IJCLab Yearly Report 2023

Written by the Directorate

1. IJCLab Year 2023: introduction and organization of the document

After several iterations in the last two years between the laboratory and the "tutelles" a **Manifesto** defining the **missions of IJCLab** has been defined and can be summarized in five points:

- **To lead and play a major role on world-class flagship projects in high-energy physics, nuclear physics, astroparticles and cosmology by contributing at all levels**
- **To lead and play a major role in the conception, design and construction of current and future accelerators.**
- **To develop and exploit research infrastructures and technological platforms supporting these lines of research as well as, thanks to their irradiation performances, original research in health physics, material sciences and energy.**
- **To promote the development of new technologies for science and the valorisation of our research for the benefit of society, thereby supporting national and European industrial competitiveness.**
- **To welcome the students that the laboratory trains through and for research at the heart of a world-class university environment.**

The most relevant results for Year 2023 related to these five manifesto's points are discussed in **Chapter 2.** More extensively the Technical and scientific Highlights of the laboratory for Year 2023 are presented in **Chapter 3.**

The possibility of fulfilling these missions depends on the laboratory's capability

- **To preserve and increase the technical and scientific staff and to offer them excellent opportunities for career evolution. (Chapter 5).**
- **To have the necessary fundings and in particular we have to be able to better position ourselves and succeed in different calls for tenders. (Chapter 6).**
- **To have a favorable working environment in the tertiary sector and the ability to have infrastructure capable of housing our instruments and our technological and research platforms (Chapter 7).**

And to be able to work in an efficient collaborative manner. For that it is crucial for the laboratory (**Chapter 4**)

- **To be an important partner in the network of the largest European laboratories. To also stimulate targeted collaborations with other European laboratories and worldwide.**

- **To increase the national collaborations and in particular to find a modus operandi and a collaboration with the IRFU/CEA.**

In the annual report we discuss the actions and the results connected to the missions of IJCLab expressed in the Manifesto in the Chapters indicated in the previous items.

As a final chapter we discuss briefly the organizational news of the laboratory (**Chapter 8).**

To note that IJCLab will be examined next year by HCERES ("Haut Conseil de l'Evaluation et de la Recherche et de l'Enseignement Supérieur"). In preparation for that we are organizing IJCLab Perspectives which will be held in March 2024.

2. IJCLab Missions and success criteria

- **Leading world-class flagship projects in high-energy physics, nuclear physics, astroparticles and cosmology by contributing at all levels**

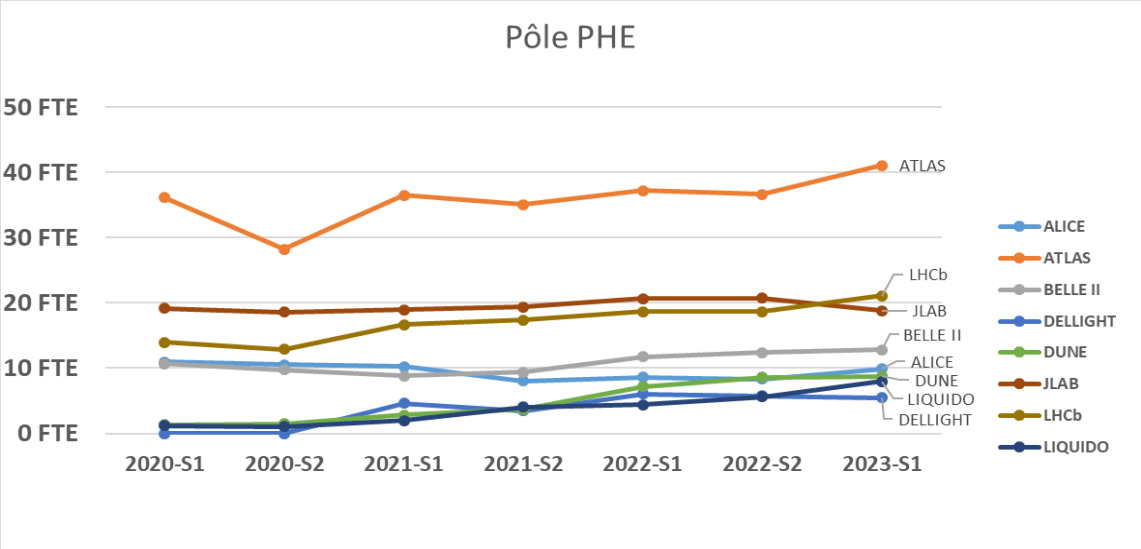
The projects and their evolution are monitored by a dedicated service (CEMAP) through a dedicated software (OSITAH-NSIP) allowing IJCLab members to declare their activity each semester. The Figure 1 shows that we have continued the projects which were initiated before the beginning of IJCLab and for most of the projects the implication has remained stable over the last years. We can notice globally an increase of the activities related to the CERN experiment (ATLAS, LHCb and ALICE). At the same time, we managed to start contributing to new emerging projects, mostly to DUNE and an increase of the Gravitational waves related activities due to an increasing contribution to the Einstein Telescope project.

The number of FTE implied on the high-energy physics, nuclear physics, astroparticles, astrophysics and cosmology activities are summarized in Table 1.

	RESEARCHERS	TECHNICAL STAFF	TOTAL	NON-PERMANENTS
HIGH ENERGY PHYSICS	46	34	80	57
ASTROPHYSICS & COSMOLOGY	29	19	48	23
NUCLEAR PHYSICS	22	10	33	18

Table 1. FTE involved in the high-energy physics, nuclear physics, and A2C (for Astroparticles, Astrophysics and Cosmology) activities;

For PHE, notice that 72 FTE are involved in CERN-based experiments and for Nuclear Physics 11 FTE in GANIL experiments.


Pôle PHE
50 FTE
40 FTE
30 FTE
20 FTE
10 FTE
0 FTE
2020-S1
2020-S2
2021-S1
2021-S2
2022-S1
2022-S2
2023-S1
ATLAS
LHCb
JLAB
BELLE II
ALICE
DUNE
LIQUIDO
DELLIGHT
ALICE
ATLAS
BELLE II
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JLAB
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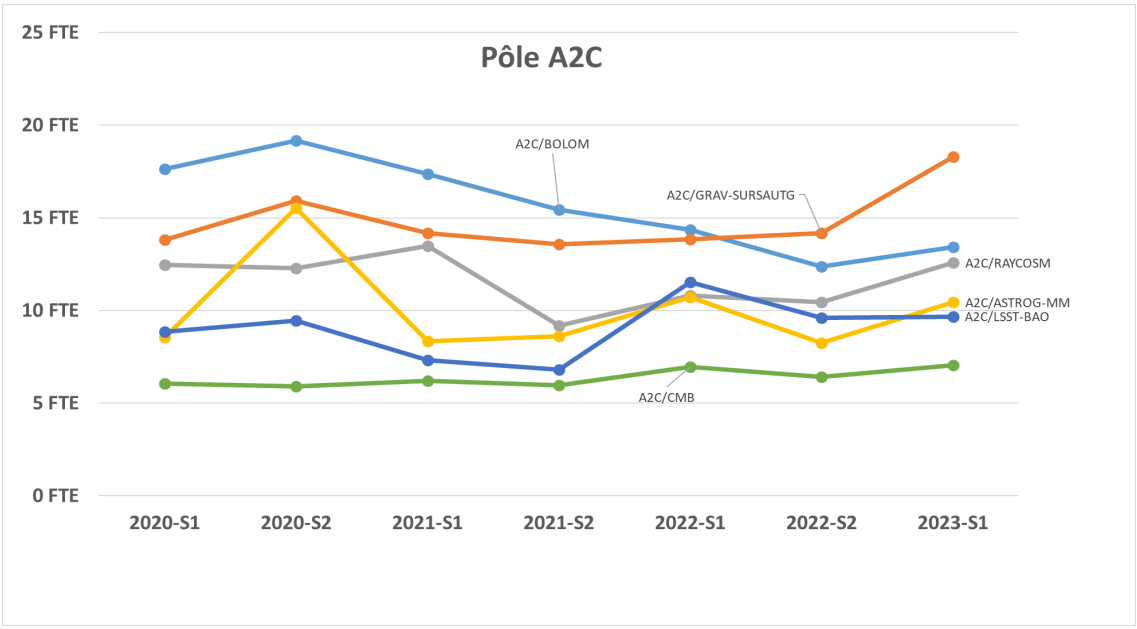

Pôle A2C
25 FTE
20 FTE
15 FTE
10 FTE
5 FTE
0 FTE
2020-S1
2020-S2
2021-S1
2021-S2
2022-S1
2022-S2
2023-S1
A2C/BOLOM
A2C/GRAV-SURSAUTG
A2C/RAYCOSM
A2C/ASTROG-MM
A2C/LSST-BAO
A2C/CMB

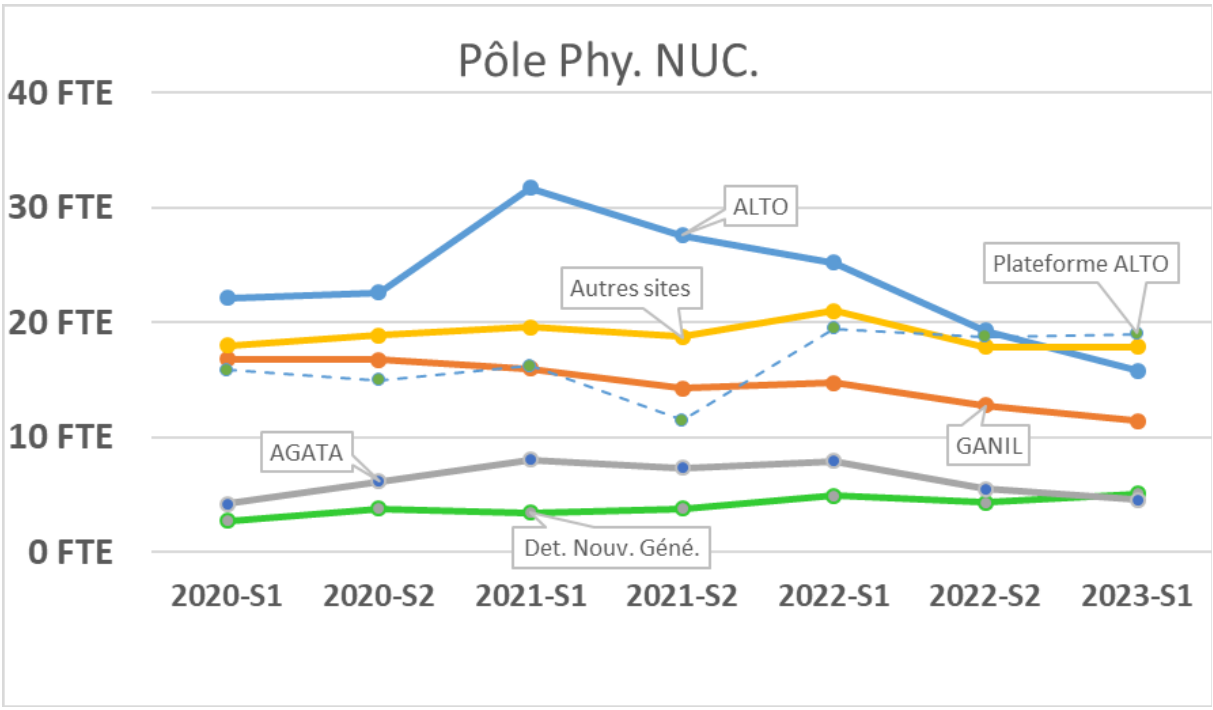


Figure 1. The Evolution of the FTE as a function of the years for PHE, A2C and Nuclear Physics projects

One can make a few comments and observations:

- The LHC projects have now entered the upgrade phase and the contributions to ALICE, ATLAS and LHCb are increasing in the number of FTE involved.
- A newcomer is the project DUNE with an increased number of people involved. IJClab has put a strong priority on hiring new researchers and engineers to work on this project. Quantitatively the number of FTE increased from 1 to 9 in the last 3 years.
- There is a constant participation in the GANIL and a decrease in the number of people involved in ALTO. The reason for that is an important work done in order to upgrade the ALTO platform in the last two years with the aim of improving the capacity of ALTO to run in parallel stable and radioactive beams but also for the opening of ALTO to other applications thanks to the irradiation capabilities. We recall here that (as shown in the plot) 19 FTE have actually worked on the ALTO platform in 2023.
- We are also moving forward with a growing implication in Einstein Telescope in parallel with a continuation of the activities in VIRGO+. The AC team's activity also increased thanks to a balloon flight that took place last summer in order to increase the TRL of an instrumental setup

for a future constellation of nanosatellites dedicated to measuring the polarization of gamma-ray bursts.

In addition to the experimental projects a strong theoretical pole has been created at the beginning of IJCLab. The activities of this pole are summarized in Figure 2

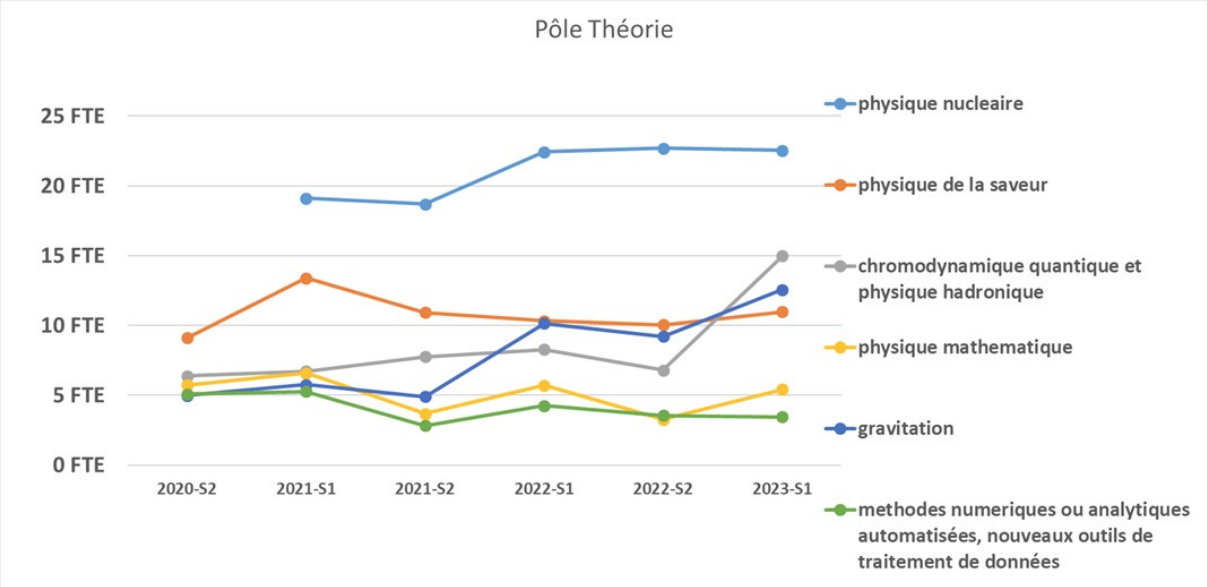


Figure 2. The Evolution of the FTE as a function of the years for Theoretical Physics.

As it can be noticed from this plot 80% of the pole is working on theoretical subjects on nuclear physics, flavor physics, QCD and Cosmology/Gravitation. The research activities are often related to the experimental projects and activities of the laboratory (see Chapter 3). The theoretical pole is also very active in participating/leading the transverse's groups (see Chapter 3).

- **Play a major role in the conception, design and construction of current and future accelerators.**

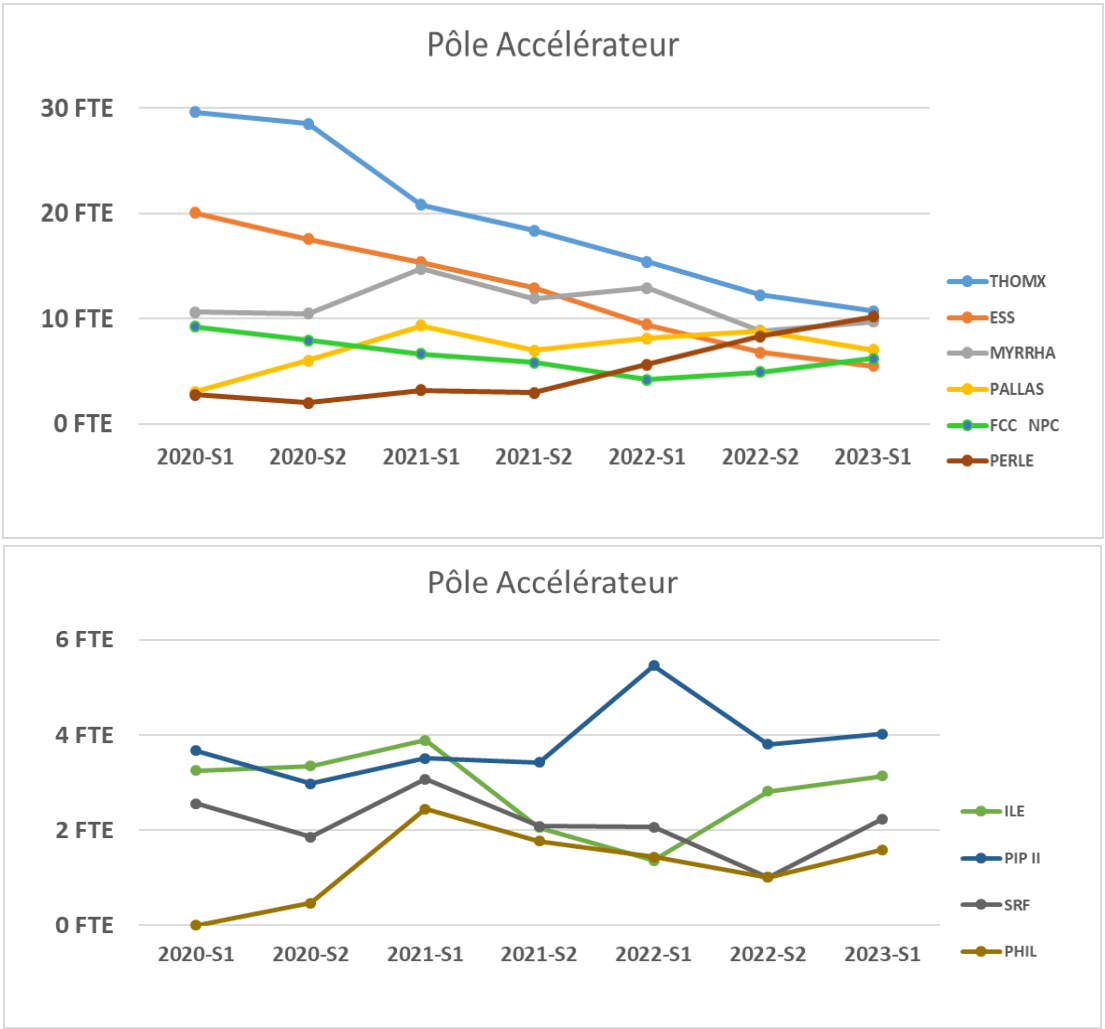


Figure 3. The Evolution of the FTE as a function of the years for Accelerator Physics projects

We are running and contributing to several of the major accelerator programs in the world.

