Research evaluation

REPORT ON THE RESEARCH UNIT:

Fusion Laboratoires Orsay (CSNSM, IMNC, IPNO, LAL, LPT)

UNDER THE SUPERVISION OF THE FOLLOWING INSTITUTIONS AND RESEARCH BODIES:

Université Paris-Sud
Centre National de la Recherche Scientifique - CNRS
Université Paris Diderot - Paris 7

EVALUATION CAMPAIGN 2018-2019
GROUP E

In the name of Hcéres[1]:

Michel Cosnard, President

In the name of the experts committee[2]:

David Mac Farlane, Chairman of the committee

Under the decree No.2014-1365 dated 14 November 2014,

[1] The president of Hcéres "countersigns the evaluation reports set up by the experts committees and signed by their chairman." (Article 8, paragraph 5);

[2] The evaluation reports "are signed by the chairman of the experts committee". (Article 11, paragraph 2).

This report is the sole result of the unit's evaluation by the expert committee, the composition of which is specified below. The assessments contained herein are the expression of an independent and collegial reviewing by the committee.
Tables in this report were filled with data provided by laboratories and supervising bodies in the unit's application and in the Excel files "Données du contrat en cours" and "Données du prochain contrat".

UNIT PRESENTATION

Unit name:	To be decided
Unit acronym:	To be decided
Requested label:	UMR
Application type:	Fusion of five laboratories (CSNSM, IMNC, IPNO, LAL, LPT)
Current number:	Not yet assigned
Head of the unit (2018-2019):	Unit not yet created
Project Leaders (2020-2024):	MM. Fadi IBRAHIM, Achille STOCCHI et Samuel WALLON
Number of teams and/or themes:	14 themes

EXPERTS COMMITTEE MEMBERS

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Vice-Chair:	Mr Paolo GIUBELLINO, National Institute for Nuclear Physics, Italy
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INTRODUCTION

HISTORY AND GEOGRAPHICAL LOCATION OF THE UNIT

The geographic proximity in the Orsay valley of the Paris-Sud university campus (future Paris-Saclay university) and recent research developments led five laboratories - Centre de sciences nucléaires et de sciences de la matière (CSNSM), Imagerie et modélisation en neurobiologie et cancérologie (IMNC), Institut de physique nucléaire d'Orsay (IPNO), Laboratoire de l'accélérateur linéaire (LAL) and Laboratoire de physique théorique (LPT), to consider a merger. In that respect, a steady two-year process of reflections regarding a long-term evolution of the organization of science in the Orsay valley has been organized. The reflections are based on three main observations: (i) the scientific and thematic frontiers among these laboratories are diminishing; (ii) a new positioning on certain topics is necessary because of the evolution of the disciplines; (iii) the technical potential of these laboratories constitutes a world-leading force that needs to be better organized.

In July 2018, the decision was finally taken to create on January 1st 2020 a new unit from the merging of the five current laboratories, all operated by CNRS, with a common history related to the creation (in 1956) of the university and research campus of Orsay. The future unit will be distributed in several existing buildings and the creation of the new unit will not necessitate any significant movement of personnel, although there is an ongoing need for substantial renewal of staffing levels in many unit areas.

MANAGEMENT TEAM

At the time of the review, phase 3 of planning for unification of the merged Orsay unit was just getting underway. Committee members were presented with a nominal organizational plan at that time, which is envisioned to encompass the following.

The structure of the unit will be composed of "scientific poles" gathering the activities of the already strong and ongoing themes for the unit. They will be seven "scientific poles" at the time of the creation of the unit: Nuclear Physics, Particle and Hadronic Physics, Astroparticles and Cosmology, Energy and Environment, Health Physics, Theory and Accelerators Physics. All the technical forces will be gathered in an "engineering pole". The structure of the unit is completed by an "administration pole", as well as by "support services" and by the platforms directly attached to the directorate.

The directorate of the unit will be composed of a director, two deputy directors, the directors of the "scientific poles" or associate scientific directors, the director of the "engineering pole" or associate technical director as well as the administrative director. The two deputy directors (one with a research profile and one with an supporting research profile) are in charge of cross-cutting and operational activities for the entire unit, without any particular thematic emphasis. They guarantee the proper functioning of the unit as a whole and help the director on a daily basis with particular attention to support services.

The directors of the "scientific poles" have the status of associate directors with a role of animation, scientific strategy in their theme and operational management of the pole.

The associate technical director leads the "engineering pole" and has the responsibility for developing a strategic vision for the technical aspects of the laboratory and representing the strategic visions for the different technical activities and services.

The associate scientific directors and the associate technical director are full members of management team, participating, defining and collectively implementing the strategic and operational vision and policy of the unit; they also guarantee the visibility of the pole outside the unit at both the national and international level.

The directorate is completed by the administrative director in charge of steering, supervising and coordinating the administrative services. This individual participates, along with the director, the deputy directors and the scientific and technical associate directors in the development of policies for each unit and organizes their implementation within each area of responsibility.

HCÉRES NOMENCLATURE

ST2 – Physique.

SCIENTIFIC DOMAIN

The new unit will have the capacity and vocation/ambition for a strong impact on a wide range of scientific and technical domains worldwide. The research themes of the new unit are Nuclear Physics, Nuclear Astrophysics & Astrochemistry, Health Physics, Solid-state Physics, Particle Physics, Hadronic Physics, Data Science, Theoretical Physics, Nuclear Energy & Environment, Physics of Neutrinos, Dark Matter, Astroparticles & Cosmology, Accelerator Physics, Multidisciplinary and Detector R&D.

This new unit aims to be the driving force in several major flagship projects at national and international level, some of which derive from the historical disciplines of the participating laboratories, others coming from emerging themes at their interfaces. This new ensemble should also encourage and help to support projects at more local scales, on faster cycles, likely to appear according to scientific news and/or technical innovations. Furthermore, a large perimeter of the new unit will provide space and appropriate actors for a certain number of transverse themes (e.g. involving theoretical physics, health physics, etc.), the growth of which can be otherwise limited by the perimeters of current laboratories.

