IJCLab Yearly Report 2022

The Directorate

Table des matières

1. IJCLab Year 2022: introduction

The Year 2022 saw the official inauguration of the laboratory on May 16th in presence of the supervising bodies of the laboratory (CNRS, Université Paris-Saclay and Université Paris Cité) and with a large participation of the laboratory members and collaborators.

Figure 1: Inauguration of IJCLab with the two sculptures symbolizing the infinities investigated at IJCLab in the background

Two sculptures in the shape of the infinite sign, symbolizing the letter "I" of both IJCLab and Infinity, were unveiled at this occasion by Antoine Petit (CNRS CEO) and Sylvie Rétailleau (then President of Université Paris-Saclay, now French Minister for Higher Education and Resarch*)* and they will be placed in front of the two buildings at the extremes of the Orsay Campus occupied by IJCLab. The first internal celebration for IJCLab members took place on May 17th.

Figure 2: Some pictures of the first internal celebration for IJCLab members

The present document aims at providing concise information by reporting the main achievements and evolutions of Year 2022 for IJCLab.

2. IJCLab Mission and success criteria

Due to the many discussions made with the supervising bodies towards (and following) the creation of IJCLab and the recommendations of the SSC, a letter of intent was drafted by CNRS/IN2P3 to set the missions of IJCLab and to define its success criteria (in qualitative and quantitative terms). The letter containing the description of missions and objectives of IJCLab is given in Appendix 2.

In the following we take each item of the mission letter and we give a brief overview of the relevant actions, activities and results over last year. This provides a starting point for the evaluation requested by the CSS in its first recommendation from 2021: *"…The SSC will appreciate to receive a more detailed view of this ambition and the associated indicators. In particular, the SSC thinks that a high-level "vision, mission and values" statement defined by all governing bodies (CNRS, Université Paris-Saclay (UPSay) and Université de Paris (UP))) is mandatory to guide the strategic plan and to be able to assess the success of the lab."*

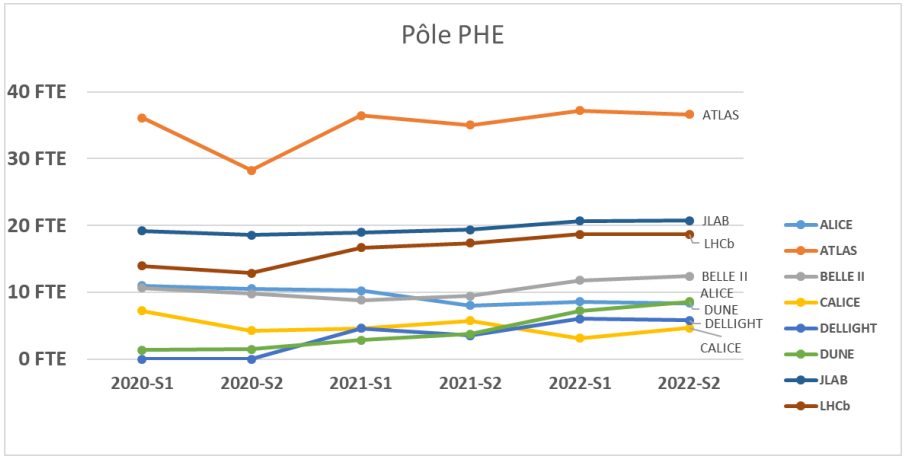
- **Leading world-class flagship projects in high-energy physics, nuclear physics, astroparticles and cosmology by contributing at all levels**
  Target: Take charge and lead new projects in these areas.

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 2 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 two years and a half. At the same time, we managed to start contributing to new emerging projects, mostly to DUNE and more modestly to Einstein Telescope.

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

	Researchers	Technical Staff	TOTAL	Non-permanent
HEP	49	30	79	51
Astrophysics & Cosmology	27	16	43	21
Nuclear Physics	23	16	39	21

Table 1. FTE involved in the high-energy physics, nuclear physics, astroparticles and cosmology activities; For PHE, notice that 62 FTE are involved in CERN-based experiments and for Nuclear Physics 14 FTE in GANIL experiments.


Pôle PHE
40 FTE
30 FTE
20 FTE
10 FTE
0 FTE
2020-S1
2020-S2
2021-S1
2021-S2
2022-S1
2022-S2
ATLAS
JLAB
LHCb
BELLE II
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DUNE
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CALICE
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ATLAS
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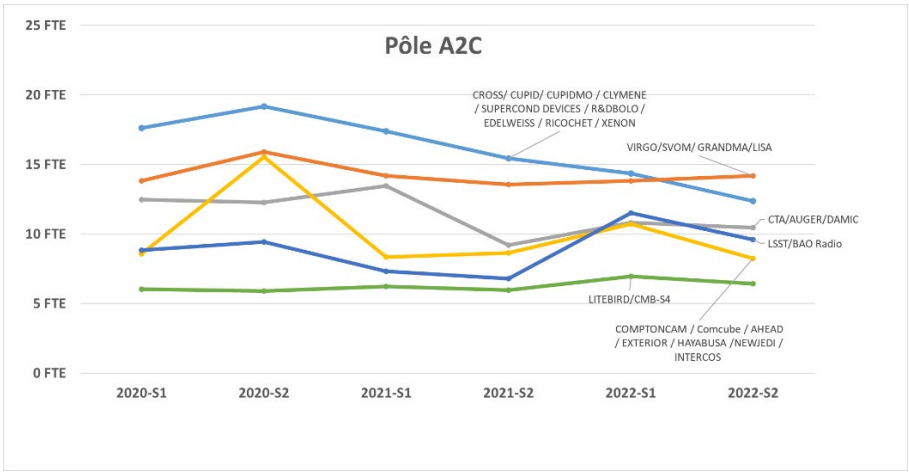

Pôle A2C
25 FTE
20 FTE
15 FTE
10 FTE
5 FTE
0 FTE
2020-S1
2020-S2
2021-S1
2021-S2
2022-S1
2022-S2
CROSS/ CUPID/ CUPIDMO / CLYMENE / SUPERCOND DEVICES / R&DBOLO / EDELWEISS / RICOCHET / XENON
VIRGO/SVOM/ GRANDMA/LISA
CTA/AUGER/DAMIC
LSST/BAO Radio
LITEBIRD/CMB-S4
COMPTONCAM / Comcube / AHEAD / EXTERIOR / HAYABUSA /NEWJEDI / INTERCOS

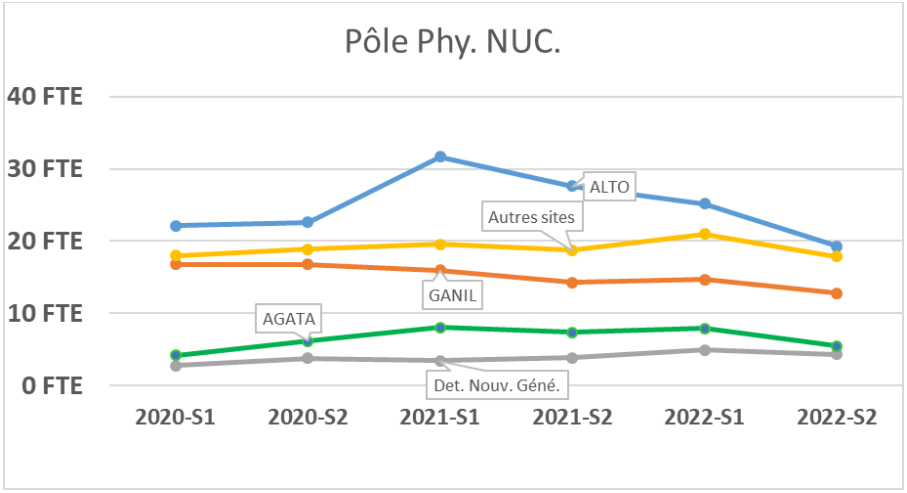

Pôle Phy. NUC.
40 FTE
30 FTE
20 FTE
10 FTE
0 FTE
2020-S1
2020-S2
2021-S1
2021-S2
2022-S1
2022-S2
ALTO
Autres sites
GANIL
AGATA
Det. Nouv. Géné.

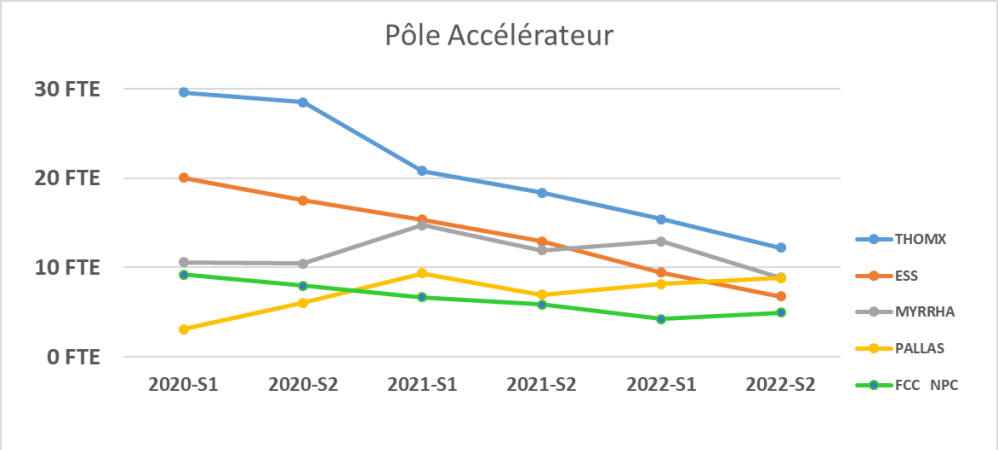
Figure 2. The Evolution of the FTE as a function of the years for PHE, Astroparticle and Nuclear Physics projects

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 remain with a rather stable (slightly increasing) number of FTE involved.
- A newcomer is the project DUNE with an increased number of people involved. IJClab has put a strong priority to hire new researchers and engineers to work on this project. Quantitatively the number of FTE increased from 1 to 9 in the last 2 and ½ years. One junior University lecturer and one junior CNRS researcher have been hired.
- There is a constant participation to the GANIL and ALTO projects and AGATA (now moving to LNL in Italy).
- We are also moving forward with a growing implication in Einstein Telescope in parallel with a continuation of the activities in VIRGO+. For the latter activity, the construction activity has diminished for the moment but we welcome 5 more researchers: 1 optical engineer, 1 junior University lecturer + 1 junior CNRS researcher and incoming movements: 1 University Professor + 1 CNRS researcher

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

Target: Take charge and lead new projects.