The main observations (see Figure 3) concerning very recent changes (mostly in the last year) are:

- A significant decrease of the forces needed for ThomX (end of the construction phase) and ESS (end of the production phase).
- A still significant activity on MYRRHA
- A significant increase of the contribution to new project: PERLE, with today about 10 FTE
- A stabilization over the last 3 years of the needed forces on PALLAS and PIP II
- A regain of activity under the umbrella of FCC-NPC.

Besides that, we have several technological platforms which are essential for accelerators physics activities:

- We keep upgrading SUPRATECH with investments required for the realization of present and future experiments (ESS, Myrrha, PIP II, PERLE + SRF R&D)
- We continue the update of the LaseriX platform. The laser is currently being upgraded to 50 TW for the PALLAS project to build a compact laser plasma section accelerating electrons up to 200 MeV. LASERIX is participating in the TWAC project as a source of photoelectron excitation for the RF gun, and to produce the THz wave dedicated to electron acceleration in a dielectric waveguide. For the DELLIGHT project, LASERIX is used to demonstrate experimentally that the electromagnetic field carried by an ultra-intense laser pulse can modify the refractive index of a vacuum.
- Vacuum & Surfaces platform has been inaugurated. The aim of this platform is to maintain, acquire and adapt surface analysis resources to provide the best possible response to gas accelerator materials issues, with particular emphasis on dynamic vacuum and superconducting RF cavities. Installed in Halls D3 and D4 of Building 209C, this unique space houses a variety of equipment.

  - Area D3 includes materials characterization tools such as an X-ray diffractometer (DRX), a secondary ion spectrometer (SIMS), a confocal microscope, a scanning electron microscope (SEM), and most recently a photoelectron spectrometer (XPS).

  - Space D4 is more specifically dedicated to ultra-high vacuum and materials for particle gas pedals. It includes multi-technology racks for in-situ analysis of ultra-high vacuum surfaces subjected to particle bombardment and heat treatment.

- **To develop and exploit research infrastructures and technological platforms supporting these lines of research as well as original research in health physics, material sciences and energy, thanks to their irradiation performances.**

Some important progress has been achieved very recently, with quite significant investments, in particular:

- Significant investments are undergoing to upgrade the **detector platform of IJCLab** both from the infrastructure and the equipment viewpoints.
  - **PSI** (**Platforme SIlicium**) for the characterization, the preparation and the test of the silicon detectors, mainly for the ATLAS upgrade.
  - **DQC (Détecteurs Quantiques Cryogéniques**). A Platform for study and test of innovative cryogenic quantum detectors (mainly bolometers) for neutrino physics and the search for galactic dark matter.

- The **ALTO**
  - **ALTO-LEB:** The successful on-line commissioning of the new front-end in October 2022 allowed it to perform decay spectroscopy measurements with the new setup COeCO. The new stabilization system to track the position of the lasers in the source was also successfully commissioned on-line at the same time of the switch between both laser schemes (Ag and Ga). During summer of this year, emittance measurements were performed with stable beams to characterize the ion source and improve the beam transport. The analysis is under progress. The offline commissioning of the new beamline towards the Penning trap mass spectrometer MLLTRAP was partially done.
  - **ALTO-HEB**: The integration of Radiograff setup for radiobiological applications on the precision dosimetry beamline 320 is under progress. This project is in the framework of the BioALTO project. The installation of SPACE ALTO, the precision irradiation station for industrial clients, at beamline 320 is almost completed. The commissioning is expected by the end of the year. Currently the dedicated chamber, the vacuum, the control system and the scanning system have been tested. The rejuvenation and upgrade of the magnetic spectrometer SPLIT-POLE is under progress and should be ready for a campaign of measurements beginning in 2024. The construction of the high-efficiency/resolution hybrid gamma-ray spectrometer Nu-ball2 was performed. All the associated experimental campaigns were done. The last beamtime was performed during week 25. Nu-ball2 was completely removed from ALTO on Monday 31st of July. During the nu-ball2 campaign at ALTO: 16 experiments were approved, 12 ran, 10 successful, 300 Tb data collected. 8 experiments financed by EUROLABS and ARIEL,160 international visitors.

- The **JANNuS-SCALP and Andromede** platforms are now merged in a unique platform, named **MOSAIC**, of Ion beams for synthesis, modification and characterization of materials, and ion-matter interactions studies. 71 available elements, from protons to gold nanoparticles and in the energy range: from 50 eV to 32 MeV. This platform is a member of the EMIR&A French accelerator federation, Research Infrastructure. It is splitted in two sites. Building 108 hosts: 2 MV Tandem (ARAMIS), an ion implanter of 190 kV (IRMA), a 200 kV in situ TEM, a 40 kV mass spectrometer (SIDONIE) recently renovated and upgraded (see YR2022) and a SEM-EDX AFM. The Hall SuperACO hosts: 4 MV Tandem (Andromède), an accelerator of 30 kV for aggregates (Tancrède) and a new ion implanter which will be transported from Lyon of 400 kV (Némée).

- **To promote the development of new technologies for science for the benefit of society, thereby supporting national and European industrial competitiveness.**

Several activities in laboratory are developed and/or transferred to Industrial. The industrial partnerships are summarized in table 7.

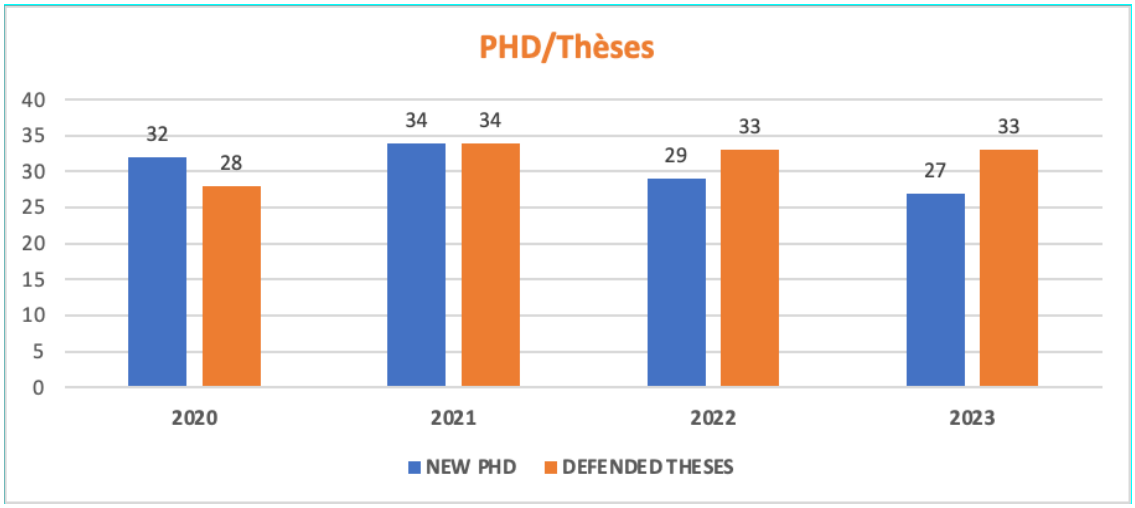
Here we would like to underline a long-standing project started in 2017 on an ultra-sensitive gamma camera for locating and characterizing radioactive decommissioning waste which was developed together with ANDRA and was delivered in September.

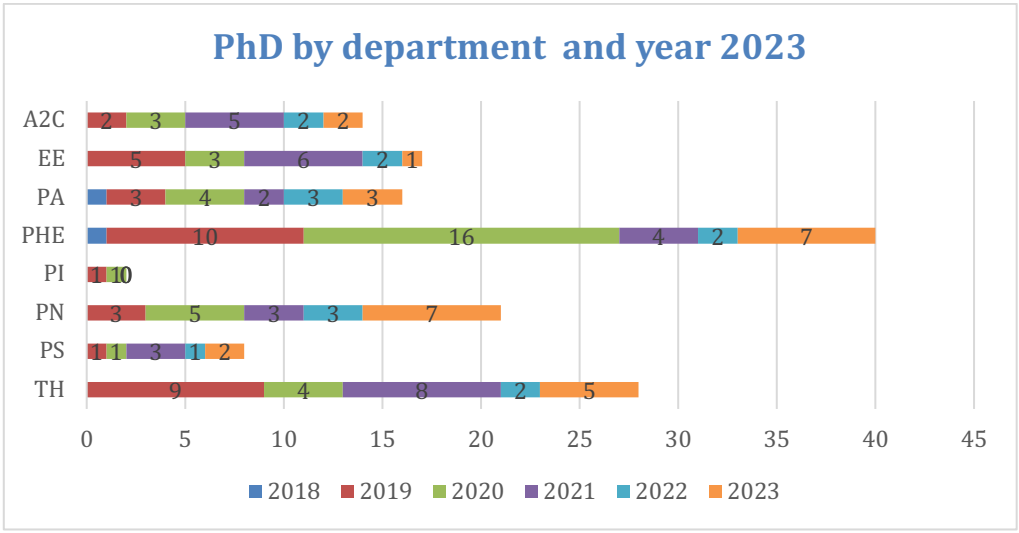
- **To welcome the students that the laboratory trains through and for research at the heart of a world-class university environment.**

The number of PHD students has stayed constant over the last year with about 120 PHD students present at the same time at the laboratory. More than 30 PHD thesis are defended per year and more than 30 new PHD students are starting their thesis every year. The laboratory has also put a strong priority on welcoming internship students.

PhD Students.

In Figure 4 we show the number of new PHD entering IJCLab and PhD defenses over the years.





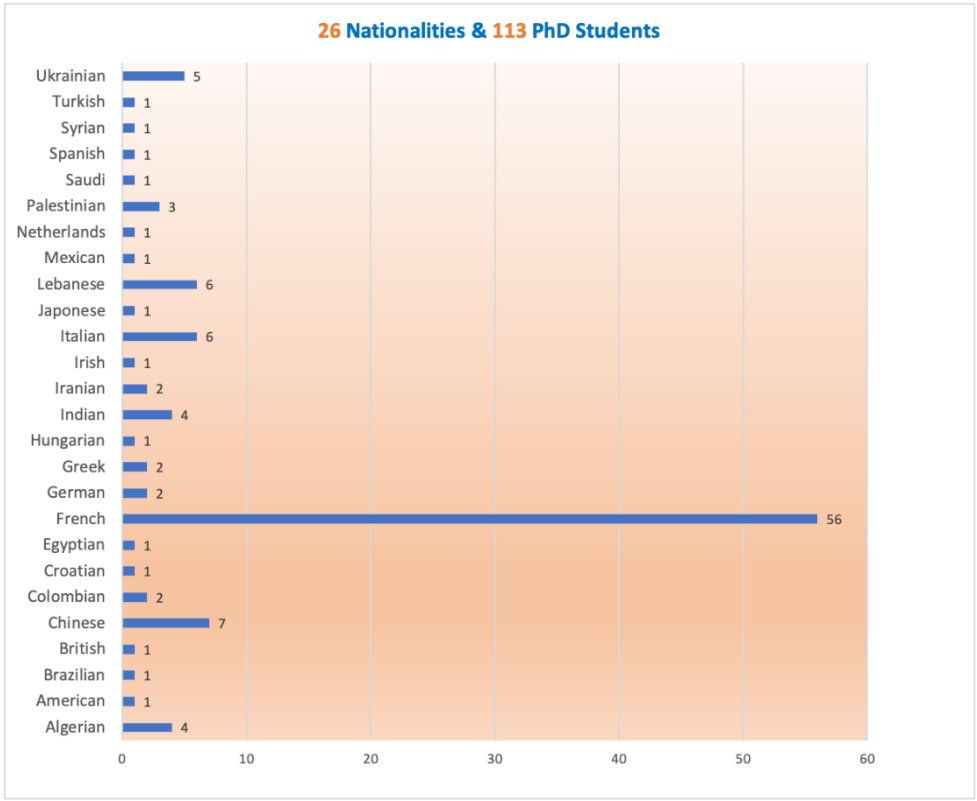


Figure 4. (Top) The number of new PhD entering IJCLab and PhD defenses over the years (Middle) Number of PhD students according to their current year of PhD and main research department of activity: TH Theory, PS: Health Physics, PN: Nuclear Physics, PI: Engineering, PHE: High-Energy Physics, PA: Accelerators, EE: Energy and Environment, A2C: Astroparticles, astrophysics and cosmology. (Bottom) Nationality of the PHD students.

Interesting to underline that the PHD students are of 26 nationalities.

INTERNSHIPS.

IJCLab has also a strong involvement in internships as a gateway to research for students. The Figure 5 and Table 2 below summarize the situation in the last four years. This constitutes an important financial effort of the laboratory as most of these internships are supported by the laboratory.

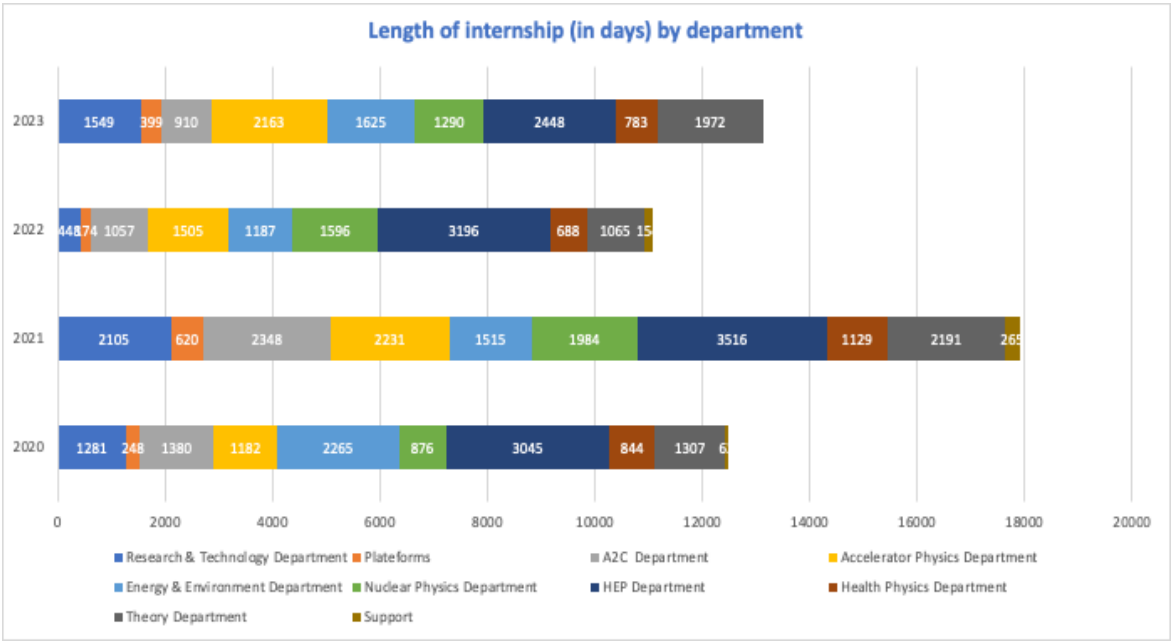


Figure 5: Number of internships according to their main department of activity: TH Theory, PS: Health Physics, PN: Nuclear Physics, PI: Engineering, PHE: High-Energy Physics, PA: Accelerators, EE: Energy and Environment, A2C: Astroparticles, astrophysics and cosmology.

	2020	**2021**	**2022**	**2023**
Number of internships	151	210	148	169
Number of months	530	664	436	505
% L	25%	32%	24%	43%
% M1	28%	36%	32%	30%
% M2	47%	32%	34%	27%

Table 2. Quantitative data for internships: total number, number of month and percentage of internship student from Master 2, Master and Bachelor.