UNIT WORKFORCE

	Unit workforce	
	Fusion Laboratoires Orsay	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	20	20
Assistant professors and similar positions	46	46
Full time research directors (Directeurs de recherche) and similar positions	72	72
Full time research associates (Chargés de recherche) and similar positions	82	82
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	1	1
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	365	365
Permanent staff	**586**	**586**
Non-permanent professors and associate professors, including emeritus	5	
Non-permanent full time scientists, including emeritus, post-docs, PhD students	198	
PhD Students	118	
Non-permanent supporting personnel	39	
Non-permanent staff	**242**	
Total	**828**	**586**

GLOBAL ASSESSMENT OF THE UNIT

The merger of the five existing Orsay valley laboratories, represents an exciting opportunity to form one of the most powerful multidisciplinary institutions of its kind in Europe, if not worldwide. As stated later in this report, the individual research groups at the Orsay laboratories are universally regarded as excellent and internationally well-connected, and so represent an excellent starting point for the merged unit. Some of the now separate but closely aligned scientific groups, such as nuclear, particle, and astrophysics theory, will result in a uniquely powerful, intellectually broad and diverse effort, which in combination with the Paris universities, will be immediately recognized as world leading. In other cases, developing brand new scientific efforts at the boundary between existing fields may offer even greater potential scientific payoff, if such diversity can be fostered and flourish in the merged unit. There may also be many opportunities, as suggested by several groups, for increased support of data analysis and interpretation thanks to enhanced collaboration with the data science and theory groups after the merger. These are just some of the possible important opportunities to take into account in developing the strategy and vision for the future direction of the merged unit.

DETAILED ASSESSMENT OF THE UNIT

UNIT'S RESPONSE TO PREVIOUS RECOMMENDATIONS

The five Orsay laboratories have responded to most of the 27 recommendations from the last AERES review. In a few cases, responses are deferred until completion of the merger process, since they relate directly to organizational structure, strategic planning and priorities, which are evolving as part of the merger process. Imminent retirements in some existing groups threaten the long-term viability of these efforts, but the future evolution should be addressed as part of global strategic planning for the merged unit. Links with local universities appear to be strong and healthy and new opportunities may arise as part of the planning for the newly merged unit. In general, the management of the various laboratories have done a good job in addressing the recommendations of previous reviews within the constraints of funding, available positions, and in the context of ongoing steps toward the merger of the five laboratories.

CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

A – Scientific outputs and activities, academic collaborations, reputation and appeal

Scientific outputs and activities, academic collaborations, reputation and appeal From 01/01/2013 to 30/06/2018	**Fusion Laboratoires Orsay**
Articles	
Scientific articles	3488
Review articles	32
Other articles (professional journals, etc.)	17
Books	0
Scientific book edition	5
Book chapters	16
Meetings	0
Meeting abstracts	1849
Meetings and congress organisation	287
Electronic tools and products	
Software	12
Databases	1
Tools for decision making	0
Solver competition tools	0
Instruments and methodology	
Prototypes	Yes
Platforms and observatories	Yes
Other products	
Artistic creations	0
Movie or theatre play creation	0

Movies	4
Editorial activities	
Participation to journal editorial boards (books, collections)	38
Peer reviewing activities	
Reviewing of journal articles	Yes
Grant evaluation (public or charities)	Yes
Participation to lab site visit committees (Hcéres, etc.)	Yes
Participation to institutional committees and juries (CNRS, Inserm, etc.)	Yes
Academic research grants	
European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	50
National public grants (ANR, PHRC, FUI, INCA, etc.)	137
Local grants (collectivités territoriales)	24
PIA (Labex, Equipex, etc.) grants	5
Grants from foundations and charities (ARC, FMR, FRM, etc.)	3
Visiting senior scientists and post-docs	
Post-docs	188
Visiting senior scientists	499
Scientific recognition	
Prizes	25
Distinctions	14
IUF members	3
Chair of learned and scientific societies	Yes
Invitations to meetings and symposia (out of France)	1129
Members' long-term visits abroad (> 6 months)	27

Strengths

Orsay laboratories staff members have continued to successfully pursue the development of major new experiments at the international level, while also leading the scientific exploitation of a suite of existing highly impactful experiments. The level of leadership in the international community and innovation shown in developing new programs is remarkable, as evidenced by the large number of prizes and awards (39), many invitations to speak at international conferences, the large number of publications (more than 3500) in the review period, and successfully winning competitive grants and awards. The impact of contributions under individual research themes are detailed below, but are all highly regarded.

The Orsay unit staff has been recognized with major leadership roles in large international collaborations and are sought after and contribute in leading ways to instrumentation, software and physics analysis. This enviable position is made possible by a strong and highly skilled technical staff and world-class technological infrastructure in many scientific areas. This new unit will then rely on high quality technical services in the fields of Instrumentation, Electronics, Mechanics, Informatics, and Acceleration Techniques. This ensemble includes about 300 scientists, engineers and assistants, representing a unique potential for the design, development and use of the instruments needed to meet the challenges of the coming decades (accelerators and detectors). It allows the new unit to play a major role in the building process of upcoming experiments and facilities. The presence of a large set of research infrastructures or technological platforms is also a key

characteristic of the new unit. These platforms are at the service of the science developed in the current laboratories aiming for strong impact and recognition at the international level.

Weaknesses

In embarking on the merger process, it will be challenging to maintain the focus of the staff on outstanding scientific productivity, innovation and leadership during the transition. Development of strategic planning for scientific direction that accounts for the wide array of interests, capabilities, and scales and timelines for the scientific infrastructure involved, while also being realistic in supporting international commitments, will be important for the newly merged enterprise.

Assessment of scientific outputs, reputation and appeal

The scientific output of the Orsay laboratories is outstanding in pursuing a wide array of world-leading research across the spectrum of particle, nuclear and astroparticle physics, as well as a variety of multidisciplinary fields. The achievements have continued to add to the reputation of the Orsay laboratories and improve their international standing in a way that offers great promise for the merged unit.

B – Interactions with the non-academic world, impacts on economy, society, culture or health

Interactions with the non-academic world, impacts on economy, society, culture or health From 01/01/2013 to 30/06/2018	
Socio-economic interactions / Patents	
Invention disclosures	5
Filed patents	4
Accepted patents	3
Licenced patents	3
Socio-economic interactions	
Industrial and R&D contracts	30
Cifre fellowships	9
Creation of labs with private-public partnerships	0
Networks and mixed units	0
Start-ups	0
Clinical trials	2
Expertise	
Consulting	Yes
Participation in expert committees (ANSES, etc.)	Yes
Legal expertise	Non
Expert and standardization reports	Non
Public outreach	
Radio broadcasts, TV shows, magazines	89

Journal articles, interviews, book edition, videos, etc.	59
Other popularisation outputs	Yes
Debates on science and society	19

Strengths

The future unit will have a great potential for innovation and valorization/technology transfer allowing emerging or strengthening strong partnerships with industries.

