

IJCLab

Laboratoire de physique des deux infinis Irène Joliot-Curie

*New Laboratory born in 2020
from the merger of 5 Orsay laboratories*



RER B
Bures

RER B
Orsay

www.ijclab.in2p3.fr

730 Collaborators
260 Researchers & Professors
340 Engineers & Technicians

150 People accredited to supervise PhD

140 PhD and Post-docs
50 European and International Research Grants
150 National and Local Research Grants

600/y Articles in international peer-reviewed journals

7 Scientific Poles

1 Engineering Pole

5 Research Platforms

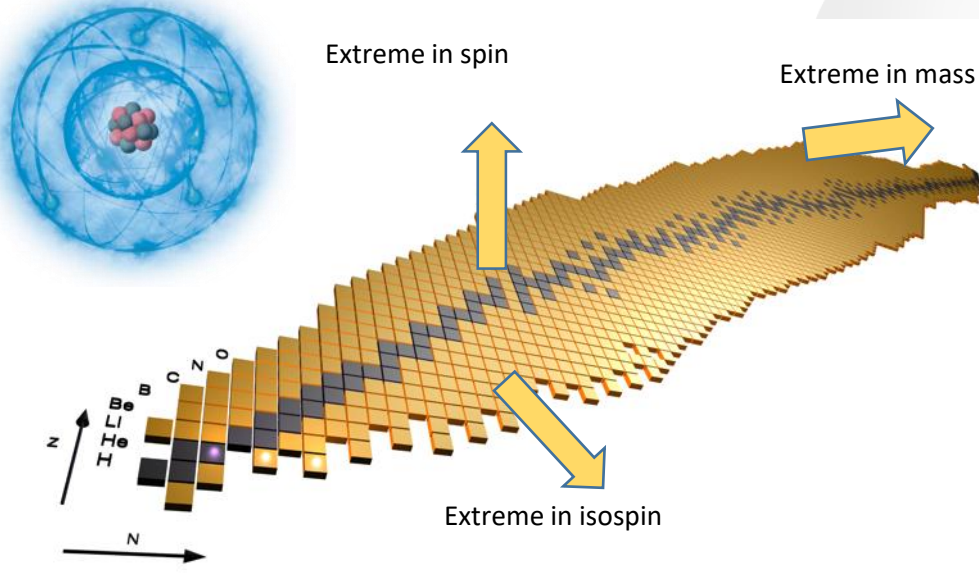
6 Technical Platforms

50000 m² of Buildings

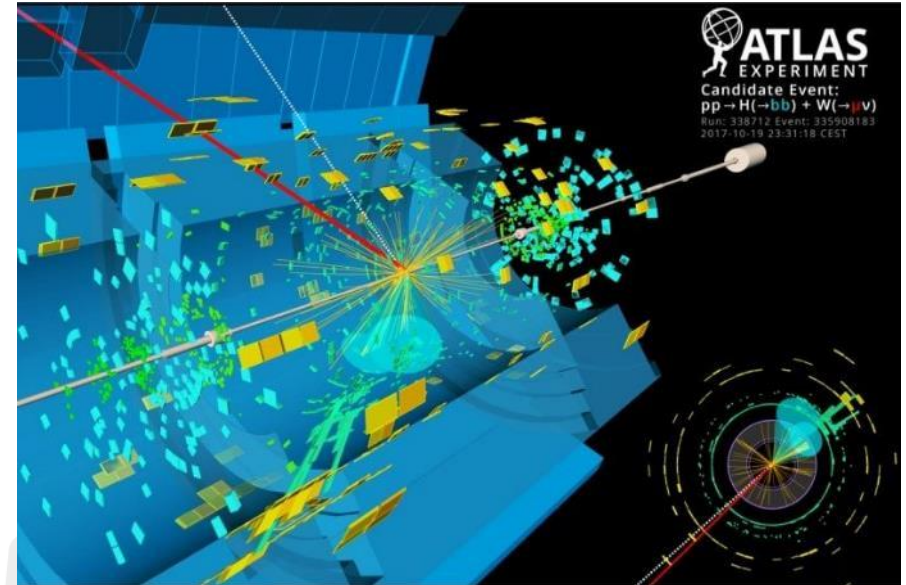


IJCLab in a nutshell (1)

Historically : Probing matter at small distances/high energies



Nuclear Physics



Particle Physics

Understanding the building blocks of matter, their interactions, and how matter properties emerge from them

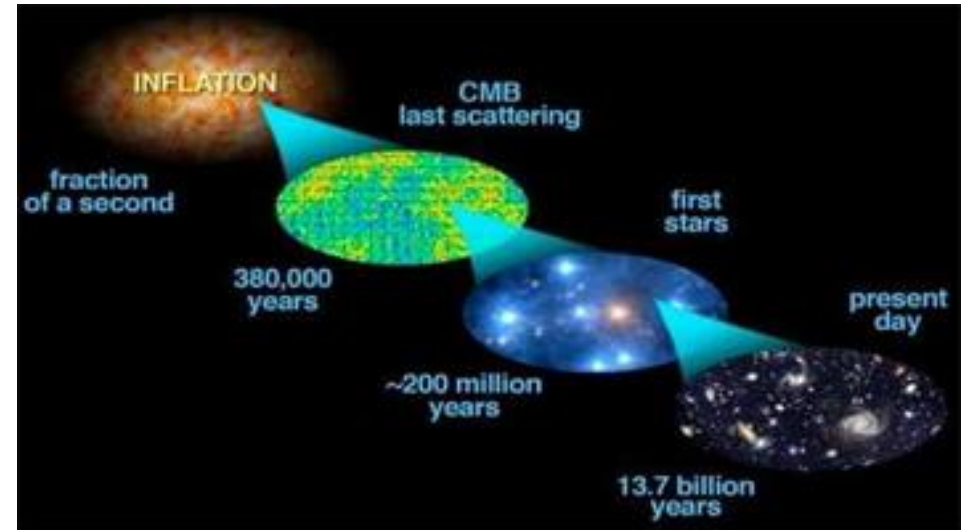


IJCLab in a nutshell (2)

High energies also involved in studying violent phenomena of the Universe
with natural links with high-energy physics



Astrophysical events
(high-energy cosmic rays,
black holes merger,
general relativity...)