MASTER and DOCTORAL SCHOOLS

We have in particular important responsibilities in the following Master programs:

- M2 NPAC (Nuclei Particles Astroparticles and Cosmology) (around 35 students/year) directed by Fabien Cavalier
- M2 Grands Instruments/PLATO (around 15 students/year) directed by Sophie Kazamias
- M1 Nuclear Energy (around 25 students/year)
- M2 Nuclear Energy (around 50 students/year with 5 different majors)
- M1 General Physics (around 40 students/year)

One of the main Doctoral School in Physics of the Paris-Saclay University, ED PHENIICS, with more than 200 registered PhD students is directed by David Verney

INTERNATIONAL PROGRAMS TO ATTRACT STUDENTS.

Several international training activities are also led by IJCLab researchers/teachers. We mention here the largest ones and those who attract most the international students:

- **Trans-European School in HEP** (mostly East European countries), Winter School in HEP (**WISHEPP)** (Palestine), International **QCD school**.
- International student exchange networks: **Erasmus+ MIC Colombia, Georgia, Ukraine and Plaestine** (globally more than 50 students/year)
- **Erasmus Mundus Lascala** (large-scale instruments) and **Quarmen** (quantum research)

3. Scientific and Technical highlights and events in 2023

3.1 The Scientific Poles and the Engineer Pole

NUCLEAR PHYSICS

ALTO:

April 2023, an experiment was performed within the **nu-Ball2** campaign. It aims to characterize and understand neutron/gamma de excitation of fission fragments.

Over the five weeks, an ionization chamber (to get fission fragment kinematics) was installed and signals recorded. Around the chamber, the nu-Ball2 hybrid spectrometer was used. Its geometry included 24 **GAMMAPOOL Germanium clovers** and 70 **PARIS** phoswitches. During the experiment, 28 Tb of data were acquired and are now being analyzed using usual techniques and with new AI developments. In 2023, the **TETRA** setup was re-installed. All pumping systems were renewed. TETRA detector has been restarted, adjusted and aligned. In November, a measurement using silver neutron-rich radioactive beams, (E. Cantacuzène's PhD thesis) will be performed. These measurements are possible thanks to the development of LASER beams for ionizing silver atoms (A. Segovia's PhD thesis).

In addition, this same experimental campaign should enable us to finalize the characterization of the **COeCO** setup (G. Tocabens PHD thesis)

GANIL:

First in-beam commissioning of the **SIRIUS** detector on a low-energy line at GANIL (https://nuclear.ijclab.in2p3.fr/en/sirius-sees-its-first-beam-at-ganil/). Data analysis revealed some bugs in the firmware, which have now been corrected. It also demonstrated that the time resolution of the SIRIUS detector is sufficient to separate the superheavy nuclei of interest from possible contaminants at the focal plane of SPIRAL2's Super Separator Spectrometer (S3).

The **MUGAST@LISE** campaign at GANIL led by IJCLab has successfully begun in April 2023. It combines the MUGAST silicon and CsI array with 12 EXOGAM clusters and a new zero-degree detection system. The first experiment focused on the study of neutron-proton pairing in 48Cr, and the second on the study of shell spacing and spin-orbit splitting at the N=40/50 shell gap. This campaign will continue in 2024 and 2025. IJCLab's NESTAR team is the Principal Investigator of four of the six experiments already accepted which cover a wide range of topics: shell model, multi-neutron systems, nuclear astrophysics and clustering. The last proton bound calcium isotope ^{35}Ca has been studied by two-nucleon transfer reaction ^{37}Ca(p,t) at GANIL with the **MUST2** array coupled to the **CRYPTA** liquid Hydrogen target. The size of the N=16 gap has been deduced from the measurement of its mass and confirms that ^{36}Ca is a doubly-magic nucleus. The fact that N = 16 magicity is strongly present at both edges of the valley of stability, in ^{24}O and ^{36}Ca, gives strong constraints to the proton-neutron interactions involved in the shell-model calculations when adding 12 protons to the sd-shells.

The **NEWGAIN (NEW GAnil Injector)** project, by building a new injector for the Spiral2 facility, will enable GANIL to deliver some of the world's highest beam intensities for heavy beams ranging from carbon to uranium in the 10 MeV/A energy range. This year, the project entered the construction phase and the first orders were placed.

Other sites:

RIKEN

An experiment proposed by a team of the Nuclear Pole of IJCLab was carried out with the **SAMURAI spectrometer at RIKEN** in order to measure the differential cross section of the alpha

cluster knockout reaction (p,p-alpha) on unstable beams for the first time. Such an approach allows us to probe the spatial distribution of α-cluster in the nucleus of interest. In this first study a-clustering in the neutron-rich Beryllium isotopes was investigated. Analysis of the differential cross-sections validated the molecular-type structure of the ground state of ^{10}Be predicted by microscopic models, represented by two alpha particles with the two excess neutrons occupying circular orbits around the axis of this nuclear molecule. These results bring experimental evidence that clustering plays a crucial role in the ground-state of light neutron-rich nuclei, challenging the conventional picture that cluster states typically lye near the α decay threshold (the Ikeda threshold rule).

Contribution to the chapter of the Nuclear Physics Division in the book "150 ans de la Société Française de Physique", published by EDP Sciences (2023).

HEP (High Energy Physics)

After the start-up of LHC run 3 in 2022, data collection from proton-proton collisions continued in 2023. The integrated luminosity (32fb^{-1} delivered to ATLAS) was smaller than expected due to a Helium leak in one of the inner triplet magnets. After the repair, five weeks were devoted to PbPb collection marking the first heavy-ion run in 5 years with a collision rate increased by a factor of 10. Meanwhile, IJCLab teams in the three experiments continue to analyze the data from runs 1, 2, and 3. New results include the measurement of the Higgs boson mass by the **ATLAS** experiment with a precision of one permille in the Higgs to $\rightarrow\gamma\gamma$ channel using for the first time a transverse energy-dependent calibration based on the full Run 2 data. The **LHCb** team has contributed to several new results on lepton flavor universality tests (R(D*) and R(K*)) showing good agreement between data and the Standard Model predictions. The **ALICE** team released new results on the cross-section and polarization measurements of J/psi photoproduction at very low pT in PbPb collisions with nuclear overlap showing similarities with the process in ultra-peripheral collisions. The three **ATLAS** upgrade projects **(HGTD, ITk and LAr**) are making good progress towards the preproduction that should start in 2024.

The **Belle II** experiment has been in its first long shutdown (LS1) since June 2022 and will restart data taking early 2024 with higher luminosity. The IJCLab group led the effort to the installation and commissioning of the new DAQ system based on the PCIe40 card developed by IN2P3, and contributed significantly to the improvement of the cooling system of the beam pipe near the interaction region.

For **FCC-ee**, measurements of the first prototype electrodes for a future noble-liquid calorimeter have enabled us to understand the origin of fine crosstalk effects, and a subsequent prototype has been designed. An intermediate-size prototype of **GRAiNITA** was built, and cosmic data were acquired and analyzed to characterize different materials.

The **CALICE/ILC** group is about drawing lessons from the beam tests with a highly granular silicon-tungsten electromagnetic calorimeter in 2022. This resulted in a coordinated R&D effort on the gluing of Si sensors to the interface board. First conclusions are expected in Spring 2024.

The **DeLLight** team successfully measured the deflection signal in air with very low-energy pump pulses. The signal, measured as a function of various experimental parameters, agrees with the expected signal induced by the nonlinear optical Kerr effect in air. This measurement is an important achievement since it validates the experimental method of the DeLLight project toward a measurement performed in the vacuum with a high-intensity external pulse.

At **JLab**, within the **CLAS** collaboration, the campaigns on polarized hydrogen and deuterium targets, as well as the campaign on nuclear targets have ended. In Hall-C, the data collection campaign for the **NPS** detector, built in the laboratory, has started and will end in 2024. In addition, the full-size prototype of the **ALERT** detector was tested at ANL in the field; the experiment was planned at JLab for 2024/2025. For **EIC**, an electronics test bench was installed and the first version of ASIC was tested.

Several analyses are on-going with data recorded by **HADES** at GSI**.** Among them**,** the analysis of quasi-free pion-proton reactions measured in the second resonance region allowed to constrain e+e- production mechanisms with emphasis on time-like electromagnetic baryon transition form factors.

The **SuperNEMO** detector has been completed and the gamma and neutron shieldings should be installed in the coming months. During the summer, the detector was running continuously for 26 days to measure the background. The radon contamination of the tracker (6 ±2 mBq/m3) is at the level of the previous detector NEMO-3 without the improvements to come.

The **DUNE** prototype for the Vertical Drift detector has been installed in the NP02 cryostat at CERN. The IJCLab team has been strongly involved in the cathode installation and the validations needed for the upcoming productions. Meanwhile, the analysis of cold box and NP02 data continued with a focus on comparing data and simulation.

The prototype "Mini-e" of **LiquidO** is under exploitation and the process of light confinement when entering the "opaque regime" agrees with the expectations. A second more ambitious prototype "Mini-gamma" is under construction at IJCLab and will enter production soon in exploitation.

A2C: ASTROPARTICLES, ASTROPHYSICS AND COSMOLOGY

The **COMCUBE** CubeSat mission project, coordinated by the A2C/AC team, has been selected by ESA for a 6-month study phase. A first prototype of the instrument was successfully tested during a stratospheric balloon flight from the Timmins base in Canada as part of the Strato-Science 2023 CNES campaign. The A2/AC team’s contributions on the initial analyses of **Ryugu** samples brought back by the JAXA Hayabusa 2 space mission were published in two Science articles. The IJCLab team participates in the PEPR "Origins", in the frame of the ASTRO-AFMIR ANR proposal.

In **CTA**, most of the experimental work was focused on the definition of the operating mode of the single-photon calibration system for the NectarCAM camera. It has been used to characterize the response of the first camera. A study on the identification of candidates for PeV particle acceleration through a multi-wavelength analysis of galactic SN remnants has been performed, paving the way for CTA observations.

For **AUGER**, the exploitation of phase I data is continuing. The team has been particularly involved in two publications on the constraints on dark matter production mechanisms, and on a catalog of the 100 highest-energy events. Another study provides a universal parameterisation of the transparency of clusters to the most energetic cosmic rays, explaining why the Virgo cluster is not seen by AUGER. In **AUGERPRIME**, the upgrade of the scintillators and the electronics of the stations coordinated by the A2C/APHE team, has been installed on site. J. Biteau has been awarded a fundamental chair at the Institut Universitaire de France from 2023 to 2028.

For **DAMIC**, following the commissioning of the prototype detector, the IJCLab team took part in the publication of binding limits on the effective cross-section between particles in the hidden sector and electrons by exchanging so-called "heavy" photons, and a second letter is being submitted. The final detector is being installed at LSM.

In **VIRGO**, the A2/OG team is concluding the analyses of the O3 data and preparing the O4 campaign. Several publications were led by members of the team especially on the links between GW emission and Gamma-rays bursts and detector characterization. For **ET**, the A2C/OG team increases its involvement in the project with active participation in the design of vacuum tubes and cryostats, computing model, squeezing and scientific case. IJCLab hosted the second collaboration meeting in November.

In **SVOM**, the MXT on-board scientific software, under the responsibility of IJCLab, was delivered to CNES after a final review and the lab accepted to extend its responsibility to all parts of the on-board software. The team also participated in the development of the ground segment on which a review has just been concluded, and is preparing the GW-related scientific exploitation

The A2C/OG team also participated in several publications within the **GRANDMA** collaborations, in particular, on gamma-ray bursts follow-ups and on interesting visible light triggers detected by ZTF and filtered by **FINK**.

On **LSST,** beyond the implication of the team in cosmological analysis preparation in DESC, the holographic spectrograph installed on the LSST auxiliary telescope is operational and now routinely provides measurements of the main atmospheric parameters like the grey absorption, the precipitable water vapor and the ozone, that will be used to compute color corrections and applied to photometric data.

FINK is being deployed at CC-IN2P3, and is used by more than 100 users a day. Seven preprints and publications were written in 2023, (more than 20 new type Ia supernovae (SN) were discovered). The community now covers 14 countries with about sixty members. An asteroid has been named *julienpeloton* in recognition of J. Peloton's work on the solar system with FINK. Several teams of the lab participate in the development of modules for multi-messenger analysis.

The **A2C/CMB** team led two main publications, one on constraints on MSSM-inflation combining particle physics and cosmological measurements, and the other one on the update of the cosmological constraints using the last CMB Planck PR4 data. The team is currently preparing the analysis of the **Simons Observatory** (SO) which will see its first light next year. It recently joined a French proposal for an extension of SO with an additional Small Aperture Telescope to be installed in 2027 in the desert

of Atacama. In parallel, the team continues to prepare the phase A feasibility study of **LiteBIRD** at CNES which will be reviewed in early 2024.

In 2023, the **CUPID** collaboration selected a technology developed within the A2C/ASSD for the light detectors, which are the most technologically advanced elements and play a crucial role in monitoring the radioactive background.

In **RICOCHET**, the A2C/ASSD team has manufactured the first group of 18 Ge detectors that will run at the ILL research nuclear reactor site in Grenoble from early 2024. The team will also play a leading role on **TESSERACT** by developing Ge detectors with an unprecedented combination of single-electron charge threshold and exceptionally low background.

The **A2C/ASSD** team continues to investigate quantum effects in disordered thin films. Amongst the highlights is the discovery of superconductivity in amorphous YxSi1-x thin films up to about 1 K. The A2C/ASSD team has also demonstrated that this compound exhibits a strong electron-phonon decoupling, which is a major result both from the basic condensed matter point of view and for applications in superconductor-based detectors.

ACCELERATOR PHYSICS

The contribution to **ESS** is now finished. After its successful qualification test at Uppsala in June, the 13th and last cryomodule has been delivered to Lund. All Spoke Cryomodules which have been prepared and assembled at IJCLab are now installed into the tunnel and connected, at the end of October, to the cryogenic distribution (also under the responsibility of IJCLab). Before summer, the second cool-down of the Spoke cryogenic distribution was successfully done, giving cryo losses within the specifications. As of today, the spoke section of the linac which has been designed by IJCLAB is completed.

Major milestones have been achieved this year for the **PIP-II** project. After several months of process optimization on Supratech platform, 2 Spoke cavity prototypes have been successfully validated in vertical cryostat at IJCLab. This demonstrates that the current cavity design, fabrication and surface cleaning processes meet the ambitious technical specifications of the project. Moreover, 4 prototype power couplers produced by PMB company have been successfully delivered to Fermilab. Their performances are being assessed.

For the **MYRRHA** project, the prototype Cryomodule designed and assembled at IJCLab has been tested at 2K. The amplitude and phase regulation of the accelerator field, in addition to the frequency regulation of the cavities during the test allowed the validation of the ability to manage the fault tolerance aspects. Moreover, the 2 first pre-series SPOKE cavities manufactured by RI-Germany have been tested at IJCLab.

After significant progress on **ThomX** accelerator systems commissioning, we started the commissioning of the optical cavity and the first interactions between the amplified power laser and the

stored electrons in the ring. The first X-rays were detected at the end of June in non-synchronized mode: roughly 10^7 ph/s with a laser power of 30kW. Since, a continuous effort is performed to improve synchronization between laser pulses and electron bunches at the Interaction Point. We obtained during the preliminary test 10^8 ph/s with a poor laser power (6 kW). We expect to reach a first breakthrough of a flux greater than 10^8 ph/s in the coming days.

For **PERLE** Project, the Prepare to Build phase (P2B), including the TDR release, is still ongoing with important achievements on lattice design (250 MeV and 500 MeV versions), related beam dynamics studies and SRF system design and prototyping. Another important achievement is the acquisition of a fully-equipped, load-lock DC photogun, designed for high bunch charge production, with its photocathode production facility from the RI company. This first brick of PERLE will be installed in the IGLEX-IJCLab building in the upcoming months. The associated laser system and its clean local were also acquired and will be installed in the same area. Another important achievement was the approval of the **iSAS projet (Horizon Europe Infra-Tech 2023)**, a game changer for PERLE as it will allow the involvement of new collaborators with significant contributions, to get funds to study and built the first Cryomodule and to profit of the ambitious R&D activities and technological development foreseen within the project to improve the efficiency of PERLE.

The contribution to the **R&D in colliders** is in good track, these activities are deployed in SuperKEKB: fast luminosity measurement and polarimetry, and in future colliders in particular the Higgs factories either linear, **ILC-CLIC** through **ATF3-KEK,** or circular, **FCC-ee**. The activities are focused on: **nanobeams**, **monochromatic collider schemes**, **positron production**, **polarimetry**, **dynamic vacuum** and **material studies for SRF**.

R&D on modifications of the surface properties of materials to improve the performance of accelerator components (cavities and beam lines), has focused on different aspects: (i) Reduction of the multipacting effect via thin layers of TiNC or alternating NbN/TiN multilayers via collaboration with SIMAP (Grenoble); (ii) plasma processing for the *in-situ* decontamination of superconducting accelerating cavities is on-going on the specific case of Spiral2; a PhD student has been hired and will drive this R&D over the next 3 years in the framework of several projects (iii) dynamic vacuum: experiment measuring the electron desorption yield is being carried out on the PHIL photoinjector, in order to simulate the phenomena of electron desorption by high energy electrons (experimental simulation of the effects Compton electrons in FCC-ee). A first experiment is scheduled before the end of 2023; (iv) a project on superconducting thin films for SRF cavities activity is launched this year. A post-doc has been hired and will drive this study in collaboration with partner laboratories (SIMAP and ICMMO).