In general, the research platforms seem to offer an exciting opportunity for further development of commercialization activities. SCALP in particular is a good example of self-financing platform, open to industrial users. Yet its economic model may not be applicable to all platforms (charging beam for scientific users).

Weaknesses

ThomX is an innovative compact X-ray machine. In addition to IN2P3 skills, including Fabry-Perot optical cavity development, collaboration with relevant partners should ensure success for this challenging concept. However, the potential commercialization opportunities do not seem clearly defined.

Assessment of the interactions with the non-academic world

Given the scope and the level of expertise of the merged unit, the potential outcome in commercialization is high. The hiring of a dedicated head of knowledge transfer in 2018 is an important step and an excellent way to boost these kinds of activities. This person will be able to drive the commercialization process while remaining close to scientists and thus identifying innovative results or services. The proposed centralized beam request is a good tool to boost visibility.

C – Involvement in training through research

Involvement in training through research From 01/01/2013 to 30/06/2018	
Educational outputs	
Books	12
E-learning, MOOCs, multimedia lessons, etc.	5
Mean number of publications per student	> 2
Scientific Output (articles, books…) out of PHDs	> 400
Training	
Habilitated (HDR) scientists	160
HDR obtained during the period	33
PhD students	297
Defended PhDs	175
Mean PhD duration	181
Internships (BTS, M1, M2)	839

Education	
Courses with international label (ERASMUS, etc.)	68

Strengths

The Orsay Valley laboratories are all designated as Unité Mixte de Recherche CNRS/University (UMR), with a total of 61 teaching staff (professors (PR) and assistant professors (MCF)) in five faculties of the Université Paris Sud (84%) and the Université Paris Diderot (13%). There is also a healthy ratio of 1:2 for professors *vs* assistant professors. For the Université Paris Sud, five separate departments have connections to the Orsay laboratories, with 7% of the Chemistry Department from the five laboratories and 26% of the Physics Department. Correspondingly, teaching staff make up between 20% (IPNO) and 66% (IMNC) of the laboratory research staff. Teaching occurs at all levels (bachelor, masters, Ph.D.), includes both cross-laboratory efforts, contributions by non-academic staff and specialized training (Nuclear Energy Masters, PHENICS Doctoral School), and encompasses specialized schools (Joliot Curie School Lectures, IN2P3 Instrumentation School Lectures, International Summer School on QCD) and training based on laboratory platforms (SCALP, ALTO). Some 175 Ph.D. students have graduated over the review period (2013-2018) and 33 Habilitations à diriger des recherches (HDR) have been awarded. Permanent staff are also involved in many leadership positions in University departments and programs. These education and outreach efforts are very impressive and add enormously to the impact of the Orsay laboratories and the quality of their research.

The five laboratories are in close proximity to many laboratories of the Paris-Saclay university and to many others in the Paris region. This unique context places the new unit in an environment rich in training opportunities for intensifying the teaching activities (initial, basic science, technological and professional), for disseminating knowledge and for numerous training activities.

Weaknesses

Several of the five laboratories have large fractions of teaching staff and close connections to campus departments. This tight relationship is part of the highly successful strategy of these laboratories, but may leave these programs and capabilities vulnerable in the larger merged unit unless they are actively preserved and enhanced.

Assessment of the involvement in training through research

The education effort of the five laboratories is demonstrably impactful in terms of numbers of students and HDR trained, the quality and innovativeness of the teaching programs, and the tight integration into the relevant departments at the universities and the research programs of the laboratories themselves. The energy, integration and coordination across the laboratories, and the innovative use of platforms as educational opportunities are all major assets to this program.

CRITERION 2: UNIT ORGANISATION AND LIFE

Unit organisation and life (situation on 30/06/2018)	
Women/men ratio in the unit	0.38
Women/men ratio among unit scientists	0.34
Women/men ratio among unit PhD students	0.45
Women/men ratio among team leaders, unit head and deputy heads	0.55

Strengths

Diversity and inclusion are clearly a priority for the management of the Orsay laboratories and the gender balance all the way from Ph.D. students to scientists to managers reflects this commitment. The five Orsay laboratories have been moving systematically forward with exploring the option and making the case

for a merger in the future, to create a large diverse and powerful scientific organization with world-wide reputation and standing. This is a challenging process and management has been proceeding systematically through a multi-step process to develop this vision. The uncertainty weighs on the existing scientific staff, but commitment to process and engagement of the staff is clear.

The perimeter of the new unit is completed by several supporting activities (Administration, Logistics, and Infrastructures) which strongly and vitally support all the scientific and technical activities.

Weaknesses

A prolonged period of uncertainty about the future of the Orsay laboratories will make recruitment and retention difficult. Many units in the existing laboratories have been experiencing slow declines in funding and personnel over the last decade, leading to situations where retirements are not being replaced and the sustainability of ambitious scientific programs may not be viable. In addition, change and uncertainty can be demotivating for some high performing staff, particularly in small units with scientific goals that broadly support the yet-to-be-defined mission of the merged unit, but which otherwise may feel threatened by much larger research efforts. The challenges of hiring through national searches is also difficult, particularly in a highly competitive market internationally for female scientific and technical staff. Directors will need to manage change carefully to preserve the sterling reputation of the Orsay laboratories and the full commitment of the scientific and technical staff.

Assessment of the unit's life and organisation

The Orsay valley laboratories offer an exciting and inclusive environment for their scientific and technical staff, and have achieved an impressive gender balance in their population of students, staff and leadership. The challenges of managing change and uncertainty through the merger process will be many, but the importance of the quality of the personnel in the merged organization will be paramount to its success, so planning should take advantage of many existing models of institutional transition in continuing to foster and maintain an inclusive and attractive scientific and working environment. The continued emphasis on engagement and transparency through the transition process will be important.

CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

Strengths

The planning for unification of the five Orsay laboratories has proceeded through two phases to date, with reports at each phase. CNRS and the university have encouraged the development of the next stage of planning for unification. The committee agrees that this would be a very positive outcome and could lead to a vibrant major center for scientific research in France and worldwide.

Weaknesses

Some fraction of the staff is sceptical, based on their experience with the process to date, about whether their viewpoints will be considered in the development of the concept and approach to FLUO ("future laboratoire unifié d'Orsay"). As a result, they also appear to be focused more on enumerating the risks of moving to such a unified large lab, rather than finding and proposing solutions to these challenges. This may be an opportunity to reset expectations, provide a clearer vision of the output from the next step, and re-engage the staff in a more effective way.

There are concerns about consistency of promotions within technical and administrative and the possibility of changes in levels assigned to jobs with implications for salary. There is also a concern about the overhead of multiple layers of management. It is not completely clear where administrative concerns and planning will be addressed in the working group structure.

The scope and vision for FLUO will likely evolve with time as opportunities arise and the planning process should acknowledge this.

The uncertainty going forward is weighing heavily on staff morale. A balance between the speed of implementation, confusion about the goals from the previous stages of the process, and the need to listen

and incorporate concerns and input from the staff will need to be addressed. A multitude of related issues (promotions, space management, harmonizing administrative tools, representation in lab management structures) are obvious concerns and uncertainties. Some steps and decisions may be rushed and this could be exacerbating the morale problem and a sense that input is not being seriously considered. On the other hand, there may be some merit to just moving forward to reduce the level of uncertainty. Some agreed triage of the importance of the identified issues, may allow focus and more timely action.

The smaller labs in particular see a high degree of flexibility and responsiveness from their organizations and staff, which allow for tailored support of their respective science environments. These communities are keen to maintain a tight connection between their mission support and science projects.

There is a perception that, despite declining resources and staffing levels, there is no movement towards making hard decisions and stopping some of the commitments by setting realistic priorities.

The committee saw evidence of mismatch between communicated goals and expectations in some areas of the unification planning. This seemed particularly the case for administrative services.

The connection to both Paris Sud and Paris Diderot is very important to the success of the new unit, including in the era as Paris Saclay emerges; these links should be maintained going forward.

Assessment of the scientific strategy and projects

The planning for unification of the five labs has proceeded through two phases to date and is now entering a phase of detailed planning and the working group (WG) level. However, the management and organizational structure required to develop and articulate an overall scientific strategic plan was just beginning at the time of the review and the committee is not in a position to comment on the completed plan as yet. The committee does note the future merged unit rests on a powerful foundation of world-leading expertise, with excellent scientific productivity across many fields of science and technology, and outstanding connections to the international scientific community. If the merger is performed well, and the committee makes a number of recommendations below on the approach to the merger process, the committee believes a powerful new multidisciplinary unit will emerge in the Paris Orsay region that is able to compete with peer institutions worldwide.

RECOMMENDATIONS TO THE UNIT

A – Recommendations on scientific production and activities (criterion 1)

Regarding commercialization of other platforms, a good fraction of the income generated by the platform should be used, not only to cover the running costs, but also for its further development. This helps motivate people to prioritize and directly realize the benefit of commercialization activities.

While there appears to be good coordination between the actual laboratories in education, every effort should be made to make sure the emphasis on high quality training, education and outreach continues in the merged laboratory and that it continues to be viewed as a valuable component of the new laboratory's mission.

B – Recommendations on the unit's organisation and life (criterion 2)

The challenge for large multidisciplinary institutions is to identify, establish and align its mission around impactful scientific opportunities, while taking into account a diverse array of scientific approaches, ranging from single-investigator to large-scale team science, executed on time scales varying from less than a year to decades, and requiring a diverse set of unique but time evolving technical skills. It will take some time to develop the organizational structures, the management systems, and the strategic planning capabilities to realize this exciting vision. Best practices can be sought out and adopted from similar institutions elsewhere in the world, but the management of the new unit will need steadfast support in working through possible approaches and implementations. The merger represents a big cultural shift for much of the unit staff, so maintaining morale and developing ways to engage the staff in long-term planning will be essential. It will be equally important for CNRS and the administrations of the Paris universities to buy into this vision, so that sponsors and merged unit are fully aligned as far as the outcomes being sought, the resources and systems

needed to achieve these goals, and the scientific, technical and administrative staff are excited and fully behind this outcome.

C – Recommendations on scientific strategy and projects (criterion 3)

Consider adopting best practices for brainstorming sessions and using professionals to train facilitators in the art of leading such discussions as part of the execution of each working group within the next phase of the FLUO development.

Consider the development of a FLUO strategic plan (10-20 years horizon) as a possible stretch goal for the WG phase of the concept development. Such a strategic plan would exercise the rigor of setting priorities within realistic constraints and demonstrate an open and transparent science-, resource- and competitiveness-driven optimization. This could be a new working group, or an additional phase that attempts to deploy the WG recommendations for how FLUO should be managed. There are many examples of prioritization processes already in place at comparable labs around the world that could be considered.

Use this strategic plan as the first example of an annual process of input and discussion with relevant members of CNRS management about the future direction of the merged unit.

CNRS and FLUO should consider adopting such an approach as an annual exercise in aligning strategic planning and expectations between FLUO and its sponsors.

Encourage the WG participants to engage in the development of constructive solutions, rather than enumerating concerns. These proposals can be derived from best practices elsewhere, perhaps adapted for the circumstances of the French community and its funding agencies.

FLUO is strongly encouraged to provide resources (coaching and mentoring) to help staff with change management.

Develop a short inspirational big-picture vision for FLUO and what it would be, with as wide as possible engagement from the staff.

CNRS and the new FLUO unit should be prepared for a multi-year process of developing systems, management structures, and set expectations appropriately that initial approaches may need to evolve based on early experience. Similar international scientific institutions may be able to serve as a model for both agency management and laboratory planning in developing these processes, which should encompass not only scientific investment and strategy, risks and mitigations, but also the underlying infrastructure, institutional administrative support structures, buildings, research platforms, and other long-term assets.

FLUO should be making much more use of external advice, with experience in change management in major scientific institutions. Set more realistic expectations on how much progress can be made at each step of the unification process, rather than setting the expectation that all answers will be in place on January 1, 2020. More effort should be devoted to broadly engaging the scientific staff and addressing concerns that will affect morale long-term.

