université PARIS-SACLAY
FACULTÉ DES SCIENCES D'ORSAY

IJCLab Irène Joliot-Curie Laboratoire de Physique des 2 Infinis

A new European Laboratory.

cnrs
NUCLÉAIRE & PARTICULES
You know as IN2P3 !

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

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

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

RER B Bures

IJCLab is occupying a large part of the Orsay Campus (~50000m²)

IRFU/CEA in the same Campus

Some News from IJClab

Extension Virtual Data bâtiment 206

PSI-Silicon

A lot of activities are going on …

Cafeteria – Bât.102

Entrée du laboratoire – Bâtiment 100

Extension bâtiment 108

MOSAIC

Ateliers bâtiment 100

Ateliers bâtiment 200

ThomX and PERLE

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

Hall D3-D4 Bâtiments 201

Vacuum & Surfaces

…et voilà IJClab !

7 Research Poles
31 research teams and 2 Departments

1 Engineering pole
4 Departments with 10 Services

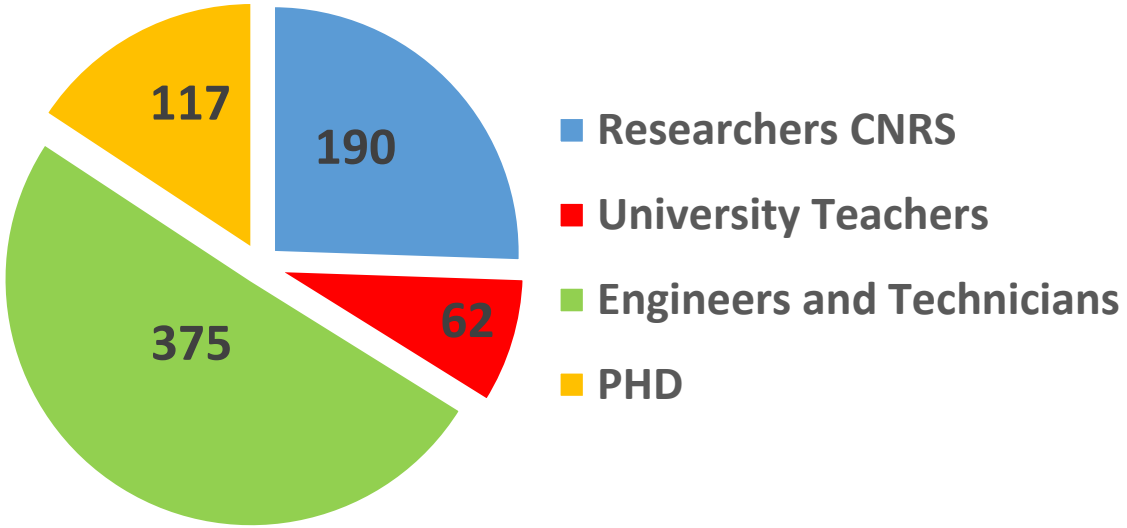
1 Administration Pole
3 Divisions + 1 Service