The **PALLAS** project has generated the first electrons between 150-300 MeV using the second generation of target developed at IJClab. The charge reached is up to 100 pC with low divergence (<1.5 mrad) and state-of-the-art stability of laser-plasma accelerator. The experiment was made at LOA SJ-100TW facility in collaboration with LOA, LLR, LP2I Bordeaux and INFN-LNF. Major progress has been made on the development of the command-and-control system and tested during the first beam generation runs on the LOA's SJ 100TW laser. A first large random scan of a laser-plasma injector

configuration simulation using fast-efficient PIC code has been published. The first target generation target has completed with successful control of the high-Z gas dopant crucial factor for low dark current beam source. The assembly of the PALLAS beamline continues at IJClab and the first beams are expected for spring 2024.

Funded by the European innovation Council, the **TWAC** project, starts in April 2022 and seeks to create a compact Terahertz high gradient accelerating structure that can provide femtosecond-scale electron bunches for research into ultrafast phenomena. This innovation has potential applications in medical treatments due to its lightweight. First prototypes of the accelerating structures have been made. The project, coordinated by IJCLab, is realized in partnership with Phlam INP laboratory, the ARES accelerator at DESY, the Terahertz team at university of Pécs, and two companies Iteox and Radiabeam Europe. The first terahertz acceleration demonstration is expected in 2024.

Within the Equipex+ **PACIFICS** (2022-2027), equipment for Pallas project and the R&D on materials for accelerators were acquired this year and are already installed and used. Other acquisitions of specific test bunches will follow in the upcoming years.

ENERGY AND ENVIRONMENT

Research activities in the field of molten salts have strongly increased these last two years with the renewed interest of the nuclear industry for the molten salt reactor. In the frame of several projects from France 2030 (**ISAC, MOSARWASTE, PORTHOS, SELF**) and from Euratom (**SAMOSAFER, MIMOSA**) some new thematics were developed such as the synthesis of actinide chlorides, the management of the gaseous fission products and the use of gas mixtures for the control of the oxo-acidity of the molten salt. In the framework of the PEPR **DIADEM** (project A-Dream), the team is working on the use of an amphoteric compound to control the redox potential of the salt and limit the corrosion of the structural material. The creation of a ***Laboratoire commun de recherche*** **between IJCLab-CNRS and NAAREA**, a French start-up which develops small molten salt reactors is in progress. A peculiar focus is put on the important issue of microstructural stability of structural materials upon coupled effects of corrosion and irradiation.

In continuation of earlier studies on the quantification of errors in reactor simulations and their use in prospective studies of nuclear fuel cycles, major developments have taken place around the **CLASS** cycle simulation code. These newly developed models, which use the **DONJON & DRAGON** calculation chain from Montreal, take into account the complete core scale. Their development culminated in 2023 with the implementation of thermal-hydraulic feedback on fuel depletion. Studies carried out using these new models have shown that the biases induced by earlier, simpler models were the main source of error in cycle calculations. These new methods, used complementary, enable the team to estimate the errors induced by the various modeling options, from the simplest to the most complex (assembly, complete core, complete core with thermal-hydraulic coupling). This allows

detailed study of scenarios discussed at national level, such as nuclear industry scenarios or RTE scenarios (RTE is the French electricity transmission network manager).

HEALTH PHYSICS

The Radiotherapy axis has continued to expand, with the recent recruitment of Quentin Mouchard, an associate professor at UPC, who has joined **BioALTO**, the experimental radiotherapy platform under construction to be set up at ALTO.

Within **THIDOS** (Internal Dosimetry project), the first clinical prototype gamma camera dedicated to thyroid treatment monitoring has passed safety tests and is ready for use on patients. The first clinical evaluation will start in early 2024.

The newly **MODERATO** project, which involves the acquisition of videomicroscopy data on complex cellular models (3D, two types cell population, spheroids) subjected to multimodal ionizing radiations has showed their first results using original algorithms to track individual behavior (proliferation, migration, morphology change) within the population.

Concerning the **PRISM/TTRIP** project, first pure 155Gd targets (155Gd/Gd > 99,9%) have been produced with the **SIDONIE** ion separator of the MOSAIC platform and were irradiated at ARRONAX and NPI/REZ for measurements of the effective cross sections of the 155Gd(p,n)155Tb reaction. Impact of the co-produced 156Tb contaminant on the image quality performed with 155Tb is investigated through first Monte Carlo simulations of a phantom in a SPECT camera. In parallel, the first candidate molecules for 155Tb chelation compatible with the use of monoclonal antibodies have been synthesized and their structural analysis should begin shortly.

Regarding the imaging axis and more particularly the **IMOP** project, we investigated, based on deep ultraviolet and near-infrared excitation, the potentiality of the endogenous fluorescence analysis to characterize brain metastasis origin and to highlight the heterogeneity of molecular components and properties according to the metastasis sub-types.

Finally, models developed by the team MOV have evolved to better adjust clinical data (tumor radius measurements versus time) from patients with low-grade gliomas (data provided by The Sainte-Anne Hospital in Paris). Among them, a simple model with 4 parameters was used and successfully predicted the time of the tumor regrowth after radiotherapy in 75% of the cases. Being able to predict the time of regrowth is of great importance because clinicians can adapt the follow-up of patients, according to the fact that they are either fast or slow responders.

THEORY

Mathematical Physics: Using random tensor methods, detection in tensor principal component analysis was pursued, with a patent pending. Besides, several results have been obtained in stochastic analysis. A gauge model including gravity has been developed that provides a new approach to Quantum

Gravity and the potentially observable imprints of quantum causality, which would prevail near the Planck scale, have been derived. A strong implication in European consortiums mixing experimentalists and theoreticians exploiting present and future experiments in multi-messenger cosmology must also be outlined.

Cosmology and Gravitation: The search for black hole solutions and their perturbations, the cosmological bispectrum, domain walls and their phenomenology have been the main direction of research. The latter is most important for the phenomenology of compact object and their gravitational wave imprint. One highlight has been the discovery of explicit and simple black holes with primary hair, one of the first examples found in the literature. Additionally, the solutions found have for the first time the feature of being regular compact objects for a specific relation between the black hole charges. Perturbations of these solutions, figuring out in particular their quasi-normal modes is now underway. Phenomenology of melting walls in cosmology is also discussed which seem in very good agreement with the recent data of NANOGrav GW recently released.

Physics Beyond the Standard Model: New avenues towards reheating through evaporation of primordial black holes were explored. The effects of fragmentation on the post-inflationary epoch of reheating were considered. A detailed study of the freeze-in production of dark matter in the form of a sterile neutrino was undertaken. Coherent neutrino scattering on nuclei was studied using an effective field theory approach, resulting in new important constraints on non-standard interactions. An introductory level review of effective field theory techniques in the context of SMEFT - an effective field theory of the degrees of freedom of the Standard Model - was prepared.

Flavor Physics: The Standard Model predictions for B-meson decays with missing energy have been revisited, and these results were used to interpret the first determination of the decay $B \to K\nu\nu$ decay branching fraction by Belle-II, within a general Effective Field Theory (EFT) framework. Other low-energy probes of new physics have also been studied with EFTs, such Λ_b and Λc baryon semileptonic decay modes, as well as meson decays that violate lepton flavor. We have also provided a systematic study of high-energy probes of flavor-physics EFTs at the LHC, which are complementary to the searches performed at low energies. These results were compiled in a new Mathematica package, called HighPT, which is available for theorists and experimentalists.

Nuclear Physics: The activities on compact stars have been going on, especially on the neutrino cross-section in dense matter, on the impact of the three-body interaction in neutron matter, on the superfluid fraction in the « pasta » phases of the crust, and on the hypothesis of hybrid stars constrained by gravitational wave signals. The team has also a leading role in the development of tools on quantum computers to tackle the many-body problem.

QCD: Non-perturbative linear power corrections in Λ_{QCD} have been investigated for collider processes involving massive top quarks, e.g. single top production, ttbar production in qqbar fusion, with implications for mass extractions of the top quark. The stability of next-to-leading order QCD corrections for J/Ψ photoproduction within collinear factorization has been improved with the inclusion of high-energy factorization (HEF) via a matching procedure. The first analytical computation of the diffractive production of a high pT hadron through fragmentation was done, at NLO, in the QCD

shockwave approach of gluonic saturation. Exclusive photoproduction of a $\pi^0\gamma$ pair was shown to violate collinear factorization at leading twist, for the very first time for an exclusive process, and understood, due to the presence of Glauber gluons.

Statistical Physics: The concept of equivalent impedance of electro kinetics is generalized to circuits of (autonomous) thermodynamic devices with many thermodynamic currents and forces in non-linear relationship

RESEARCH and TECHNOLOGY (2023 Engineering Pole highlights)

- The **IDROGEN** boards show excellent results measured by SYRTE laboratory in Paris Observatory. The shift between two signals spread in very different length optical fibers is now 50ps thanks to the embedded CERN White Rabbit technology.
- First results were obtained with the Single Photon Electron calibration system designed at IJCLab on **NectarCam for CTA.** The calibration screens are painted, with the dip-coating technique, according to a specific pattern to uniformize the light emission towards the focal plane.
- After intensive tests at Canfranc laboratory in 2023, IJCLab technology **Neganov-Trofimov-Luke bolometers** has been chosen for **CUPID** light detectors with responsibility for half of the production (2000/2 detectors).
- The **COMCUBE** instrument was exploited during a balloon flight in august 2023. There was a strong involvement in the project from electronics, mechanics, detectors and data acquisition teams.
- **ThomX commissioning** is ongoing with a strong involvement in mechanics and CC.
- The **Neutral Particle Spectrometer (NPS)** designed at IJCLab has been commissioned at Jlab in 2022-2023.
- The first tests of prototypes were settled in the **R&T Grainita (LiquidO technology)**. We can now see a proof of concept.
- The **mini-Gamma detector** (LiquidO technology) is under construction. It is a complex four-sub detector instrument with an inner 100l opaque scintillator heart. The first results are expected at the beginning of 2024.
- **DUNE mechanics for chimney and anode design** is now completed. The Anode was mounted in module 0 at CERN with COLDBOX tests. The mechanical teams are now preparing the production which begins in 2024, the tools for shipping, and the organization for the installation at SURF.
- The characterization of an **ASIC EICROC** (Omega) able to read-out the new generation of pixelated (500 x 500 µm2) silicon sensors **AC-LGAD** is ongoing at IJCLab. The first results are promising.

- The **Belle II IP beampipe** is a very sophisticated one. The cooling system of this state-of-the-art beam pipe is essential because "wall loss" and synchrotron radiation create significant heat all around the IP region. We have been working on a project to improve the cooling at the IP region thanks to advanced thermal simulations.
- The **PLUME luminometer** installed on the **LHCb** experiment at CERN is now the LHC reference for the accelerator luminosity measurement.
- Proof of concept validated for a **new radiation detector for in situ dose verification** in radiotherapy with the **Dosimoens** project. The electronics were designed and prototyped at IJClab.

3.2 The Transverse Groups

The Transverse Groups are a group of people working on projects/activities on a theme which, by its very nature, cuts across the divisions. They have a budget to run them. These groups may be more scientific in nature, in which case they are closer to the CNRS GDR (Research Group) concept, or they may have a strong technical connotation, significantly involving technical staff from the engineering, accelerator or platform divisions.

Transverse Group: Cosmology, Particle Physics, Theory:

This transverse group brings together researchers from the A2C, PHE and Theory departments. During last year, two workshops were organized, one in 2022 and the other in 2023, each lasting half a day and giving rise to very lively presentations and discussions between members of the laboratory and guests from other French laboratories. Two highlights to point out are:

- one topic discussed during the workshops was published: members of the A2C and PHE pole together with theorists from the APC and L2C labs revisited MSSM inflation.
- the MADMAX experiment was discussed in depth with members of MADMAX from CPPM and DESY leading to further investigations into a possible contribution from an RF-accelerator expert and members of PHE to be organized by the A2C department.

Transverse Group: Flavor (quarks and leptons):

This transverse group brings together researchers from the A2C, PHE and Theory departments. The second meeting of this group was organized in June 2023, with a series of shorter presentations given by PhD students and post-docs, in addition to a closing talk on "Radiative leptonic decays of pseudoscalar mesons from lattice QCD". Furthermore, topical seminars have been regularly organized by this transverse group.

Transverse Group: Additive Manufacturing and Innovative Technologies:

The FATI transverse group is looking at the applications of Additive Manufacturing to the needs of the different research activities of the laboratory. The website of the group is at http://fati.ijclab.in2p3.fr/

it features several realizations made by members of the group using additive manufacturing. The group meets almost every two months and organizes occasional seminars (10 until now). The group also co-organizes with local partners workshops on additive manufacturing applied to the physics of the two infinites and is involved with a national network dedicated to additive manufacturing in CNRS.

Transverse Group: Nuclear Physics in the cosmos:

This transverse group brings together researchers from the A2C, PHE and Theory departments. Two workshops are organized each year, the second one for 2023 was delayed to February 2024 for organizational reasons. Each workshop lasts for less than half a day. Emphasis is put on lively presentations and discussions between members of the laboratory and guests from other institutions.

Transverse Group: QCD:

This transverse group brings together researchers from the HEP and Theory departments. The goals of this transverse group are to animate discussions and scientific exchanges among experimental projects and the theory community, to participate to the emergence of new transverse research activities, strengthen the existing ones, to help to build the future of the QCD research area at IJCLab (LHC upgrades and FT, EIC, FAIR, new theoretical developments) and to make connection with the national GDR QCD (renewed with extended physics scope) and with local projects (Labex P2IO Gluodynamics project). The transverse group was involved in the organization of the international workshop “QCD Evolution” at IJCLab in May 2023, with more than 80 participants.

Transverse Group: Computing and Data:

The transverse group “Computing and Data” consists in promoting exchange about advanced software and machine learning techniques and organizing local workshops and seminars. In 2023 6 seminars were held on: Algorithms and Software Complexity (with IN2P3 computer science researchers), ChatGPT, CHEP Debrief, Scientific Metadata Management (with AMI team), COFUND DeMythif.AI, FPGA and RISC-V. On top of the internal communication for those seminars, the mailing list has hosted some thirty announcements about external events (seminars, workshops, training courses, schools, data challenges, hackathons, calls for projects, funding) about quantum computing, ia and data science, reproducible research, optimization, open data and software, supercomputing, software engineering, etc.

4. Collaborations@IJCLab

Recently, collaboration between IJCLab and the Aimé Cotton Laboratory (also in Paris-Saclay) has been strengthened on subjects related to ion manipulation, laser spectroscopy and, in particular, the study of the hyperfine structure of molecules. A significant synergy has emerged between the technical and

scientific needs of the two laboratories. In particular, the Aimé Cotton laboratory is involved in the HINA project at IJClab, which aims to generate, cool and store HCIs (highly charged ions) using traps, in order to study their decay. This work continues a long tradition of collaboration between the former IPN and the LAC on the spectroscopy of radioactive atoms. Scientific discussions have recently resumed between IJCLab and the LAC, in the context of very high precision measurements (one of the key themes of the INP-CNRS's future plans) which bring together interests common to nuclear physics and the physics of ultra-cold gases.

The aim here is to explore the use of the multicharged ion production technique for the study of physics beyond the Standard Model. The possibility of P, T violation in nuclear systems, in particular the Schiff moment, depends on the existence of a low-energy parity doublet in the nucleus. This has been suggested for 229Pa and would result in an amplification of the P, T effects by several orders of magnitude; however, this remains unconfirmed. A search for low-energy gamma transitions linking the two members of the doublet could be envisaged in actinides using STJ (Superconducting Tunnel Junctions) detectors at cryogenic temperatures. A highly-charged ion beam is needed to implant the nuclei at energies corresponding to 100 kV. In practical terms, this approach involves implanting ions into STJ detectors. For this implantation to be effective, it is essential to accelerate the ions. By choosing multi-charged ions rather than single-charged ions, it would be possible to obtain increased acceleration, leading to considerably improved implantation efficiency.

- **To be an important partner in the network of the largest European laboratories. To also stimulate targeted collaborations with other European laboratories and worldwide.**

We will not discuss extensively the existing and ongoing historical collaborations with most of the large research centers and laboratories in Europe, USA and Asia (mainly Japan).
Here we just summarize some important partnerships started or signed in 2023. They are summarized in Table 3.

type	Pays - organisation	partenaire	Pôle(s)
Accord technique	CERN	ISOLDE	Nucléaire
Accords circonstanciels permettant d'obtenir l'aval de la Fonctionnaire Sécurité Défense	Allemagne	TU Darmstadt	PHE
	Brésil	Université de São Paulo	Santé
	Ghana	GAEC	E&E
	Inde	SRM University	Théorie
	Israël	Bar-Ilan University	A2C
	Italie	La Sapienza	A2C
	Royaume-Uni	Liverpool University	Accélérateurs

Table 3. Some important partnerships started or signed in 2023.

