instances”



IJClab : in a nutshell Scientific Departments

7 Pôle Scientifiques

All the themes of the "physics of the two infinities" with the presence of strong historical/existing poles, emerging poles and activities at the interfaces.

PHYSIQUE NUCLÉAIRE
NUCLEAR PHYSICS

A2C Astroparticles, Astrophysics
& Cosmology

Accelerator Physics

Including RF and cryogenic services

PHE Physique des Hautes Energies
High Energy Physics

Theory

Energy and Environnement

Health Physics

~ 120 PhD



~180 staff members

4 Departments :

Electronics / Computing
Instrumentation / Mechanics
 with 10 Services

IJClab in a nutshell : Technical Skills

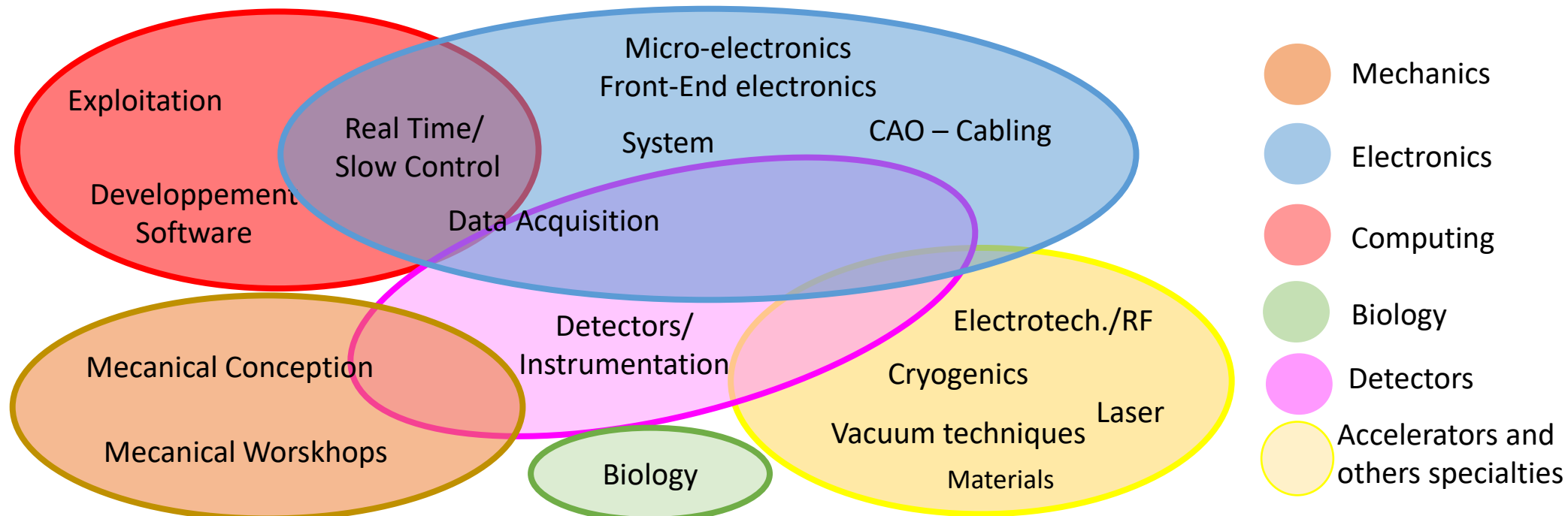
Services in accelerator Pole

- RF
 - Cryogenics
- ~30 staff members

Technical staff with technical skills/expertise

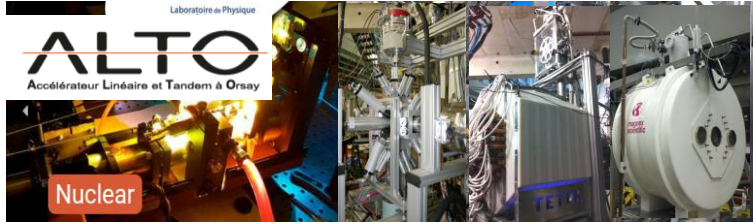
essential pillars for the laboratory to design, draw and build instruments.

- Technical services are fuelled by the challenges of research (R&D and projects)
- The proximity of technical and research teams (integrated teams)
- The ability to combine and make coexist versatility and specialization





IJCLab in a nutshell : Some Large Platforms



- **15 MV Tandem** (from proton to aggregates)
- **electron linac** -> radioactive beams by photofission

Nuclear, Health physics, Irradiation

Opened to external users



Several MeV protons, multicharged atomic ions, gold molecules and nanoparticles

Nuclear/A2C, Health physics, Irradiation

Opened to external users



Ion irradiation / implantation and *in situ* characterization techniques (TEM, IBA)

Energy, nuclear materials, Health physics, Irradiation physics and chemistry

Opened to external users



IJClab in a nutshell : Some Medium-Small size Platforms

Semiconductor Platform : Silicon Detector Characterisation/Production



A2C Research themes



CALVA

Cavity locking/Squeezing for VIRGO and ET

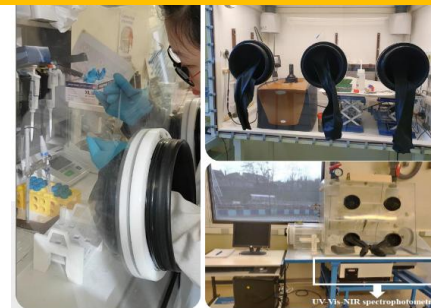
Micrometeorite Preparation/analysis



Myrtho

γ Detectors development / characterization

Radiochemistry laboratory Actinides - Bat 107



Health research themes



non linear optical biphotonique imaging

VIRTUAL DATA

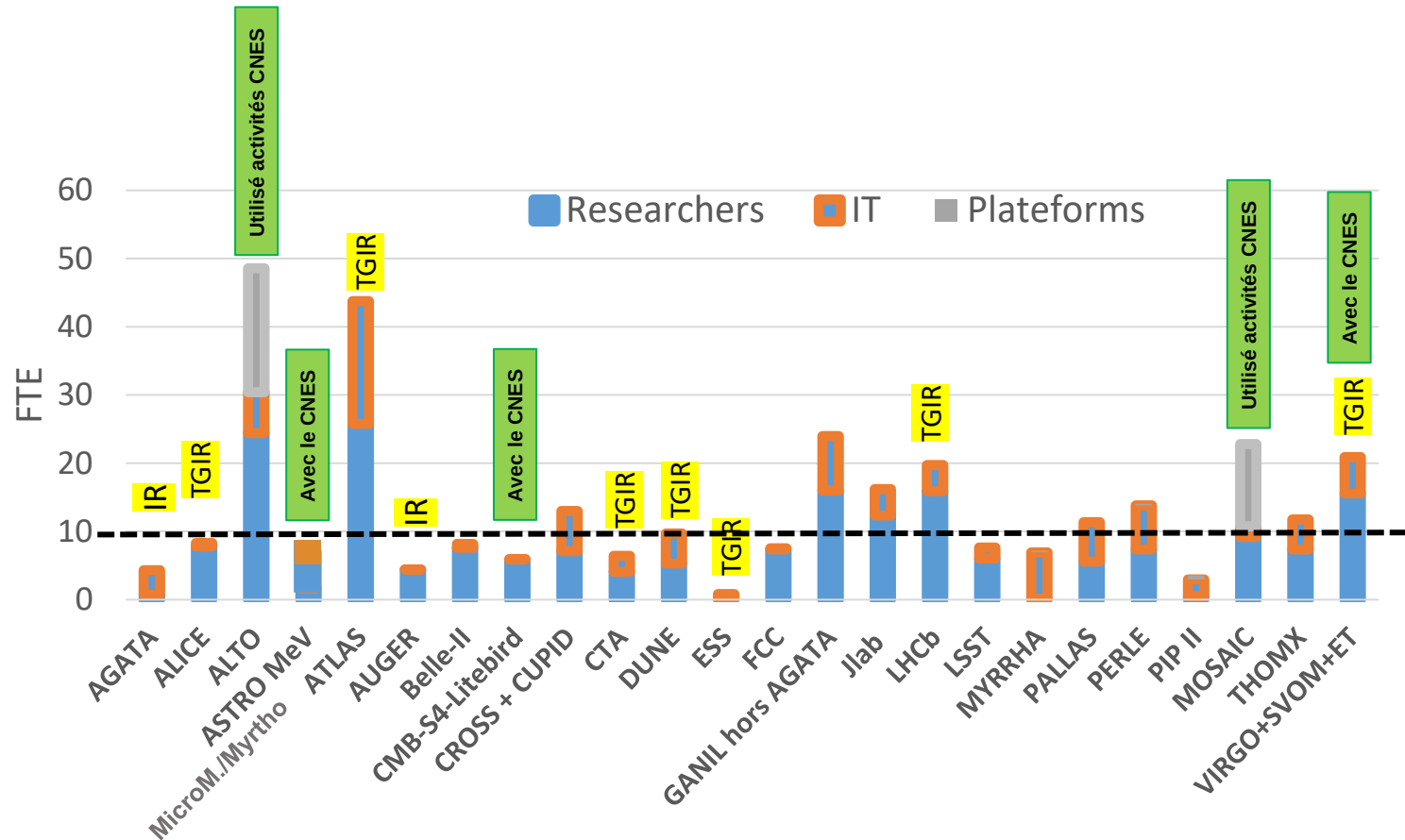
Advanced computing resources
infrastructure : Grid / Cloud