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 : Technical Skills

1 Pôle Ingénierie 4 Départements

~180 staff members

4 Departments :

Electronics / Computing
Instrumentation / Mechanics

with 10 Services

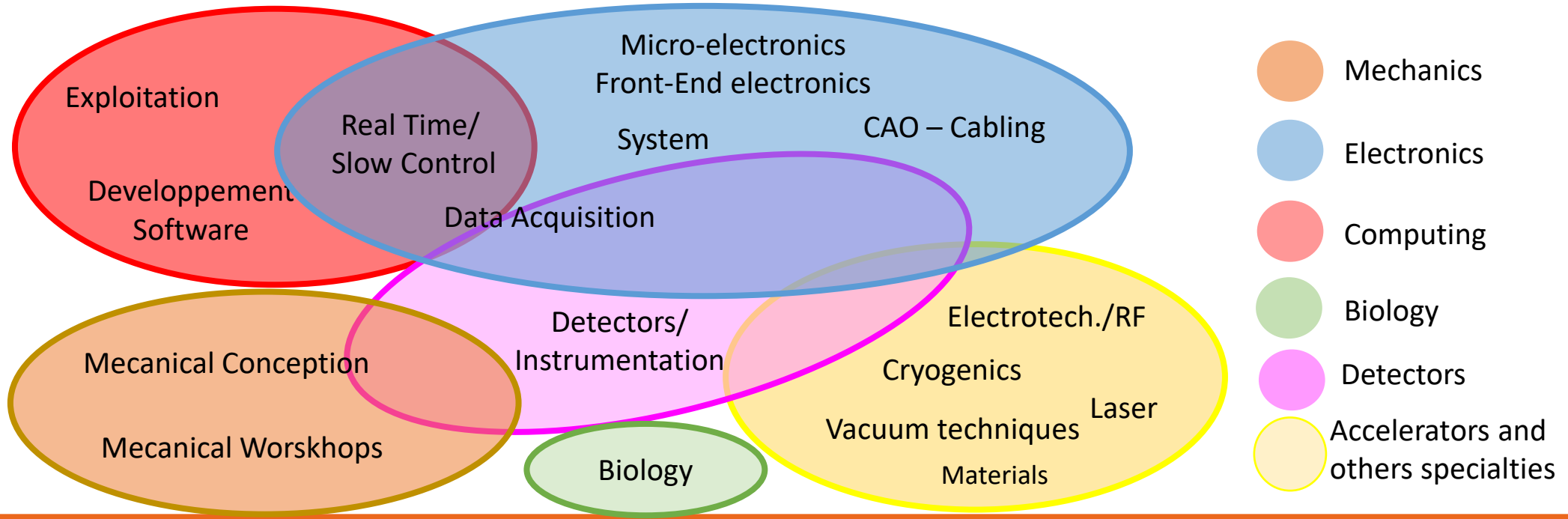
Services in accelerator Pole

- **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

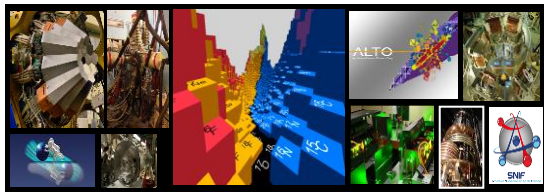


IJClab Scientific Departements

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

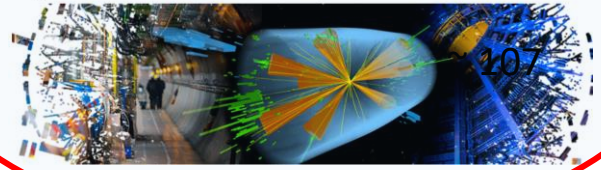
Accelerator Physics

Including RF and cryogenic services

Theory

Energy and Environnement

PHE Physique des Hautes Energies High Energy Physics



Health Physics

~ 120 PhD

HEP Physics and Projects

~120 FTE* in HEP

Within France, most of these projects are done with other **IN2P3 laboratories** and with strong contributions from **IRFU/CEA-Saclay**

- **Structure of nucleon (and of hadrons)**
- **New state of matter : Quark Gluon Plasma**
- **New particles, symmetries beyond Standard Model**
- **Origin of the mass of elementary particles**
- **Particle-antiparticle asymmetry (CP violations)**
- **Masses and mass hierarchy of neutrinos**
- **Nature of neutrinos (Majorana or Dirac)**

** FTE = Full Time Equivalent*

*** Main hardware contributions, besides the activities in Physics analysis*

MAIN PROJECTS

~35* **ATLAS** (elec. calorimeter, ITK and HGTD)**

~20 **LHCb** (calorimeter, upgrade electronics, Plume luminometer)

~10 **ALICE** (dimuon tracking, electronics) *gradually joining LHCb*

→ Start of activities (physics and detector R&D) for FCCee

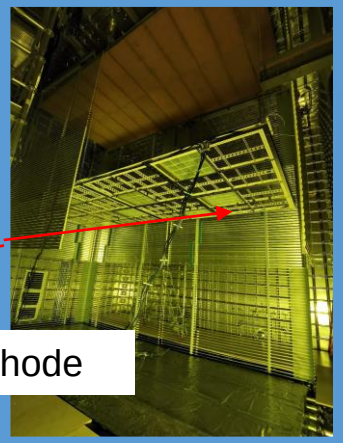
~10 **Belle II** (Cerenkov, DAQ upgrade, *synergy with LHCb*)

~15 **JLaB experiments** (detectors construction), *moving also on **EIC***

~10 **DUNE** (mechanics+ mounting at CERN) */rapidly increasing*

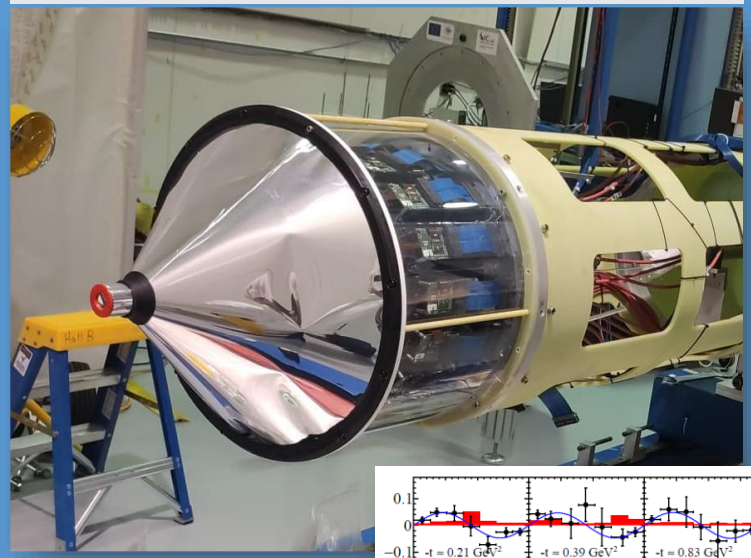
Recent IJCLab Highlight for High Energy Physics

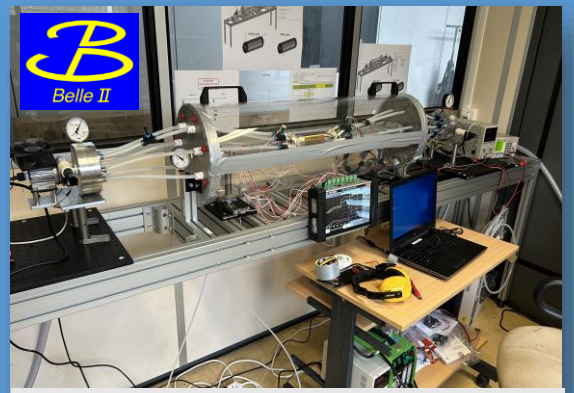
Module-0 vertical drift fully installed at CERN