THEME-BY-THEME ANALYSIS (PROJECT)

Two transversal themes "Detector Physics and R&D" and "Data Science" have been identified by the merged unit at the time of the visit. There are parts of all the other themes and will be not evaluated here.

Theme 1: Nuclear Physics

Theme leader: To be defined

THEME SCIENTIFIC DOMAINS

This theme covers all the experimental activities in nuclear physics and federates a very important community in France.

THEME WORKFORCE

	TH1	
	Nuclear Physics	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	2	2
Assistant professors and similar positions	5	5
Full time research directors (Directeurs de recherche) and similar positions	14	14
Full time research associates (Chargés de recherche) and similar positions	13	13
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	1	1
Permanent staff	**35**	**35**
Non-permanent professors and associate professors, including emeritus	0	
Non-permanent full time scientists, including emeritus, post-docs, PhD students	24	
PhD Students	17	
Non-permanent supporting personnel	0	
Non-permanent staff	**24**	
Total	**59**	**35**

Global assessment of the theme

The nuclear physics groups at IPNO and CSNSM have a fruitful collaboration among them and all together constitute the largest nuclear physics community in France and one of the largest in Europe. World-class experimental activities are performed, with excellent scientific production, at ALTO, GANIL (Caen), ISOLDE-CERN, JINR (Russia), JYFL (Finland), RIKEN (Japan), LNL and LNS (Italy), TRIUMF (Canada), ANL. Several members have leading roles in international collaborations. These groups have been involved in the design, construction and exploitation of state-of-the-art equipment at national and international facilities. Their role in the developments and performances of the ALTO facility is remarkable, together with that in S3-LEB at GANIL.

The committee find excellent research activities in both nuclear structure and reactions properties of current interest. The research efforts span a set of complementary measurements: nuclear spectroscopy of neutron-rich and SHE, electromagnetic moments and mass spectrometry together with nuclear reactions and the study of the equation of state. There have been important developments in the construction, characterization and design of instrumentation for nuclear spectroscopy (AGATA, OUPS, CLODETTE). Two large gamma-ray arrays, MINORCA and Nu-ball, have been constructed with local and European resources for targeted experimental campaigns that have produced important results and involved a large international user community. POLAREX has been installed at ALTO and will be part of a recently funded P2IO LABEX project. A few group members are devoted to the study of fundamental properties such as the neutron dipole moment at PSI, the gravitational interaction with antimatter at CERN, and atomic mass evaluation. The group has excellent visibility and recognition internationally, with leading roles in different research lines such as the spectroscopy of super-heavy nuclei, the measurement of nuclear moments and lifetimes, prompt gamma-ray and decay spectroscopy of nuclei far from stability, nuclear reactions and mass spectroscopy. They also have important responsibilities within international collaborations for the development of instrumentation and experimental resources (AGATA, SPIRAL2, JINR, CERN_ISOLDE, GSI/FAIR). IPN scientists and engineers have led the development of the charged particle arrays MUST2, MUGAST and future GRIT which play a major role in the scientific program at GANIL with RIBs.

Strengths

The group has demonstrated excellent scientific productivity in international journals that includes several review articles and excellent performance in the management, development and exploitation of ALTO. Group members are spokespersons for several experiments performed at international facilities (ALTO, GANIL, JYFL, JINR, TRIUMF, HIAF, ISOLDE-CERN, LNL, LNS, iThemba, ANL, ILL, RIKEN). Funding from national agencies has been successfully obtained to finance experimental resources (ANR, labex). The labex P2IO program *Terra Incognita* provides a framework to strengthen the collaboration with Saclay activities. Group members are involved in teaching activities, which facilitates attracting Master and PhD students. There is very good collaboration between theorists and experimentalists and very good collaboration with the Electronics and Informatics Services allows the successful development of high-performance experimental resources.

Weaknesses

The variety of research lines pursued by the group is stimulating. However, the fragmentation of personnel in several small groups may preclude further large-scale projects, leading roles in international collaborations and weaken priority developments. The reduction of funds over the last 5 years compromises the activity of the group.

Recommendations

Enhance synergies among the small groups, contributing with complementary skills in common adventures with a leading international role. It is Important to play a leading role in some S3 and DESIR developments and the related physics program. Improvements to the performance of the ALTO facilities should continue, enhancing the attractiveness for external users. Investigations into the possibility of combining RIB with the PERLE facility project should also continue.

Theme 2: Particle Physics

Theme leader: To be defined

THEME SCIENTIFIC DOMAINS

This theme covers all the experimental and theoretical activities related with high-energy physics.

THEME WORKFORCE

	TH2	
	Particle Physics	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	4	4
Assistant professors and similar positions	1	1
Full time research directors (Directeurs de recherche) and similar positions	15	15
Full time research associates (Chargés de recherche) and similar positions	10	10
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	0	0
Permanent staff	**30**	**30**
Non-permanent professors and associate professors, including emeritus	0	
Non-permanent full time scientists, including emeritus, post-docs, PhD students	35	
PhD Students	18	
Non-permanent supporting personnel	0	
Non-permanent staff	**35**	
Total	**65**	**30**

Global assessment of the theme

The Particle Physics (PP) activity is present at LAL, in the form of experimental research, and at LPT, in theoretical research. A small link between LAL and CSMSN exists in the context of the R&D of CUPID double beta decay project. In overview, the main activity in PP concerns the LHC (ATLAS and LHCb) from both the experimental and theoretical point of view. A recent small involvement in Belle 2 has been started at the LAL. LAL has been involved in the ILC from the beginning of the formation of the high energy Linear Collider community. Overall, the visibility, performance and track record of the experimental particle physics group is exceptional. On the theoretical side the performance can also be qualified as exceptional. The invitation to be part of the process for defining the European strategy for particle physics in 2020 is an indication of outstanding quality of the LAL laboratory's global contribution to experimental, theoretical and accelerator fields. The technical contributions by the LAL to the LHC are very important and visible. This includes the construction, integration, and follow-up of different components of ATLAS and LHCb detectors, some with high-level responsibilities. The laboratory is also quite involved in upgrade of these two experiments. The engagement in data analysis at LAL is very broad, ranging from historical channels related to the Higgs, to searches for new physics, to electroweak precision measurements in ATLAS in rare and semileptonic decays, heavy ions, charmed hadrons, etc., in LHCb. The LPT has been engaged on the theoretical side both on the Higgs Boson physics and the flavor physics. Non-accelerator PP is modestly represented by neutrino physics with the SuperNEMO and, recently, SoLid experiments. The impact of LAL's participation in SuperNEMO is nevertheless very important from a practical and historical point of view. Sterile neutrinos are one of the topics studied at LPT but it is not clear if this is related to SoLid.