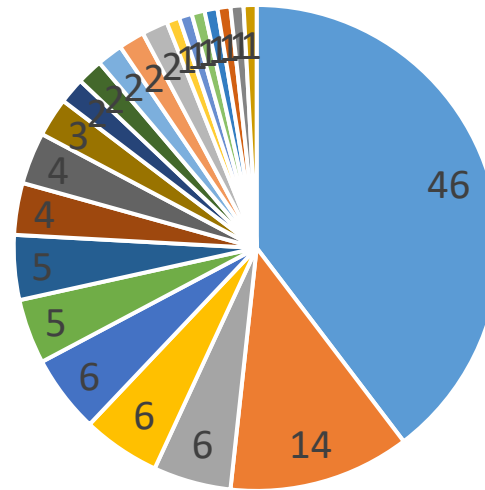
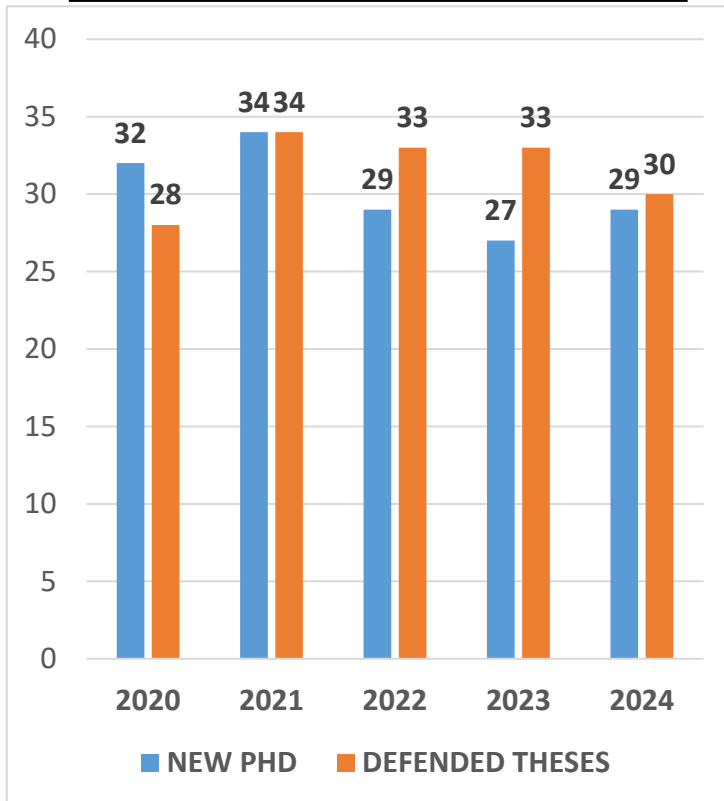
Extensive participation in and leadership of major global projects.

Lead and play a major role in world-class flagship projects in high-energy physics, nuclear physics, astroparticle physics and cosmology, and accelerator physics, contributing at all levels.





- ~30 theses defended/year
 - ~slightly more than 30 incoming PHD students per years since IJCLab
- ~120 PHD student @IJCLab**