Cathode

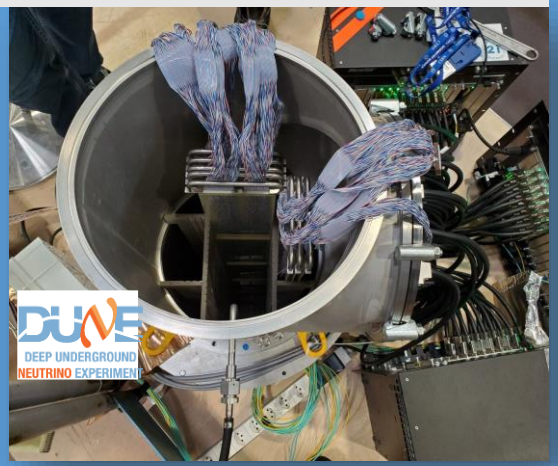
Completion of **ALERT** wire chamber delivered to **Jlab. Data taking in Jan 2025**

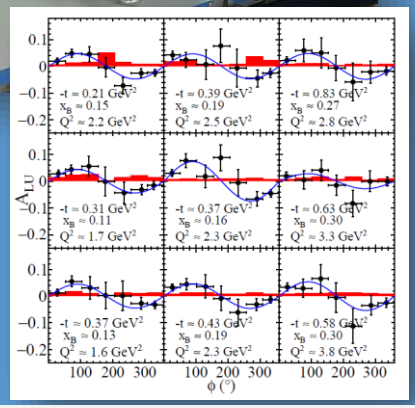




Inner vertex detector air cooling test bench for Belle 2 upgrade

Cheminey in cryogenic conditions)

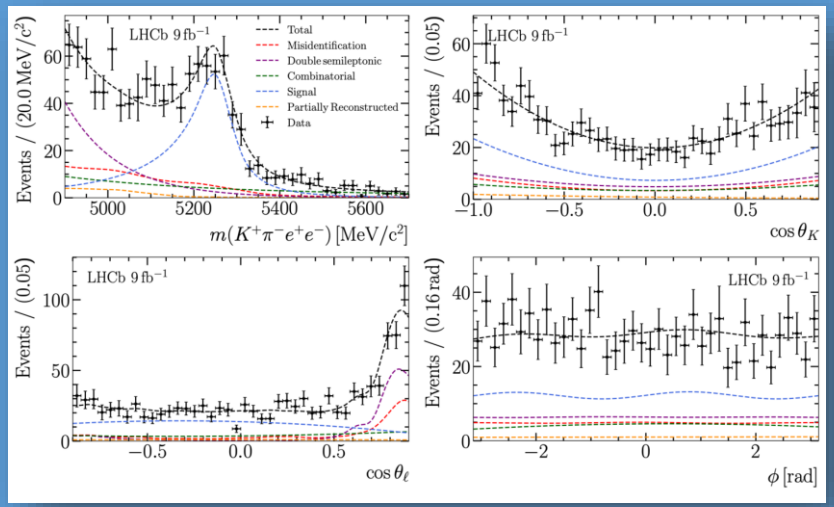




JLab: first measurement of deeply virtual Compton scattering on the neutron

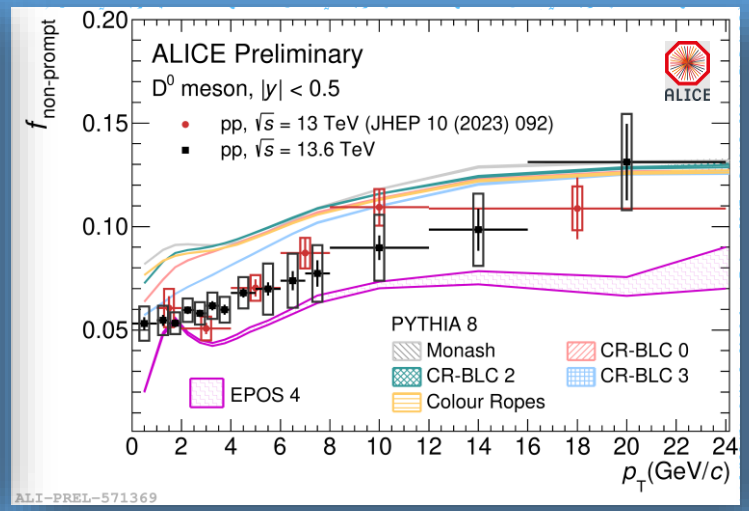
Cooling system of the new beam pipe at KEK

Recent IJCLab Highlight for High Energy Physics : @LHC ~65FTE

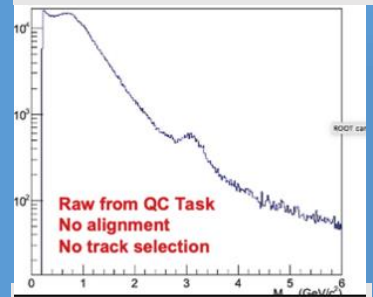


LHCb: first angular analysis of $B \rightarrow K^{*}e^{+}e^{-}$:no sign of LFV effects are observed

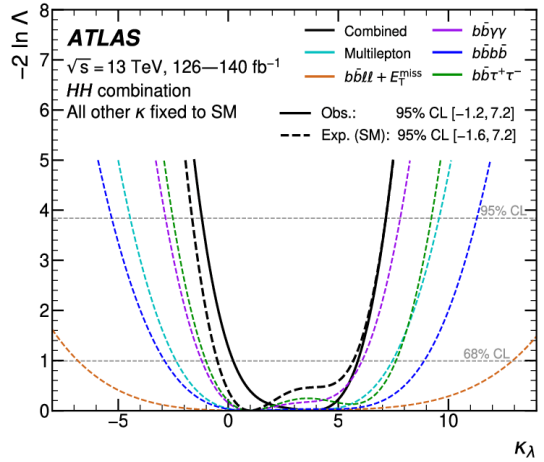
LHCb is reading out its ~ full detector at 40 MHz with a fully software trigger Luminosity (PLUME detector) information sent to the LHC machine