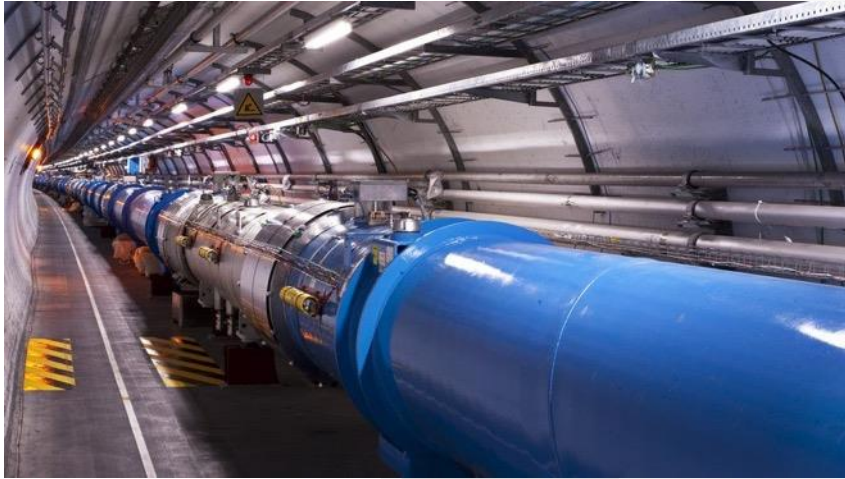


Cosmology
(evolution of the Universe,
inflation, large structures,
dark matter and energy)



IJCLab in a nutshell (3)

Building tools to perform these investigations

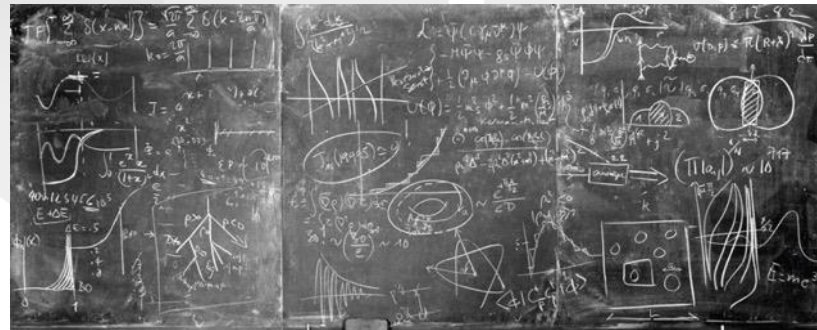


Accelerators



Detectors

Theory : interpreting
and relating results



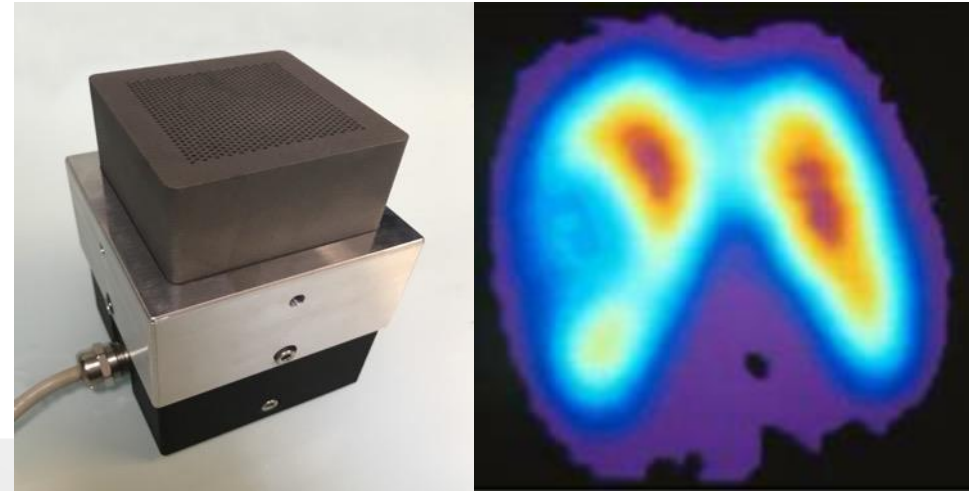
and suggesting new
tests and ideas



Tools and concepts applied in areas with impact on society



Energy and environment
(nuclear energy,
radiochemistry...)



Health physics
(imaging,
therapy by irradiation)

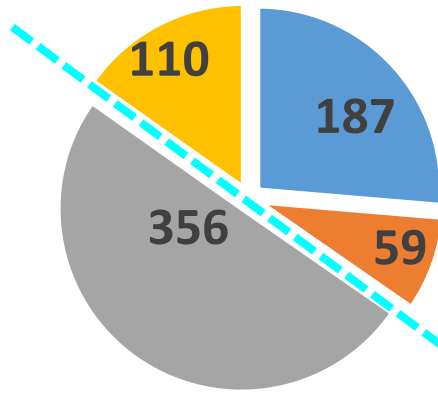


IJCLab

Staff Status

(including non permanent)

- Researchers CNRS
- Researchers-Teachers
- Engineers + Technicians
- PHD



710 people
+ 120 Internships
+ trainees (« Apprentis »)
+ long-term visitors

All in all ~ 800 people present at the laboratory

CNRS (Centre National de la Recherche Scientifique)

- ~17000 researchers + 16000 technical staff
- 10 institutes among them **IN2P3 (Institut national de physique nucléaire et de physique des particules)**
- IN2P3 composed by ~20 large-scale laboratories
- IJCLab mainly linked to IN2P3 ~1/4 of HR of the IN2P3

Université Paris-Saclay

- 275 laboratories : 9000 researchers, 11000 IT (*University and research organism altogether, comprising CNRS and CEA*)
- 13th Shanghai ranking (Physics : 9th World, 1st Europe)
- 48000 students (with 9000 Master, 4000 PHD)