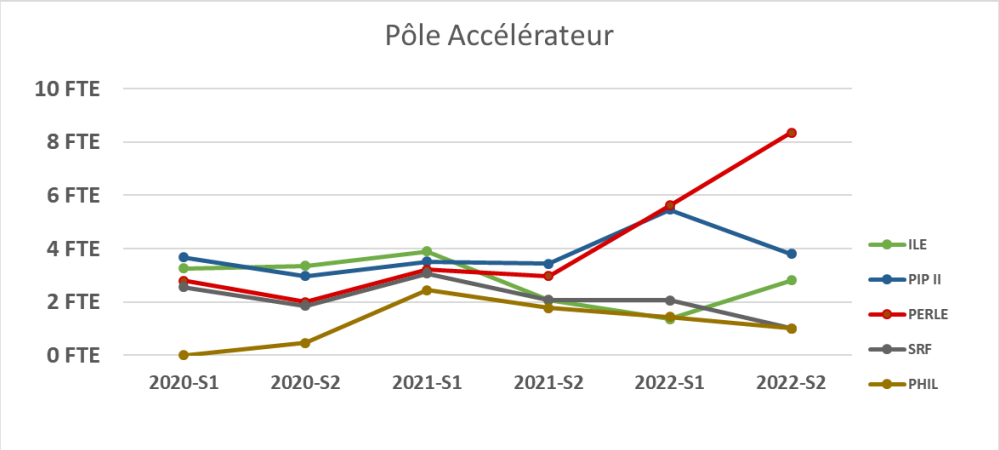


Figure 3. The Evolution of the FTE as a function of the years for Accelerator Physics projects

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

The main observations 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
- A stabilization over the last 3 years of the needed forces on PALLAS and PIP II
- After a decreasing of the activities on future colliders (ILC, KEK…) a new 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 some investment (0.3M€ for a vertical cryostat) required for the realization of present and future experiments (ESS, Myrrha, PIP II, PERLE + SRF R&D)
- We keep running the key platform for the PALLAS project. Several work extensions have been made to host the PALLAS experiment.
- We created the Platform "Vide & Surface" in a brand-new building (1,2M€ investments of infrastructure) where we collect all the equipment needed for the characterization of the material surface studies for ultravacuum.

- **To be an important partner in the network of the largest European laboratories. To also stimulate targeted collaborations with other European laboratories and worldwide.**
  Target: The indicator is the capacity to stimulate new and stronger collaborations with European partners and also with American laboratories.

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). Some important partnerships started or were signed this year: ICRADA (with JLab), MoU with Helmholtz Zentrum Berlin (HZB), collaboration agreement with the ESS-Bilbao laboratory; participation to the European INFRADEV call for Einstein Telescope. Other new collaborations and partnerships are reported in the Scientific Highlights of Chapter 3 as well as in Chapter 5 where we list the success of the various external calls.

- **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.**
  Target: Find a good balance between fundamental and technological research and openness to the outside world (academic and industrial). Definition of a more appropriate economic model, in connection with a strong and assumed policy of valorization.

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

  - The ALTO Platform starts activities related to radiobiology. Some beam time has been already requested and allocated by the ATLO PAC for radiobiological activities for the RadioGraaff equipment. A dedicated line call Bio-ALTO is under construction in connection with the Accelerator Physics and Health Physics Scientific Departments.
  - The SPACE-ALTO project is about to be finalized with a consolidated cost of about 2M€. The new lines and equipment (including for instance a new neutron Licorne-like line) will be soon operational and will offer more running time to the industrials.
  - The SIDONIE Spectrometer of the JANNuS-SCALP platform has been rejuvenated and upgraded in order to produce targets for the radionuclei project PRISM. The first targets have been produced and will be soon irradiated at the Arronax cyclotron in Nantes. The cost of the operation amounts for the moment to 140k€.
  - The JANNuS-SCALP and Andromede platforms will be merged in a unique platform to reinforce the study of materials under ion irradiations for energy and accelerator physics. New equipment are expected to be installed in the coming months: a XRD (X-ray Diffractometer) for JANNuS-SCALP and a 400KeV ion implanter from IP2I Lyon. The operation cost to ensures the reliability and sustainability of Andromede and to install the implanter reaches about 300k€ (to be shared with IP2I-Lyon). The value and the installation of the XRD (X-ray Diffractometer) equipment will amount to 500k€. A new line dedicated to astrochemistry and stellar ice irradiation is under development and will be installed in 2023 for an evaluated cost of 150k€.

- **Find a modus operandi and a collaboration with the IRFU/CEA**
  Target: Work/collaborate more on a few new large projects (accelerators or other disciplines). Participate in joint responses to calls for proposals.

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).
For the last IR* obtained (DUNE/PIP II), CEA has received the IR funding on PIP II while CNRS got the funding for the DUNE detector. IJCLab is also involved in PIP II directly financed with IN2P3 funding.
In the last two years we can also mention that the PACIFICS funding will increase joint activities with IRFU/CEA concerning accelerator physics (magnets and cavities). The request for a PEPR funding (Programmes et Equipements Prioritaires de Recherche Exploratoire) on Accelerators R&D and the demonstrator PERLE@Orsay (joint project of CNRS/IN2P3 and CEA/IRFU) has not been submitted in the end, as CEA/IRFU and CNRS/INP decided to submit a proposal energy fusion oriented.

- **To be able to position ourselves more efficiently and succeed in different calls for tenders**
  Target: Significant increase in the number of ANR, ERC and other European calls for proposals (Curie, FET-OPEN...).

Our success rate has significantly increased since the creation of IJCLab and it will impact the global budget positively for the years to come (See Chapter 6.2). In 2021 and 2022 we succeeded in several calls for a total amount of 12.9M€ and 5.4M€ of research contracts for 2021 and 2022. The large difference between 2021 and 2022 it is due to the fact that in 2022 we were not successful in any big European call as ERC or EIC.

- **The valorization of our research with a strong economic and social impact as well as the links with the industrials must change dimension.**
  Target: The number of pre-maturation or maturation projects, patents, as well as partnerships with industry, including the creation of LabCom

  The actions on valorizations are summarized in Chapter 6.2 and recalled here
  - Increase the opening of platforms to industrial partners: ~1M€ (PIA-filière BPI/Region) for ALTO, with the financial support of CNRS to hire a fixed-term staff in charge of technological transfer
  - Transfer of Knowledge for the assembly of cryogenic cryomodules to CNIM (Toulon), in the context of the production of cryomodules for Myrrha
  - 1 Startup created: Beams Gamma Camera (Health Physics) (hosted at the laboratory)
  - 6 Technological Transfer Grants from DECLIC (TRL1-2) to Maturation (TRL 8) ~3.0M€
  - 19 Contracts with industrial partners ~2M€
  - 8 CIFRE PhD funding with enterprises.

- **To have a strong link with universities and specially to play an essential and central role in teaching.**

Target: Funding of multidisciplinary initiatives, funding and renewal of platforms. Positioning in Paris-Saclay (GS, Department, Labex), impact in teaching and student hosting capacity, increase in the number of theses and internships

- Funding of multidisciplinary initiatives, funding and renewal of platforms: Several actions have been done concerning the renewal of the platforms which have a strong interdisciplinary character fostering partnerships with local academic and industrial partners: ALTO, SIDONIE in SCALP, SCALP-JANNuS and ANDROMEDE. Important investment are also done for LaseriX.
- Positioning in Paris-Saclay (GS, Department, Labex):
  - Regarding the Graduate School Physics (transverse structure created by Université Paris-Saclay to coordinate research and M-D training in physics among its various components), Sébastien Descotes-Genon is the deputy director for research and Sophie Kazamias is the deputy director for training. The Graduate School is structured along three axes, one of them is the "Physics of the two infinities", whose director is Tiina Suomijarvi.
  - Elias Khan is the president of the Physics Department of Faculté des Sciences (one of the main components of Université Paris-Saclay) and we are very active in CCUPS (committee in charge of hiring and following the careers of Paris-Saclay lecturers and professors)
    - section 29 (elementary constituents):15/18 IJCLab members, chaired by Fabian Zomer
    - section 30 (optics): 4/20 IJCLab members
    - section 33 (chemistry of materials): 4 IJCLab members / 16 members
  - Patrice Hello and David Verney are director and deputy directors of the PHENIICS Doctoral School
  - Fabien Cavalier is the co-director of the Master NPAC and Sophie Kazamias of the Master Large Instruments GI-PLATO.
  - Gaël Sattonnay is one of the co-directors of the Master Nuclear Energy.
  - Bruno Espagnon is the deputy director of the P2IO Labex, ending at the end of year 2022.
- Student hosting capacity, increase in the number of theses and internships: the number is slightly increasing with about 110 PhD student present each year at IJCLab, whereas the number of the internships is largely increased in the last two years reaching nearly 230 internships this year;

- **To continue the transformation of the urban planning of the Orsay Valley**

  Target: In-depth renovation of the buildings and their surroundings and the consequent improvement of the quality of life at work. Renovation of buildings capable of housing instruments and platforms.

The transformation of the Orsay Valley started in 2015 involving the renovation of some buildings, the extension of others, the adaptation of some infrastructures to welcome research equipment. A first financial support of 20.7M€ (CPER "Contrat Plan Etat Région") was obtained in 2015 with the support of Université Paris-Sud and it is almost fully finished (see Chapter 7). A second financial support of 9.1M€ has been recently obtained, once again with the support of Université Paris-Saclay. It will be available in 2023 for further renovation and hosting of scientific equipment.

- **To remain attractive for staff in terms of career**
  Target: The maintenance or even the more targeted and strategic reinforcement of the research and technical staff of IJCLab. The increase of the number of promotions of IT agents.

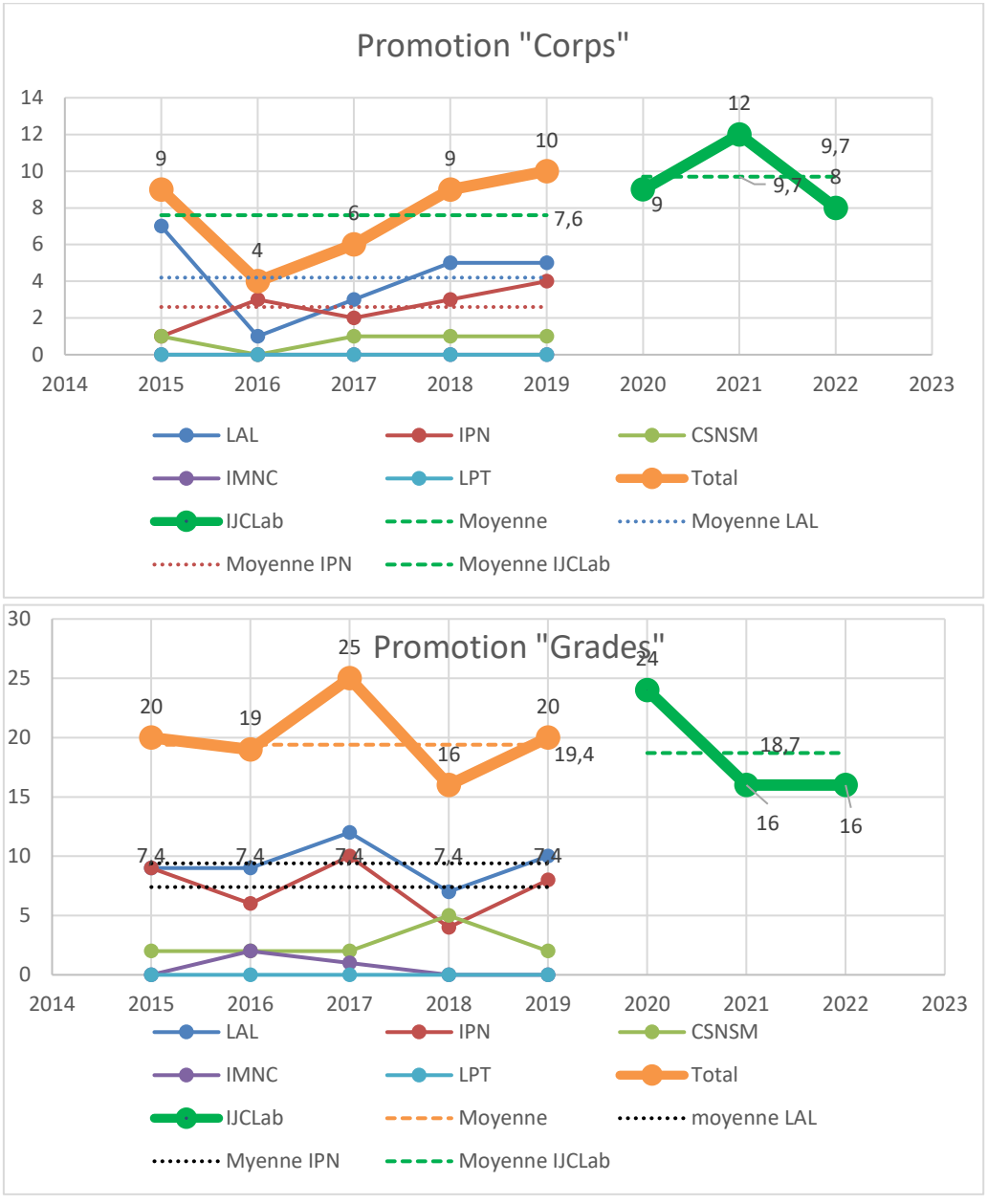


Figure 5: Number of promotions as a function of the year for two types of promotion: "changements de corps" (top) and "changements de grade" (bottom)

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 threo years are shown in the plots showing that the situation is at least similar compared those of the earlier laboratories.