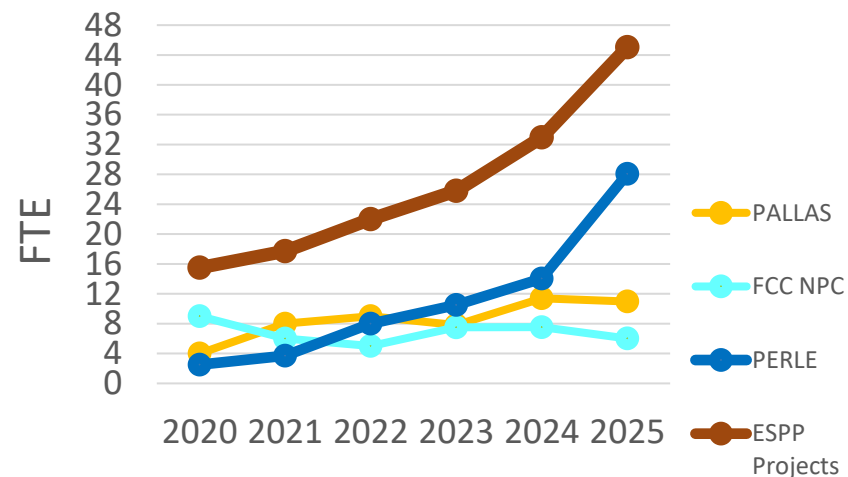
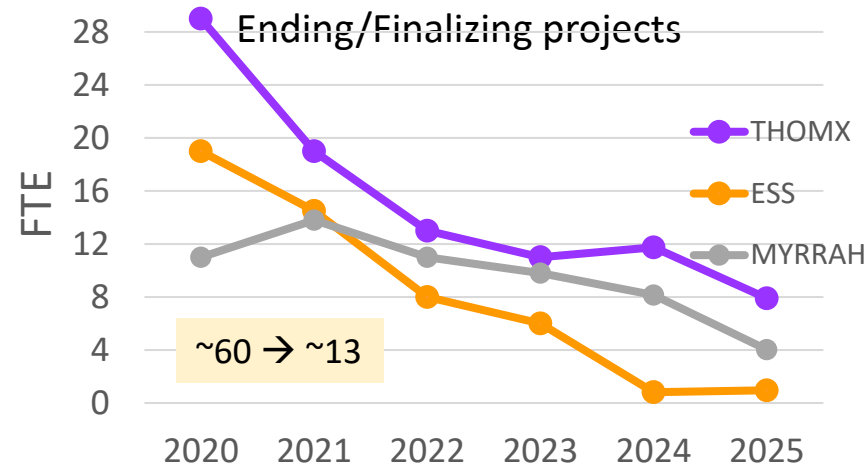
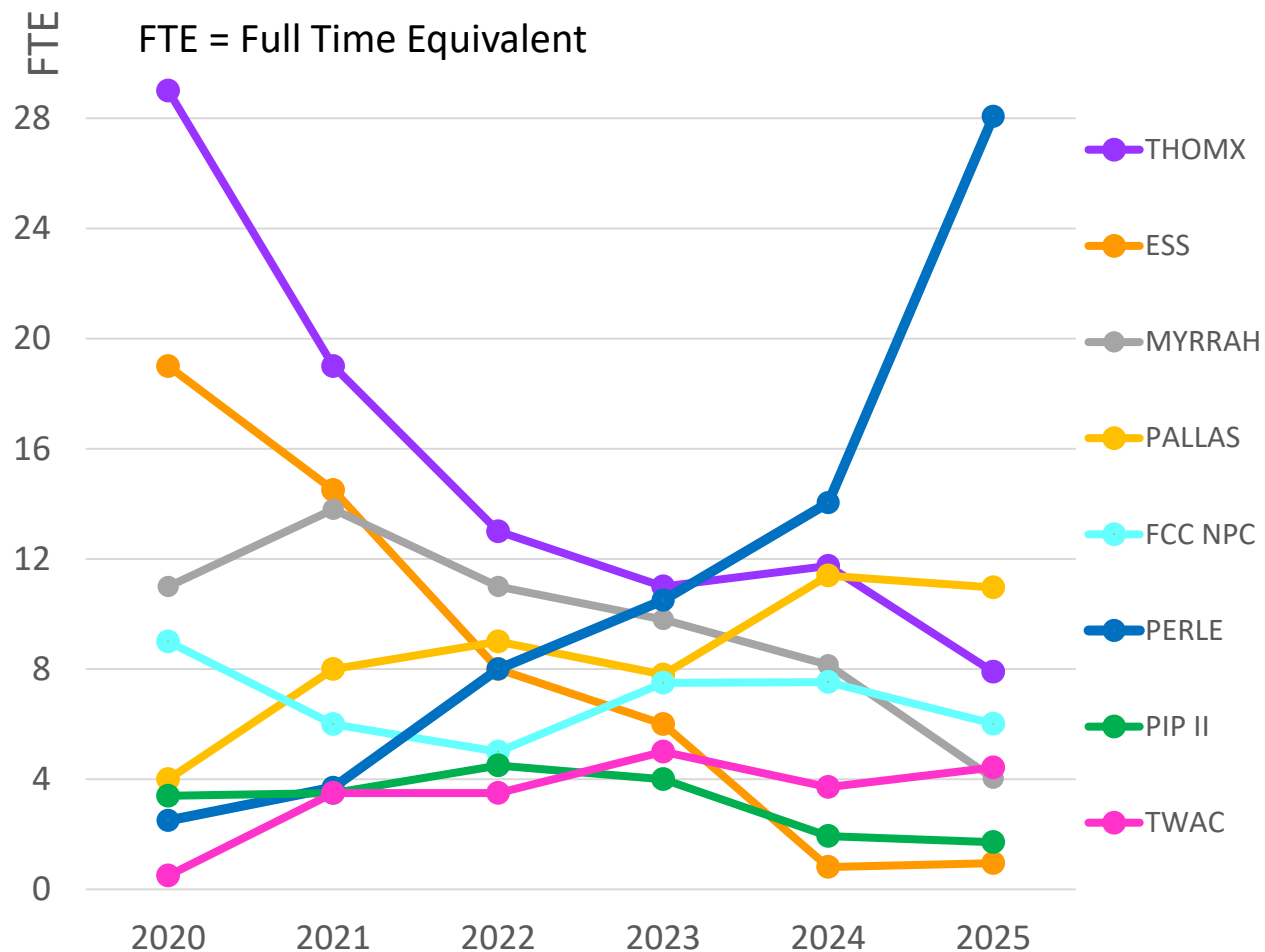
+ 150 Internships/y
~500 Internships months
From Bachelor → Master



FOCUS on Accelerator Physics activities



Accelerator Physics: Projects 2020-2025

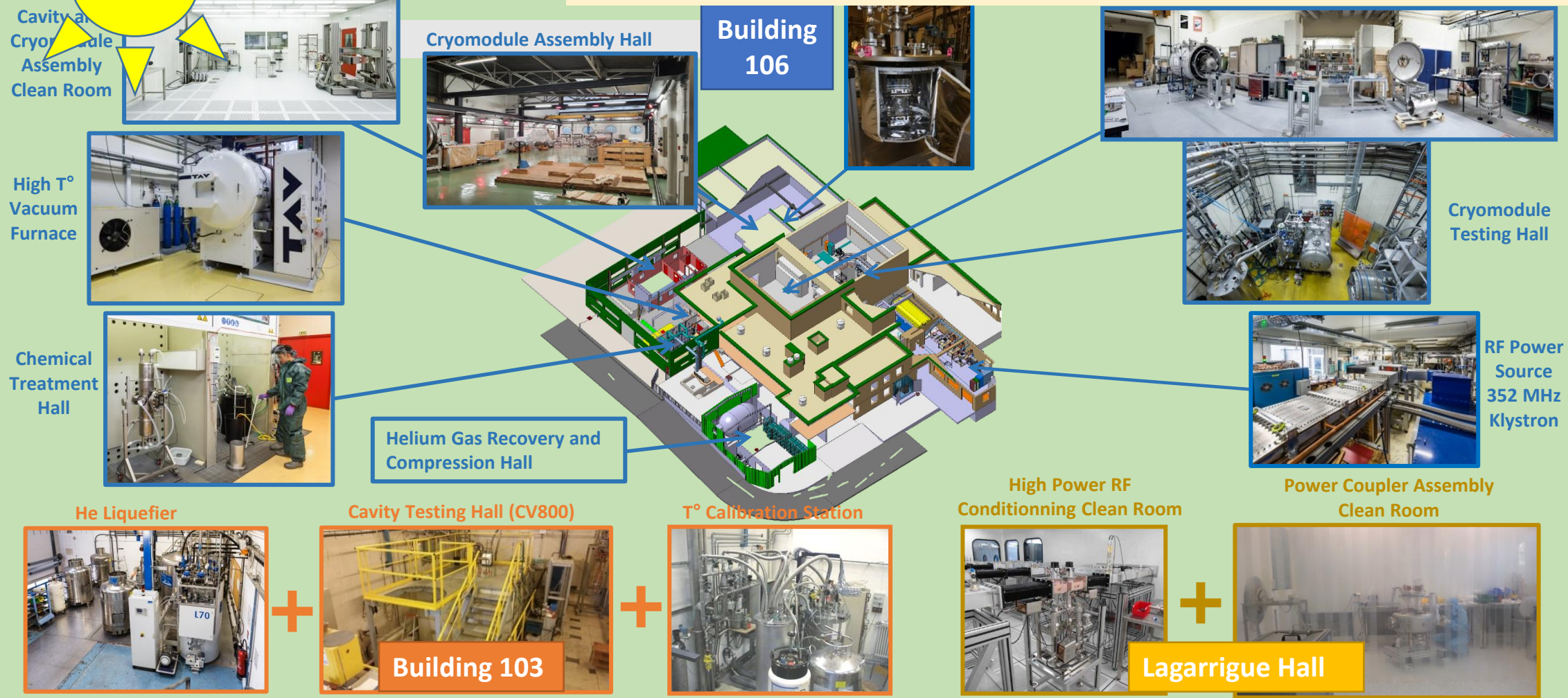




Accelerator Physics: general considerations

- **Research pole** created (~15 PhD present) and with **two specific services : RF and Cryogenic**. Strongly linked to Platforms (**SupraTech, Vide & Surface, LaseriX**)
- R&D, contribution to large international projects and construction of local accelerators **according to the European Strategy (FCC, ERL, Laser-Plasma)**. The end of some projects, allows to start new ambitious ones.
- Contribution to large accelerator worldwide in our discipline (**PIP II**). Starting and ramping-up possible contribution for **FCC**. Exploring possibilities for **EIC**
- **Finishing ThomX with success**
- **New project PERLE : an ERL machine as a unifying and structuring project for the pole and for the laboratory**

SUPRA Tech R&D on the superconducting cavities continuously upgrading : ESS, PIP II, Mhyrra, PERLE...