ALICE: First non-prompt charm-hadron measurement in Run 3: Measurement down to pT = 0



ALICE muon spectrometer rejuvenated



ATLAS: combination of run2 searches for Higgs boson pair production → constraints on the Higgs boson self-coupling modifier

ATLAS ITk pixel: lab qualified for module assembly. The production should start by the end of the year

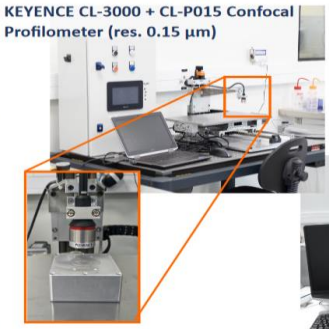
PSI : Technical platform devoted to characterisation of semi-conductor materials/devices

Test Room

^{90}Sr 37-MBq beta source

UP GRADE

visual inspection & metrology



Mainly constructed and now used for

- **ATLAS-ITK**

But also

- ATLAS-HGTD
- EIC

...

electrical characterisation

Accelerator Physics and Projects

~70 FTE in Accelerator Physics

Within France, most of these projects are done with **other IN2P3 laboratories** and with strong contributions from **IRFU/CEA-Saclay**

~20 FTE **PERLE** - ERL @Orsay with international collaborators → **40 FTE in 2025**
~10 FTE **PALLAS** – Laser Plasma in situ experiment with LaseriX laser
~10 FTE **ThomX** in site project – on going End of the project dec 2025
~ 5 FTE for R&D activities in this domain.
~ 7 FTE Activities in **Future Colliders** (LHC, SuperKeKB, FCC, ILC …)
~ 5 FTE **Myrrha** in the projects since the beginning – now in Minerva
~ 5 FTE **PIP II** on going contribution
~ 5 FTE **ESS** Strong contributions (cavities and cryomodules). *Finishing in 2024*

Human and Financial Resources Plan
Rearranged accordingly to the Accelerator Roadmap

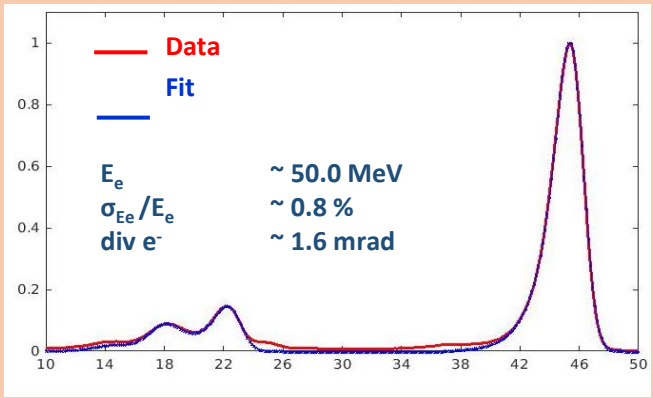
Strong expertise and activities/services (with dedicated platforms)

- **RF Technology. ~ 15FTE**
- **Cryogenics. ~10FTE**
- **Vacuum technology** + characterization of **material for accelerators ~10FTE**

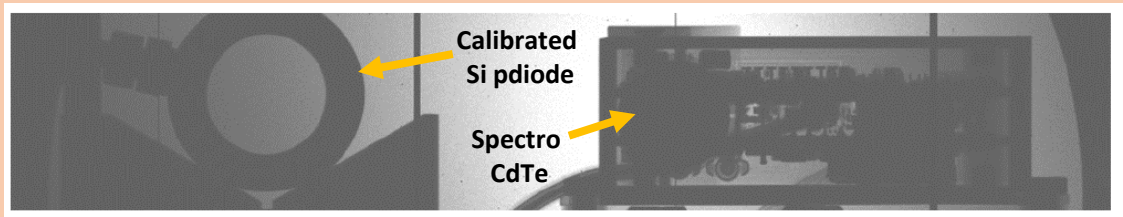
ThomX : A high-intensity Compton source at Orsay

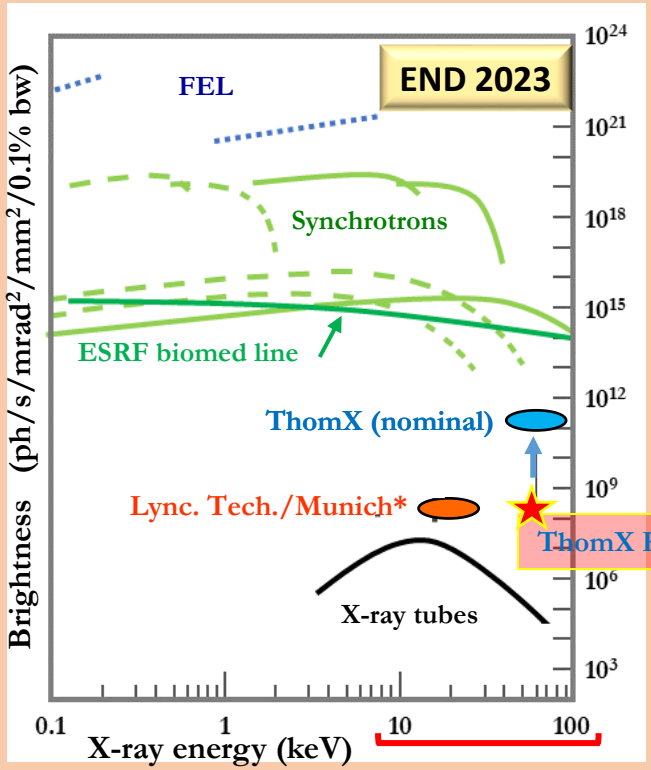
➢ **End 2023 : First e-/laser SYNCHRO**

- ❑ ABSOLUTE FLUX measurement in X-Hutch with a calibrated diode
- ❑ Spectrum with the ~ 10^{10} ph/s beam