3. Scientific and Technical highlights and events in 2022

3.1. Structuring activities within IJCLab and with external collaborators

With external collaborators

Two days of exchange took place between IJCLab and the Aimé Cotton Laboratory to discuss the various possible collaborations between the two laboratories. The common themes concern lasers (ALTO, Virgo, ThomX, etc.) and ion manipulation. Collaborations are being discussed following these days, mainly around laser spectroscopy activities at ALTO and SPIRAL2. The laser spectroscopy of molecules was of particular interest to the participants and joint work should be further developed in this direction.

Within IJCLab

Inside IJCLab, during 2021, six transverse groups were created with the aim of developing further scientific activities transverse to the departments: Flavors (quarks and leptons); QCD; Additive Manufacturing Innovative Technologies (FATI); Computing and Data; Cosmology and High Energy Physics (COSPT); Nuclear physics in the cosmos. As explicitly asked by SCC we give here some details of their activities by the time of this report.

- **Transverse Group: Cosmology, Particle Physics, Theory:**

This transverse group brings together researchers from the A2C, PHE and Theory departments. Two workshops were organized, one in 2021 and the other in 2022, 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.

- **Transverse Group: Flavor (quarks and leptons):**

This transverse group brings together researchers from the A2C, PHE and Theory departments. Two days were organized, one in May 2022 and the other in November 2022. These days included review presentations as well as a series of shorter presentations mainly given by PhD students and post-docs. These days brought together between 50 and 100 participants from all over France. In addition to these days, topical seminars have been regularly organized by the transverse group since Septembre 2021. A workshop on g-2 reporting experimental and theoretical news was also organized.

- **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 (7 until now). The group also co-organized with local partners a workshop on additive manufacturing applied to the physics of the two infinites in June 2021 with more than 120 participants.

- **Transverse Group: Nuclear Physics in the cosmos:**

This transverse group brings together researchers from the A2C, Nuclear Physics and Theory departments. The goals of this transverse group are to build a local community from theory to experimentalists and observers, to trigger discussions between interested people on common topics within IJCLab, to strengthen existing collaborations within IJCLab and to discuss possible links with GDRs/PNs: RESANET, GW, PNHE, ... The transverse group organized its kick-off meeting in February 2022 with 30 participants, 8 presentations.

- **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 organized 7 "café QCD" in 2021, where the publication of one of the group members is discussed, and two international conferences: HF2022 Heavy flavor from small to large systems in October 2022 and QCD@LHC2022 in November 2022. In addition to this, the transverse group organizes topical seminar and lectures by emeriti for students.

- **Transverse Group: Computing and Data:**

The transverse group "Computing and Data" is restarting slowly after the pandemic break. The goals of this transverse group consist in promoting exchange about advanced software and machine learning techniques and organizing local workshops and seminars. The organization of seminars has resumed this autumn. The topics will be: Machine Learning and Quantum Computing activities, computer science research at IN2P3, problems of precision management and its insidious impacts, Software and Computing issues for high energy physics, Origins of AI in High Energy Physics: from Orsay to Chicago – and back!

3.2. Scientific and technical highlights

NUCLEAR PHYSICS
ALTO:

- **ALTO-LEB:** The FRISAL front-end is commissioned. The first photoionized beam of the ALTO Ag element was obtained, which bodes well for the increase in the range of beams available for studies by users. The existence of two possible ionization schemes (Ag and Ga) with the possibility of switching from one to the other in a few hours, will contribute to the programming flexibility and reliability of the installation.
- **ALTO-HEB**: The NuBall2 multi-detector gamma-ray system at ALTO was built and commissioned, as part of an international collaboration with a strong support from the platform, engineering and nuclear teams involved. About ten experiments have been approved by the PAC representing 3000 hours of beam time. The Nuball campaign is currently under way and will end in the summer of 2023. In parallel, the reliability of the Split Pole spectrometer has been increased, which should enable a major campaign of nuclear astrophysics experiments to take place end 2023. In collaboration with IP2I in Lyon, a line dedicated to radiobiology experiments has been installed at the facility.

GANIL:

- **S3-LEB:** The first high-resolution laser spectroscopy with S3-LEB was performed on the Er test element.
- **NFS**: First nuclear structure experiments are performed. The pygmy dipole resonance (PDR) was seen in 140Ce. A « colossal » mirror energy difference between 36Ca and 36S was measured through transfer reactions at GANIL using MUST2 and a solid H target.

Other sites:

- **AGATA:** The detector and upgrade project became a Research Infrastructure for the French Ministry for Higher Education and Research. Launch of phase 3π for the detector. IJCLab had an active participation in the AGATA campaign at Legnaro (both from a technical and scientific point of view).
- **Isolde**: IJCLab took part in experiments at Isoltrap mainly in the 100Sn region. The results published in Nature Physics give strong indications on the mass of the 100Sn doubly magic nucleus and show that mass measurements of 99-101In challenge ab initio theory of 100Sn.
- **Andromede:** Both **New Jedi** and **Stella** campaigns were successfully completed.

HEP (High Energy Physics)

The Year 2022 has been marked by the LHC restart. The three LHC teams at IJCLab, **ALICE, ATLAS and LHCb** have successfully commissioned the detectors after modifications (sometimes important as for ALICE and LHCb) during Long Shutdown2. Collisions were recorded in the three detectors. The ALICE rejuvenation has been completed and the commissioning to run at high rate with no trigger is now in progress. **ALICE** registered the first Pb-Pb collisions on 18th November 2022. For LHCb, the ECAL & HCAL readout at 40 MHz works well and the newly installed PLUME luminometer provides the official LHCb luminosity to the LHC. Meanwhile, IJCLab teams in the three experiments continue to analyze the data from runs 1 and 2. Yasmine Amhis, from the IJCLab LHCb team, has been elected as the LHCb Physics Coordinator.

2022 marks the 10th anniversary of the Higgs discovery and Nicolas Morange from the ATLAS team of IJCLab is one of the editors of the ATLAS+CMS paper in Nature. As far the upgrade phase 2 is concerned, to be noted that for **ATLAS-ITK**, important steps have been taken: about 20 modules have been produced in the **PSI platform** in the framework of the Parisian cluster (2000 modules to be provide in total). Worthwhile to mention the significant progress in the organization and equipment of the PSI platform.

Belle-II is now successfully taking data with the new **DAQ** (based on **PCIe40**) developed by IJCLab people in synergy with LHCb. Karim Trabelsi of the IJCLab B-factories team has been elected as the new spokesperson of Belle-II.

For **ILC** related activities, the CALICE SiW ECAL with the new Slab reading system was tested on beam successfully. Roman Poschl is the spokesperson of CALICE.

R&D activities started on **EIC** both for the Electromagnetic Calorimeter and for the Roman Pots, in synergy with the electronic developments done in the **HGTD-ATLAS** project.

JLab New CLAS12 data collection started in June 2022 and will last until March 2023 and the IJCLab team is very active in the data analysis and related publications. The Spokesperson of CLAS12 is Silvia Niccolai of the IJCLab JLab/EIC team. The Neutral Particle Spectrometer (**NPS**) has been successfully commissioned in fall 2022.

The **DUNE** activities have significantly increased at IJCLab with the completion of the mechanical designs of the chimneys and anodes, an active participation to the operational start of the ColdBox at CERN and in the precise characterization of the cathode. Recently 6-meter tracks have been reconstructed in a large cryostat. For the future activities the construction of the assembly and test is now started in the mechanical workshop of building 100 of the laboratory.

On September 7 2022, a collaboration agreement was signed between EDF and the CNRS concerning the **SuperChooz** project in neutrino physics. SuperChooz detectors will use **LiquidO**, an innovative detection technique, developed at IJCLab.

At IJCLab the **DeLLight** experiment is installed at the LaseriX platform. The goal of the experiment is to measure the variation of vacuum refraction index caused by strong laser fields. The first measurement was performed in air with a low energy pump pulse for validation and calibration of the experiment, before turning to measurements in vacuum very soon.

A2C: ASTROPARTICLES, ASTROPHYSICS AND COSMOLOGY

The data analysis for the search for gravitational waves signals are continuing in **Virgo Ligo, Kagra** (LVK), IJCLab is getting more involved in **Einstein Telescope (ET)** in particular regarding the vacuum chamber. For **SVOM**, although the launch is delayed to October 2023, IJCLab delivered the final version of the MXT on-board software to CNES.

Recently eAstrogam (co-PI Vincent Tatischeff of IJCLab) has finally not been selected after the second phase of the ESA M7 call. IJCLab was in in charge of the structural mechanical modeling for **EIRSAT-1**, a 2U **CubeSat** being developed as part of the ESA “Fly Your Satellite” program. This program is an excellent way to consolidate our expertise on mechanics for space. ESA review was successfully passed on the 7th of October.

While the **Auger** group is deeply involved in the data analysis, publishing results in particular on dark matter searches and study of the dark sector coupling, the preparation for **CTA** is continuing. The IJCLab deliverables on NectarCam at IRFU have been installed and tested, in particular for single photon electron and flat-field calibrations.

For **LiteBIRD** we have largely participated in the writing of a Technical Design Report (PTEP paper), and we are involved in the CNES TDR (PTEP paper), and in the CNES Project Office for the Phase A2 feasibility study, whose review is postponed to autumn 2023. In parallel we continue the analysis of ACT data and the preparation of **Simons Observatory** whose first light is expected next year.

At **LSST** the analyses of atmospheric spectra measured by the holographic disperser installed on the LSST auxiliary telescope are ongoing. Meanwhile, more and more scientific papers are published, based on the FINK broker, in particular with the current analysis of ZTF alert data, the commissioning of LSST, and the observational campaigns with the GRANDMA telescope network since 2021, and preparing for the forthcoming O4 run of LVK in 2023.