Strengths

Two flagship projects are particularly noteworthy: the ATLAS group with major hardware and research responsibility and the LHCb group, which despite a smaller size, is quite visible in the collaboration with excellent scientific productivity and hardware contributions. The presence of AppStat group is an asset for optimization and enhancement of new analysis strategies leading to new physics discovery. In the context of the future unified laboratory, the presence of a strong theory group is an asset and an attractor for students. The ILC group is quite visible in the field. Their experience in detector development is an asset even if the ILC might not be approved. The Japan decision to host the ILC is still pending.

Weaknesses

The desire to diversify the activities of the Particle Physics team has led to initiating projects with too few researchers. This is particularly true in the dark matter and neutrino physics areas. The balance of university vs CNRS is not very good for permanent physicists, in particular at LAL. The duplication of the activity in theoretical particle physics between LAL and LPT would naturally be addressed in the framework of the larger unified unit.

Recommendations

If the ILC is not approved, the ILC team should be encouraged to join one of the existing activities. Within the future unified unit care should be exercised to maintain adequate balance in the allocation of resources between flagship projects like ATLAS and LHCb, and smaller initiatives. The group should plan to consolidate projects which are getting substantial external funding by promoting them strategically (avoiding obsolescence): this attitude could attract researchers with grants.

Theme 3: Hadronic Physics

Theme leader: To be defined

THEME SCIENTIFIC DOMAINS

The theme covers the experimental hadronic physics dealing with the hadrons and nuclei structure and high density and temperature matter properties.

THEME WORKFORCE

	TH3	
	Hadronic Physics	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	1	1
Assistant professors and similar positions	0	0
Full time research directors (Directeurs de recherche) and similar positions	5	5
Full time research associates (Chargés de recherche) and similar positions	9	9
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	0	0
Permanent staff	**15**	**15**
Non-permanent professors and associate professors, including emeritus	0	
Non-permanent full time scientists, including emeritus, post-docs, PhD students	14	
PhD Students	9	
Non-permanent supporting personnel	0	
Non-permanent staff	**14**	
Total	**29**	**15**

Global assessment of the theme

The research activities in experimental hadronic physics cover a wide range of experiments dedicated both to the structure of hadrons and nuclei and to the properties of strongly interacting matter at very high densities and/or temperatures. The research of the group is of overall excellent quality. These activities are carried out, in the framework of international collaborations at the main European and international laboratories (JLAB, CERN-LHC, GSI/FAIR) using both hadronic and electromagnetic probes. The group is also involved heavily in the ProRad at PRAE program of electron scattering, focused on the measurement of the radius of the proton. It is strongly involved in developments for the construction, characterization and design of state-of-the-art instrumentation in the framework of international collaborations and is playing a significant role in the preparation of the concept of a future Electron Ion Collider (EIC). It is also deeply involved in the development of fixed-target experiments with ALICE and LHCb at the LHC.

Strengths

The group has ample visibility in the international community, with leading roles in several research lines. In particular the group has the leadership of the nDVCS experiment at JLab Specific measurements at Jlab, of the muon tracking system of the ALICE experiment at the LHC and of the pion beam program of the HADES experiment at GSI and FAIR. The group, in all of the international collaborations in which it participates, has important responsibility for the development of instrumentation and experimental resources. This has been true in the past and continues at present, with a strong involvement in upgrade programs of the different experiments. There has been very good scientific productivity and prospective roles in major experimental programs. There are significant synergies between the different programs in which the group is involved.

Weaknesses

No major weakness was identified.

Recommendations

The unified unit could contribute both to the experiments and to the accelerator.

The synergies among the different activities of the group should be encouraged in view of medium term and long-term scientific goals.

Theme 4: Astroparticles and Cosmology

Theme leader: To be defined

THEME SCIENTIFIC DOMAINS

The theme covers all the activities concerning astroparticle and cosmology experiments, spanning from the gravitational waves detection, high-energy muons and dark energy.

THEME WORKFORCE

	TH4
	Astroparticles and Cosmology

Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	3	3
Assistant professors and similar positions	3	3
Full time research directors (Directeurs de recherche) and similar positions	10	10
Full time research associates (Chargés de recherche) and similar positions	7	7
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	0	0
Permanent staff	**23**	**23**
Non-permanent professors and associate professors, including emeritus	2	
Non-permanent full time scientists, including emeritus, post-docs, PhD students	16	
PhD Students	10	
Non-permanent supporting personnel	0	
Non-permanent staff	**18**	
Total	**41**	**23**

Global assessment of the theme

Astroparticles

The astroparticle theme addressed here covers the activities from the three of laboratories: LAL (VIRGO, SVOM, EUSO), IPNO (AUGER/AUGER-prime and CTA) at and CSNSM (eAstroGAM).

The LAL group has played a leading role in the VIRGO project since its beginnings in the 1990s. LAL is also a leader in the R&D for the advanced Virgo project. More recently the team has become involved in SVOM, a future Franco-Chinese satellite dedicated to gamma ray burst studies. They were previously involved in EUSO-balloon, a pathfinder project for a future satellite to study of ultra-high energy cosmic rays, but due to uncertainties in the future of the project and lack of manpower these efforts are no longer being pursued.

The IPNO group has been a major player in the Auger experiment since its beginnings. They are also contributing (electronics, bases for the SPMT) to AUGER prime, an upgrade of Auger to improve the shower-by-shower measurements of the mass composition. In the past they have participated (front end electronics, simulations) to LHAASO, an array currently under construction in China. More recently (2015), they have joined the CTA consortium, a future gamma ray ground-based telescope facility.

The CSNSM group is co-leader of the large project eASTROGAM, a gamma-ray satellite observatory, for which they have developed a new gamma ray detector (COCOTE) to explore the 0.1 and 100 MeV energy range. The project will be proposed in 2019 and launch in 2028.