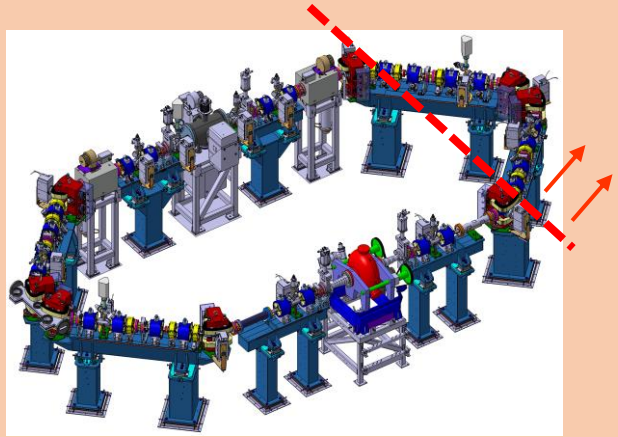
- ❑ First « radiography »





2024

- ❑ Mechanically increase the ring circumference by ~14 mm



- ❑ New accelerating section → 70 MeV
- ❑ Restart on going !

Data taking and experiments until end 2025

International Collaboration PERLE@Orsay : 5MW multi-tours ERL for Future Colliders (LHeC, FCC), Nuclear Physics and Compton Scattering

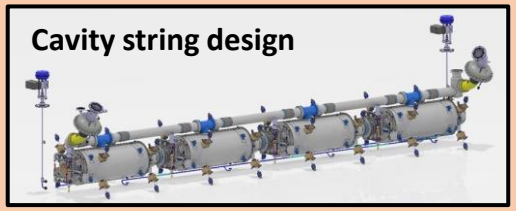
- **DC-gun + photocathode+ preparation chamber** acquired and installation is ongoing in the IGLOO.

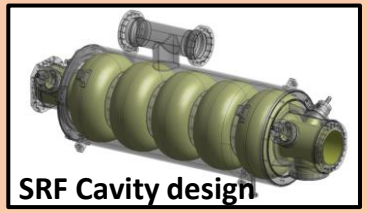

DC Gun installation


Photocathode Production Facility (PPF) assembly


Laser room installation

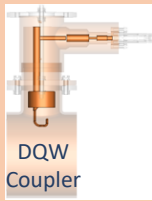
- **LINAC cryomodule is funded** by the **UE Program iSAS** (+ **IN2P3 matching funds** + CM vessel from ESS…). Components design is ongoing:


Cavity string design


SRF Cavity design


Probe Coupler

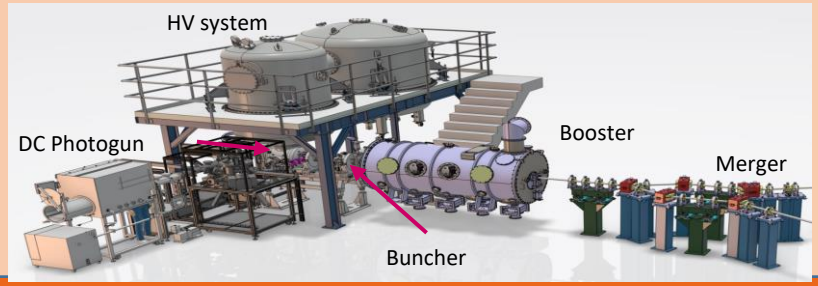

Hook Coupler


DQW Coupler


Vacuum vessel

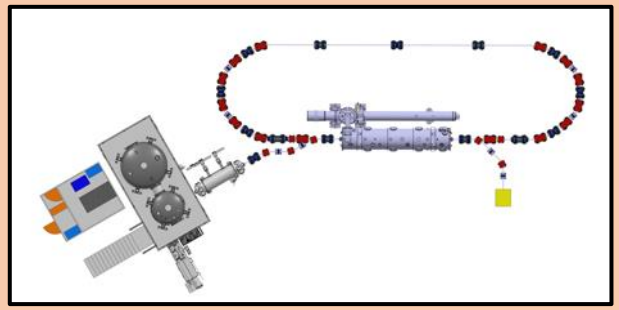

Thermal shield

- Funds obtained within **National program (CNRS).** it secure **the full injection line.**



With these 2 funds, we are close to realise PERLE 1 turn

~2028



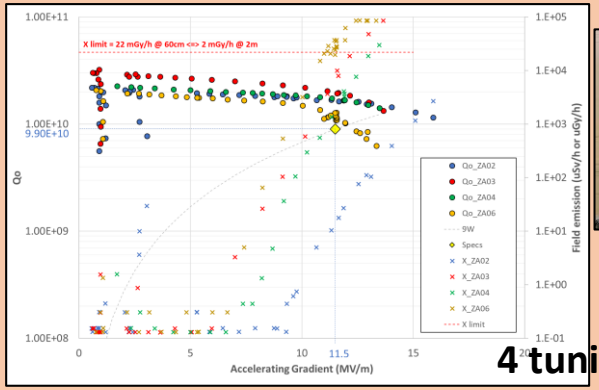
Other Highlights on Accelerators Physics