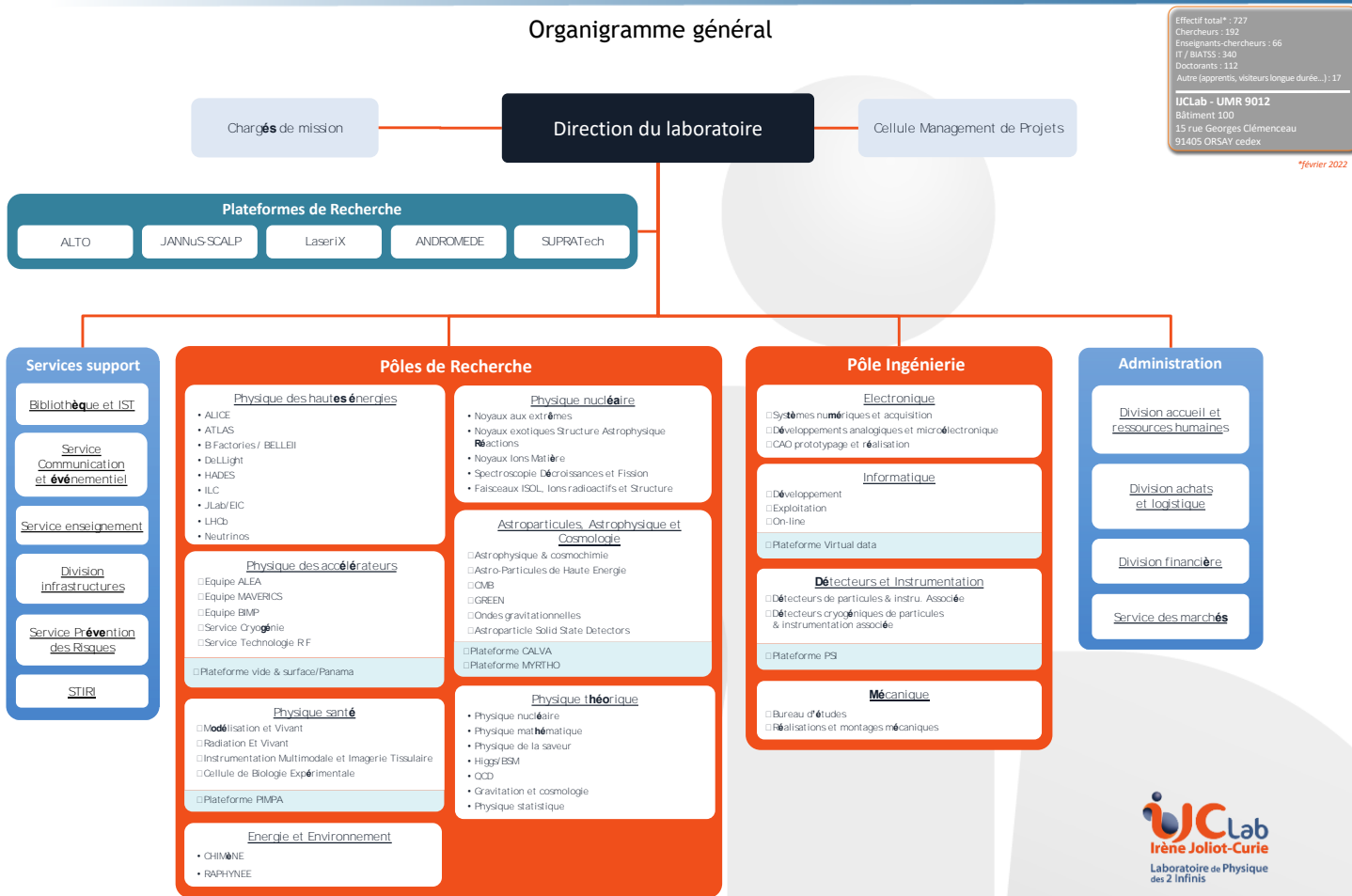
Université Paris Cité

- Specific links with IJCLab in Health Physics



Laboratory organization

Organigramme général



710 members
 530 staff
 250 researchers
 360 engineers and technicians

7 Research poles
 31 teams
1 Engineering pole
 4 technical departments
 11 services
1 administrative pole
 3 Divisions
 1 Service
8 support services
5 research platforms

- 3 governing bodies
- CNRS (through IN2P3, Institut de Physique Nucléaire et de Physique des Particules)
 - U. Paris-Saclay
 - U. Paris Cité (Health Physics)



www.ijclab.in2p3.fr

Dernière MAJ : 20/03/2022



7 Scientific Poles

PHYSIQUE NUCLÉAIRE
NUCLEAR PHYSICS ~ 70

A2C Astroparticles, Astrophysics & Cosmology ~ 60

Accelerator Physics ~ 90

PHE Physique des Hautes Energies ~ 100
High Energy Physics

Theory ~ 80

Energy and Environment ~ 40

Health Physics ~ 25

~ 110 PhD



1 Engineering Pole



~ 180 members
10 services in 4 tech depts

Mechanics

- Design office
- Mechanical realizations and assemblies



Workshops

- lathes
- milling machines
- 3D printer
- sheet metal work + control

IT and computing

- Development
- Operations
- On-line

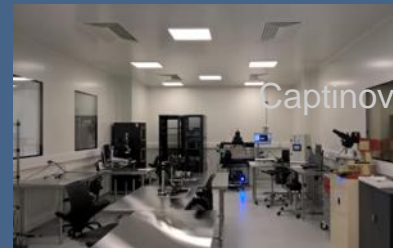


Virtual Data datacenter
51 racks (2000 servers)
up to 600kW

Detectors and Instrumentation

- Particle detectors
- Cryogenic detectors

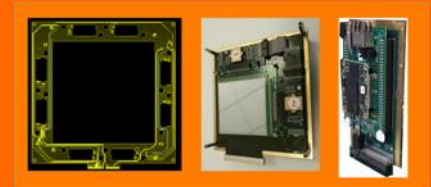
and associated instrumentation



Captinov clean room for detector building and testing

Electronics

- Analog dev. and microelectronics
- Digital systems and acquisition
- CAD prototyping and production

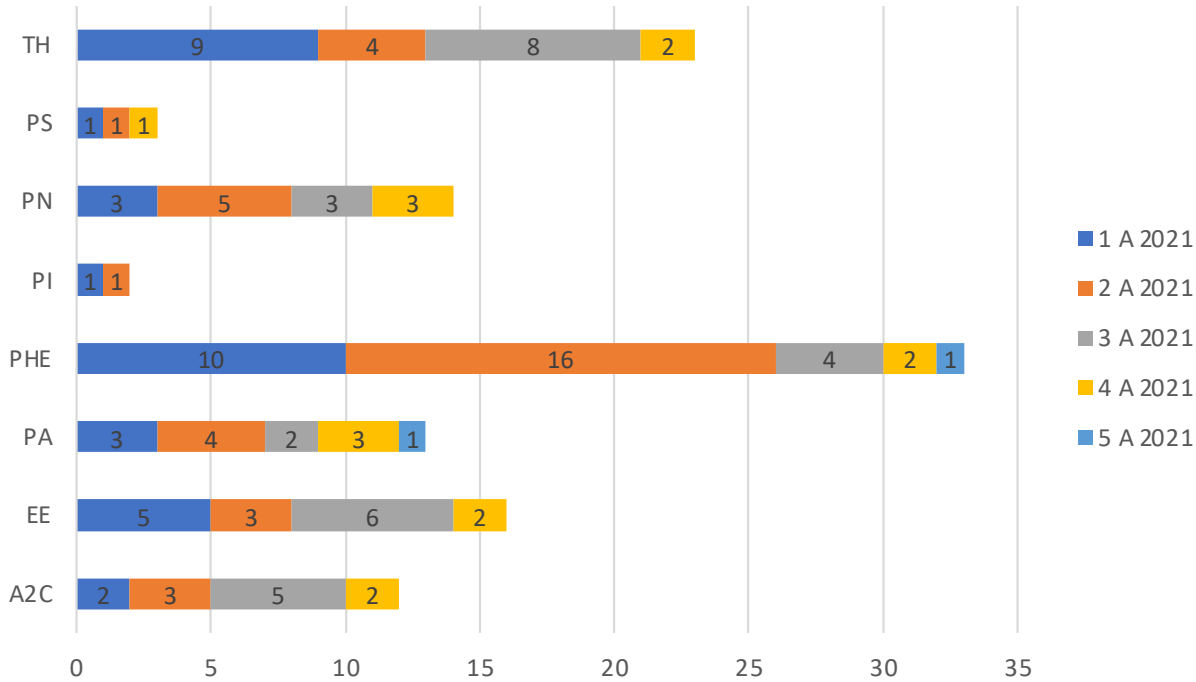


Low noise electronics for Si track sensors



PhD students at the end of 2021

Doctorant par pôle et par année (2022)