An important partnership including the full laboratory has been started with a similar size laboratory, the IFJ PAN, in Krakow (Poland). It is the first bilateral collaboration of IJCLab, multi-poles. A first joint workshop took place in April 2023. Joint funding of pre-projects and PhD students is planned, and the first workshop was held from 7 to 8 December 2023. A collaboration agreement was signed between the 2 parties.

- **Find a modus operandi and a collaboration with the IRFU/CEA**

With IRFU/CEA the links and the common activities are numerous and in general IN2P3/CNRS and CEA participate together to large Research infrastructures IR* such as: HL-LHC (CERN), GANIL/SPIRAL 2 (Caen), CTA (Spain and Chile), FAIR (Germany), ESS (Sweden).
In 2023 no new important partnerships have been established with IRFU.

5. Human ressources (to updated)

5.1 Manpower: global picture and evolutions

The repartition of IJCLab staff by status is broadly summarized in Figure 6, which remains globally stable with respect to Y2021.

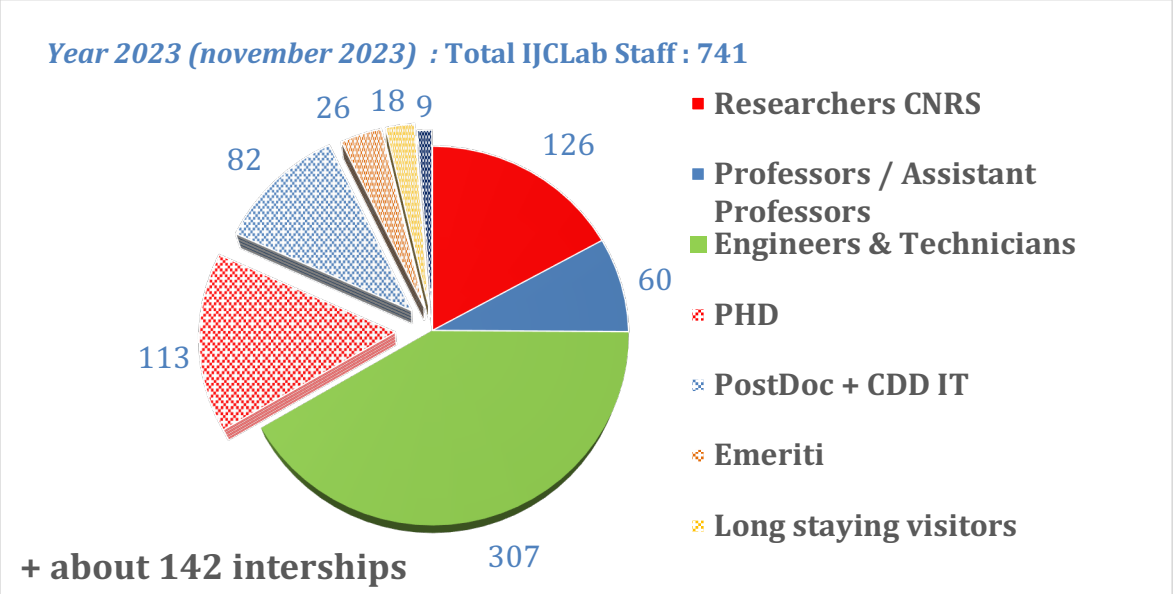


Figure 6. IJCLab staff status

The total number of people at IJCLab is of 741 with and about 142 internships.

PERMANENT STAFF: 493 permanent staff members.

The yearly evolution of technical staff (Figure 7) and researchers (Figure 8) is shown in the following figures.

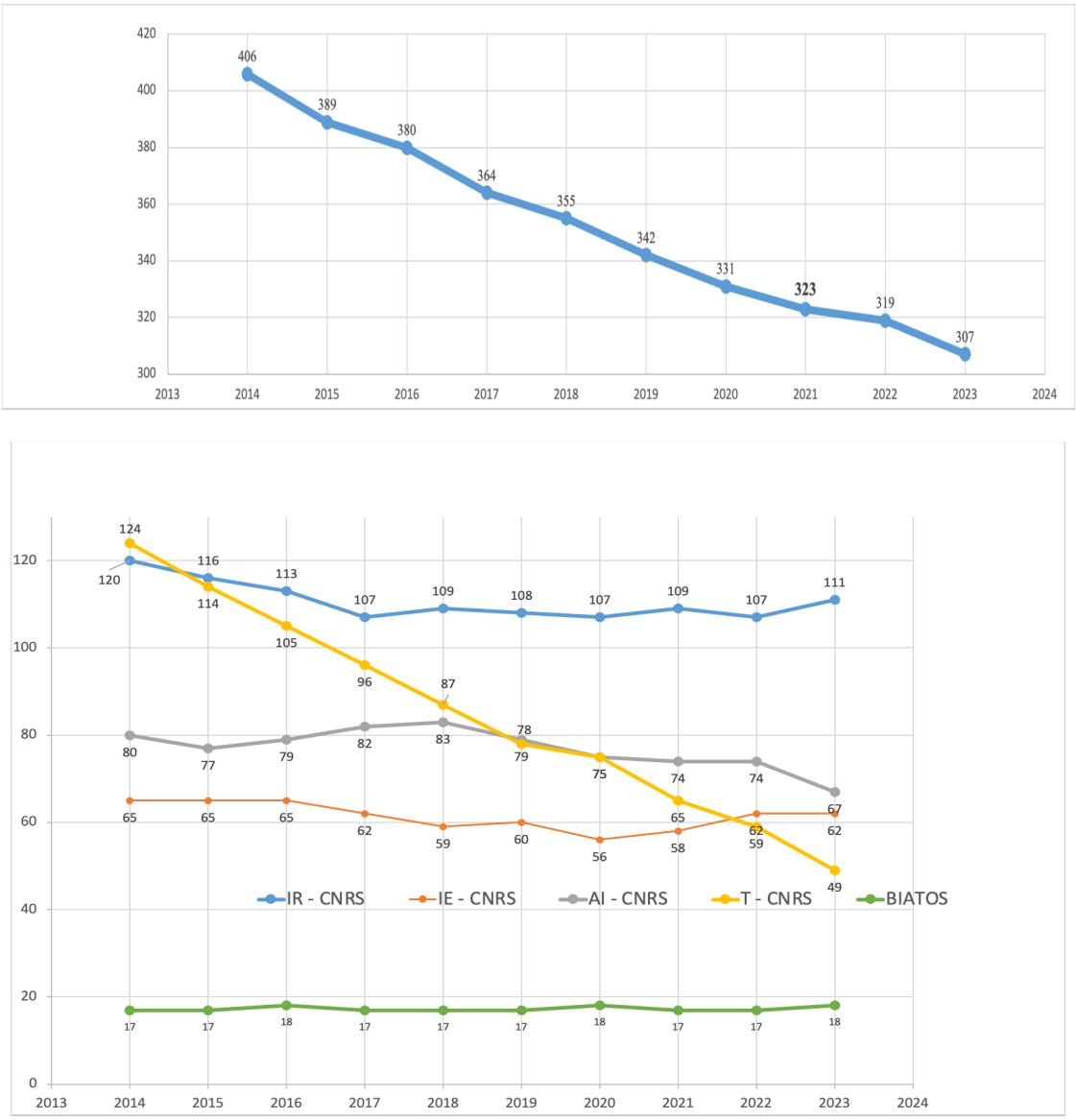


Figure 7. Yearly evolution of the technical staff. For CNRS staff : IR = Ingénieur de Recherche (Blue), IE = Ingénieur d'étude (Red), AI = Assistant Ingénieur (green), T= Technicien (violet). For University staff: BIATSS include all categories (orange). The indicated numbers are given at the end of the year indicated in the x-axis.

For the permanent technical staff and for several years before the creation of IJCLab, there was a -13 balance on average between hiring and departures. This is mainly due to retirements which are impossible to compensate with the current level of recruitment at CNRS and University (about 25 openings each year at the national level).

In Year 2021 and Year 2022, where we had fewer departures and more recruitments. Unfortunately, this tendency has not been confirmed in Year 2023. On average since the creation of IJCLab there is a loss of about 9 persons per year. Most of the lost are in the technical staff. In the last two years it is compensated hiring non permanents staff on own IJCLab resources.

Regarding future retirements, an exact year-by-year assessment is difficult to provide since it depends on many (and often highly individual) factors. To get a somewhat rough idea of the situation, we can expect about 15 retirements per year for the next five years given the demographics of the laboratory (see figure 8). The next two years will be particularly critical.

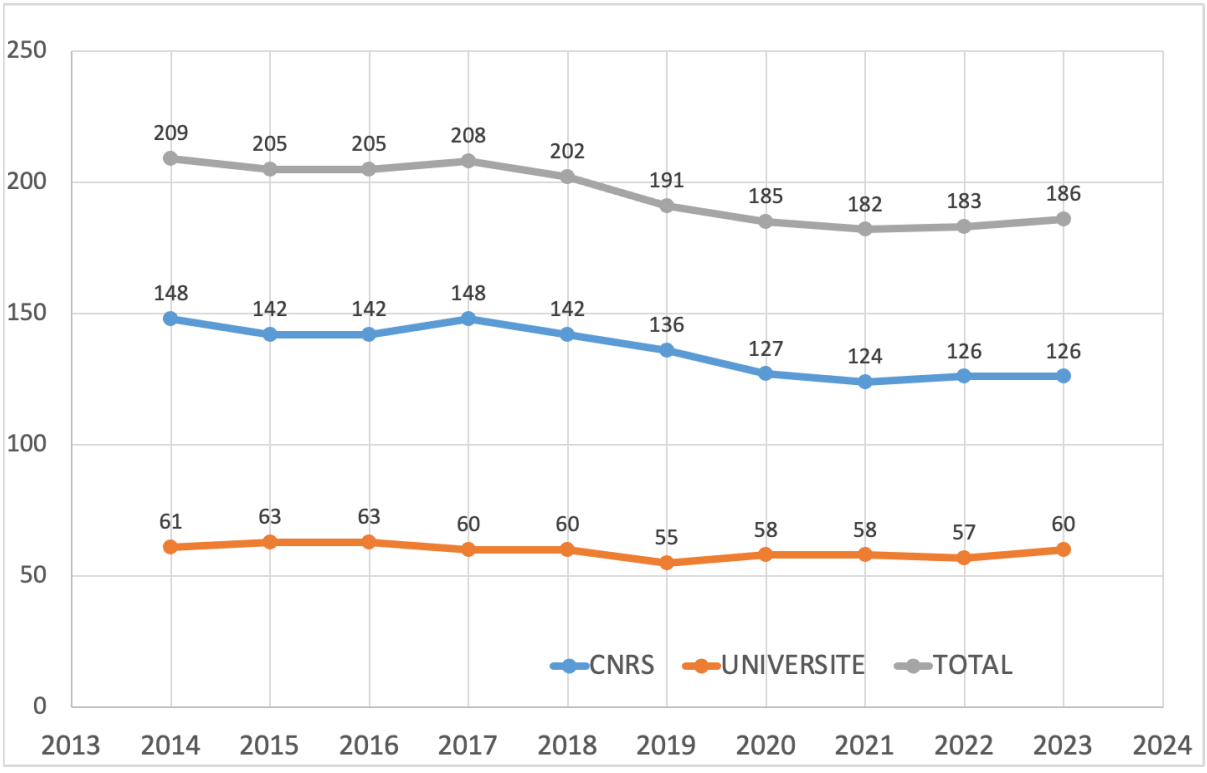


Figure 8. Yearly evolution of the research staff. In brown (blue) for CNRS researchers (University lecturers/professors), in green for the total.

As far as permanent researchers (CNRS and University) are concerned, prior to the creation of IJCLab, we had a period of stability (until 2017) in terms of HR, followed by a loss of about 6-7 researchers per year due to retirements and mobilities to other laboratories.

In the last years, since the creation of IJCLab we have again reached stability (a slight increase) thanks to a quite important number of new recruitments and incoming mobilities.

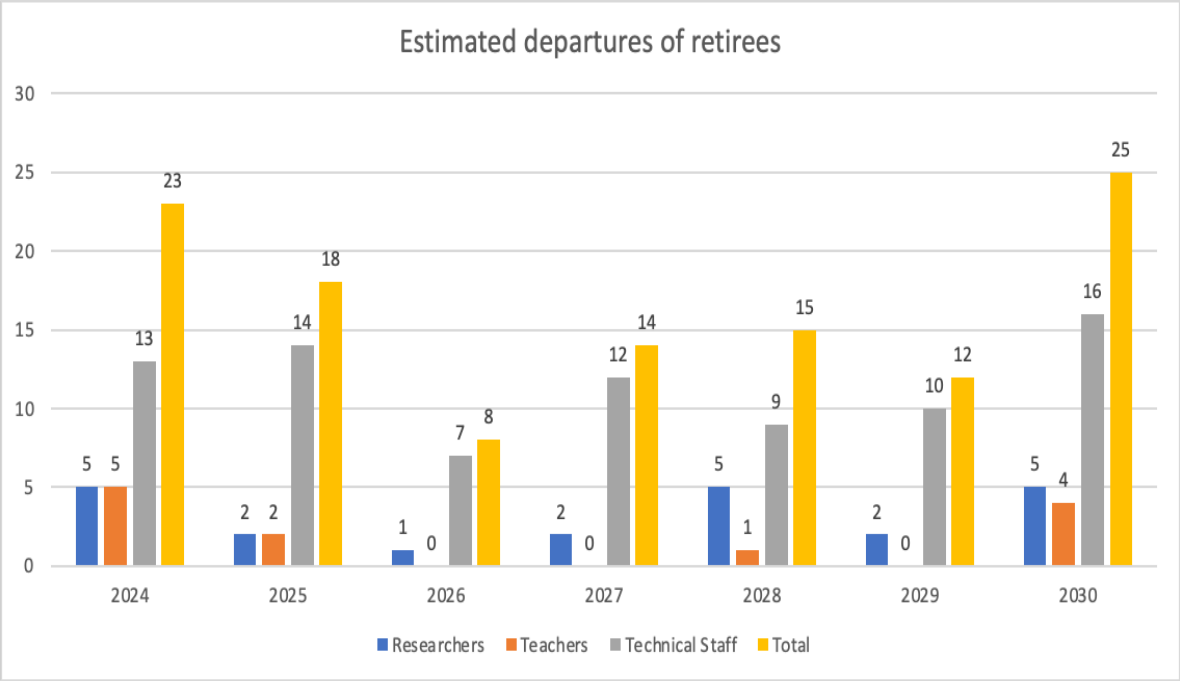


Figure 9. Number of people (researchers, teachers and technical staff) 64-year-old 67-year-old taken as a reference age for the technical staff (researchers) at the time given in abscissa.

As for researchers, once again, it is difficult to give an exact number of departures to retirement year by year. On average, we may expect about 4 retirements per year (see Figure 9).

NON-PERMANENT STAFF

The non-permanent members of the laboratory gather PhD students on three-year contracts, PostDoc (often with two-year contract), technical CDD (fixed-term contracts), emeriti, long-stay visitors and internships. PHD and internships are detailed in **Chapter** 2.

Post-Doctoral fellows, Temporary Technical staff contracts and apprentices. Figure 10 shows the number of post-Doctoral fellows; Temporary Technical staff contracts and apprentices present in the laboratory over the last 3 years given at the end of the year. For completeness, we also indicate the number of emeriti.

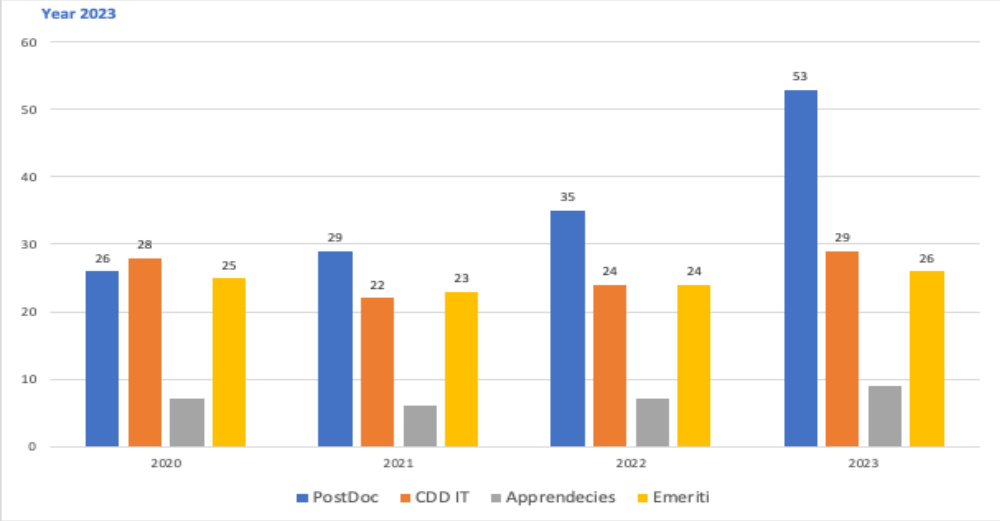


Figure 10. The number of new PostDoc, Technical CDD, Apprentices and Emeriti at IJCLab

Finally, the evolution of the IJCLab staff (permanents and non-permanents) is shown in Figure 11. As already comment this plot summarized what has been already shown before, namely a general reduction of the permanent technical staff a slight increase of the permanent researcher staffs and an increase of non-permanents position (mainly Postdoc). The non-permanents staff has increased from 28% to 33 from 2020 to 2023.