New Platform : Vide & Surface

A platform dedicated to surface analysis + Ultrahigh Vacuum studies of materials used in accelerators

Surface analysis of materials

Vacuum Expertise



ISIS multi-technical set-up (XPS)



Hall D4



Scanning Electron Microscope



Compact XPS



LASERIX is a UHI laser facility

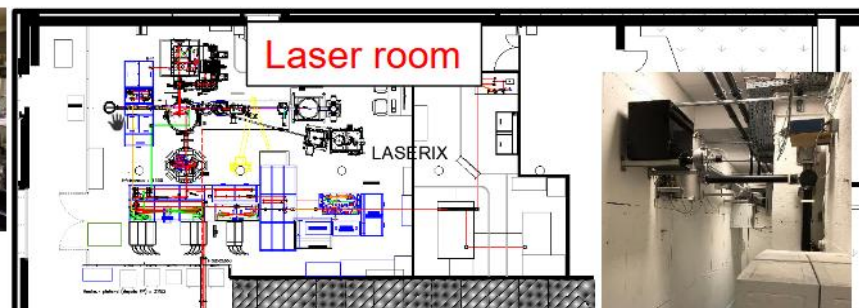
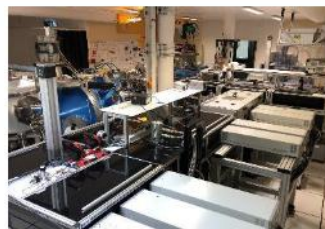
Coherent, high-intensity, ultrashort sources (50 fs to 10 ps) in the near-infrared (800 nm) and EUV (30–90 eV) spectral ranges.

Delivering beams to :

PALLAS - compact eLPA (200MeV)

TWAC - THz e- in a Dielectric

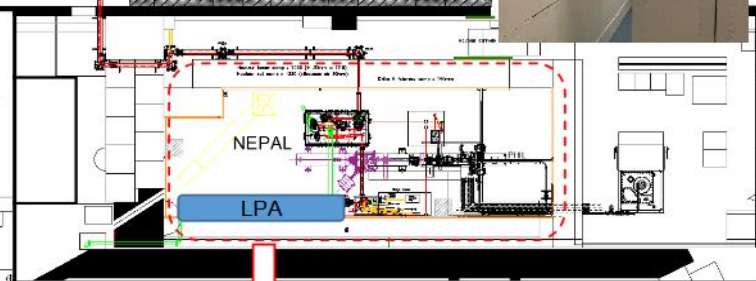
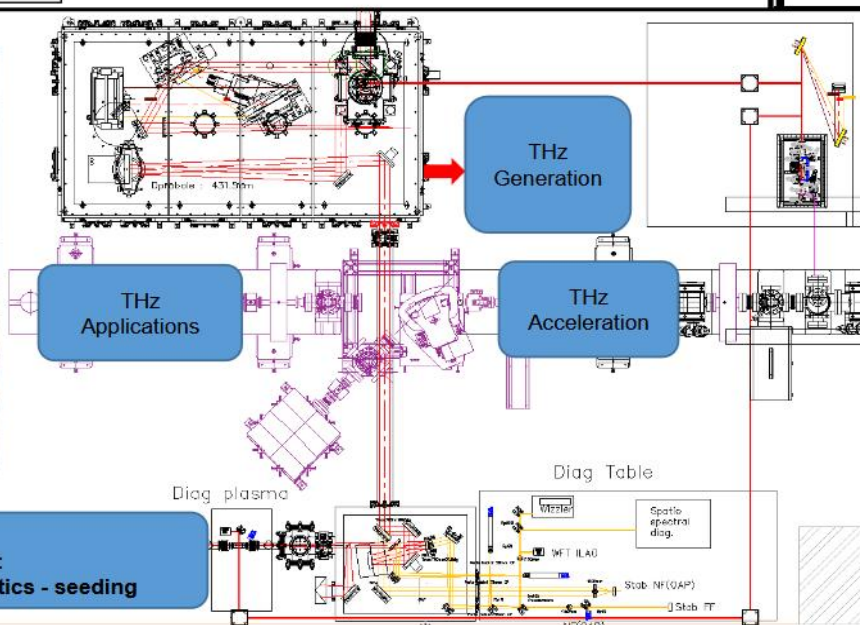
DELLIGHT - QED experiment



Radio-protected area



PALLAS
E beamline :
Conditioning – diagnostics - seeding



Cooling groups (2x 75 kW): Air conditioning + instrumentation

ESS In-kind contribution is finished!

- 14 Spoke cryomodules
- Cryogenic Distribution System



CNRS Contribution to PIP-II



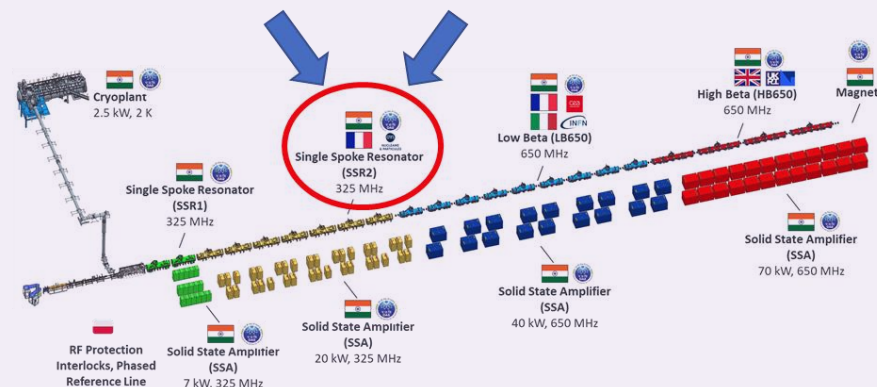
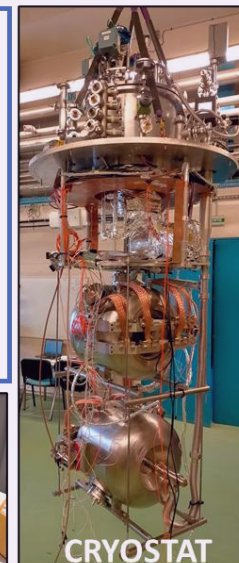
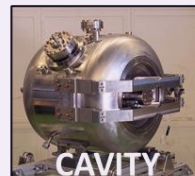
Prototyping Phase (2018 – 2025)

- Support to **design**.
- **Fabrication** of 5 tuners and 4 couplers in France.
- Cryogenic **testing** of tuner and cavities @