For the double-beta decay project **CUPID**, in the year 2022 an intense R&D activity has taken place in particular by improving a Li_2MoO_4 crystal growth technology (together with a startup in Grenoble) and by developing the scintillating bolometers further.

IJCLab has actively participated in the analysis of the first carbonaceous samples of the Ryugu asteroid (**Hayabusa2** project) getting new and interesting information about its history.

ACCELERATOR PHYSICS

For the **MYRRHA** project, the first proto RF couplers have been conditioned at nominal RF power, passing the cryogenic test of the prototype cryomodule. An important technological milestone was achieved with the production by RI-Germany of the first superconducting cavity designed by IJCLab.

The contribution to **ESS** is about to be completed. Regarding the serial delivery of 13 Spoke Cryomodules, 11 have been assembled and 9 validated and delivered to Lund. The spoke cryodistribution under the responsibility of IJCLab has been installed in the tunnel. The pressure test of auxiliary lines has been performed and validated. The cooldown of the whole cryo distribution lines started as planned beginning of December and we registered a 4K stable operation during a few days.

One can also notice the progress of our contribution to **PIP-2**. The first prototype cavity, based on a common design with FermiLab, has been delivered to IJCLab by Zanon and after further tests, its operation is very satisfactory. The project made also significant progress on the designs and prototyping of tuners and of power couplers.

Concerning the **ThomX** project, the first beam in the linac was obtained in October 2021 and the commissioning of the Linac is being finalized. The objectives of 50 MeV, 10 Hz, 100pC have been reached. In September 2022, following the authorization of the ASN, we were also able to inject the first beam into the storage ring. In December we were able to store the beam in the storage ring for about 200 000 turns and to extract it to the beam dump. The commissioning of the storage ring is in progress.

Promising **R&D** is underway with **Ganil on plasma conditioning of superconducting cavities**. Tests on a Spiral2 cavity installed on the bench of the new "Vide & Surfaces" platform are in progress.

For the **PERLE** project, the activity on the TDR and the preparation for construction is speeding up. Several collaboration agreements have been signed with international partners. The installation of the DC Gun has started in the Iglex-IJCLab and the first part of the injection line should be ready by the end of 2023.

For the plasma laser acceleration project, **PALLAS**, the experiment continues to be set up. In particular, the first structured plasma produced in the new targets tested on the dedicated test bench at LASERIX should be highlighted.

The year 2022 corresponds to the actual start of the Equipex+ PACIFICS (until 2027). With 2.7 M€ of equipment for IJCLab, it will allow to fund part of the PALLAS project and R&D on materials for accelerators.

ENERGY AND ENVIRONMENT

Two of IJCLab platforms (**JANNuS-SCALP and Andromède**) which are part of the French **EMIR&A** federation will be joined in a single platform, grouping top-level equipment dedicated to the modification and characterization of materials under ion irradiation for the laboratory but also for external academic and industrial users. New equipment will be also installed to ramp up the quality of the newly formed platform, in particular the new in-situ XRD coupled to an irradiation beam line, obtained through a recent SESAME call (Région Ile-de-France) as well as an 400 KV ion implanter transferred from IP2I Lyon. The joint platform will be fully operational in 2024. Following recent experiments at the JANNuS-SCALP platform, important results for nuclear applications (fusion and fission) have been obtained in the synthesis of the Oxide Dispersion-Strengthened (ODS) Steels by ion implantation.

Regarding **radiochemistry activities** the electronic structure of Pa (protactinium) was measured for the first time by RIXS and high resolution XANES at the SOLEIL facility (on the MARS radioactive beam line) leading to a better understanding of the chemical bonding of actinides relevant for the nuclear fuel cycle and the reprocessing of spent nuclear fuel. The documents needed to set up a "Laboratoire Conventionné de recherche en Radiochimie fondamentale" between CEA-DAM, CEA-DES and IJCLab is in the validation process. It constitutes a recognition of the unique facilities and skills available at IJCLab in this field (building 107, actinide chemistry).

HEALTH PHYSICS

The significant upgrades performed for the **SIDONIE** ion separator of the SCALP platform are still under progress but have already led to first results for the **PRISM** project of radio nuclei production for health physics. A first experiment to be performed at the ARRONAX facility in Nantes will consist in assessing how the impurities still present in the produced target disturb the physics program to be realized.

Concerning **IMOP,** a pilot clinical study (GHU Paris Psychiatry and Neurosciences.) was performed with "OptiPen", an optical instrument developed on the basis of a bimodal spectroscopy probe, based on several fresh samples from more than sixty patients. The processing and analysis of the data from this clinical study will be financed by SATT Paris-Saclay.

Within THIDOS (Internal Dosimetry project), the first clinical prototype (wide field) dedicated to vectorized therapy (thyroid treatment monitoring) has been finalised.

Regarding simulation and theory, models are designed in collaboration with the Sainte-Anne Hospital on predicting the evolution of low-grade gliomas after radiotherapy to determine when the tumor will stop responding to radiotherapy and start growing again of great importance, aiming to improve the quality of life of patients and to prepare the treatment plan.

THEORY

Mathematical Physics: methods inspired by tensor techniques in quantum gravity have been applied to algorithmic problems, with applications relevant to data analysis and to artificial intelligence, in close collaboration with the CEA-LIST (creation of TensorLab).

Cosmology and Gravitation: work is going on gravitational waves and modified gravity with a possible explanation for the existence of compact objects (2-5 solar masses) as observed by Virgo-Ligo. A cosmological scenario with domain walls, of interest from the point of view of both gravitational wave observations and dark matter production, has been proposed, evading the well-known cosmological domain-wall problem.

Physics Beyond the Standard Model: The gravitational production of radiation, dark matter and leptogenesis at the very first moments of reheating (end of inflation) has been investigated. The sensitivity of certain nuclear beta-decay observables on new physics beyond the standard model has been studied, with promising phenomenological perspectives.

Flavor Physics: Low-energy observables for semi-leptonic decays of heavy baryons, in particular of Λ_b and Λ_c baryons, have been studied. The distribution tails of the collision cross section at the LHC for the mono and dilepton production processes, shows promising features as alternative high-energy probes of flavour physics, generally investigated at lower energies. A new Mathematica package, called HighPT, has been developed and is available for theorists and experimentalists.

Nuclear Physics: In the ab-initio few-body physics, cross-sections were computed for the alpha-deuteron fusion reaction at very low energies, which are relevant for the ^{6}Li big-bang nucleosynthesis. A new method was proposed to separate the contributions of neutrons and protons to excitations of neutron-rich exotic nuclei. Promising results were obtained in the study of neutron-star matter in the framework of renormalization-group based low-momentum interactions.

QCD: The activity on parton distributions has been pursued, in particular towards the extraction of Generalized Parton Distributions. In the field of gluonic saturation, the first computation in the QCD-shockwave approach for the production of two hadrons though partonic fragmentation has been performed at next-to-leading order.

Statistical Physics: The model based on the mean-field game theory (collaboration with LPTMS) has reproduced experimental results (density and velocity fields) of a crowd of pedestrians deformed due to the passage through a cylinder.

RESEARCH and TECHNOLOGY

We are strongly involved in many R&T programs often with other IN2P3 laboratories:

- **CHANGE** (PI IJClab): new wire chambers with studies on alternative wire options
- **EMCAL EIC** (PI IJClab): readout of EIC Ecal PbWO4 crystals with SiPM and dedicated electronics
- **PCIe400** (PI CPPM): next generation of the successful PCie40 boards
- **TIMED** (PI IJClab): use of White Rabbit Protocol for time synchronization in µTCA crates, with additional involvement in the **REFIMEV ANR** on this subject with the SYRTE laboratory in Paris.
- **LHCb CALO2** (PI IJClab): Readout electronics for Time measurement with high precision in ECAL

4. Human ressources

4.1. Manpower: global picture and evolutions

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

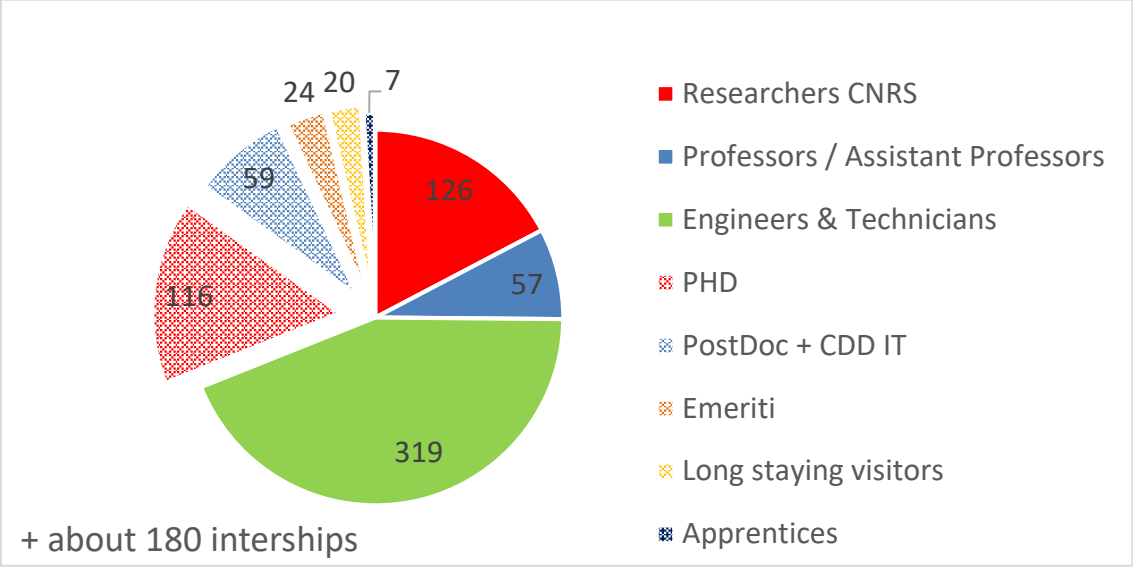


Figure 5. IJCLab staff status

The total number of people at IJCLab is of 721 with and about 200 internships.

PERMANENT STAFF: 502 permanent staff members

The yearly evolution of technical staff (Figure 6) and researchers (figure 7) is shown in the following figures.