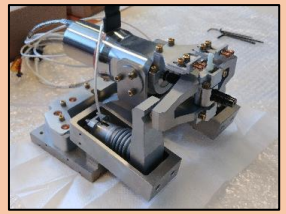
ESS — Spoke cryomodules & Cryogenic Distribution System

In-kind contribution is finished! All cryomodules installed in the tunnel and connected to the cryogenic distribution

PIP2

All cavities have been tested and shipped to FNAL. 4 cavities validated





4 tuning systems validated at cold

PALLAS: laser-plasma @ IJClab

Finalisation of the assembly/ mounting

Injection at > 50pC,

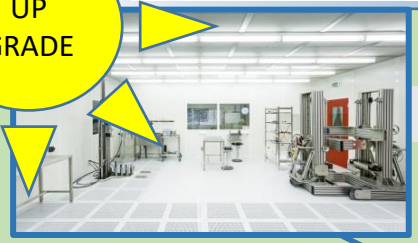
div: 1-1.5mrad between 160-350MeV

SUPRATech

UP GRADE

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

Cavity and Cryomodule Assembly Clean Room



Cryomodule Assembly Hall

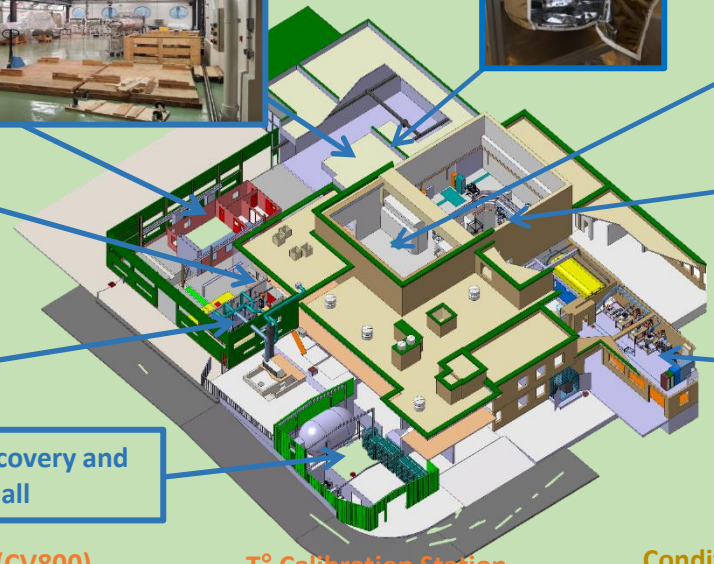
Building 106

High T° Vacuum Furnace

Cryomodule Testing Hall

Chemical Treatment Hall

RF Power Source 352 MHz Klystron



Helium Gas Recovery and Compression Hall

He Liquefier

+

Cavity Testing Hall (CV800)

Building 103

+

T° Calibration Station

High Power RF Conditionning Clean Room

+

Power Coupler Assembly Clean Room

Lagarrigue Hall

New Plateform : Vide & Surface

New

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

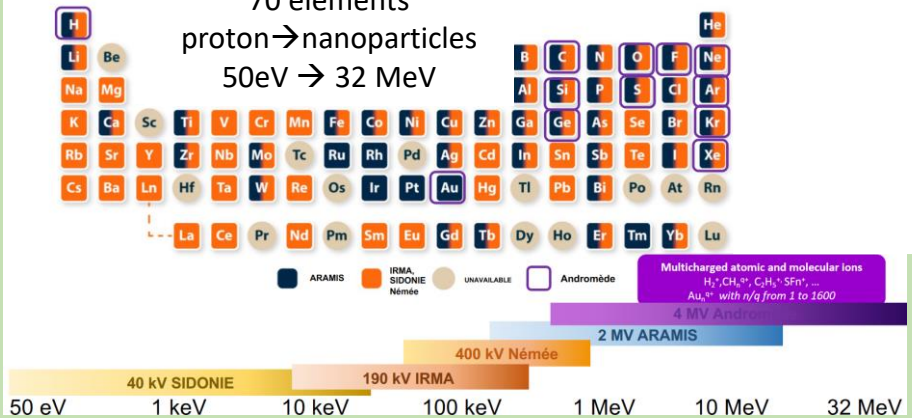
Compact XPS

mosaic a multidisciplinary platform with complementary equipment

Up grade

Ion beams for
synthesis,
modification,
analysis
of materials,

70 elements
proton→nanoparticles
50eV → 32 MeV



Other Very Large and Large projects at IJCLab

Within France, most of these projects are done with other **IN2P3 laboratories** and with strong contributions from **IRFU/CEA-Saclay**

- Detections of new Gravitational waves and new astronomy
- Multi-messenger : transient sky, acceleration mechanisms, dynamics of the violent Universe
- Origin of the elements / nuclear processes at work in astrophysical sites
- Fundamental tests of fundamental physics: (modified)Gravity, Lorentz Invariance.
- Model of Primordial Universe. Improving knowledge of cosmological parameters; CMB
- Search for (primordial) GW of inflation through CMB B modes
- Elucidating the Dark Energy
- Search for Dark Matter directly and indirectly : WIMPS, Dark Photons, Axions…
- Neutrino Physics : masses, sterile neutrinos, interactions
- Nature of neutrinos (Majorana or Dirac)