SUPRATech

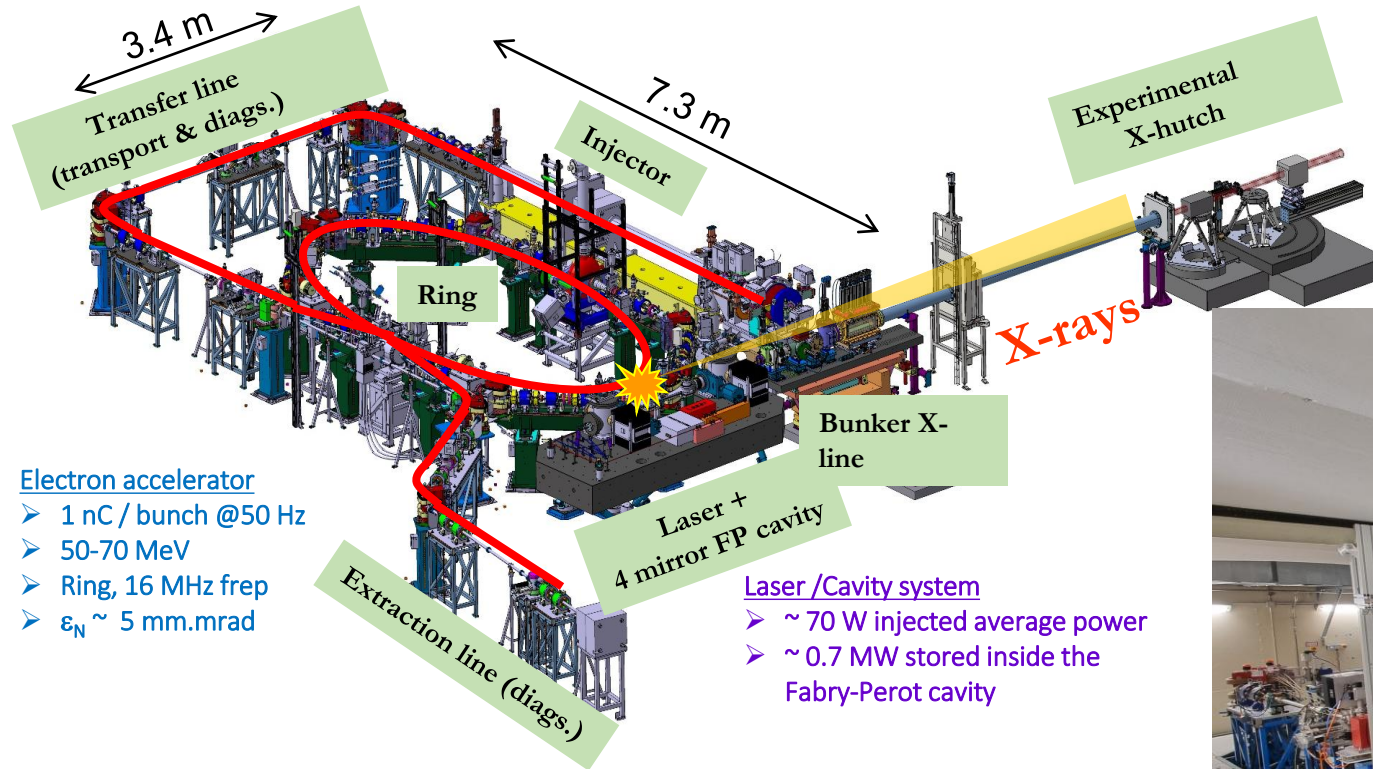
Production Phase (2025 – 2027)

- **Upgrade** of cryostat
- Cryogenic **test** of 30 cavities delivered « ready for test » by industry.
- Surface **re-processing**
- Shipping to FNAL





ThomX demonstrator - I



Compton X-rays up to 90 keV
produced by 50 MeV e-
for applications with an average flux $>10^{10}$ ph/s

Electron accelerator

- 1 nC / bunch @ 50 Hz
- 50-70 MeV
- Ring, 16 MHz freq
- $\epsilon_N \sim 5$ mm.mrad

Laser /Cavity system

- ~ 70 W injected average power
- ~ 0.7 MW stored inside the Fabry-Perot cavity

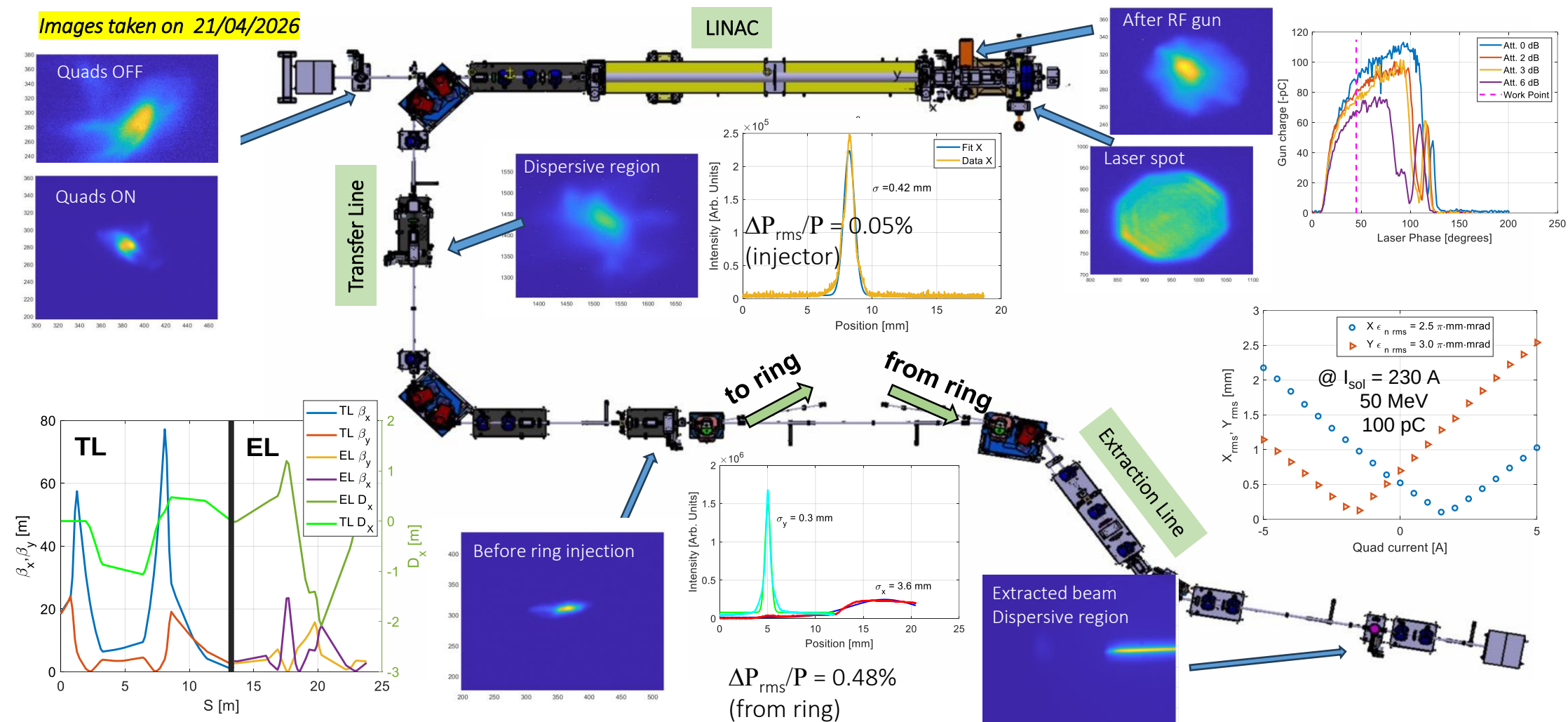
Started in ~ 2010
Ended 18th July 2026
And now under dismantling