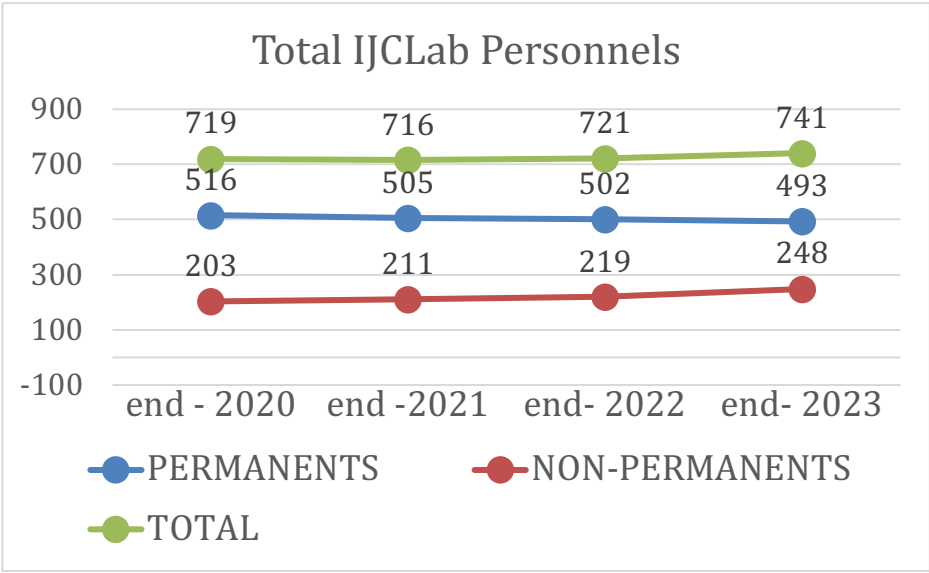


Figure 11. Evolution of the IJCLab staff

5.2 Distribution of manpower according to activities and projects

The global distribution and the evolution by semester of the FTE affected in the research activities of the different scientific departments of IJCLab is shown below in Figure 12 and Figure 13.

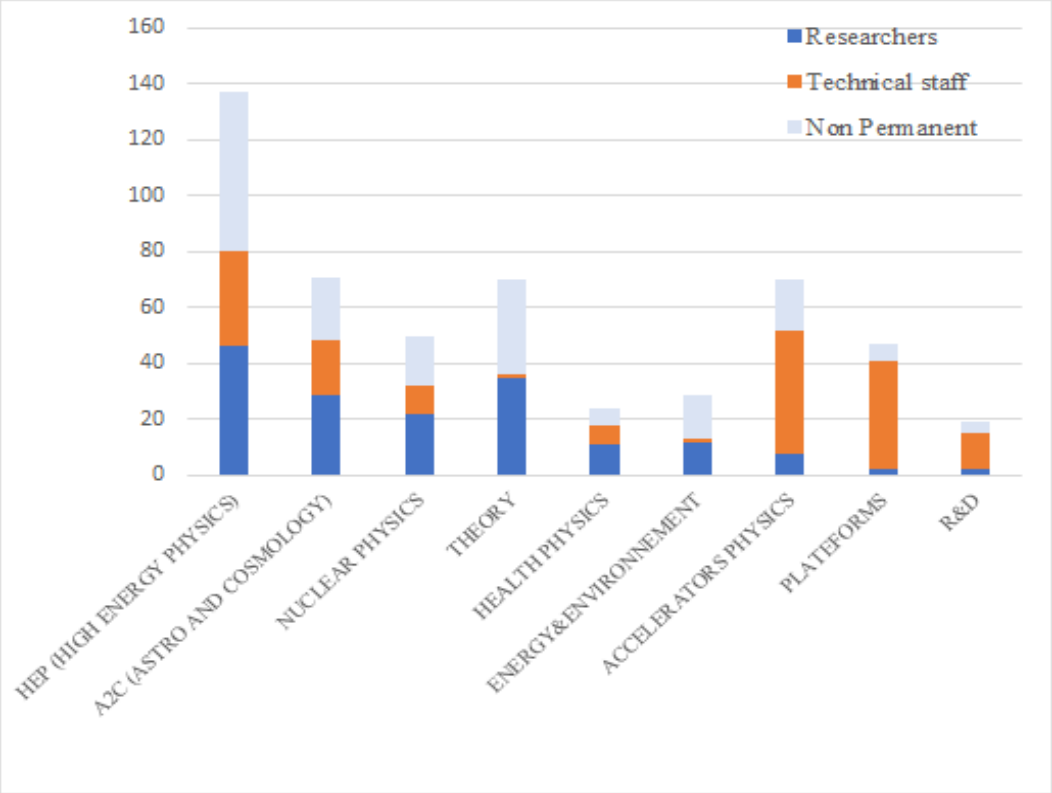


Figure 12. FTE distributions in Year 2023 over the activities in the IJCLab departments. R&D stands for transverse activities in the engineering poles which are not directly related to any project of a scientific department.

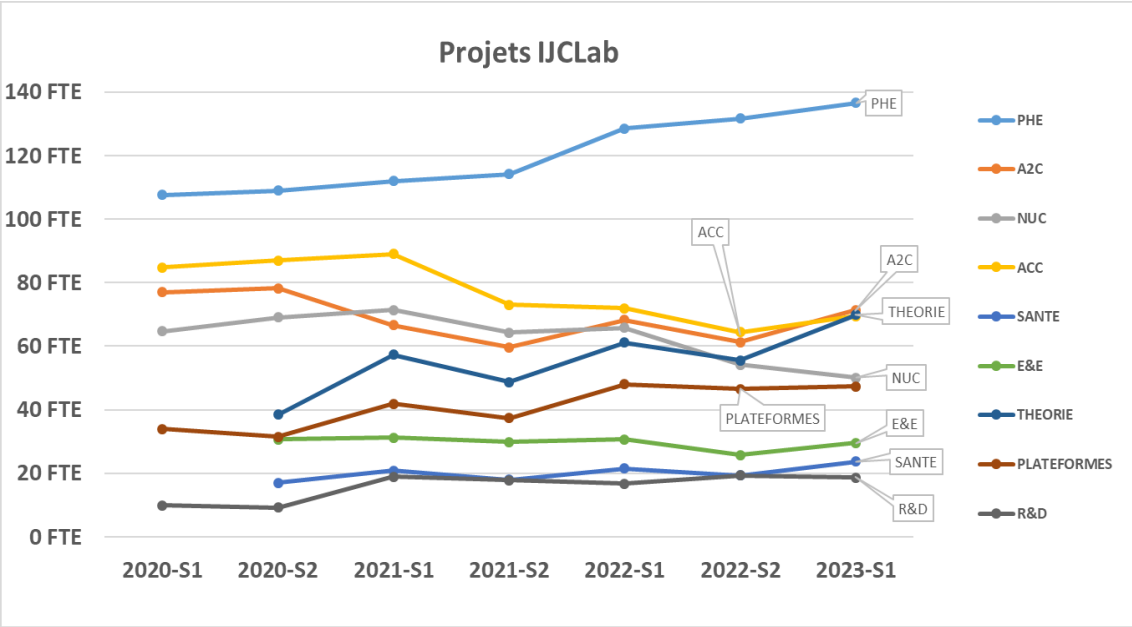
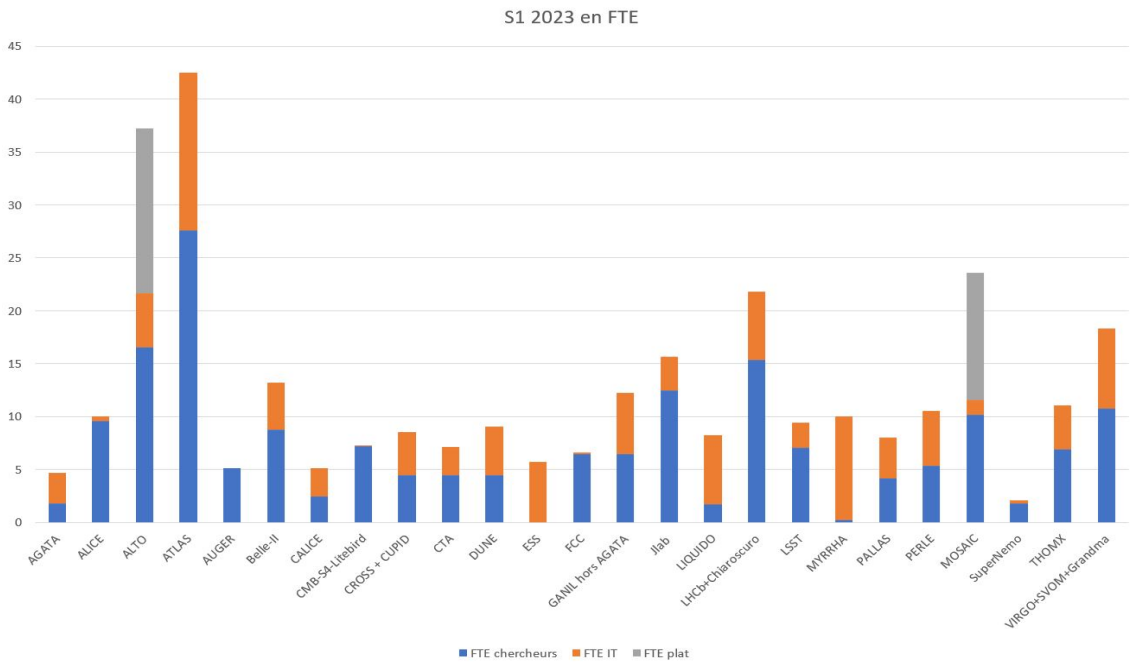


Figure 13. FTE evolution by semester over the activities in the IJCLab departments.

The Figure 14 shows the distribution of FTE for the projects with the highest need for human resources at IJCLab



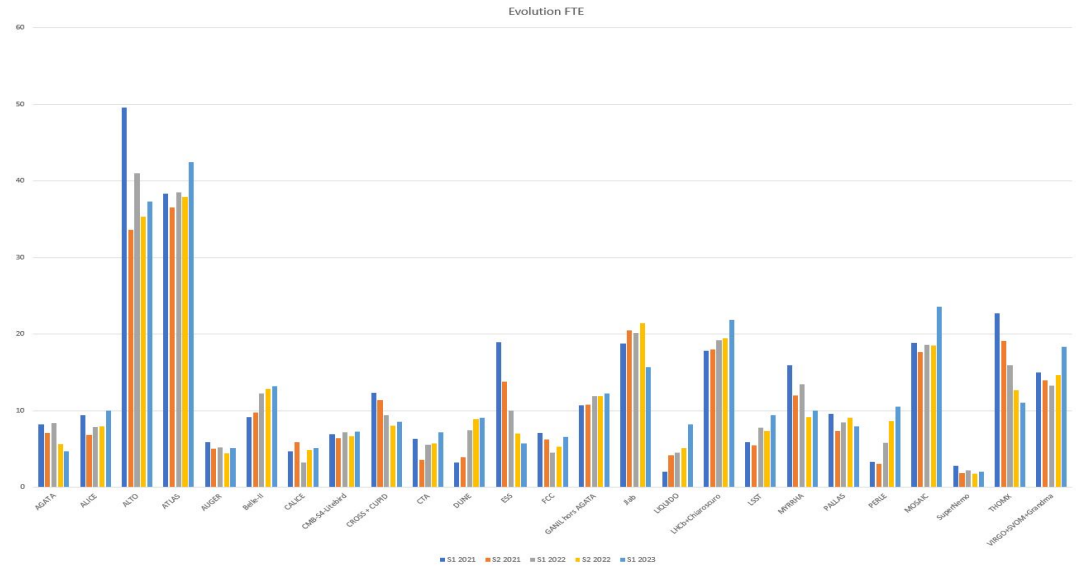


Figure 14 (top) Distribution of FTE between researchers (blue), engineers (orange) and platform staff (grey) for the projects with the highest need for human resources at IJCLab. (bottom) Distribution of the total number of FTE for 2021 and 2022.

5.3 Career of permanent technical staff

Figure 15: [updated end of December] Number of promotions as a function of the year for two types of promotion: "changements de corps" (top) and "changements de grade" (bottom)

We have performed an analysis concerning the careers of the technical staff at IJCLab. At the creation of IJCLab a major concern was that the number of promotions of technical staff could decrease. The results of the last three years are shown in the plots showing that the situation is at least similar compared to those of the earlier laboratories.

6. Budget

6.1 Global Budget

The budget is shown in Table 4 and Figure 16 and compared with the budget for previous years (without the salaries). The first part of the budget is the one attributed by IJCLab Governing Bodies ("tutelles") every year. It is dedicated to the normal functioning of the laboratory (infrastructures, equipment and missions) and for the execution of the specific research/project activities.

Budget spent [M€] *(rounded to the nearest 2 digits)*		***Y2020***	***Y2021***	***Y2022***	***Y2023***
Assigned by Governing Bodies	*Laboratory Operation*	*4.24*	*4.36*	*3.84*	*3.6*
	Specific Programs (TGIR, AP, ERM)	*3.57*	*3.78*	*3.76*	*2.89*
Contracts	*Europe*	*0.52*	*1.26*	*1.87*	*2.03*
	ANR - EQUIPEX	*0.89*	*0.53*	*1.18*	*2.93*
	Industry, BPI IDEX, PIA, CNES, DIM, SESAME, LabEx	*2.04*	*1.66*	*3.11*	*2.03*
Own Resources (overheads, services…)	*"Ressources propres banalisées" (obtained outside pre-assigned funding and contracts)*	*0.99*	*0.99*	*0.81*	*0.88*
	AGDg (Indirect costs from contracts, management fees)	*0.72*	*0.41*	*1.00*	*1.49*
TOTAL		*12.97*	*12.99*	*15.57*	*15.55*
"Frais Campus" now payed by university (~1.4M€ in 2022)				*~1.4*	*~1.4*
CPER 2015-2022		*4.16*	*4.78*	*1.88*	*2.77*

Table 4. IJCLab budget implemented in Year 2023 as compared to Years 2020-2022.

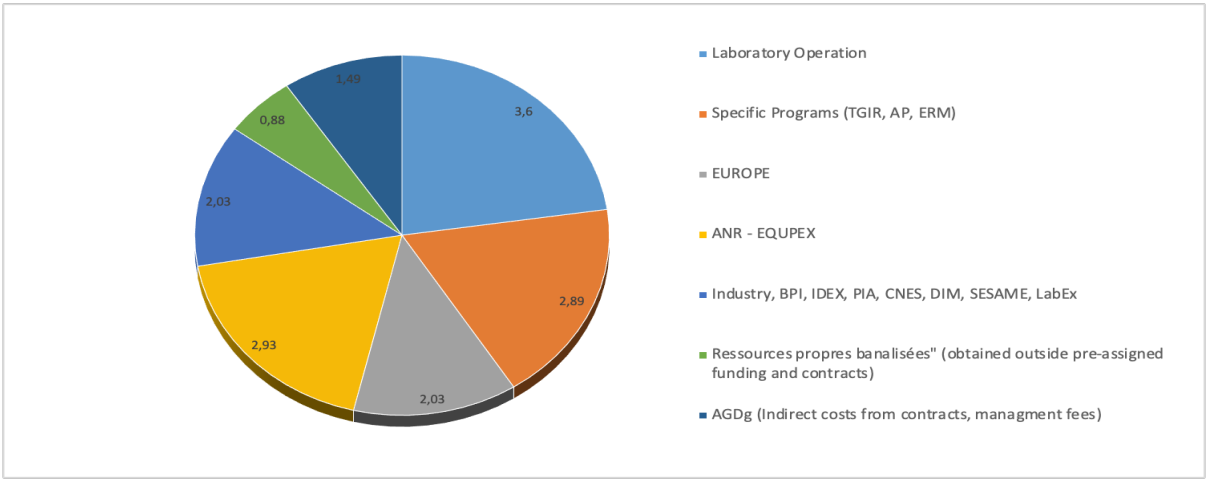


Figure 16. Budget implemented in 2022 as shown in the previous table.

This budget is complemented by funding coming from different contracts (ANR, Europe, Industry, Region...), which must be spent on pluriannual basis. The IJCLab budget is completed by what we call "own resources" ("Ressources propres"), which comes from the contract overheads and from the different services provided by the laboratory to external academic and industrial partners. This last part of the budget is mainly used for hiring personnel (technical and research, theses, internships), to impulse/help emerging projects punctually and to acquire new equipment outside of pre-assigned project funding. Finally IJCLab has received a budget from Region/State/Department "CPER 2015-2022 CD91, RIDF, ETAT)" which can be used for the renewal of the IJCLab infrastructures.

The Table 5 shows the IJCLab "masse salariale" (total payroll) for Year 2021 from CNRS and Universities for permanent and non-permanent staff.

	YEAR 2021	
	Permanent staff [M€]	Non-Permanent [M€]
CNRS	36.302	3.221
UNIVERSITÉ PARIS-SACLAY	5.074	2.547
UNIVERSITE PARIS-CITÉ	0.842	0
TOTAL	42.218	5.768

Table 5. IJCLab "masse salariale" (total payroll)

6.2 Focus on the success to different external calls

We would like to focus on the obtention of external contracts due to the success of IJCLab teams to some important calls. Table 6 presents a summary of the situation in 2022 and 2023.