70 FTE in Astroparticle and Cosmology

~20 **VIRGO+SVOM** (vacuum, optics, locking, squeezing,on-line), also **ET**
~10 **CTA + Auger'** (Telescope calibration)/(electronics)
~ 7 **Astro@MeV**(full detectors,) - *space experiment*

~10 **LSST/FINK** (electronics, broker, ancillary telescope)
~6 **CMB/LiteBird** (mechanics, calibration on board equipment's)
- *space experiment*

~12 **CUPID/Double Beta** (bolometers, mechanics)

- Complexity of nuclear structure from the interaction among nucleons
- Limits on nuclear stability
- Heavy and Super Heavy Nuclei.
- Nucleosynthesis and origin of the elements in the universe.
- Properties of nuclei and strongly-interacting matter at high energies

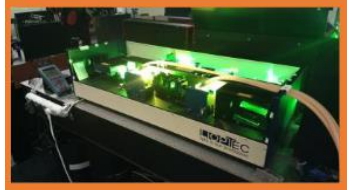
60 FTE in Nuclear Physics
+15 to operate the ALTO Platform

(contributions to the detectors, tragets, beam lines equipment's)
~20 **ALTO experiments** (COeCO, MLLTrap, LINO, POLAREX,NuBALL ..)
~20 **GANIL experiments** (S3-LEB, MUGAST AGATA-now in Legnaro)
~15 **Experiments at ANL, Dubna, Jyväskylä , LNL, CERN-ISOLDE**

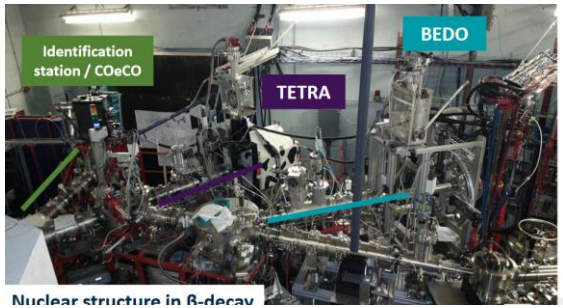
+ Increasing activities in **Health Physics :**
radiotherapy and imagining (ex : radionuclei, BIO-ALTO…)