ThomX demonstrator - II

Images taken on 21/04/2026

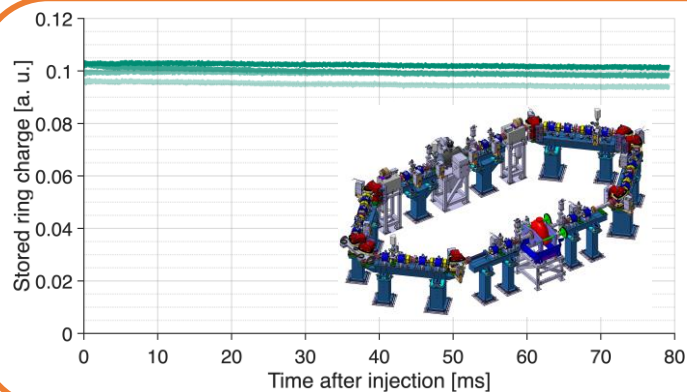




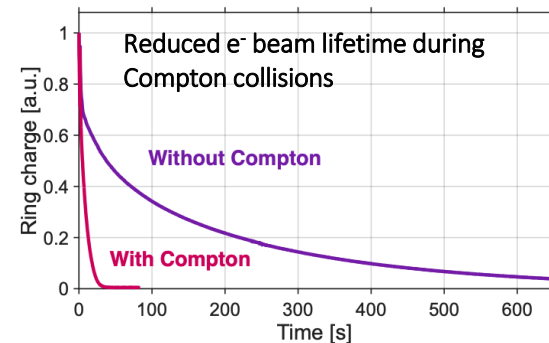
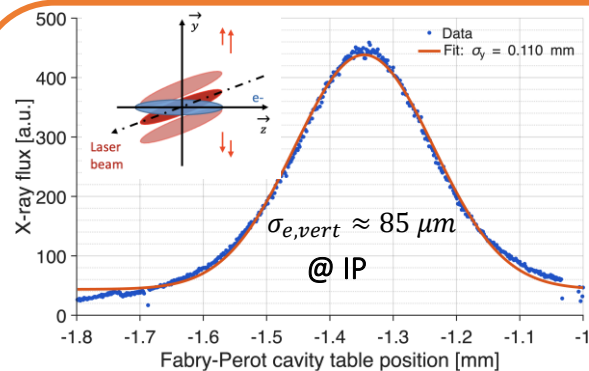
ThomX demonstrator - III

Routine e^- beam storage and laser synchronization demonstrated, with Compton X-ray **flux up to $\sim 10^{11}$ photons/s**

Accelerator performance: reproducible e^- beam storage

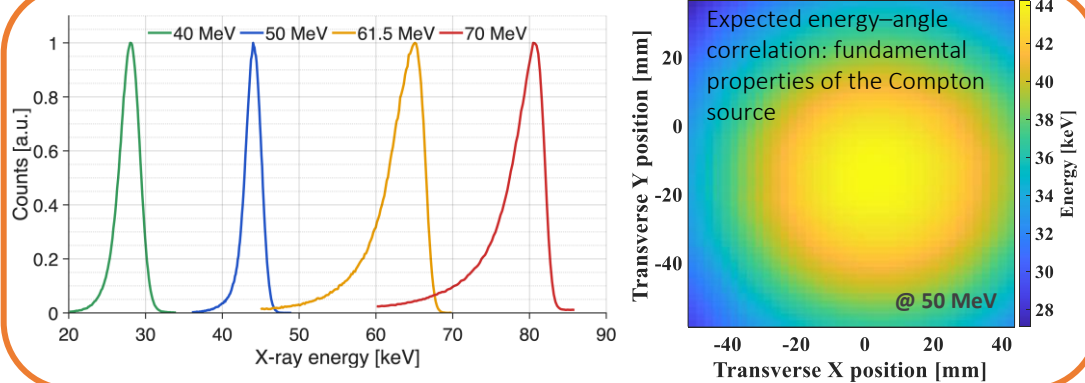


Experimental evidence of Compton X-ray production



X-ray signal maximized at electron-laser spatial and temporal overlap

Tunable X-ray energy: ~ 28 – 81 keV



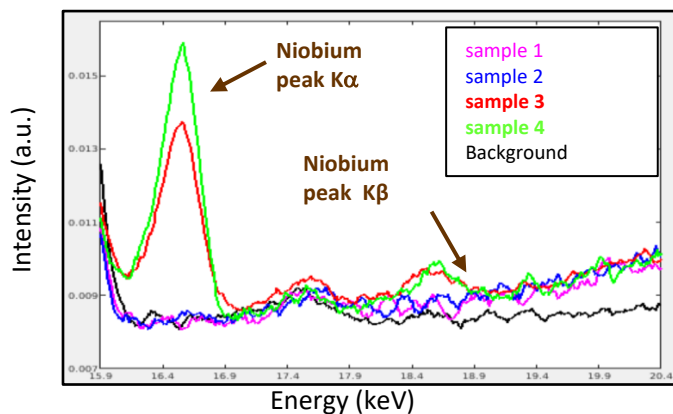


ThomX demonstrator - IV

Fluorescence spectroscopy experiments

Paraffin-embedded prostate samples from Congo.

Nb detected in 2/4 samples



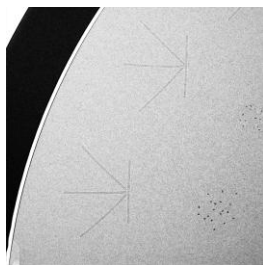
Phase-contrast imaging demonstration

Propagation-based phase-contrast imaging with standard mammographic phantoms **toward medical imaging applications**



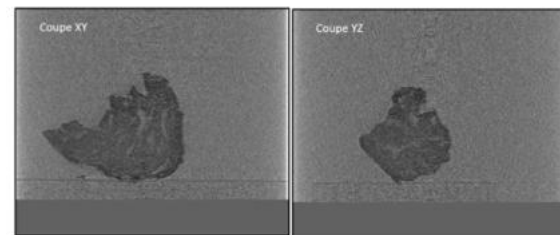
TORMAM mammography Phantom

Electron energy: 40 MeV
X-ray beam energy: 28 keV

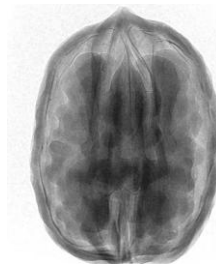


Tomographies

CT scans of **kidney stones** using an in-house Tomographic Contrast (CT) code



Walnut sample

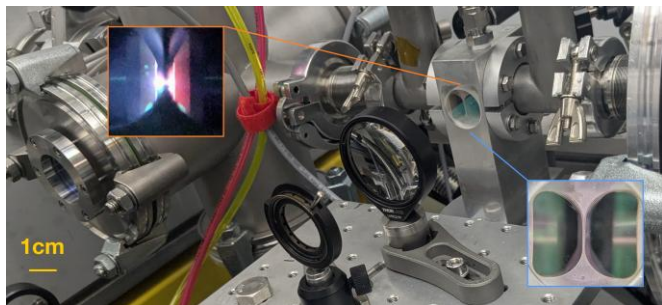


Electron energy: 40 MeV
X-ray beam energy: 28 keV
Sample-detector-distance: **3.1 m**
Source-to-sample-distance: **10.6 m**

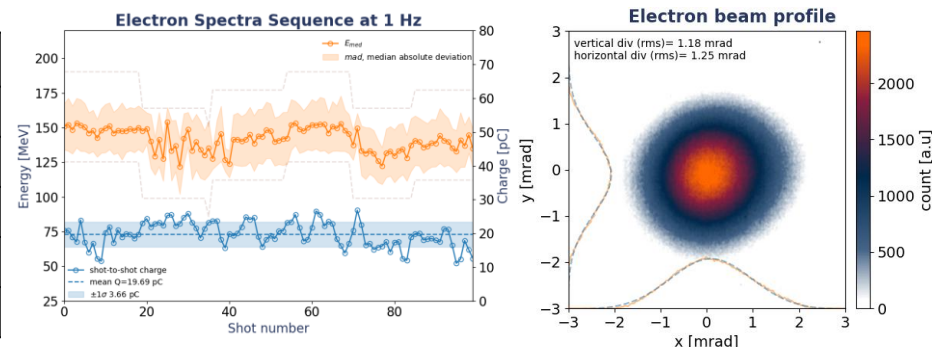


The activities in PALLAS and TWAC

PALLAS: commissioning @ 1 Hz from the laser-plasma electron source



Parameters		Goal	Achieved
Energy (E_{med})	[MeV]	150	140-160
Energy Spread (σ_E)	[MeV]	<7.5	18-100 (+)
Charge (Q)	[pC]	15-30	10-25
Divergence (θ)	[mrad]	<5	0.8 x 1.2
Stability	[%]	5	15-23