Contracts	**Year 2023**	**Budget [M€] YR 2023**	**Budget [M€] YR 2022**
ANR	ATRACT, CARL, HEIRMAX, RELANSE, CALO5D, DIVE	1,48	1,83
	PEPR: ASTRO-AFMIR, A-DREAM, HQI	0,49	
BPI	No projects in 2023	-	1,27
Europe	Infrastructures: no projects in 2023, project to start in 2024	-	0,82
	Euratom: no projects in 2023	-	0,45
	MSCA: ASYMMETRY, EAJADE	0,40	0,19

Ile-de-France Region	SESAME CRYOVAP	0,38	0,36
TOTAL		**2,75**	**4,92**

Table 6. Contracts obtained in 2023. The budget is to be spent in a pluriannual basis.

As a comparison we give the budget obtained in 2022 when a large number of ANR and European projects started at IJCLab

***ANR**: ATRACT (New Avenue of Transfer Reactions with Active and Cryogenic 3 He Targets, coordination by IJCLab), CARL (Atmospheric Calibration For RUBIN-LSST, coordination by IJCLab), HEIRMAX (Development of High Entropy, Irradiation Resistant MAX Phases), RELANSE (RElativistic LAgrangians for finite Nuclei and denSE matter), CALO5D (Calorimetry in Five Dimensions, coordination by IJCLab), DIVE (Di-Higgs in VBF Events, coordination by IJCLab)*
***PEPR**: ASTRO-AFMIR (A novel instrument for infrared hyperspectral imaging at the nanoscale), A-DREAM (Accelerated Development of corrosion REsistAnt Materials), HQI (Hybrid HPC Quantum Initiative)*
***Europe MSCA**: ASYMMETRY (Essential Asymmetries of Nature), EAJADE (Europe–America–Japan Accelerator Development and Exchange programme)*
***Ile-de-France Region**: SESAME CRYOVAP (CRYOgenic-detector facility with thin-film eVAPoration technology).*

The actions regarding industrial partnerships are summarized in Table 7

Interaction with socio-economic world / impacts on economy, society and culture					
Category	**Title**	**Partners**	**Date**	**Budget [k€] / Program**	
Platforms for industrial use	**SPACE ALTO**		**01/20 -12/22 (extended to 11/23)**	**900**	**PIA Filières BPI Region**
	X-SPACE ALTO		**09/23 - 08/26**	**100+IT**	**CNRS/DGD-I**
Technology and know-how transfer	**MITA OPALIS - Multimodal Indicator for Tissue Analysis (for) Operating Autofluorescence Light for Surgery**		**12/22 -12/23 (extended to 03/24)**	**100**	**Proof of concept – SATT Paris-Saclay**

	Peroperative sensing head adapted to be coupled to an ablation tool	**Beams**	**2022**	**-**	**Licenced patent**
	Cryomodule assembly	**CNIM**	**11/03/22**	**-**	
	DOSIMOEMS – Real-time dosimeter for radiotherapy		**04/21 - 12/2 (extended to 10/23)**	**30 +5**	**DECLIC – IN2P3 vIJCLab**
	MEMSCAN – Endomicroscopy		**12/20 - 12/22**	**150**	**CNRS Innov – Pre-maturation**
	POLYIONS	**ICCMO**	**10/20 - 01/22**	**270**	**Maturation SATT Paris-Saclay**
	Compton CAM TRL8	**Theoris, Systel electronique**	**12 /20 - 04/23**	**2 800**	**ANDRA**
Start up	**BEAMS**		**Created on march 21**	**-**	
Industrial Contracts					
NDA	**Radiation effects**	**Spin-Ion Technologies**	**28/06/22 (extended to 06/25)**	**-**	
	Opto-mechanical devices	**ARDOP**	**14/06/21**	**-**	
	MYRRHA	**ACS**	**16/03/21**	**-**	
		LABOROLEC	**11/09/20**	**-**	
	Cryomodule assembly	**CNIM**	**28/03/19**	**-**	

	Optimization of DC photo injectors	**Research Instruments**	**28/06/23**	
Research collaboration	**études de sels fondus pour le développement du concept XSMR ®/XAMR ®.**	**NAAREA**	**01/23 – 12/24**	**30**
	SuperChooz Pathfinder	**EDF**	**9/22**	**-**
	In-vivo properties of fluorescent magnetosomes	**NANOBACTERIE**	**04/22 - 03/23 (extended to 03/24)**	**60 + 57**
	Medical imaging based on the use of nuclear detection technology	**Beams**	**02/22 - 02/24**	**-**
	Pyrochemical treatment	**ORANO SUPPORT**	**01/22 – 04/25**	**262**
	MAEVA2- *concrete with depleted uranium*	**ORANO Chimie-Enrichissement**	**01/22 - 02/23**	**230**
	Graphite chemistry	**ORANO CYCLE**	**10/21- 03/25**	**200**
	Modeling of interfaces for the resolution of the Boltzmann equation	**FRAMATOME**	**07/21 - 06/24**	**37**
	Development of (GHz) laser source	**AMPLITUDE SYSTEME**	**03/21 - 03/24**	**8**
	Hosting and collaboration agreement – MINERVA	**ACS**	**03/21 – 03/23**	**-**

	Optimization of the cryogenic distribution and control systems of the superconducting Linear Accelerator – MYRRHA	**ACS**	**11/20 - 10 /23**	**15**
	Deep Eutectic Solvents	**TECHNIC France**	**03/20 - 09/20**	**-**
	Study of the process of nitrocarburizing steels in salts Molten	**IREIS**	**05/19 - 05/ 22**	**50**
	Accelerator technologies and photogun R&D	**Research Instruments**	**09/23 – 08/26**	
Service contract	**Influence of nitriding treatments on the corrosion of steels…**	**HEF**	**01/21- 07/21**	**17,5**
	Electrochemical study of molten salt	**LABOROLEC**	**04 /21 –01 /22**	**185**

Table 7. Industrial contracts obtained in YR2021 and YR2022.

7. CPER: Operations for the renovation of infrastructures

IJCLab is located in the Orsay Campus of Université Paris-Saclay in buildings that belong mainly to the University (a few are CNRS property), dating back to 1960-70. Financial support was obtained in 2015 in the framework of CPER (Contract Pluriannuel État Region) for the period 2015-2021 for a total amount of 20.6M€. This project was essentially oriented towards the extension/renovation of different buildings to host scientific equipment. Most of the operations are completed by now.

The Renovation of Building 104 is achieved in October 2023 and the "Health" Department is moved in late November. We have started the renovation of a part of Bdg 100 during 2023, the "Theory" department could be moved at the middle of 2024. The list of the operations is given in the Table 8

Operation	Budget used [M€]	Budget available [M€]	End date	
IGLEX (D1-D2)	3.6		May-21	Completed
Renovation of Building 104	4.3		Sep-23	Completed
Virtual DATA (Bat 206)	2.2		Aug-20	Completed
Workshop "Vacuum & Surface" (D3-D4)	1.2		Apr-22	Completed
Mechanical Workshops (Bdg 100, 200)	2.4		Apr-22	Completed
Extension SCALP-JANNuS Platf. (Bdg108)	1.5		Apr-22	Completed
Construction of the PSI Platform (Bdg 200)	0.4		Jul-19	Completed
Renovation Bdg 100, 102, 103, 200, 208	1.6		Dec-21	Completed
Laser area in Bdg 200	1.4		Feb-21	Completed
Renovation "Theory" Bdg 100	0.37	0.13	Jun_24	
Renovation Construction Hall Bdg 106	0.5		Mar-20	Completed
TOTAL	19.47	0.13		

Table 8. Implementation of the budget for the operation of CPER 2015-2022.

We mention here that a 1.0M€ of this program was used for renovating a building for IAS laboratory

In 2021 we have obtained an additional financial support of 9.1 M€ in the framework of the next CPER 2022-2027. This financial support has been confirmed and should be available in the first half of 2024. The project is currently under review to determine the specific operations to be implemented. About 7M€ will be mainly oriented to the renovation/restructuring of different IJCLab buildings to improve their energetic performances and the quality of work; the other 2M€ will be used for the infrastructure work for the installation of the PERLE project.

8. Organizational aspects of the laboratory

At a global level, the IJCLab organization built during 2020/2021 has not significantly changed in 2023. We list in the following the most important changes made in 2023.

Following the departure of Sébastien Descotes-Genon, deputy director, the direction has created two new positions in the direction team: Laurent Pinot, is acting as a deputy for the CPER and property assets, and Catherine Zomer as Operational Manager Support for the IJCLab.

A new "Communication and Documentation" department merging the Library and IST Department and the Communication and Events Department was created under the responsibility of Sabine Starita.

The fully updated organizational chart of IJCLab is given in Appendix 1.

Several committees have also been set up to address more societal issues within the laboratory. An environmental working group led by Guillaume Blanc was created to quantify the energy impact of IJCLab activities and to try to limit this impact. Another committee has also been set up more recently.

A working group issued from the Laboratory Council entitled "Research Support" was set up to identify operational difficulties within the laboratory and make recommendations. This working group held around twenty meetings. It was composed of CL members and 2 CLHSTE representatives; Laboratory Council members: Charles-Olivier Bacri, Laurence Berthier, Amel Korichi, Sophie Hebert, Stephane Jenzer, Sylvie Teulet and Bartjan Van Tent and 2 CLHSCTE representatives: Delphine Crépin and Aurélie Gentils. IJClab Direction has received the WG's recommendations. Following these recommendations, a QVCT working group concerning quality of life at work, led by Sophie Hebert, has been launched. Very recently, a staff survey was carried out to improve the social link between all IJCLab staff. The results of this survey were presented at the IJClab staff General Meeting on May 25, 2023.

From 9 to 12 January 2023, IJCLab welcomed the CNRS Section 01 “Tourniquet”. The visiting committee's report has been sent to all IJCLab staff.

In addition, two officers for equality, diversity and inclusion have been appointed: Ketel Turzo and Benoît Blossier.

Since 2023 we organise “la journée des nouveaux entrants à IJCLab (about 80 people every year) and we are editing the “livret d’accueil”.

As introduced last year we would like to measure the rate of involvement of the engineers in the engineering division in projects that were not initially labeled as coming from their home laboratory. We define a 'mixing rate' corresponding, for each member of the engineering department, to the time spent working on projects originating from a laboratory other than their original laboratory divided by their total working time.

Figure 17 shows the distribution of this mixing rate for all members of the engineering department. Large values of the mixing rate indicate the evolution towards a more unified laboratory. It can be noticed that the number of persons with zero mixing rate decreased from 66 (in 2022) to 49 (in 2023) and those with mixing rate of 1 increased from 7 (in 2022) to 11 (in 2023). In general, the mean mixing rate increased from 0.20 (in 2022) to 0.29 (in 2023).

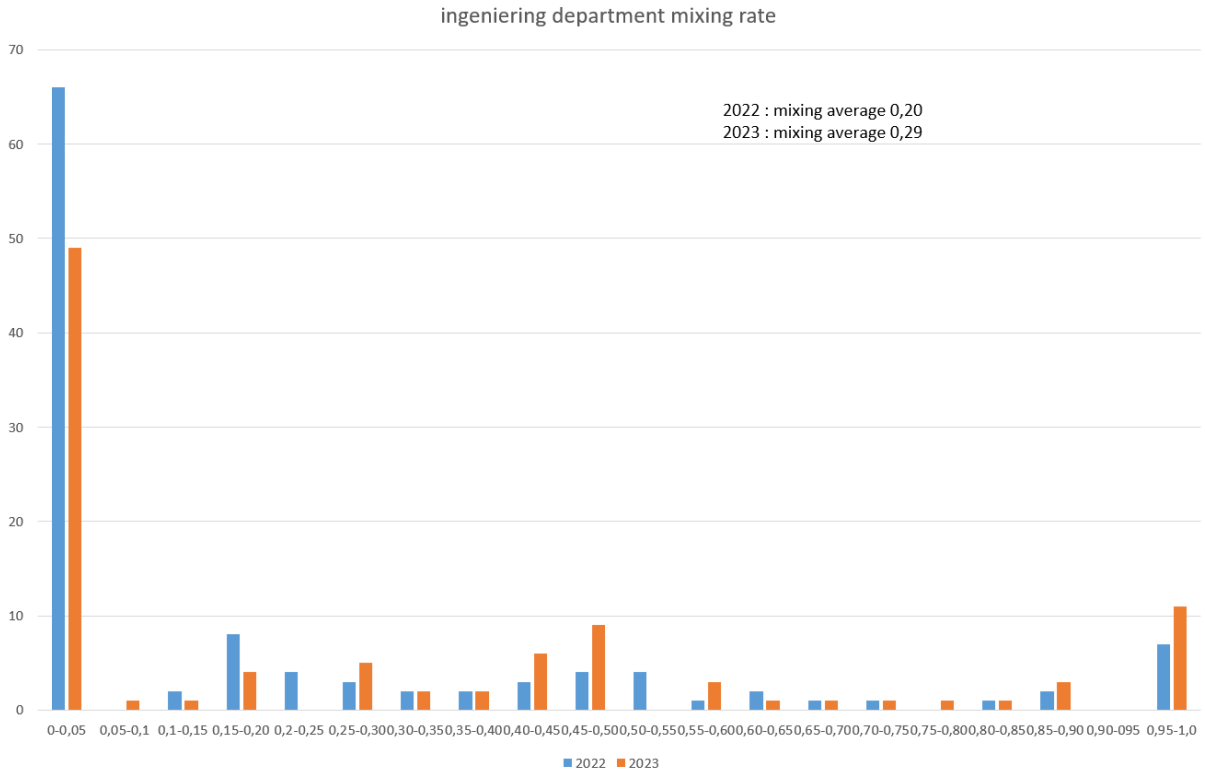


Figure 17. The 'mixing rate' or each member of the engineering division. The mixing rate is defined as the time spent working on projects originating from a laboratory other than their original laboratory divided by their total working time.

In Figure 18 we now look at mixing rate for the main IJCLab projects (indicated in Figure 14).

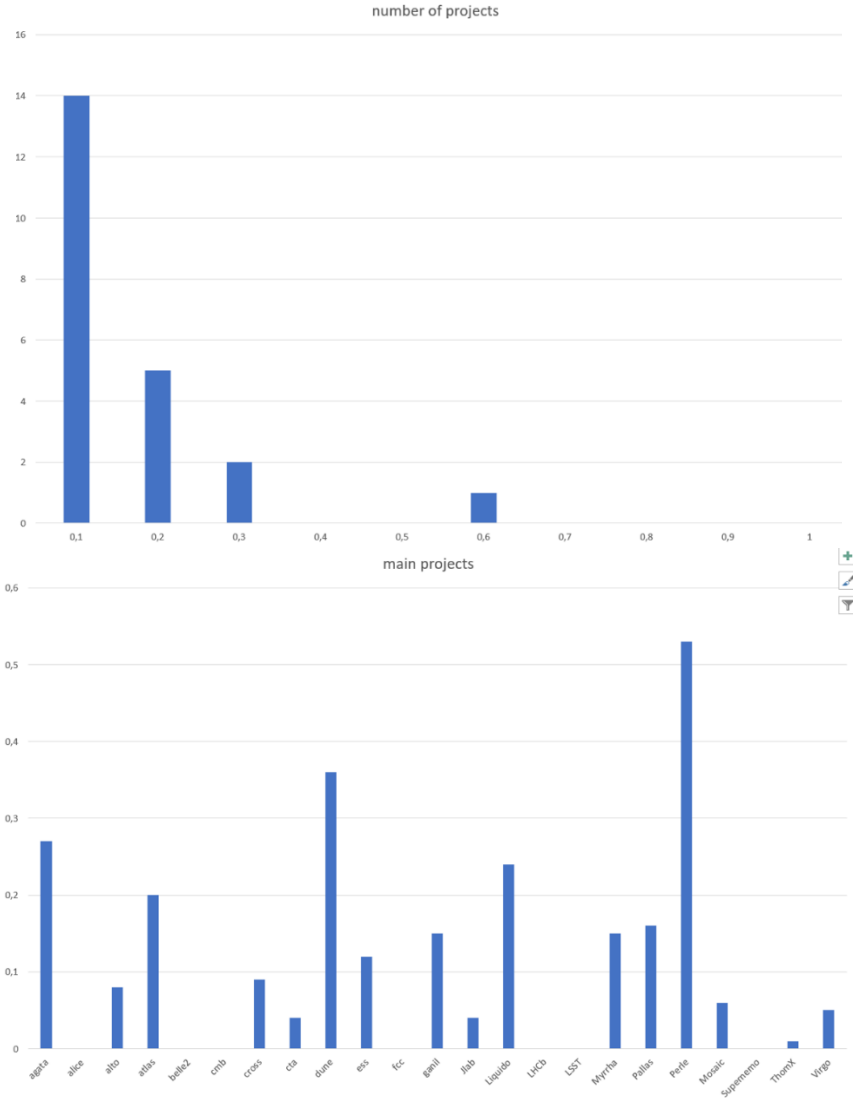


Figure 18. Mixing ratio of the main IJCLab projects (indicated in Figure 14).