All the teams are making outstanding and invaluable contributions to these experiments. Their research is world leading, of excellent quality and of high impact.

Cosmology

The group is making excellent scientific contributions on key questions of modern cosmology (CMB, dark energy, and 21 cm radiation detection), with balanced investments in corresponding new projects (Qubic, LiteBird and ACTPol/Simons Observatory for CMB, LSST and the LSST Dark Energy Science Collaboration for dark energy) and original innovative contributions to new directions (BAORadio for 21 cm radiation from neutral hydrogen). Although the team is relatively small (13 permanent scientists at LAL and CSNSM, roughly 2/3 CNRS and 1/3 University, and 3 students/postdocs) it is making important contributions to these projects in terms of technical hardware, software and catalog systems, and analysis of the cosmology implications of existing data.

Strengths

Astroparticles

The VIRGO group has made long term and key contributions to hardware, software and analysis of VIRGO. The capability to contribute to both the technical and analysis efforts is a great asset of the group. The recent very impressive discoveries of gravitational wave (GW) emission from black hole–black hole and neutron star-neutron star mergers by the LIGO/VIRGO consortium have 'revolutionized' the field of astroparticle physics and the importance has been recognized with the award of the Nobel Prize for Physics in 2018. These major discoveries have had a big impact on public awareness and support for big science.

The GW detectors continue to improve in sensitivity with the advanced LIGO and VIRGO upgrades coming online in 2019. At the LAL CALVA test facility, the potential of quantum squeezing to improve sensitivity is being explored. The long-term scientific roadmap for GWs is established and well-coordinated at the international level.

The VIRGO group has, in a relatively short time, also made important contributions to SVOM with the design of a transient alert system between the two instruments, which will certainly help pin-point and identify the origin of the GW events. The team has a clear physics focus with excellent complementarity between VIRGO and SVOM.

The Auger group has made important technical contributions to the construction of Auger and is very active in many Auger analyses. This includes the recent observation of an anisotropy in the arrival directions of the UHECR-supporting an extragalactic origin. They have high-level responsibilities within the coordination and management of Auger as well. It is good news that the French funding for Auger prime has been secured.

The CTA group includes two permanent researchers that both also participate to Auger experiment. The CTA IPNO group, in collaboration of the R&D technical team, has developed a calibration system for the NectarCAM and assumed the coordination of the extragalactic science working group. There is a good

collaboration with UC Santa Cruz exploiting public Fermi data. The French funding for CTA is now secured. The group has access to excellent Chinese students.

The CSNSM group is a co-proposer of the eASTROGAM project for which the ground-breaking polarization capabilities are of much interest.

Cosmology

The group is well positioned to make key contributions in hardware and software, through a coherent scientific roadmap, a good balance of projects related to Dark Energy (small and big), and some new visionary projects such as BAORadio. The program rests on a foundation of many years of remarkable accomplishments as part of the Planck project, which has resulted in an ever deepening understanding of the key cosmological issues. The connection to the growing CMB community in North America through the Simons Observatory is a particularly noteworthy and important development. The coupling to a strong French community on the LSST Dark Energy Science Collaboration and the important role played by CC-IN2P3 as a reconstruction center for LSST data also position the group well for the dark energy science that will be available from the LSST data set.

Weaknesses

Astroparticles

Considering the important teaching responsibilities and management commitments, the lack of permanent CNRS researchers involved in CTA is a concern.

Cosmology

Areas of concern include the reduced size of the CMB team along with a lack of clarity about the French CMB roadmap overall, the limited level of scientific productivity around BAORadio activity, which as a new area is a technically very challenging project, and Insufficient presence in international conferences. Nevertheless, the LiteBIRD mission has been selected by the JAXA as Strategic Large Mission scheduled for launch in 2027.

Recommendations

Astroparticles

For the GW group better coordination at the national level with the other French VIRGO groups would maximize efficiency and visibility.

The LHAASO experiment will soon come online and it would be a lost opportunity not to benefit from the good links already established with LHAASO.

The merger of the various laboratories offers access to nearly coverage of different wavelengths (low energy gammas, optical, high energy gammas) and messengers (photons, GW, CRs). An improved interaction between the various FLUO groups in multi-wavelength/multi-messenger astronomy should be encouraged. This could be furthered strengthened with enhanced links to the theory group. In this context, and if manpower allowed, adding a component of neutrino astronomy could only be beneficial.

Cosmology

Depending on the nature of the project, the committee favours in some cases deepening scientific interaction with partners. There also seems to be an opportunity to increase the number of graduate students (Master and PhD) in the program.

Theme 5: Neutrinos and Dark Matter

Theme leader: To be defined

THEME SCIENTIFIC DOMAINS

The theme covers the neutrino physics and dark matter searches.

THEME WORKFORCE

	TH5	
	Neutrinos	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	0	0
Assistant professors and similar positions	2	2
Full time research directors (Directeurs de recherche) and similar positions	3	3
Full time research associates (Chargés de recherche) and similar positions	8	8
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	0	0
Permanent staff	**13**	**13**
Non-permanent professors and associate professors, including emeritus	0	
Non-permanent full time scientists, including emeritus, post-docs, PhD students	9	
PhD Students	6	
Non-permanent supporting personnel	0	
Non-permanent staff	**15**	
Total	**28**	**13**

Global assessment of the theme

The Neutrino and Dark Matter domains partly overlap with Particle Physics and Astrophysics/Cosmology. Experimental activities are carried on at LAL, benefiting from a strong support from LAL technical services, in CSNSM, were the development of advanced detectors and sensors benefits of the presence of core expertise in solid state physics, and in IPNO. Participation of experimental groups in world-class experiments in neutrino physics and dark matter searches at different stages of maturity are particularly noteworthy. A mix of both running experiments (NEMO-SuperNEMO, CUPID, SOLiD and XENON) and experiments in the design and construction phase secures data and published results for both the near- and long-term future in the research domains of neutrino and dark matter physics. The contribution of the CSNSM group to the development of innovative detectors and sensors for WIMP and double beta decay searches is outstanding.

Strengths

The group is participating in world-class experimental activities in neutrino physics and dark matter searches. Also, there is a good mix of running experiments and experiments in the design/construction phase. The group brings highly qualified technical support from the home labs and unique interdisciplinary competences for innovative particle detectors and sensors.