The ALTO Platform for Nuclear Physics but also Health Physics and irradiations

UP GRADE



RIALTO

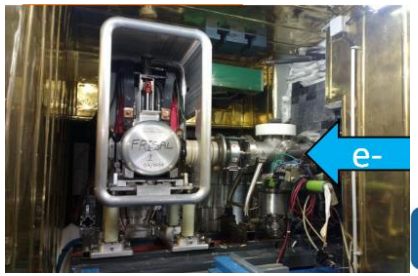


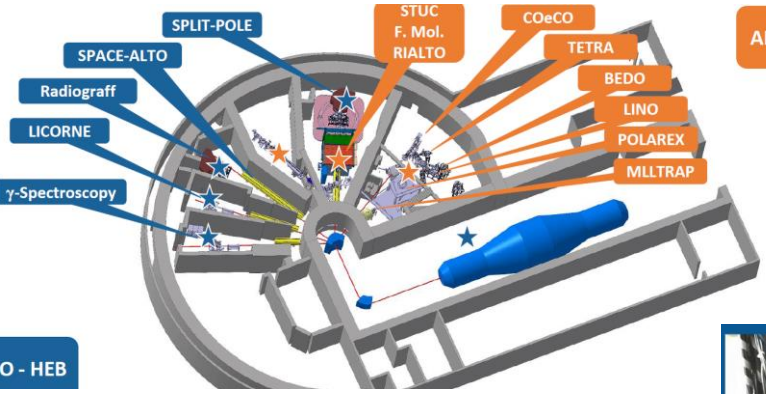
SPACEALTO

+ irradiation line for industrials

BIOALTO

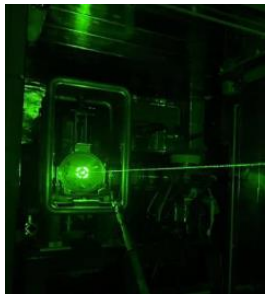
+dedicated line to Health Physics

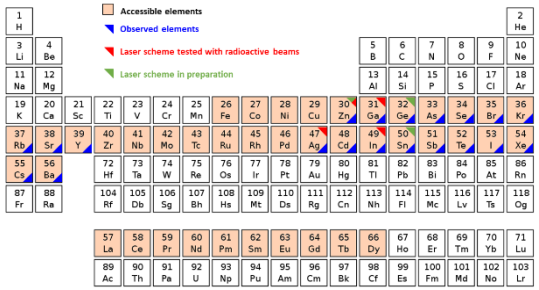


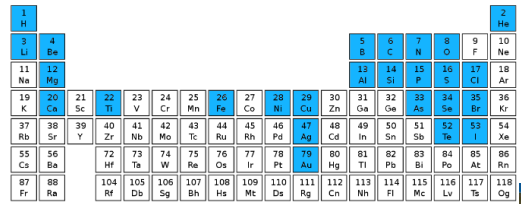


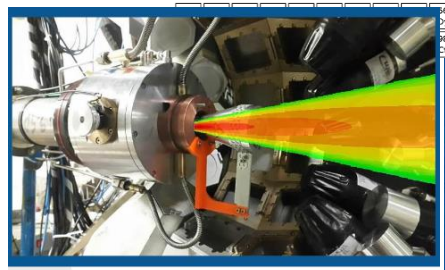
ALTO - LEB

ALTO - HEB









LICORNE

Lithium Inverse Cinematiques ORsay Neutron source

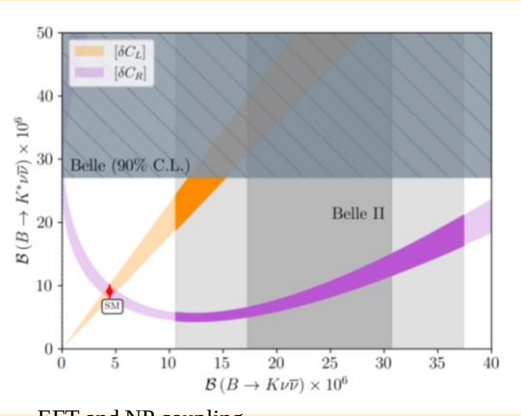
Tandem

Large Departement on Theoretical Physics

~80 People

Higgs/BSM Physics

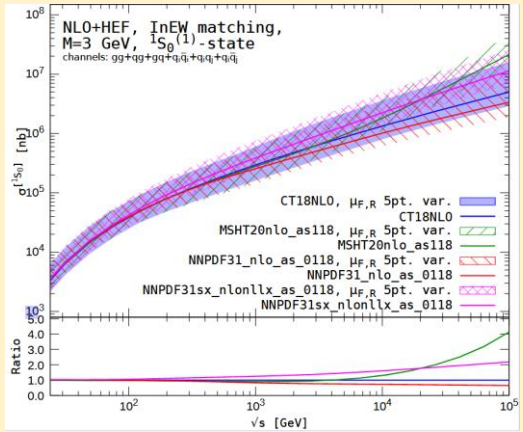
Flavour Physics



EFT and NP coupling

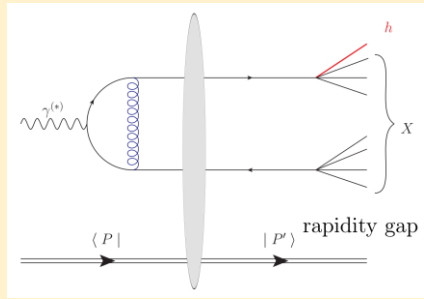
Nuclear Physics

FRANCE HYBRID HPC QUANTUM INITIATIVE



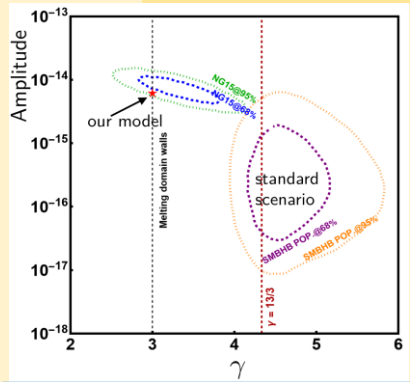
Matching next-to-leading-order and high-energy-resummed calculations of heavy-quarkonium-hadroproductioncross sections

QCD



Diffractive production of a dihadron at LHC (UPC) or EIC : the γ probe goes through a **QCD shockwave**

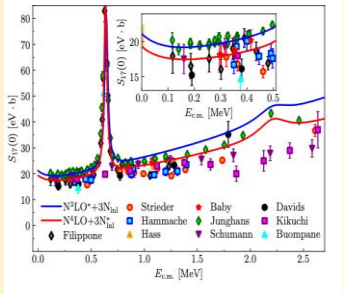
Cosmology

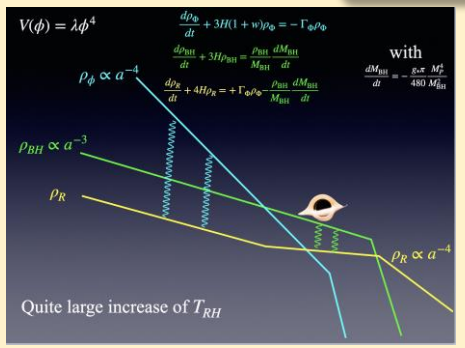


Explanation of the observation of nHz stochastic gravitational wave background by the recent NANOGrav data.

Ab-initio reaction wih light systems

Ab initio prediction of the $^4\mathrm{He}(d,\gamma)\,^6\mathrm{Li}$ big bang radiative capture
Ab initio calculation of the β-decay from ^{11}Be to a p+^{10}Be resonance
Ab initio informed evaluation of the radiative capture of protons on ^{7}Be





Primordial Black Holes Reheating

+ Mathematical Physics / Statistical Physics

Valorisation & Innovation : Report 2020 - 2024

Opening of the platformes to industrials

1,2M€ (PIA- filiere BPI/Region) ★1
100 k€ +1 Business Developer (DGDI/CNRS)

Patent and Know-how Transfers

Assembly of cryomodules (accelerators) ★1

Tumor Resection Intra-Operative Probe (Health Physics)

First IJCLab Joint Laboratory

INNOVATION MOLTEN SALT LAB (IMS LAB)

naarea · cnrs · université PARIS-SACLAY

1 Start up created BEAMS

Gamma Camera (Health Physics) (hosted at IJCLab)

Recall : Spin-off of lab: **ACS**

7 Technological Transfers

From DECLIC (TRL1-2) to Maturation (TRL 8)
~ 3,5M€

5 Patents filed

26 Contrats with industrials

(15 on going)
~ 2,8 M€
9 PHD CIFRE

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Thanks for your attention!

IJCLab Irène Joliot-Curie Laboratoire de Physique des 2 Infinis