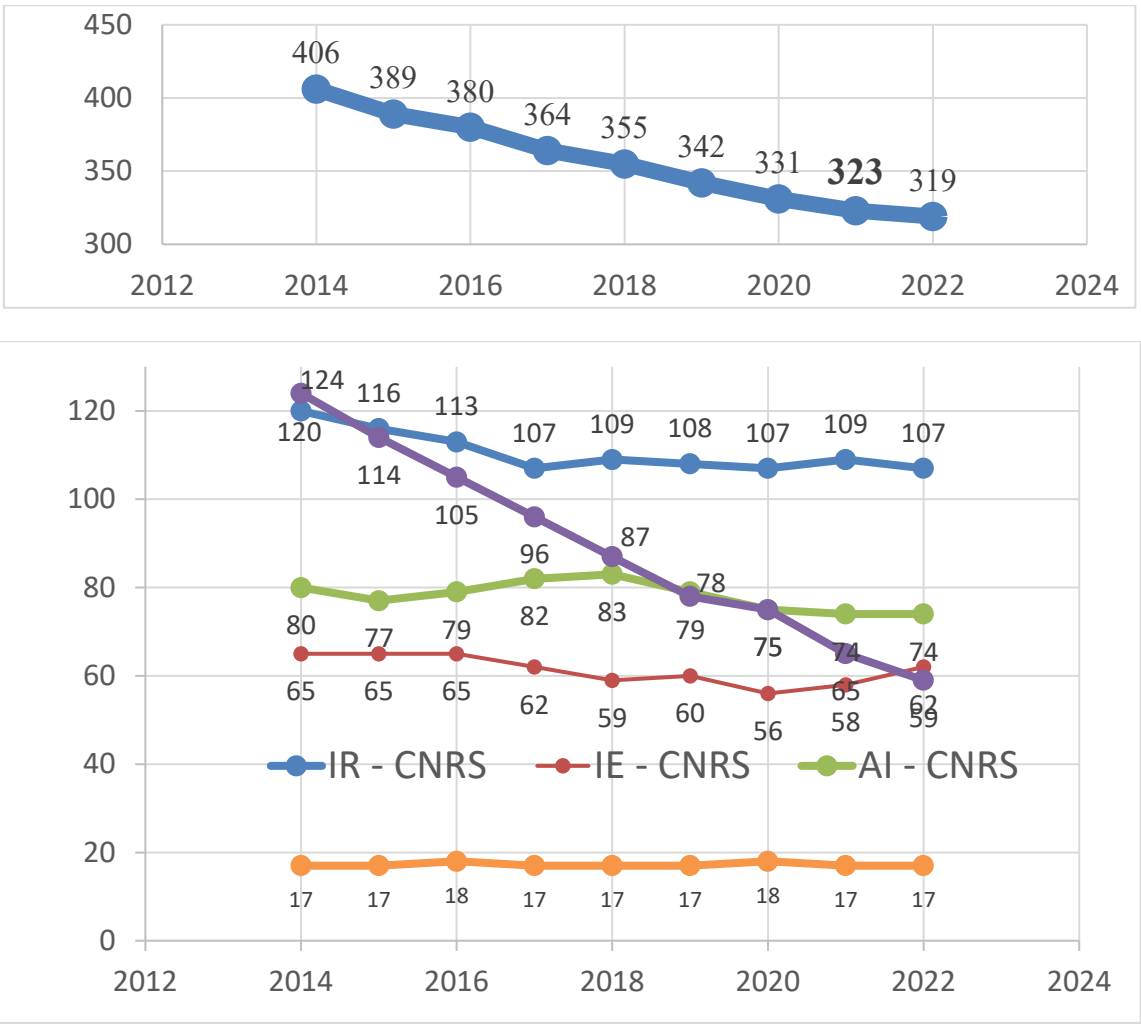


Figure 6. Yearly evolution of the technical staff. For CNRS staff : IR = Ingénieur de Recherche (Blue), IE = Ingénieur d'étude (Red), AI = Assistant Ingénieur (green), T= Technicien (violet). For University staff: BIATSS include all categories (orange). The indicated number are given at the end of the 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). This diminution is essentially driven by the decrease in the number of the T (technician) staff due to the lack of hiring on one side and the promotions to higher categories on the other side.

Together with our supervising bodies, since the creation of IJCLab we have been putting a lot of effort in trying to inverse this tendency. The outcome can be seen already in Year 2021 and Year 2022, where we had fewer departures and more recruitments. In total since the creation in 2020, 39 technical staff have been hired/joined IJCLab.

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)

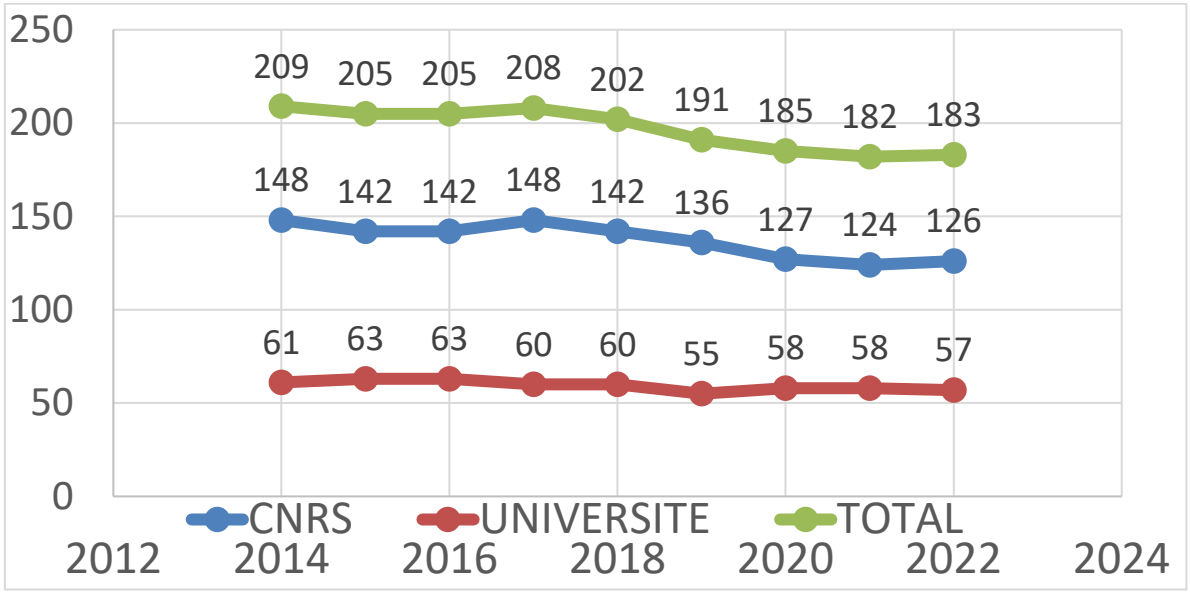


Figure 7. Yearly evolution of the research staff. In brown (blue) for CNRS researchers (University lecturers/professors), in green for the total.

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. The Year 2020 was quite particular in terms of movements due to the creation of the laboratory with a net balance of -6. In the last two Year (2021, 2022) we reached again a stability thanks to a quite important number of new recruitments and incoming mobilities. In total since the creation of IJCLab in 2020, 20 researcher staff members have been hired.

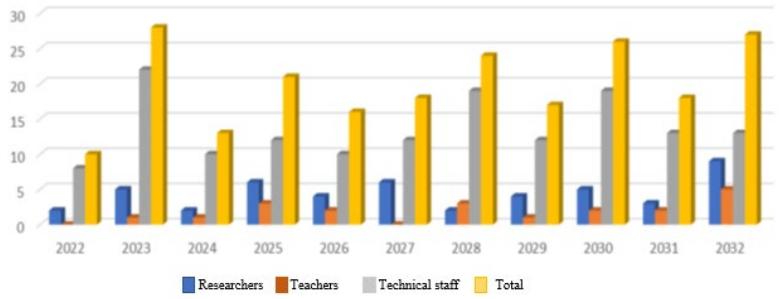


Figure 8 Number of people (researchers, teachers and technical staff) 62-year-old (taken as a reference age for the retirement) at the time given in abscissa

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 8)

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 Students. The figure 9 shows the number of PhD students (having 22 nationalities) present at the end of Year 2022 in the different IJCLab departments. Due the Covid crisis some students are now registered in their 4th (or even 5th in one case) years. In Figure 10 we show the number of new PhD entering IJCLab and PhD defenses over the years.

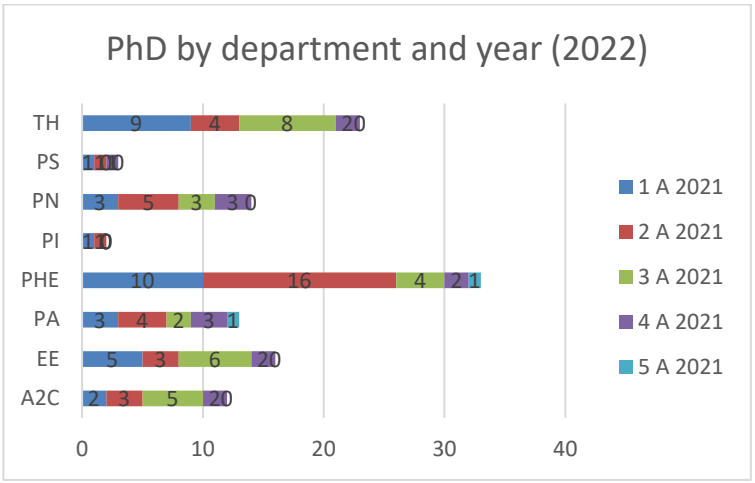


Figure 9. Number of PhD students according to their current year of PhD and main research department of activity: TH Theory, PS: Health Physics, PN: Nuclear Physics, PI: Engineering, PHE: High-Energy

Physics, PA: Accelerators, EE: Energy and Environment, A2C: Astroparticles, astrophysics and cosmology

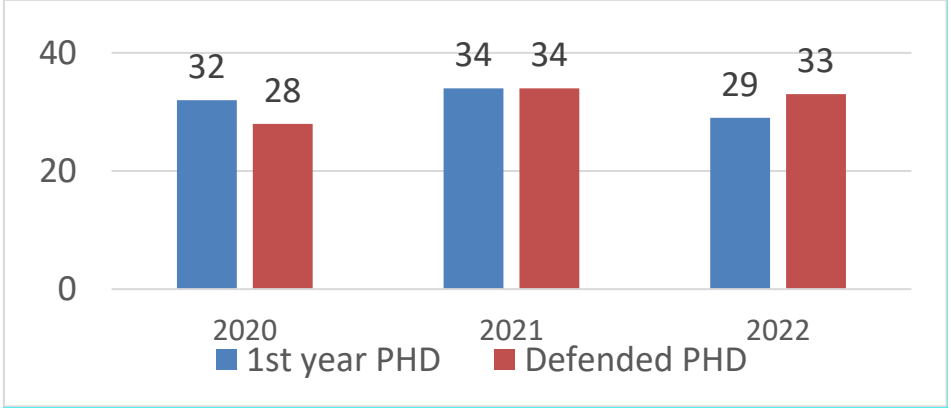


Figure 10. The number of new PhD entering IJCLab and PhD defenses over the years

Post-Doctoral fellows, Temporary Technical staff contracts and apprentices. Figure 11 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.