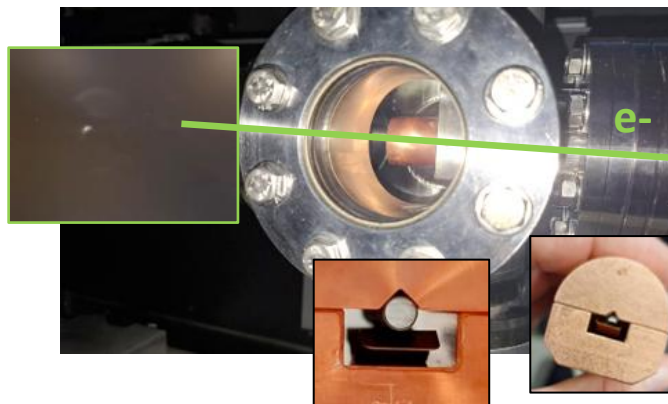


First electron beam characterized using a fully integrated diagnostic beamline within a laser-plasma accelerator — a world first!
Active stabilization loop for the laser and plasma, not currently in use.

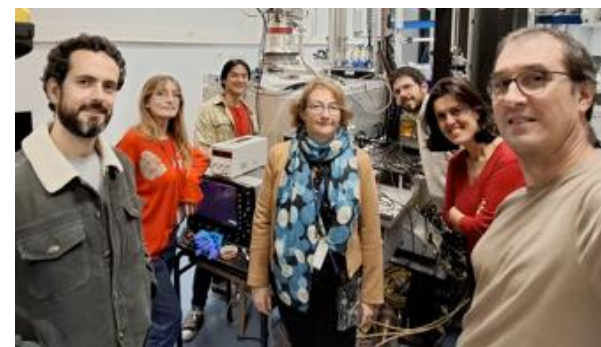
TWAC:



Generation and transport of THz radiation in air to the interaction point.



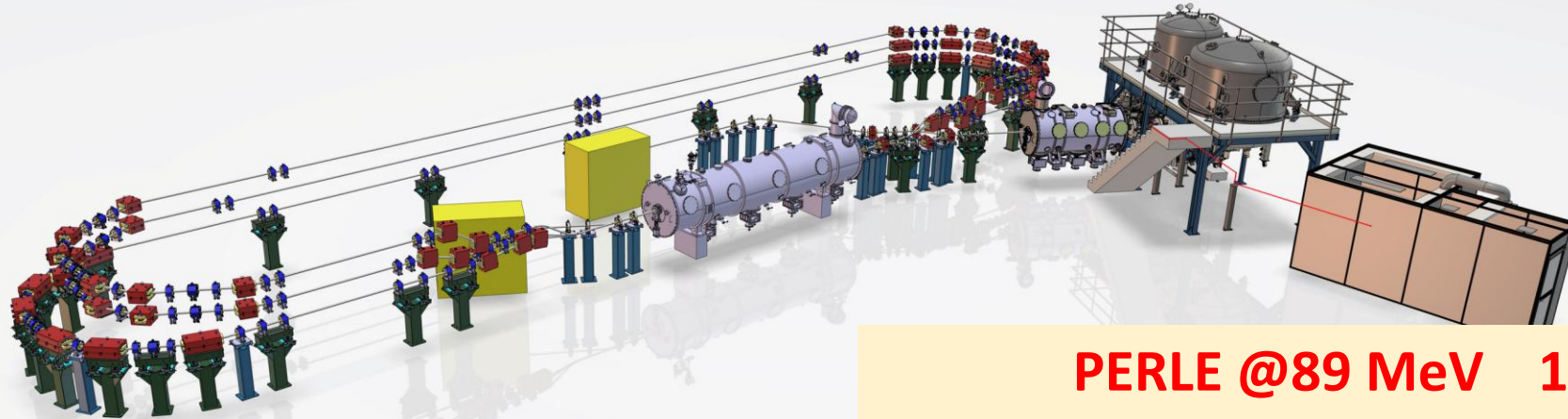
Electron passage through the ZITA (10–60 pC).



Electron bunch dose measurement using a SiC detector (developed by CSIC): 1 Gy/s for 25 pC.

Two phases :
1-turn ; 3-turns

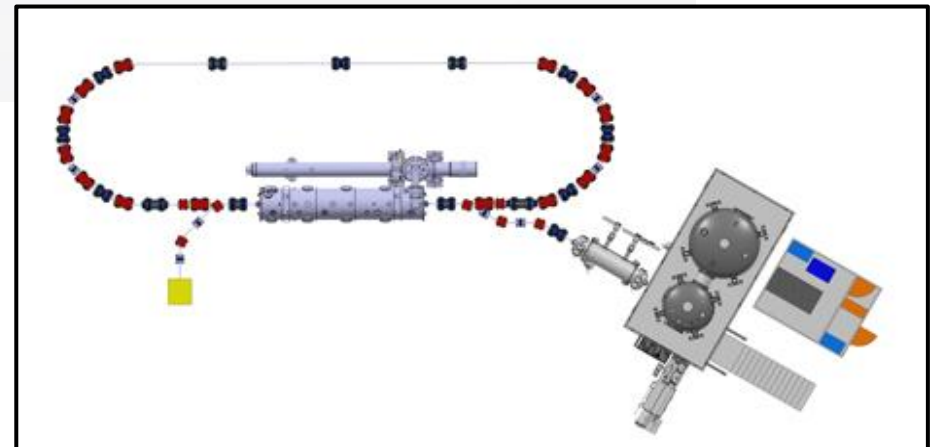
The ERL machine : PERLE



PERLE @89 MeV 1-turn
(ERL demonstrator, FCC-ee test facility)

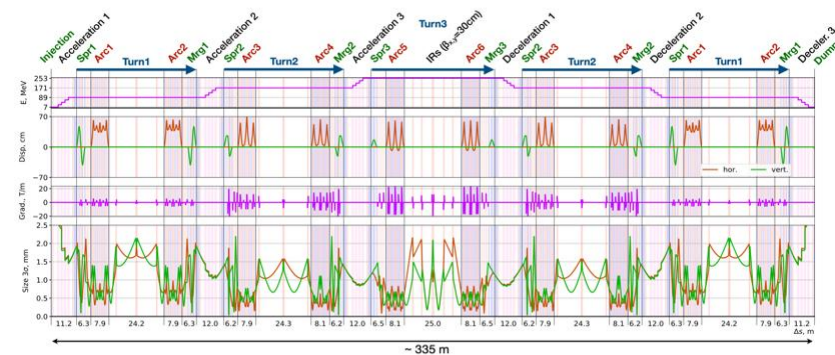
Parameters	Values
Injection Energy	7 MeV
Electron beam energy PHASE 1 (1-turn)	89 MeV 1,8MW
Electron beam energy PHASE 2 (3-turns)	250 MeV 5MW
Normalised Emittance $\gamma\epsilon_{x,y}$	6 mm.mrad
Average beam current	20 mA
Bunch charge	500 pC
Bunch length	3 mm
Bunch spacing in injector	25 ns
RF frequency	802 MHz
Duty factor	CW