116 PhD @ IJCLab

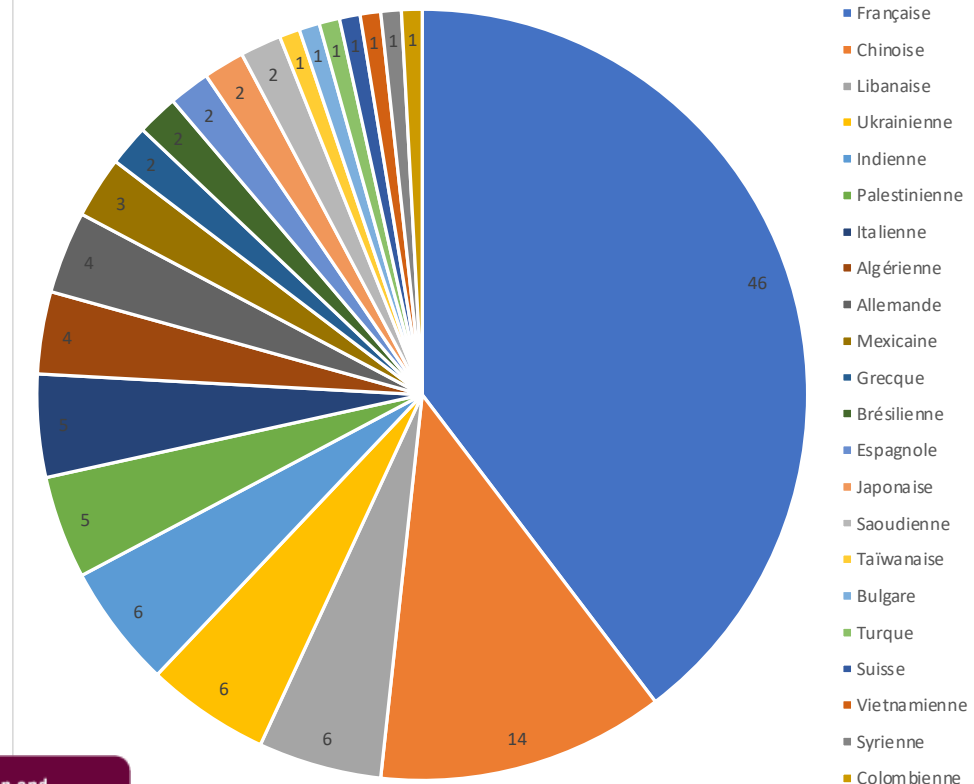
140
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50 European and
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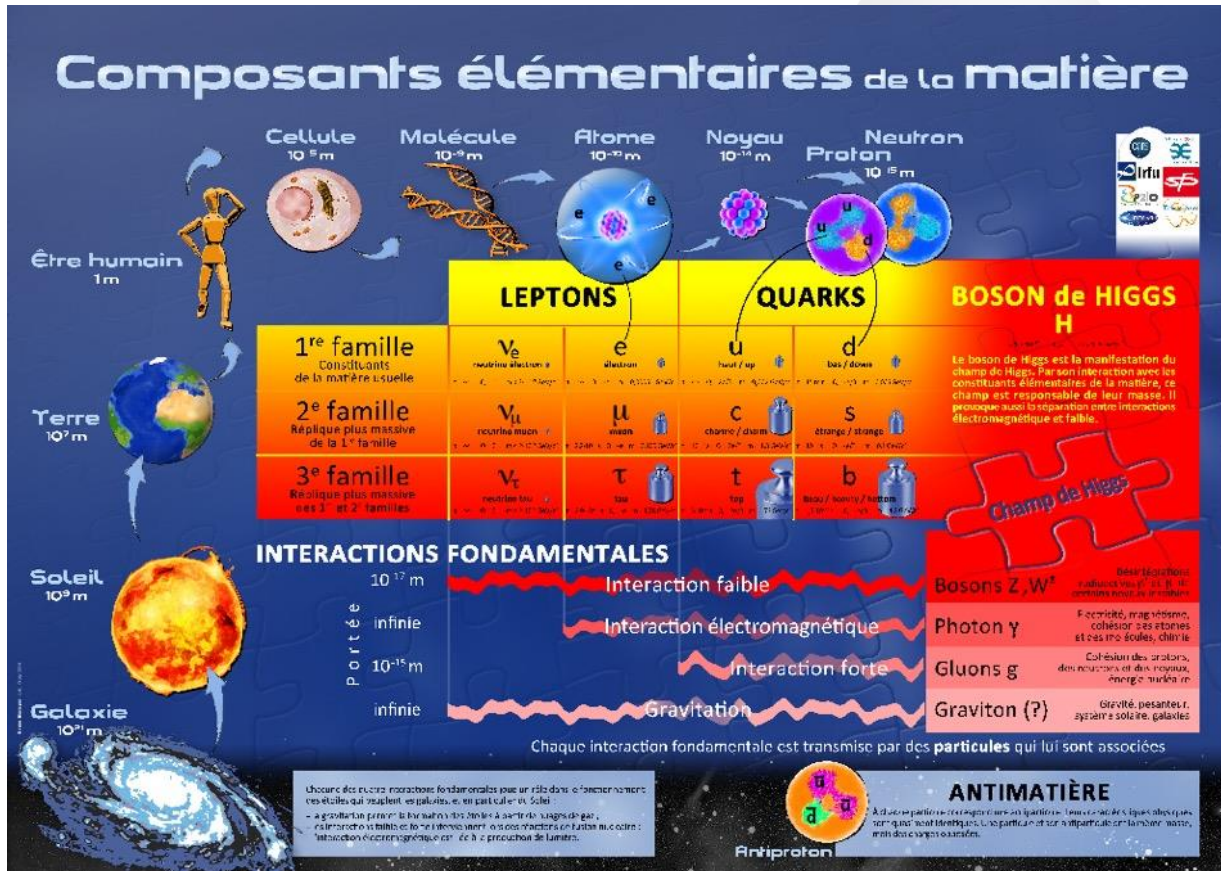
Nationalités doctorants (2022)



22 different citizenships



High-energy physics



- Probing matter at the smallest scale
- Highest energies, creating new particles in collisions (eg LHC@CERN)
- Understanding their properties and interactions