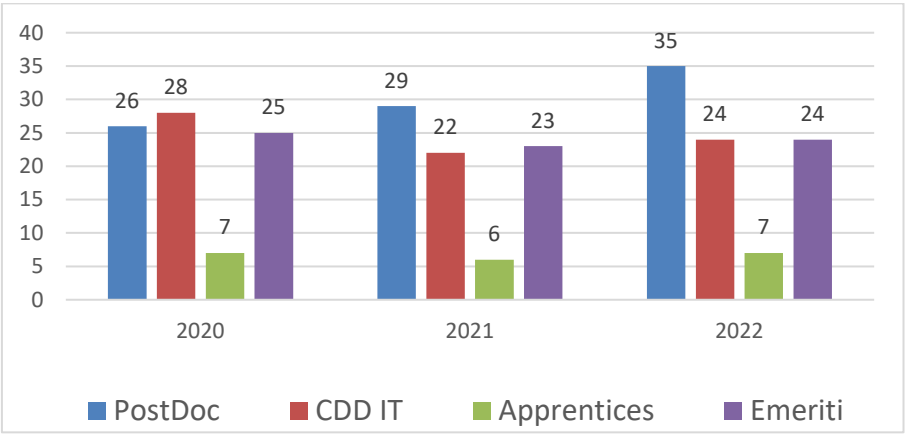


Figure 11. The number of new PostDoc, Technical CDD, Apprentices and Emeriti at IJCLab

INTERNSHIPS. IJCLab has also a strong involvement in internships as a gateway to research for students. The Figure 12 and the table 2 below summarize the situation in the last three years. This constitutes an important financial effort of the laboratory as most of these internships are supported by the laboratory

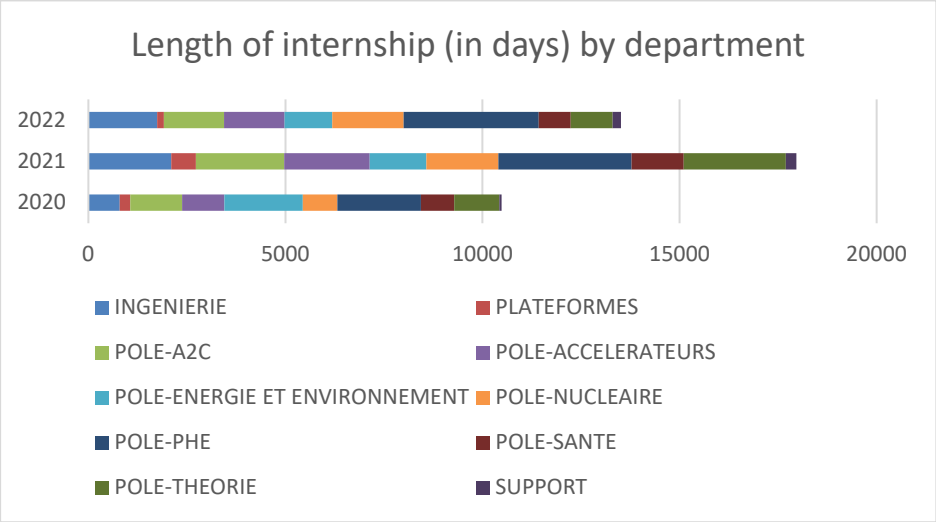


Figure 12. Number days of internships according to their main department of activity: TH Theory, PS: Health Physics, PN: Nuclear Physics, PI: Engineering, PHE: High-Energy Physics, PA: Accelerators, EE: Energy and Environment, A2C: Astroparticles, astrophysics and cosmology.

	2020	2021	2022
Number of internships	125	213	178
Number of months	375	641	483
% L	24%	32%	34%
% M1	28%	36%	32%
% M2	47%	32%	34%

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

4.2. 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 13 and Figure 14.

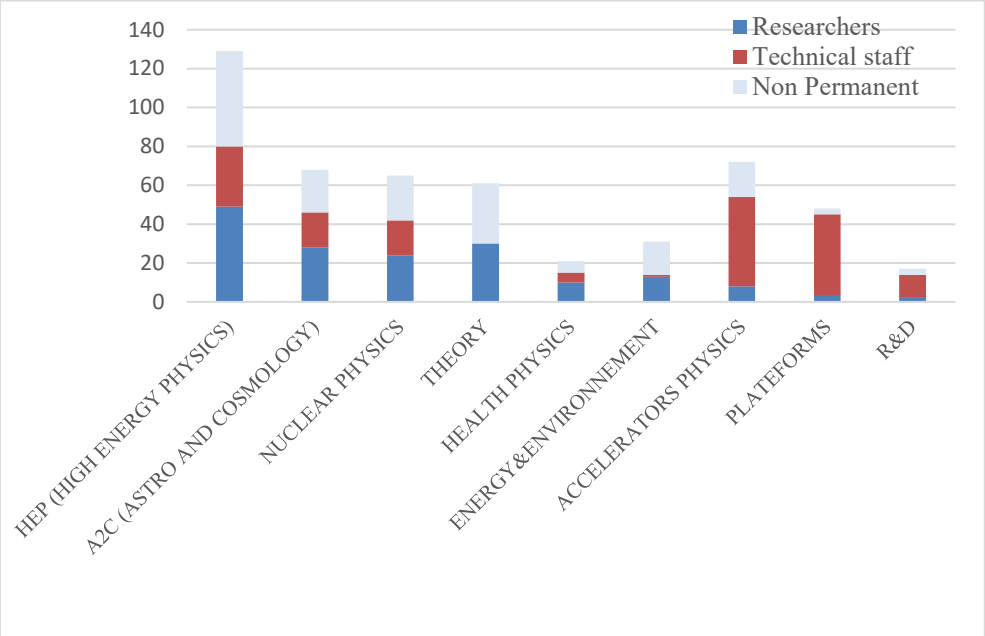


Figure 13. FTE distributions in Year 2022 over the activities in the IJCLab departments. R&D stands for transverse activities in the engineering poles which are not directly related to any project of a scientific department

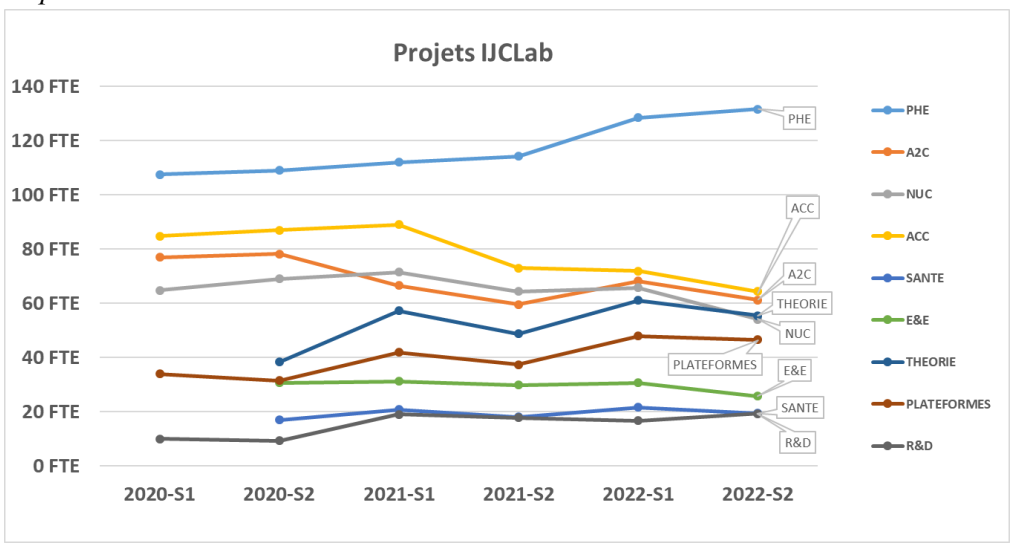


Figure 14. FTE evolution by semester over the activities in the IJCLab departments.

The Figures 15 show the distribution of FTE for the projects with the highest need for human resources at IJCLab

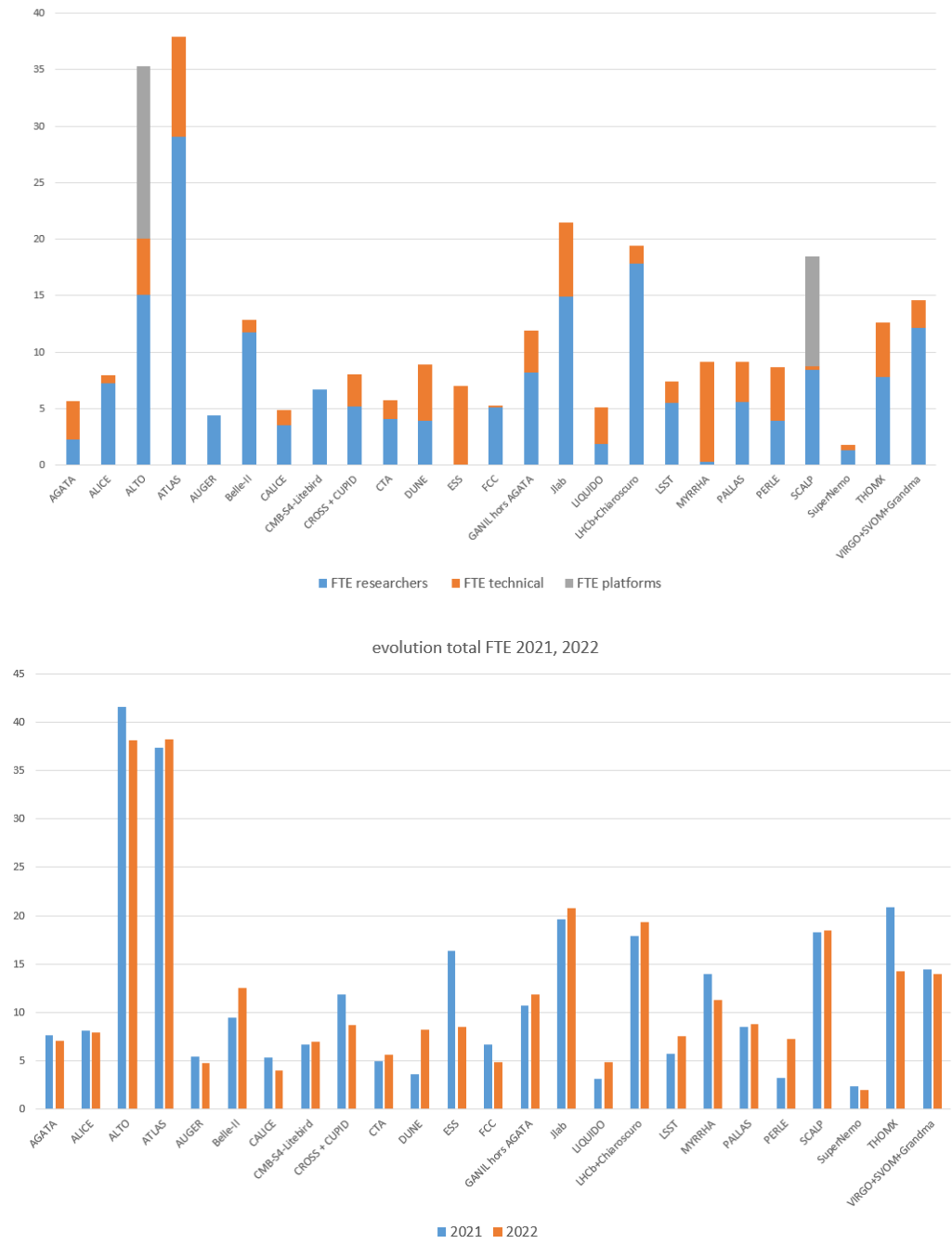


Figure 15 (top) Distribution of FTE between researchers (blue), engineers (orange) and platform staff (grey) for the projects with the highest need for human resources at IJCLab. (bottom) Distribution of the total number of FTE for 2021 and 2022.

5. Budget

5.1. Global Budget

The budget is shown in the table 3 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€] (*The numbers rounded to the nearest 2 digits in M€ units*)		**Y2020**	**Y2021**	**Y2022**
Assigned by Governing Bodies	Laboratory Operation	4.24	4.36	3.84
	Specific Programs (TGIR, AP, ERM)	3.57	3.78	3.76
Contracts	Europe	0.52	1.26	1.87
	ANR	0.89	0.53	1.18
	Industry, BPI IDEX, PIA, CNES, DIM, SESAME, LabEx	2.04	1.66	3.11
Own Resources (overheads, services…)	"Ressource propres banalisées" (obtained outside pre-assigned funding and contracts)	0.99	0.99	0.81
	AGDG (indirect costs from contracts)	0.72	0.41	1.00
TOTAL		12.97	12.99	15.57
CPER 2015-2022 (20.7M€ from CD91, RIDF, ETAT))		4.16	4.78	1.88

Table 3 IJCLab budget implemented in Year 2022 as compared to Years 2020 and 2021.