9. Appendix 1 – IJCLab organisational chart – updated at February 2023

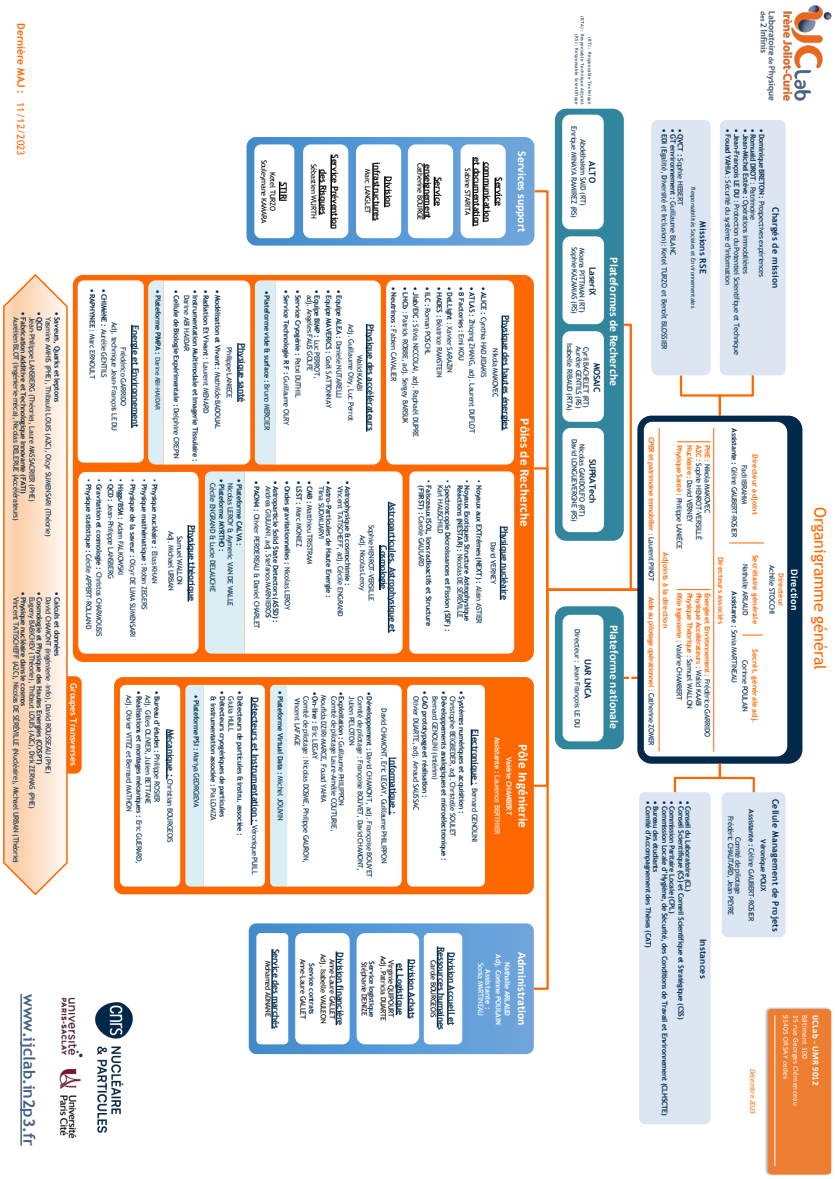


Figure 19. Organigramme of IJCLab

The Organigramme of the laboratory is shown in Figure 19.

10.Appendix 2– Subjects of IJCLab Scientific Councils (2020-2023)

Several project and activities have been examined by the Scientific Council:

- Scientific Council 19 November 2020
  - Participation to EIC (Electron Ion Collider) experiment
  - The activities in laser/plasma project PALLAS
- Scientific Council 12 Mars 2021
  - Participation to DUNE
  - GRIT and Direct Nuclear Reactions
- Scientific Council 13-14 October 2021
  - The activities on BAO-Radio
  - The project PARIS
  - The participation to MYRRHA
- Scientific Council 15-16 December 2021
  - The activities on Material under Irradiation for Energy
  - The activities on Material for Accelerators
  - R&D Bolometers and the CUPID project.
- Scientific Council 31March-1 April 2022
  - The Andromede Platform and Physics
  - The activity on Radionuclei on PRISM
  - The Super Heavy Elements
- Scientific Council 15-16 December 2022
  - The Calorimeter Upgrade of LHCb
- Scientific Council 16-17 March 2023
  - DELIGHT
  - PERLE
- Scientific Council 5-6 July 2023
  - Einstein Telescope
  - Physique des réacteurs et du cycle électronucléaire
- Scientific Council 16-17 October 2023
  - S3-LEB et physique ISOL basse énergie
  - Engineering Division @IJCLab Structure and Activities

11. Appendix 3– Subjects of IJCLab CODEC (2020-2023)

This is a body made up of members of the Management Board, heads of departments and project leaders. The CODEC examines projects - for decisions on the allocation of resources/adequacy - following the Scientific Council, to analyze major changes or the launch of new phases, the launch of new projects, etc.

More than 70 CODEC, listed below, have been organized since the beginning of 2020.

2020
24 juin : CODEC des projets PLUME et FINK
15 juil. CODEC des projets SPACE-ALTO et PALLAS
02 sept. CODEC THIDOS
17 sept. CODEC des projets FASTIME, DARWIN et CHANGE
25 sept. CODEC CUPID
30 sept. CODEC PRISM
08 oct. CODEC ThomX
14 oct. CODEC PIP-II et LiquidO
05 nov. CODEC Myrrha
18 nov. CODEC GRIT
25 nov. CODEC TULIP
09 déc. CODEC IMOP et ATLAS-HGTD

2021
27 janv. CODEC ATLAS-ITK
10 févr. Reunion Préparation COPIL IN2P3 ALTO
10 mars REVUE SCALP & ANDROMEDE
24 mars CODEC SUPRATECH
31 mars CODEC DAMIC et EIC
13 avr. CODEC NuBall & AGATA
05 mai CODEC PERLE-TDR
12 mai CODEC CAPTINNOV
19 mai CODEC ComptomCAM
16 juin CODEC THOMX
01 juil. CODEC ILE
07 sept. CODEC ALICE et LHCB
22 sept. CODEC SIXPAC
30 sept. COPIL ThomX
08 oct. CODEC ANR STIRI
10 nov. CODEC FINK
23 nov. CODEC GRANDMA
08 déc. CODEC MINERVA (PA6)
15 déc. Revue de suivi de projet CV1250

2022

26 janv. Revue JUNO
26 janv. CODEC PARIS
09 févr. CODEC PACIFICS
09 févr. CODEC SpaceALTO
16 févr. Préparation COPIL ALTO ANNULE
16 févr. Revue de préparation COPIL SupraTECH
23 févr. Préparation COPIL ANDROMEDE
07 mars Préparation ANR phase 2
07 mars Préparation COPIL JANNuS-SCALP
09 mars CODEC Liquido : Mini Gamma, TEP-Otech, AM-Otech
23 mars CODEC SQUEEZING
30 mars CODEC Revue PALLAS
30 mars CODEC TWAC
13 avr.CODEC DUNE
13 avr. Préparation Revue KDP2 PIP-II
20 avr. CODEC ANDROMEDE installation finale 201
20 avr. CODEC GRAINITA
11 mai CODEC PERLE
25 mai CODEC Fabrication Additive
25 mai CODEC Astro-Chimie
08 juin CODEC création d'une plateforme TP pour les L3 énergie
22 juin New COMET
22 juin ReX Projets : Direction / CeMaP
13 juil. CODEC INSPIRER
20 juil. CODEC - projets MOGLIH et MODERATO
14 sept. Présentation projets R&T
14 sept.Réunion de préparation KDP2 CALICE
21 sept. CODEC ThomX
30 nov. CODEC BIO-ALTO

2023

01 févr. CODEC préparation KDP2 DUNE
01 févr. CODEC LUXE
15 févr. CODEC EINSTEIN TELESCOPE
07 mars Préparation ANR phase 2
08 mars CODEC CUPID
08 mars Préparation COPIL ANDROMEDE/JANNuS-SCALP
22 mars CODEC FAIR
05 avr. Revue de Lancement production pour Atlas HGTD / ITK sur PSI
19 avr. CODEC FRIENDS3
19 avr. CODEC OPALIS - ex IMOP

10 mai CODEC TETRA/FROZEN
24 mai CODEC SPLIT-POLE
24 mai CODEC ATLAS à PSI
07 juin CODEC Dellight
14 juin CODEC BELLE2
14 juin CODEC SIXPAC
04 oct. Demandes R&T
18 oct. CODEC ThomX
18 oct. CODEC IRENA
15 nov.CODEC COMCUBE/Ballon
22 nov. CODEC PIONEER SIRIUS
22 nov. CODEC MONSTER

12. Appendix 4 – Various IJCLab awards 2020-2023

2020

- Médaille de bronze du CNRS : Nicolas Morange
- Several Prix ED Pheniics Maira DUTRA (TH/LPT) "Origins for dark matter particles : from the "WIMP miracle" to the "FIMP wonder" ; Vitalii LISOVSKYI (PHE/LAL) "Study of rare b-baryon decays and test of lepton universality at LHCb¨; Carlotta TRIGILA (PS) "Development of a portable gamma imaging system for absorbed radiation dose control in molecular radiotherapy"; Ho san Ko (pôle PHE, équipe JLab/EIC) : prix jeune chercheur/se, Laboratoire Franco-Coréen de Physique des particules, pour ses travaux de thèse en co-tutelle SNU et UPSay.

2021

- Cristal du CNRS : Véronique Puill
- Prix SFP Joliot Curie 2020 : Marcella Grasso
- Prix fondé par l'Etat de l'Académie des Sciences : Marie-Hélène Schune
- Hélène Langevin-Joliot a été élevée à la dignité de Grand'Croix dans l'ordre national du mérite.
- Several Prix ED Pheniics 2021 : Christine AGAPOPOULOU (PHE) "Recherche de la supersymétrie avec le détecteur ATLAS et développement du High Granularity Timing Detector¨; Pierre CHATAGNON (PHE) "Etude de la structure du nucléon avec CLAS12 à Jefferson Lab"; Angélique VOLLARD (A2C) "Dépasser la Limite Quantique Standard pour le détecteur d'ondes gravitationnelles Advanced Virgo

2022

- Médaille d'argent du CNRS : Vincent Tatischeff
- Cristal du CNRS : Jihane Maalmi

- Prix Jean-Louis Laclare : David Longuevergne
- Prix Académie des Sciences - Madeleine Lecoq : Suheyla Bilgen
- Sylvain David, nommé au grade de chevalier de l'Ordre des Palmes académiques.
- ATLAS Awards : Prix « Outstanding achievement awards 2022 d'ATLAS » décernés à des personnels IN2P3, dont Stefan Simion, pour ses "contributions exceptionnelles au système électronique numérique de déclenchement du calorimètre à argon liquide"
- Prix collaboration LHCb à Valeriia Zhovkovska pour le prix remis aux scientifiques en début de carrière et à Guillaume Pietrzyk pour le prix de la meilleure thèse LHCb

2023

- Prix André Lagarrigue : Daniel Fournier
- Médaille d'argent du CNRS : Araceli Lopez-Martens
- Prix Jaffé - Institut de France : Zhiqing Zhang
- Prix Mid-Career Award 2023 de la conférence Radiation Effects in Insulators (Fukuoka, Japon) décerné à Aurélie Gentils
- La start-up Beams issue d'IJCLab est lauréate du concours d'innovation i-Lab 2023 dans la catégorie « Technologies Médicales».
- Fink a reçu le prix science ouverte du logiciel libre de la recherche 2023, espoir de la catégorie « Coup de cœur » du jury, décerné par le ministère de l'Enseignement supérieur et de la Recherche

13. Appendix 5 Events and seminars at IJCLab.

A dedicated service in laboratory organizes several conferences, workshops or collaboration meetings. These events last from one day to a week. In the last three years (2021, 2022, 2023) the laboratory has organized about 20 events/year with variable number of participants as shown in Figure 20. Other events as collaborations meetings and small scientific workshops are also organized and are not yet reported in this plot.

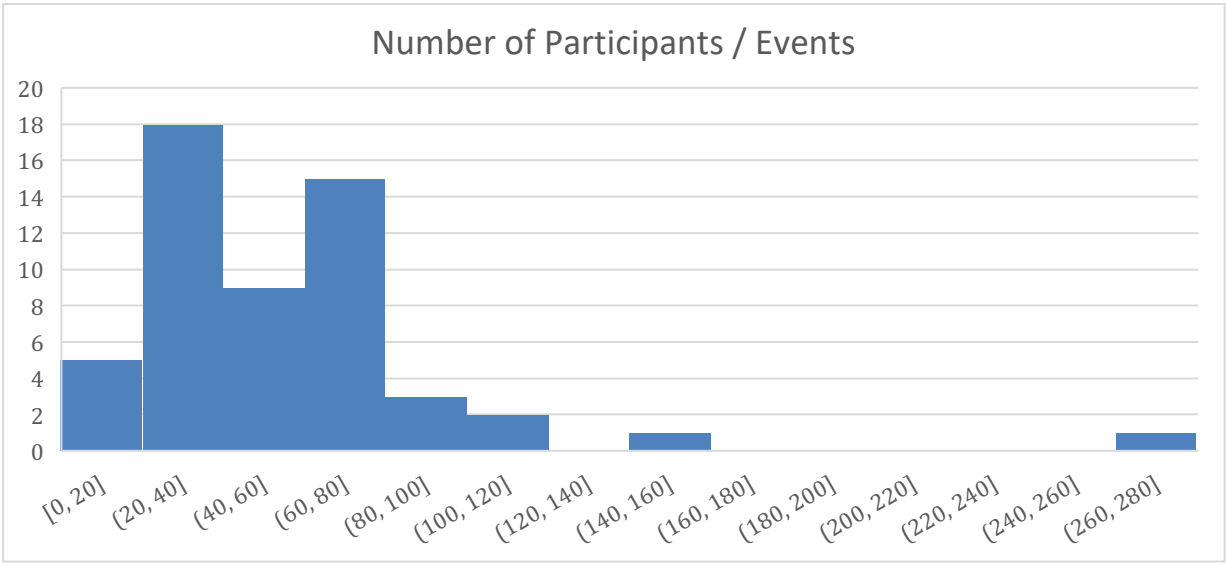


Figure 20. Number of participants to the events organized by IJCLab

In Figure 21 we report the seminars organized at IJCLab in 2023. There are different categories going from seminars in the scientific poles, between different poles, of general interest, the ERL series and the Colloquium.

We would like to underline that the European Physical Society has included the Institut de Physique Nucléaire d'Orsay (IPN) (one of the founding laboratories of IJCLab) in its list of Historic Sites. This important recognition has been celebrated with the unveiling of a commemorative plaque and a mini-conference highlighting the history of IPN and its major scientific accomplishments.

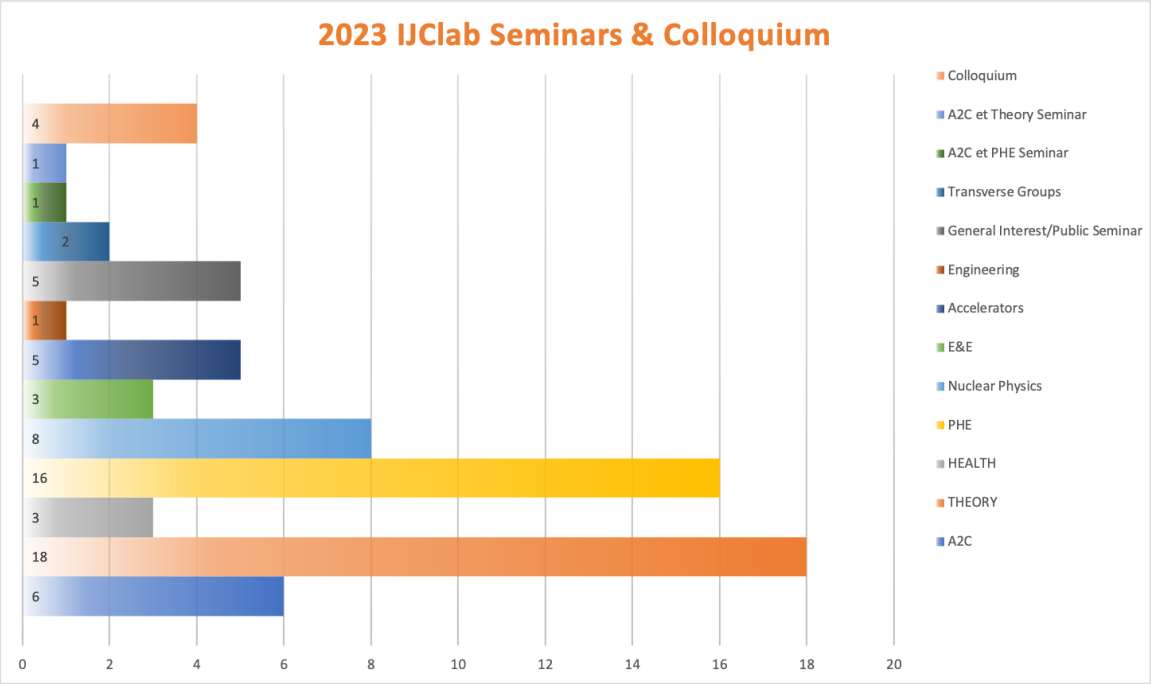


Figure 21. Number of Seminars & colloquium organized by IJCLab in 2023.

14.Appendix 6– List of Figures and Tables

14.1 List of Figures

14.2 List of Tables