Standard Model of Particle physics

- Tested and challenged for decades
- Latest addition : Higgs boson 2012



Better understanding
of the SM

Challenging the
SM

Strong interaction

Weak & electromagnetic interactions

QGP & hadronic physics

(W,Z,H,t) physics

Flavour physics

Neutrinos physics

Beyond SM

QED in intense
em field

ALICE, HADES, Jlab, LHCb

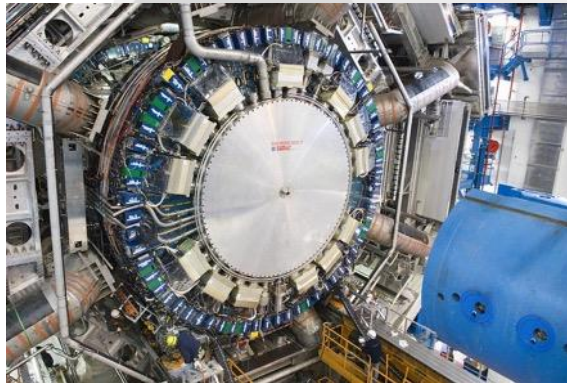
ATLAS, ILC

Belle2, LHCb

DOUBLE-CHOOZ
JUNO, DUNE

ATLAS, Solid,
(Super)NEMO

DeLLight



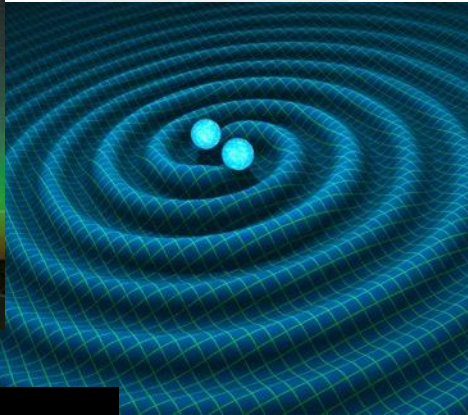
Challenging
the SM

direct searches

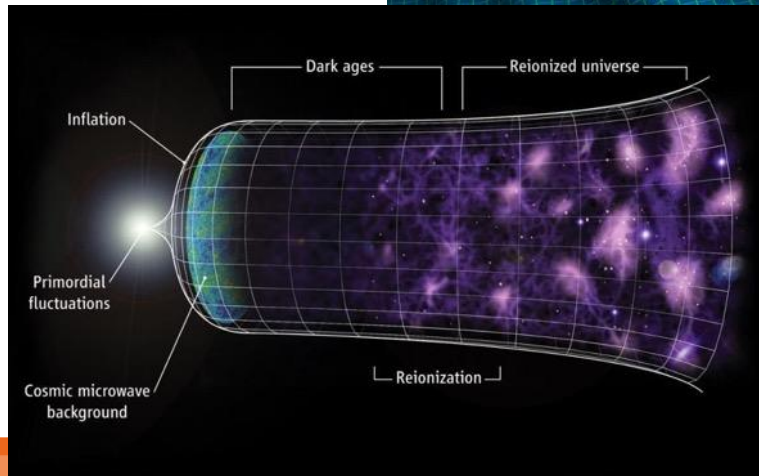
precise measurements



Astroparticles, astrophysics and cosmology



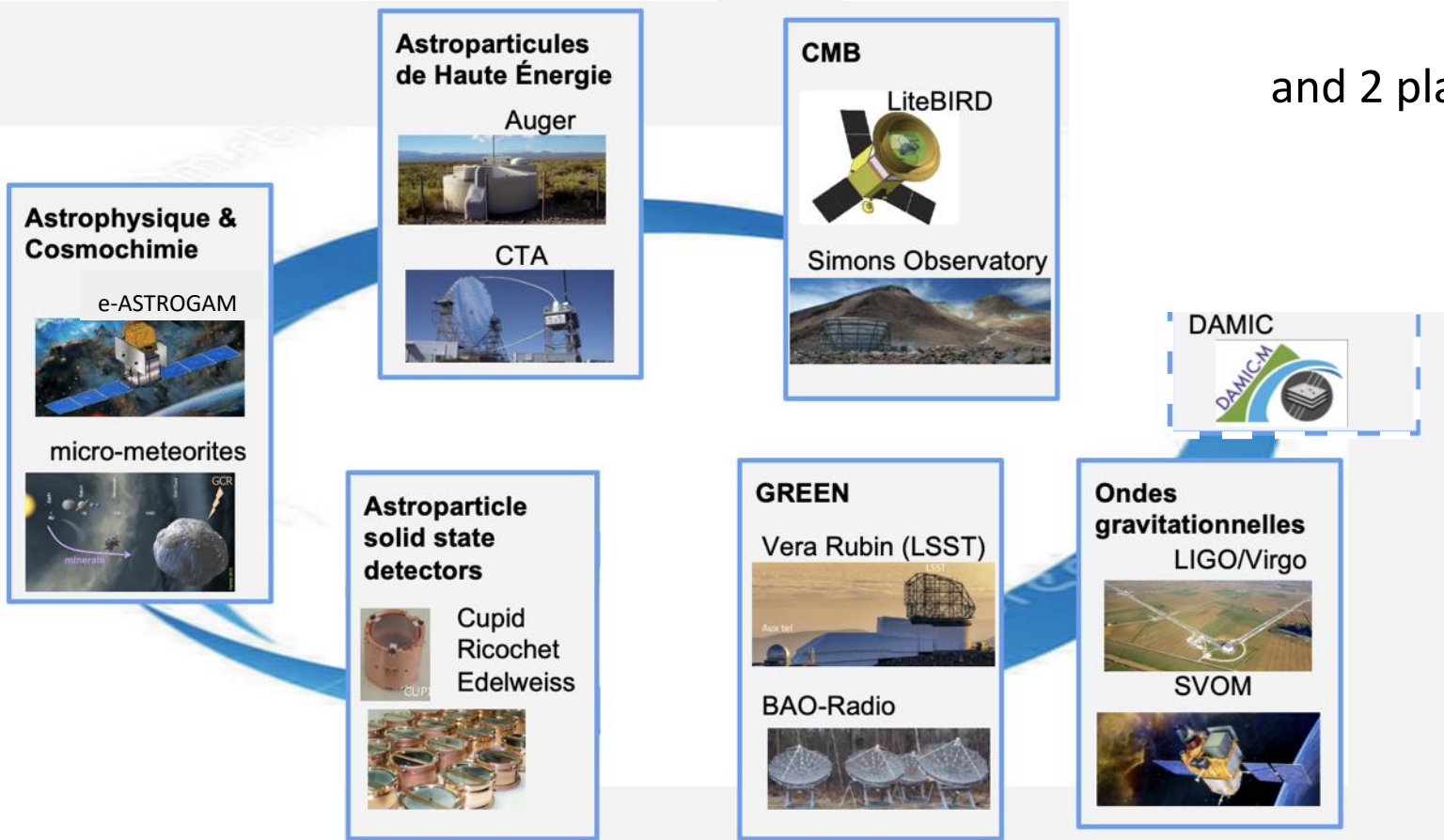
- Violent phenomena in the universe (neutron stars, black holes, AGN...)
- High-energy cosmic rays
- Evolution of the universe (Big bang, large-scale structures)
- Role of dark matter, dark energy
- Multi-messenger astronomy (gravitational waves, astroparticles...)



Connection with particle physics,
but also probing general relativity
and astrophysical questions



Astroparticles, astrophysics and cosmology



and 2 platforms:

CALVA/Exsqueez

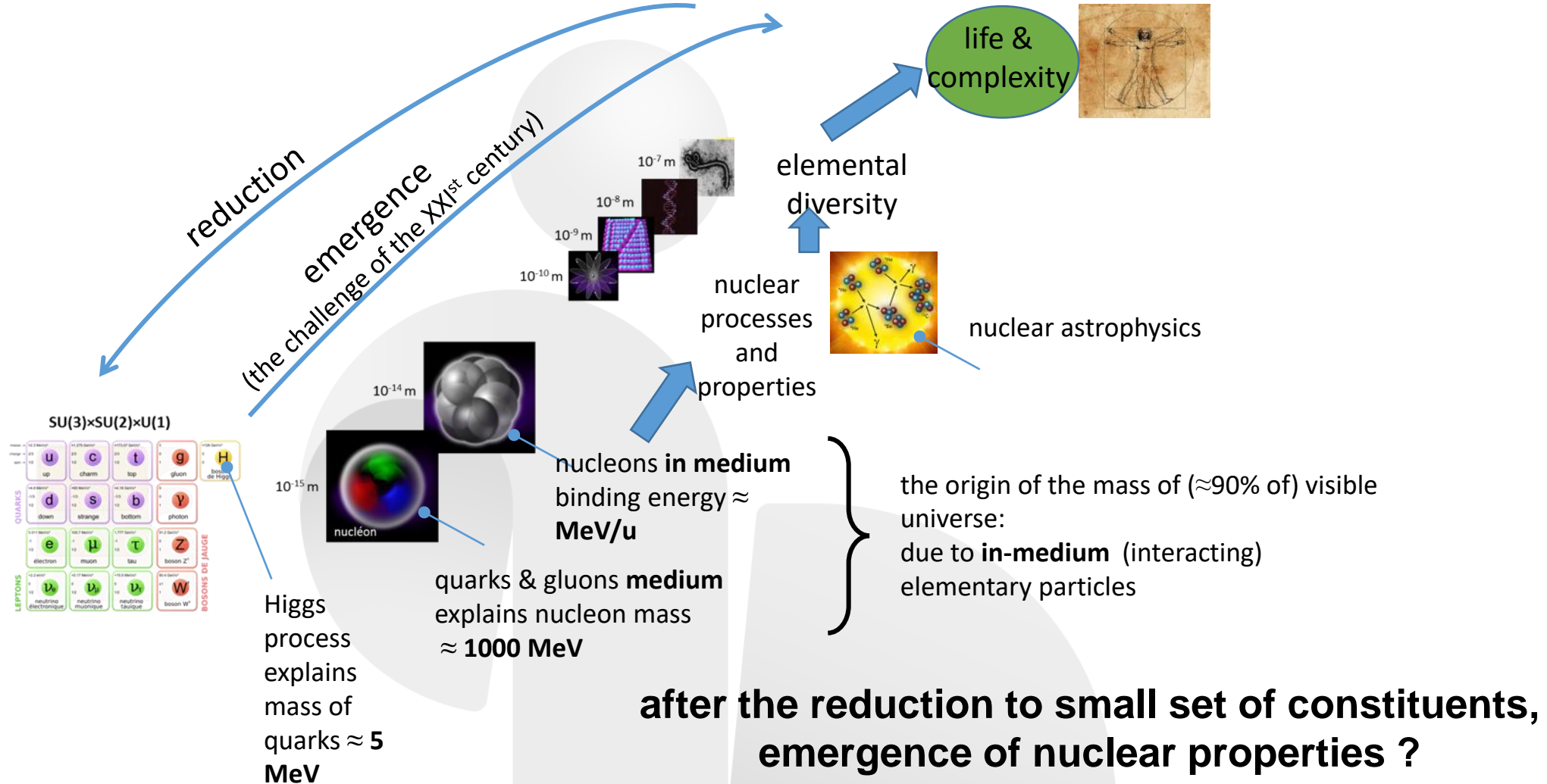


MYRTHO





Nuclear Physics





Nuclear Physics

a community of spectroscopists and builders

the discovery frontier (synthesis of new nuclei)

the precision frontier (network of observables)

with many experiments, locally (ALTO), nationally (GANIL) and internationally

Nuclear Spectroscopy : Orsay field of excellence

laser spectroscopy

- ISOLDE/CERN : CRIS, COLLAPS
- ALTO : LINO
- SPIRAL2/S3-LEB

mass spectroscopy

- ISOLDE/CERN : ISOLTRAP
- TRIUMF/ISAC (Canada) : TITAN
- ALTO : MLL-Trap
- SPIRAL2/S3-LEB & DESIR

particle and missing/invariant-mass spectroscopy

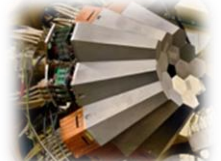
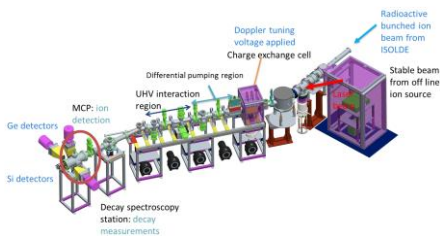
- GANIL : MUGAST, LISE, INDRA/FAZIA
- RIKEN (Japan)
- LNS (Italy): CHIMERA

delayed/recoil spectroscopy

- ALTO : BEDO, TETRA, POLAREX
- GANIL : LISE
- JINR Dubna: GABRIELA
- SPIRAL2/S3: SIRIUS

prompt γ -spectroscopy

- ALTO : MINORCA, Nu-Ball
- GANIL : AGATA
- OUPS: lifetime measurements
- JYFL (Finland) : JUROGAM2, RITU
- ANL (USA) : GAMMASPHERE
- ILL : EXILL, FIPPS

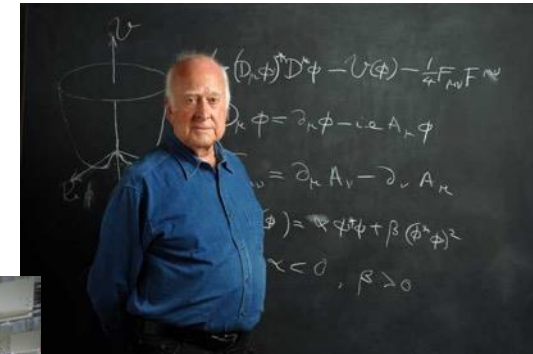




Theory

- Small teams (opposed to larger experimental collabs)
- Interaction with experimentalists from the other poles (phenomenology)
- Internal developments within pole and with external collaborators (global research)

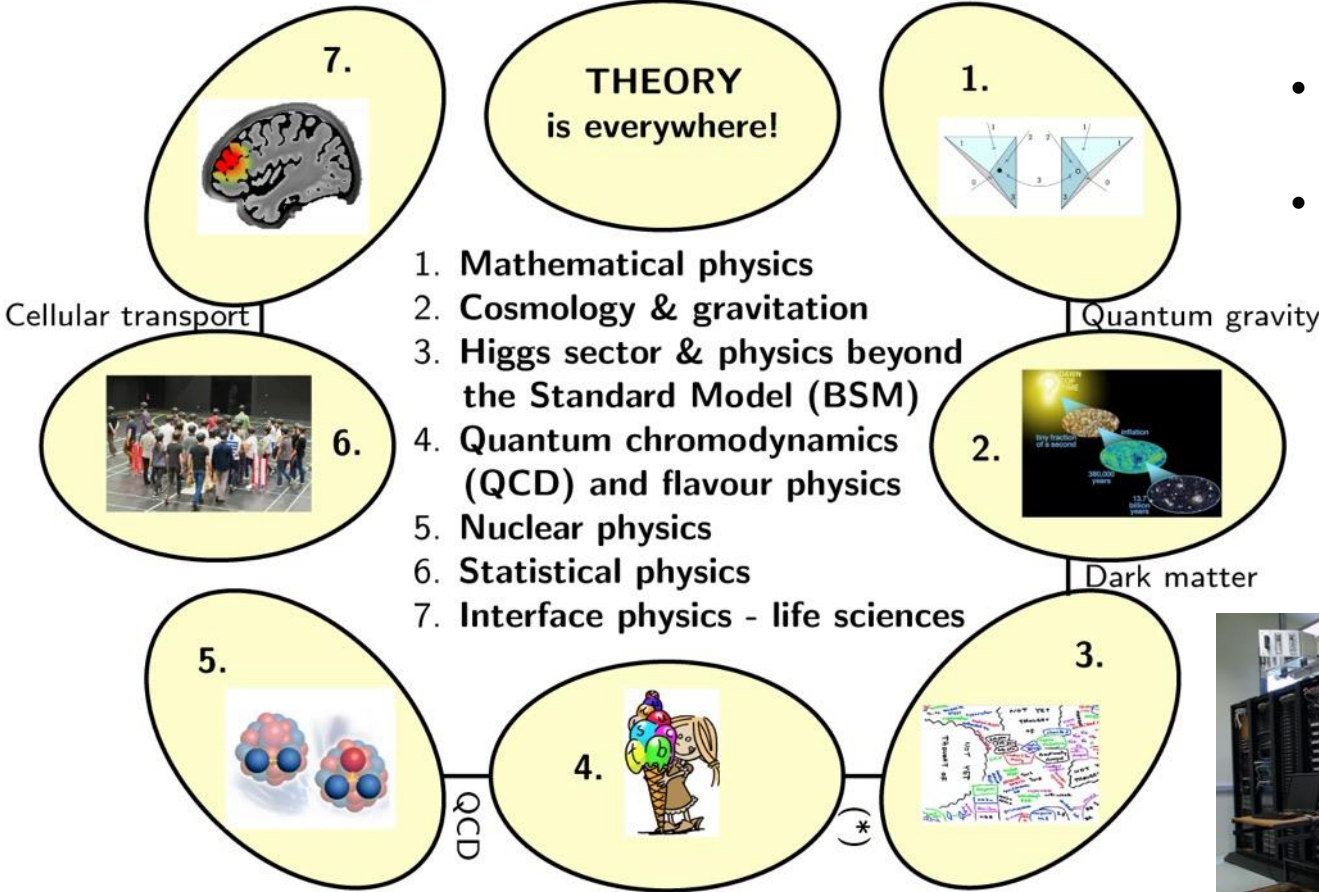
Pen, paper,
blackboard ?
Yes but...