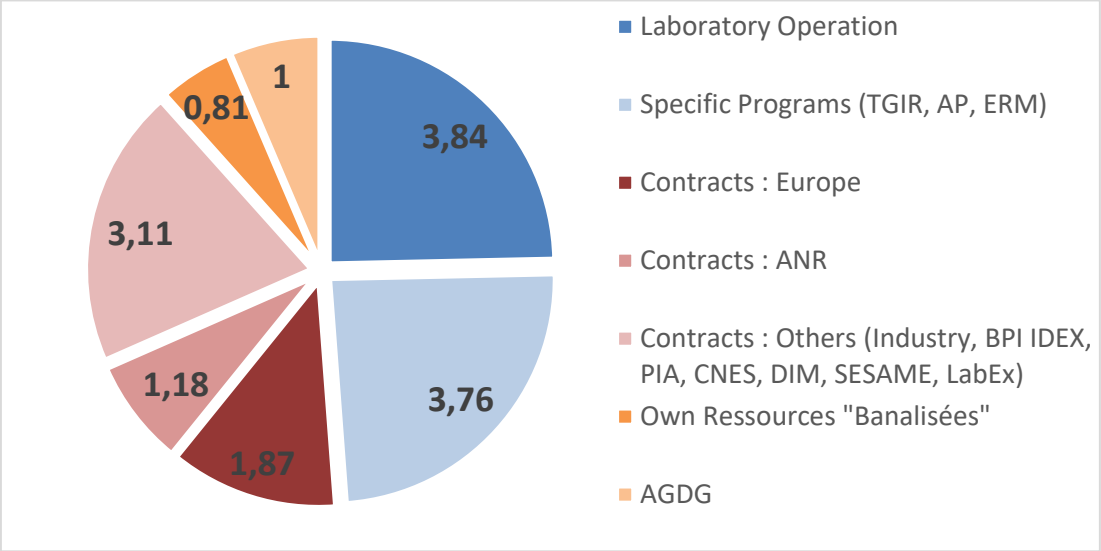


Figure 16. Budget implemented in 2022 as shown in the previous table

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/Departement “CPER 2015-2022 CD91, RIDF, ETAT)“ which can be used for the renewal of the IJCLab infrastructures.

The table 4 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 4. IJCLab “masse salariale” (total payroll)

5.2. Focus on the success to different external calls

We would like to focus here on the obtention of external contracts due to the success of IJCLab teams to some important calls. Our success rate remains high on 2021 and 2022. The Table 5 presents a summary of the situation in 2021 and 2022.

Contracts	Year 2022	Budget [M€] YR 2022	Budget [M€] YR 2021
ANR	Advanced-DeLLight, BATMAN, CIRANO, EFTatLHC, HVP4NewPhys, MALICE, MOTS, StronG, WH-RECOLTE	1,83	2,7
	EQUIPEX+		2,9
BPI	ISAC, MAEVA, MOSARWASTE, PORTHOS, SELF	1,27	-
Europe	Infrastructures : EURO-LABS, EuPRAXIA, ET-PP, interTwin	0,82	-
	Euratom : INNUMAT, MIMOSA	0,45	-
	MSCA : RadCor4HEF	0,19	-
	ERC – Chiaroscuro		2,2
	EIC-TWAC , EIC-AMOTech		4,25
P2IO	Post-docs and PhD students, invitation researchers/workshops/schools	0,49	0,7
Ile-de-France Region	SESAME SIXPAC	0,36	0,12
TOTAL		**5,41**	**12,87**

Table 5. Contracts obtained in Y2022. The budget is to be spent in a pluriannual basis. As a comparison we give the budget obtained in 2021 where we got few important European calls (ERC, EIC) and ANR-EQUIPEX+

- ***ANR:*** *Advanced-DeLLight (Optical nonlinearity in vacuum with intense laser pulses), BATMAN (Better Accuracy and robusTness for Mass Assessment of Neutrino), CIRANO (Oscillateurs à relaxation couplés à base de nanofils de VO2 pour des dispositifs neuromorphiques), EFTatLHC (La nouvelle physique via les théories effectives au LHC), HVP4NewPhys (Hadronic vacuum polarization and the search for new physics), MALICE (Magnifying the ALICE physics potential with a fixed-target programme), MOTS (Multi-messenger Observations of the Transient Sky), StronG (Strong field Gravity and black holes: images, quasi-normal modes, binaries), WH-RECOLTE (Waste-Heat REcovery with COmplex Liquid ThermoElectrics)*
- ***BPI:*** *ISAC (actinides conversion), MAEVA (concrete with depleted uranium), MOSARWASTE (matter and waste cycle in molten salt reactors), PORTHOS (Thorium valorization in molten salt reactors), SELF (metallic nuclear wastes)*

- ***Infrastructures:*** *EURO-LABS (access to infrastructures for nuclear and particle physics), EuPRAXIA (preparatory phase of an accelerator facility based on plasma technology), ET-PP (preparatory phase of the Einstein Telescope), interTwin (Development of a Digital Twin Engine)*
- ***Euratom:*** *INNUMAT (access to JANNuS-SCALP), MIMOSA (Multi-recycling strategies for molten salt technologies)*
- ***MSCA:*** *RadCor4HEF (High-Energy Factorization formalism with QCD computations for LHC)*
- ***P2IO****: Post-docs and PhD students, invitation researchers/workshops/schools*
- ***Ile-de-France Region:*** *SESAME SIXPAC (In situ X-ray diffractometer for JANNuS-SCALP)*

The actions regarding industrial partnerships are summarized in the table 6.

Interaction with socio-economic world / impacts on economy, society and culture					
Category	**Title**	**Partners**	**Date**	**Budget [k€] / Program**	
Plateforms for industrial use	SPACE ALTO		01/20 -12/22	900	PIA Filières BPI Region
	X-SPACE ALTO		12/22 - 11/25	100+IT	CNRS/DGD-I
Techology and know-how transfer	MITA OPALIS - Multimodal Indicator for Tissue Analysis (for) Operating Autofluorescence Light for Surgery		12/22 -12/23	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 - 12/22	30	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	-
	Opto-mechanical devives	ARDOP	14/06/21	-
	MYRRHA	ACS	16/03/21	-
		LABOROLEC	11/09/20	-
	Cryomodule assembly	CNIM	28/03/19	-
Research collaboration				
	SuperChooz Pathfinder	EDF	9/22	-
	In-vivo properties of fluorescent magnetosomes	NANOBACTERIE	04/22 - 03/23	60
	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	-
	Development of (GHz) laser source	AMPLITUDE SYSTEME	03/21 - 03/24	-
	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
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 6. Industrial contracts obtained in YR2021 and YR2022. The budget is to be spent in a pluriannual basis.

In a short and concise summary:

- Opening of the platforms to industrial partners: ~1M€ (PIA- filière BPI/Region) for ALTO and the possibility of hiring a Technical staff for the technological transfer
- Transfer of Knowledge on the Assembly of cryogenic cryomodules to the CNIM (Toulon)
- 1 Startup created Beams Gamma Camera (Health Physics) (hosted at the laboratory)
- 6 Technological Transfers from DECLIC (TRL1-2) to Maturation (TRL 8) ~3.0M€
- 19 Contracts with industrials ~2M€
- 8 thesis CIFRE

6. Organizational aspects of the laboratory

At a global level, the IJCLab organization built during 2020/2021 has not significantly changed in 2022. 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 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 concerning quality of life at work. In addition, two officers for equality diversity and inclusion have been appointed.

After almost three years of existence, we thought it would be interesting to measure the rate of involvement of the engineers in the engineering division in projects that were not initially labelled 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-left 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. The average mixing rate is of about 0.2, which is still quite

low. Figure 17-right shows the mixing rate for the members of the engineering department from the three main laboratories providing technical forces in the merger.

Looking at the level of the projects, it can be seen that the more a laboratory was involved in very long projects, the more the staff assigned to these projects continued to work on them. This seems logical in order to maintain the technical expertise acquired in long-term activities. On the other hand, the projects that allowed for the most important mixing were those resulting from the operation of the platforms or from the health department.

If we now look at the main IJCLab projects and define the mixing rate in the projects, then the average is 0.27 (including all technical staff in the laboratory). Figure 18-left shows the number of projects with a given mixing ratio and Figures 18-right the number of engineer and technician hours for projects with a given mixing ratio.

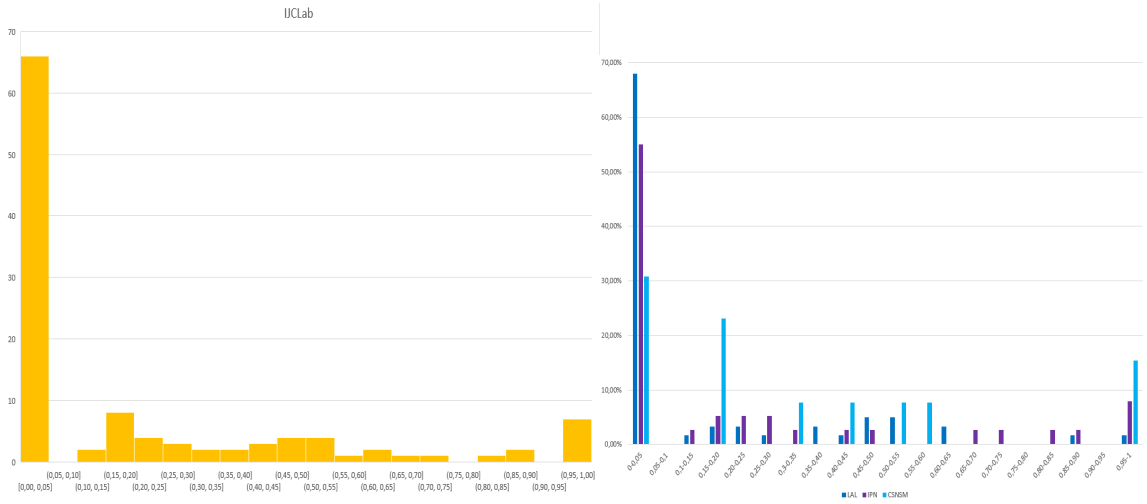


Figure 17. The 'mixing rate' or each member of the engineering division. The mixing rate is defined as the time spent working on projects originating from a laboratory other than their original laboratory divided by their total working time. The figure on the left is for the whole laboratory, the figure on the right for the three main laboratories providing technical forces.