Same parameters as LHeC

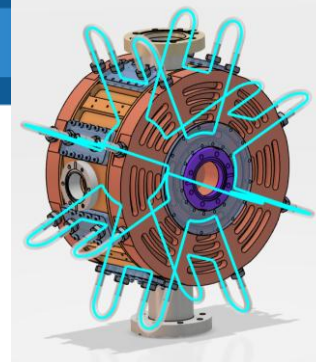
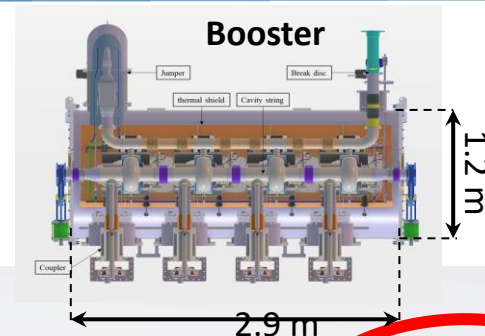
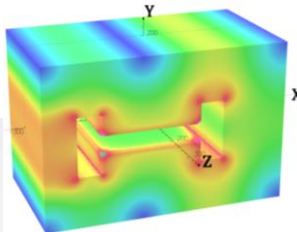




The ERL machine PERLE – Construction started

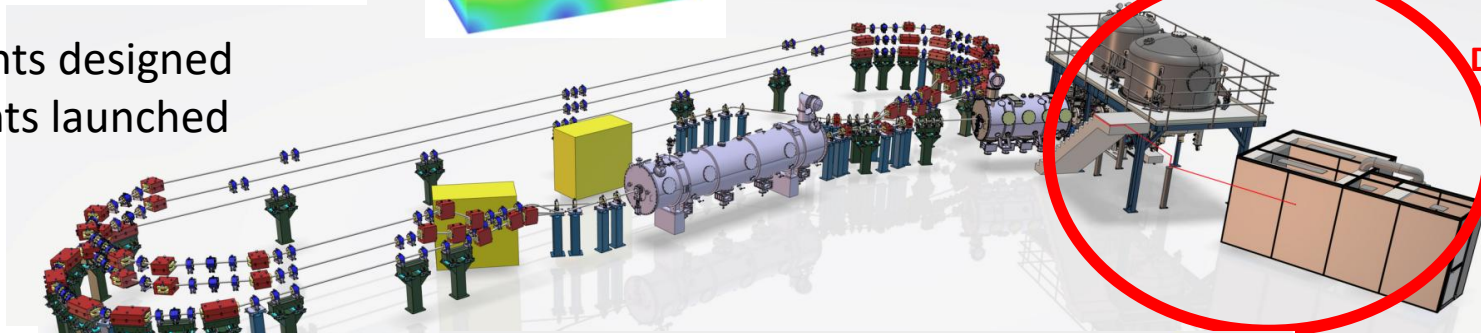


B-com magnets

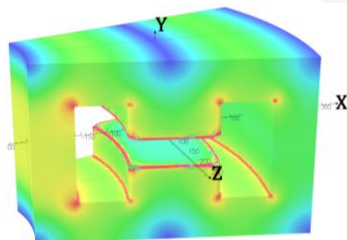


Buncher

Most all the components designed and some procurements launched



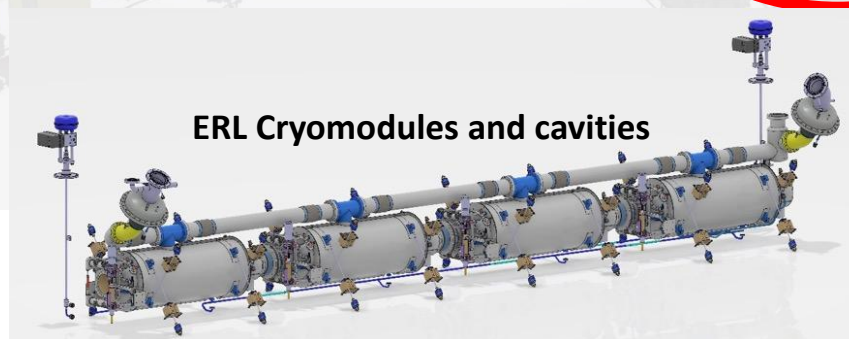
DC gun installation and commissioning



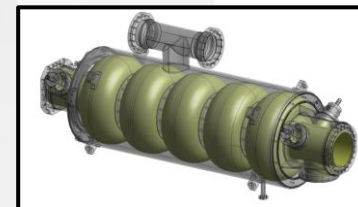
Arc dipole



HOM

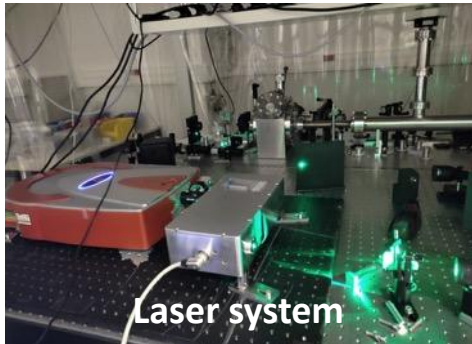


ERL Cryomodules and cavities

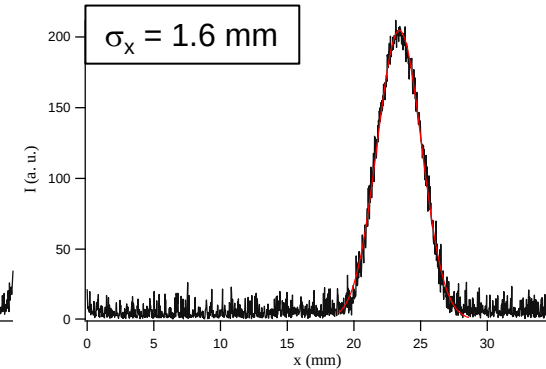
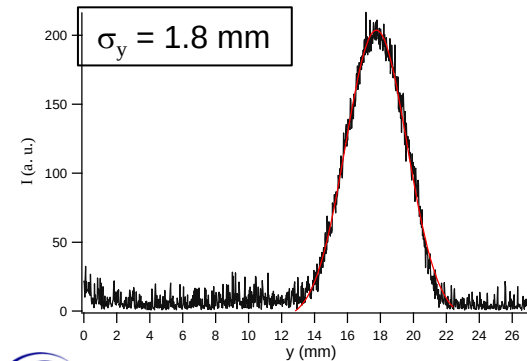
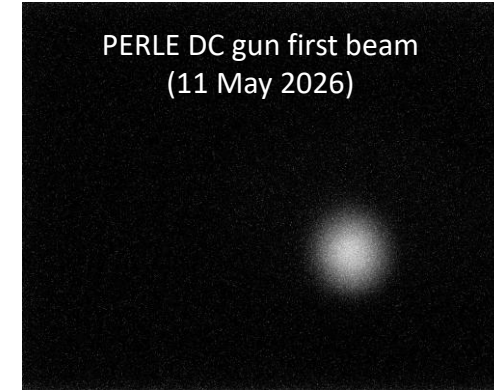




First electrons from PERLE from the DC gun



- Laser @ 10 Hz, 5 % d'AOM (=5 % de P_{laser} Max)
- HV @ 200kV in the DC Gun
- Photocathode QE = 5.2 %
- **2,5 mA beam current measured**



"This work received government funding managed by the Agence Nationale de la Recherche (ANR) in the France 2030 framework - reference ANR-24-RR11-0001"



WELCOME to IJCLab



PhASE26
Photocathodes for Accelerator
Science in Europe

SEPTEMBER 21-23, 2026
ORSAY - IJCLAB - FRANCE

Organized by CNRS/IN2P3 (LPSC and IJCLab)
at Orsay (IJCLab) France

Topics

- OVERVIEW OF PHOTOCATHODE RESEARCH
- ACCELERATOR APPLICATIONS OF PHOTOCATHODES
- PHOTOCATHODE RELATED STUDIES AND NOVEL CONCEPTS
- METALLIC PHOTOCATHODES
- SEMICONDUCTOR PHOTOCATHODES
- POLARIZED PHOTOCATHODES
- PHOTOCATHODE THEORY
- CHARACTERIZATION TECHNIQUES



indico.ijclab.in2p3.fr/e/PhASE26

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I wish you a fruitful Workshop !