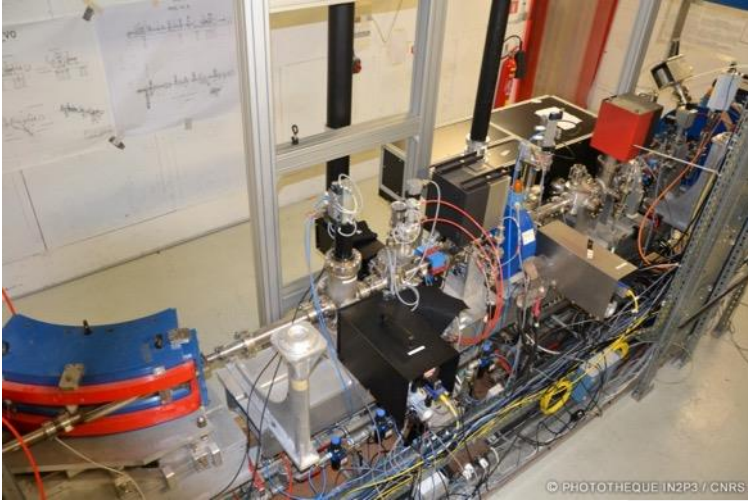


... more and more computers (analytic computation, simulations, data analysis...)



THEORY
is everywhere!





Weighing in on a **European/global scale**
by making a major contribution to the design and construction of **large machines**
(LHC, GANIL, ESS, Myrrha, PipII...)

Research Themes

- New materials for accelerators
- Supraconducting RF

- Laser-plasma acceleration
- Beam Instrumentation



Health Physics

Develop an integrated project mainly in oncology (from biological foundations to therapy)
at the heart of a laboratory with strong scientific and technical potential

Multimodal imaging
(preclinical and clinical)

Modeling
(statistical physics, animal models)

Radiotherapy
(radiobiology, radiotherapy, vector th.)

Biology
(from fundamental to experimental)

Collaborations

Upstream

R&D IN2P3, IJCLab poles
*(engineering, nuclear, theory,
accelerator), IRSN, Soleil, industry*

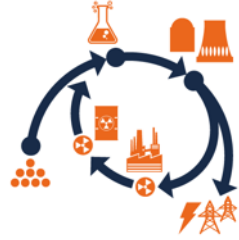


Downstream

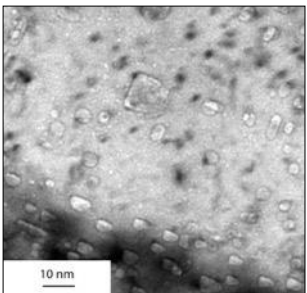
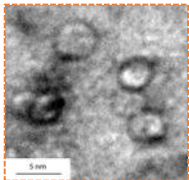
APHP, CPO, Inst. Curie,
NeuroPSI



Major societal issues in relation to nuclear energy & environment with an emphasis put on an academic approach : understanding the physics and chemistry



- Analytical chemistry in complex environment for nuclear energy; Materials and irradiation; Radionuclides in the environment
- Chemistry of actinides; Nuclear Data; Nuclear Systems and scenarios



Scientific activities

- Actinide chemistry in aqueous and non-aqueous solvents
- Innovative nuclear systems and associated scenarios
- Nuclear data; actinide targets
- Fuels, molten salts, transmutation and immobilization matrices
- Materials and irradiation

Facilities within the Lab

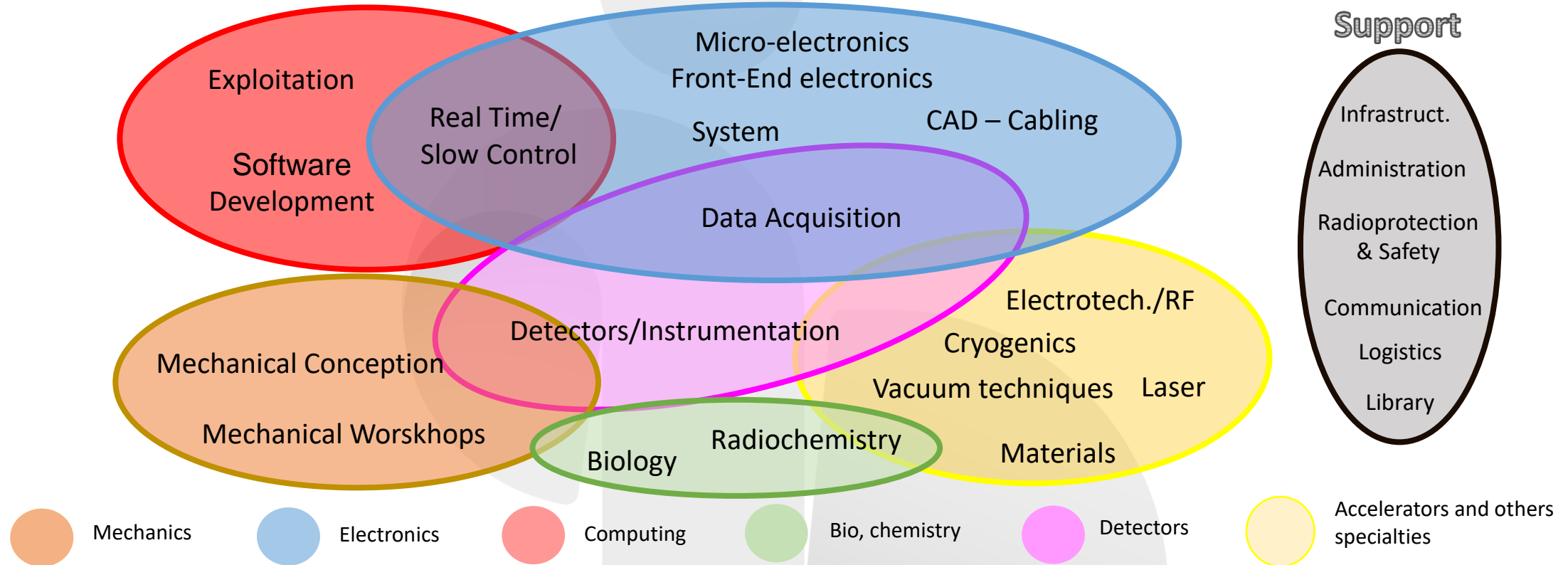
- Analysis and characterization in radiochemistry (buildings 100 and 107)
- Ion implantation, irradiation, and analysis at JANNUS/SCALP platform
- *In situ* dual ion beam transmission electron microscope at JANNUS/SCALP