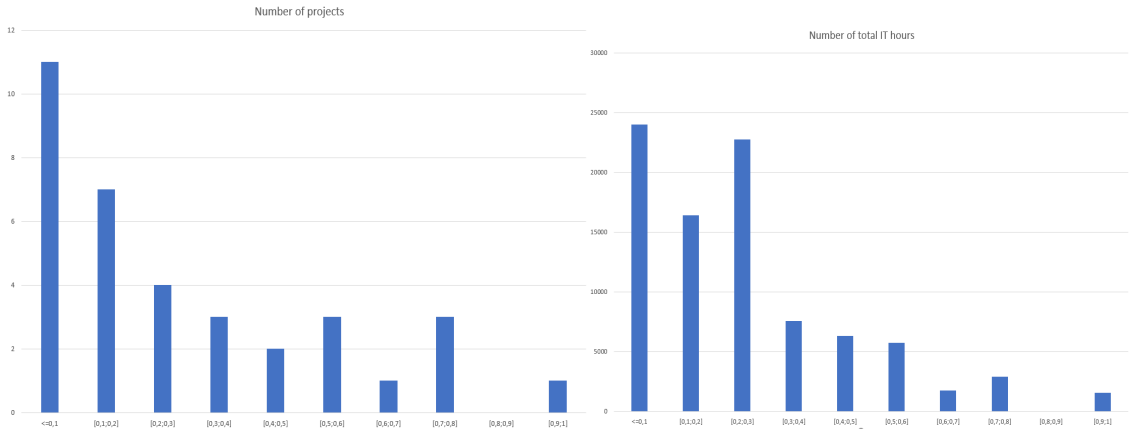


Figure 18. Left figure: the number of projects with a given mixing ratio. Right figure: the number of engineer and technician hours in the projects with a given mixing ratio.

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. A financial support has been 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. In Year 2022 we have achieved some important projects: The Workshop "Vacuum & Surface" (D3-D4), the two Mechanical Workshops (Bdg 100, 200) and the Extension of SCALP-JANNuS Platform (Bdg108). Still two projects have to be finalized in 2023: The Renovation of Building 104 and the Renovation "Theory" Bdg 100 which will allow to install all the theorist in Bdg 100 and the Health Department in Bdg 104.

The list of the operations is given in the table 7

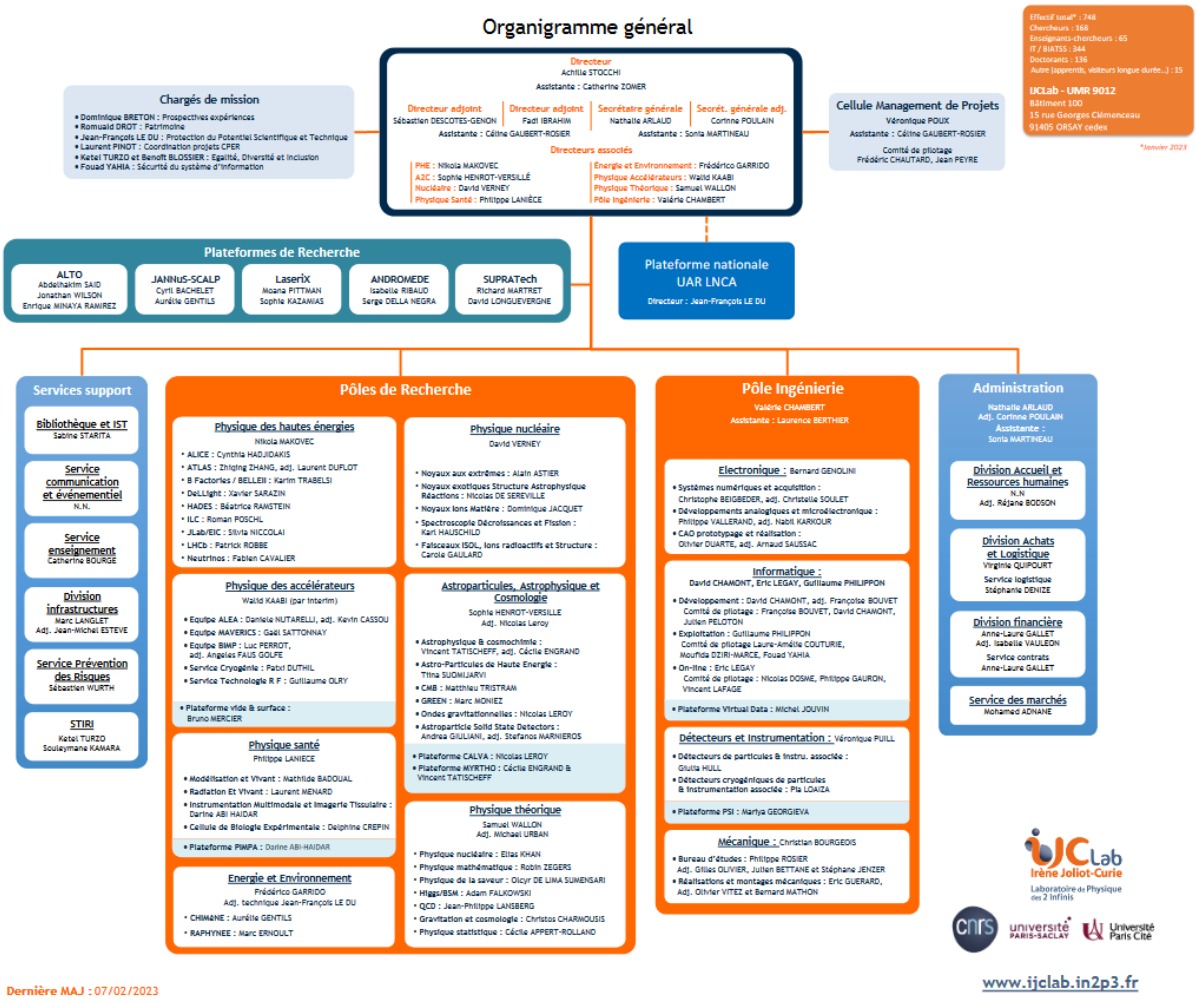
Operation	**Budged used [M€]**	**Budget still available [M€]**	**End date**	
IGLEX (D1-D2)	3.6		May-21	Completed
Renovation of Building 104	1.9	2.4	Apr-23	
Virtual DATA (Bat 206)	2.2		Aug-20	Completed
Workshop "Vacuum & Surface" (D3-D4)	1.2		Apr-22	Completed
Mechanical Workshops (Bdg 100, 200)	2.4		Apr-22	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		0.5	Sep-23	
Renovation Construction Hall bdg 106	0.5		Mar-20	Completed
TOTAL	16.7	2.9		

Table 7. 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 2023. 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 PERLE project.

Appendix 1 – IJCLab organisational chart – updated at February 2023



Appendix 2 Missions of IJCLab – Letter from CNRS. Brief description of activities and recent results related to that.

Lettre reçue avec l'attribution 2022 en crédits FEI (fonctionnement, équipement, investissement)

- **Diriger des projets phares de niveau international en physique des hautes énergies, physique nucléaire, astroparticules et cosmologie en contribuant à tous les niveaux**
  Cible : Prise en charge et pilotage de nouveaux projets.
- **Jouer un rôle majeur dans la conception, le design et la construction des accélérateurs actuels et futurs.**
  Cible : Prise en charge et pilotage de nouveaux projets.
- **Être un partenaire important dans le réseau des plus grands laboratoires européens. Impulser aussi des collaborations ciblées avec d'autres laboratoires européens et dans le monde.**
  Cible : L'indicateur est la capacité d'impulser des nouvelles et plus fortes collaborations avec les partenaires européens et également avec les laboratoires américains.
- **Développer et exploiter des infrastructures de recherche et des plateformes technologiques soutenant ces lignes de recherche ainsi que, grâce à leurs performances d'irradiation, des recherches originales en physique santé, sciences des matériaux et énergie.**
  Cible : Trouver un bon équilibre entre recherche fondamentale et technologique et l'ouverture vers l'extérieur (académique et industriel). Définition d'un modèle économique plus approprié, en lien avec une politique forte et assumée de valorisation.
- **Trouver un modus operandi et une collaboration avec l'IRFU/CEA**
  Cible : Travailler/collaborer davantage sur quelques nouveaux grands projets (accélérateurs ou autres disciplines). Participer à des réponses conjointes à des appels d'offre.
- **Être capable de mieux se positionner et réussir dans différents appels d'offre**
  Cible : Augmentation sensible du nombre de financement de type ANR, ERC, autres appels d'offre européens (Curie, FET-OPEN…)…
- **La valorisation de nos recherches à fort impact économique et social ainsi que les liens avec le tissu industriel doivent changer de dimension.**
  Cible : Le nombre de projets de pré-maturation ou maturation, les brevets, ainsi que les partenariats avec les industries allant jusqu'à la création de LabCom.
- **Avoir un lien fort avec les universités et surtout jouer un rôle essentiel et central dans l'enseignement.**
  Cible : Financement d'initiatives pluridisciplinaires, financement et jouvence des plateformes. Positionnement dans Paris-Saclay (GS, Département, Labex), l'impact dans les enseignements et la capacité d'accueil d'étudiants, l'augmentation du nombre de thèses et de stages
- **Continuer la transformation de l'urbanisme de la Vallée**

Cible : Rénovation profonde des bâtiments et ses alentours et la conséquente amélioration de la qualité de vie au travail. Rénovation des bâtiments capables d'héberger les instruments et les plateformes.

- **Rester attractif auprès des personnels en termes de carrière**
  Cible : Le maintien voire le renforcement plus ciblé et stratégique du personnel chercheur et technique d'IJCLab. L'augmentation du nombre de promotion (passage de corps et de grade) des agents IT

(translated in English)

Letter received with the 2022 allocation of "FEI" funds (operating, equipment, investment)

- **Leading world-class flagship projects in high-energy physics, nuclear physics, astroparticles and cosmology by contributing at all levels**
  Target: Take charge and lead new projects.
- **Play a major role in the conception, design and construction of current and future accelerators.**
  Target: Take charge and lead new projects.
- **To be an important partner in the network of the largest European laboratories. To also stimulate targeted collaborations with other European laboratories and worldwide.**
  Target: The indicator is the capacity to stimulate new and stronger collaborations with European partners and also with American laboratories.
- **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.**
  Target: Find a good balance between fundamental and technological research and openness to the outside world (academic and industrial). Definition of a more appropriate economic model, in connection with a strong and assumed policy of valorization.
- **Find a modus operandi and a collaboration with the IRFU/CEA**
  Target: Work/collaborate more on a few new large projects (accelerators or other disciplines). Participate in joint responses to calls for proposals.
- **To be able to better position ourselves and succeed in different calls for tenders**
  Target: Significant increase in the number of ANR, ERC and other European calls for proposals (Curie, FET-OPEN...)...
- **The valorization of our research with a strong economic and social impact as well as the links with the industrials must change dimension.**
  Target: The number of pre-maturation or maturation projects, patents, as well as partnerships with industry, including the creation of LabCom.
- **To have a strong link with universities and specially to play an essential and central role in teaching.**

Target: Funding of multidisciplinary initiatives, funding and renewal of platforms. Positioning in Paris-Saclay (GS, Department, Labex), impact in teaching and student hosting capacity, increase in the number of theses and internships

- **Continue the transformation of the Valley's urban planning**
  Target: In-depth renovation of the buildings and their surroundings and the consequent improvement of the quality of life at work. Renovation of buildings capable of housing instruments and platforms.
- **Remain attractive to staff in terms of career**
  Target: The maintenance or even the more targeted and strategic reinforcement of the research and technical staff of IJCLab. The increase of the number of promotions of IT agents.

Appendix 3– Subjects of IJCLab Scientific Councils (2020-2022).

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