Technical activities

Technical staff with technical skills/expertise essential to design, draw and build instruments

- Engineering pole with 4 Technical Departments
- Accelerator Physics pole with RF and cryogenics services
- Competences in other scientific poles and platforms as well as in support services





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

Nuclear, Health physics, Irradiation



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

Nuclear/A2C, Health physics, Irradiation



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

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

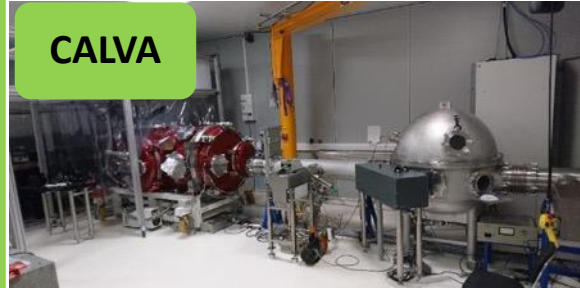
Semiconductor Platform :

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



Platforms for IJCLab projects

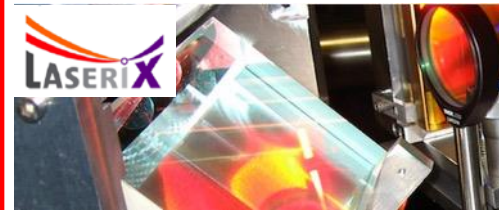
Accelerators research themes/technologies

Opening to Materials, atomic physics, detectors



SUPRATECH

R&D on the superconducting cavities (prepare, package, assemble & test of the superconducting RF cavities).



LaseriX

coherent, intense, brief (50fs to 10 ps) sources in near-infrared (800nm) and EUV (30 to 90 eV)



Vide et Surfaces
under construction

VIRTUAL DATA

Advanced computing
resources infrastructure
Grid / Cloud



Health research themes



non linear optical biphotonique imaging

5 Research Platforms



6 Technical Platforms





International collaborations

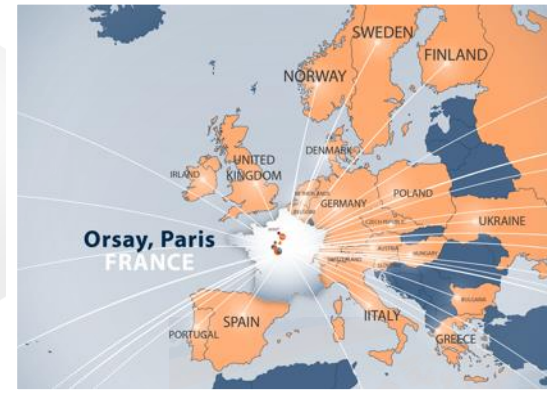
Some major laboratories with facilities or facilities in the world linked to IJCLab

World

Auger-Argentina
LBNL/SLAC-US
Fermilab-US
JLab-US
KEK-Japan
LSST-Chile
Riken-Japan

Europe

SCK-CEN-Belgium
CERN
CTA-Spain
DESY-Germany
Dubna-Russia
EGO/VIRGO-Italy
ESS-Sweden
GANIL-France
GSI-Germany
Jyväskylä -Finland
LNCA-France
LNGS-Italy
LNL-Italy
LSM-France



+ many interactions with French laboratories and industry partnerships



Teaching

Academic, Technical, Platforms

*~60 Researchers-Teachers + ~30 Researches-CNRS are involved in University teaching.
~60 Technical staff teach different skills and specialities (university / Schools..)
Research Installations/ Platforms -> Educational platforms with dedicated lines*

Internships for students

Internships: the gateway for students to discover research

*Internships at different level (from L1 to M2 and international.) :
~110 internships in 2021 corresponding to approximately ~600 months*

Thesis

PhD Training by research and for research

*~110 PhD students in the ensemble of the laboratories (from 30 different nationalities)
Number of technical theses rapidly increasing*

International Schools

Participation and creation of international/national schools

*Participation/creation of international/national schools
School : WISHEPP (Palestine), TESHEP (Ukraine...), QCD, School at L3 level...
IJCLab leads Erasmus+ MIC Colombia / Georgia / Ukraine / Palestine and Erasmus Mundus Lascala*



Our ambition is to elucidate the mysteries of **matter, energy, space, time**, and to understand the constituents of matter, their **interactions** and the origin and the evolution of the **universe**.

We aim at **driving discoveries** on these questions by

- **Contributing to and lead projects at all stages in high-energy physics, nuclear physics, astroparticles and cosmology** (proposal, design, construction, operation, data analysis) with significant **theory** support
- **Playing a major role in the conception, design and construction of current and future accelerators.**
- **Developing and operating research infrastructures and technological platforms** supporting these research areas as well as **original research in health physics and energy**
- **Promoting the development of new technologies** for science for the benefit of society and thus supporting national and European industrial competitiveness
- **Welcoming students trained at IJCLab through and for research** at the heart of a world-class academic environment.



More information

www.ijclab.in2p3.fr

For internships/job opportunities

- Check the website
- Contact directly the poles and research teams

The screenshot shows the IJCLab website interface. At the top, there is a navigation bar with logos for CNRS, Université Paris-Saclay, and Université de Paris. Below this is a large banner image with the text "Accélérateurs" and a 3D cutaway diagram of an accelerator. The main navigation menu includes "IJCLab", "Pôles Scientifiques", "Pôle Ingénierie", "Plateformes", "Enseignement & formations", "Grand Public", and "Travailler à IJCLab". The "Travailler à IJCLab" menu is expanded, showing "Stages, Thèses, Post-docs", "Autres offres d'emploi", and "Partenariats avec les entreprises". Below the navigation, there are buttons for "Accueil", "Séminaires", and "Publications récentes". The "ACTUALITÉS" section features three featured articles: "INGÉNIERIE" with the title "La chambre à dérive d'ALERT", "ASTROPARTICULES, ASTROPHYSIQUE ET COSMOLOGIE", and "Rendez-vous ATLAS PAF 2021" (10-12 mai 2021, Domaine de Châlès, ATLAS PAF 2021, Domaine de Châlès (Soloane)).