The group has a favourable ratio of PhD students senior research staff (neutrino) and has shown a remarkable capability to access funds from competitive grants.

Weaknesses

There is a concern about the viability of highly fragmented participation in experiments scattered around the world, which seems not sustainable. Success in accessing substantial funds from competitive grants may delay medium-term funding plans from Funding Agencies.

Recommendations

The participation in different experimental activities in the neutrino and dark matter domains appears very fragmented. This is likely to limit the full exploitation of the potential offered by access to strong and highly qualified technical services and multidisciplinary scientific knowledge. With the present scheme there is the risk that the Orsay contributions to experiments be too diluted to be clearly identified and acknowledged. A plan with better identification of strategies priorities is recommended.

The group has the opportunity to leverage technical services, multidisciplinary knowledge and diversity to gain a reference role in experiments with high discovery potential. In addition, the unification with a nuclear physics laboratory (IPNO) may help involve nuclear physicists in neutrino experiments where nuclear physics may play a very relevant role.

Theme 6: Nuclear Astrophysics and Chemistry

Theme leader: To be defined

THEME SCIENTIFIC DOMAINS

The main research axis of this theme is focused on the origin of chemical elements and the evolution of their abundances.

THEME WORKFORCE

	TH6	
	Nuclear Astrophysics and Chemistry	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	0	0
Assistant professors and similar positions	2	2
Full time research directors (Directeurs de recherche) and similar positions	5	5
Full time research associates (Chargés de recherche) and similar positions	2	2
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	0	0
Permanent staff	**9**	**9**
Non-permanent professors and associate professors, including emeritus	1	
Non-permanent full time scientists, including emeritus, post-docs, PhD students	3	
PhD Students	1	
Non-permanent supporting personnel	0	
Non-permanent staff	**4**	
Total	**13**	**9**

Global assessment of the theme

There are two teams working in this domain, one from CSNSM (composed by two groups, Astronuc and Astrosol, NAG and SAG from now) and the other from IPNO Astro one (composed by members of the NEESTER+NIM groups). Their global activity is excellent with two outstanding research lines. The main scientific goals have to do with the fundamental question of the origin of chemical elements and the evolution of their abundances. This is a central topic in Astrophysics that has many consequences in different fields (Cosmology, Stellar evolution, origin of the Solar System…) and, at the same time, has a strong impact on other disciplines, such as Nuclear and Particle Physics or Analytic Chemistry just to cite few examples, as a consequence of the challenging demand for new data (cross sections, isotopic abundances…). Furthermore, one of the tools to obtain information about the origin of the elements, Gamma-Ray Astronomy, has become a fundamental piece of Multi-Messenger Astronomy, as shown by the successful simultaneous observations of GW170817 by LIGO and the space missions Fermi and INTEGRAL.

There are two particular research activities that qualify as outstanding and are of fundamental long-term importance. These are areas are the isotopic characterization of micrometeorites and cosmic dust, and the detection and study of gamma rays in the MeV region.

The isotopic analysis performed by the SAG group is fundamental to understanding the origin and evolution of the different bodies of the Solar System and other planetary systems. The present attempts by the space missions Osiris-Rex and Hayabusa-2 to obtain samples of asteroids and return them to the Earth for analysis, and the plans by the James Webb Observatory to study other planetary systems, as well as a number of future mission proposals to explore asteroids, clearly show a high level of interest in this topic. In this sense, the analysis performed by the group on the Antarctic micrometeorites collected at Concordia-Dome C, as well as dust already obtained by Rosetta and, in the near future, by Hayabusa 2, is outstanding.

The part of the electromagnetic spectrum between roughly 0.1 and 100 MeV is known as the MeV frontier because it is poorly explored and contains extremely important information about different phenomena in the Universe that are related to Nuclear and Particle Astrophysics. The teams NAG-INPO have designed a new detector (Compton CAM) for a new space mission (eASTROGAM) aimed to cross this frontier. They are co-leaders of this mission, which involves about 400 people from 29 countries (see arxiv 1711.01265 for details).

Besides these efforts, the team is studying nucleosynthesis during the Big Bang, the evolution of stars and the interaction of cosmic rays with the interstellar matter, as well as processes that produce acceleration particles in different environments, such as solar flares, stellar explosions, interstellar medium…. They are also working on the determination of the cross sections for nuclear reactions that are critical in high precision Astrophysics – IPNO, NAG.

The IPNO and NAG groups are strongly involved in the determination of the cross sections for nuclear reactions that are critical in high precision Astrophysics. Nucleosynthesis processes induced by galactic cosmic-rays, and occurring in massive stars and binary systems with a compact object, are under study. A variety of experimental methods (direct and indirect) are used for this purpose using both stable and radioactive ion beams. These experiments lead by the NAG and IPNO groups are carried within international collaborations at local and national facilities such as ALTO and GANIL, respectively, and abroad such as MLL and iThemba.

Finally, all of the groups are collaborating on research related to the origin of the Solar System as revealed by primordial radioactivities, as modified by Sun-Earth solar wind interactions that synthesize 10Be – SAG, NAG, INPO.

Strengths

The three teams in the group working on two or three prominent, complementary topics that are close connected and have produced a number of papers in the top scientific journals. There are good opportunities to obtain external funding and the group has access and/or ownership of appropriate infrastructure (Antarctica facilities, space observatories, clean rooms, accelerators, MYRTHO Platform), as well as participation in important space missions such as Rosetta and Hayabusa. The group also is well integrated into the international network in this field, has leadership of a gamma-ray observatory proposal (eASTROGAM), and is partnering well with the industry. The number and quality of publications, PhD theses, projects and funding possibilities show that the group has an excellent trajectory.

Weaknesses

The team is medium sized (eleven permanent staff, eight non-permanent and four PhD students) with two expected retirements. This theme is also not currently identified as a separate unit on the organizational chart for the merged laboratory. The research has a strong dependence on the platforms (MYRTHO, SCALP, ALTO) and therefore its continued impact is tightly coupled to their future.

Recommendations

Consider increasing the manpower attached to the group. Find a way to ensure access to the relevant platforms under good conditions. Because of this theme is cross-cutting, the group could end up being distributed into three different organizational units. If this were the case, we would suggest providing them with mechanisms to facilitate collaboration and visibility as an interdisciplinary group within the designated FLUO research lines. As part of its scientific compulsory program, in 2018 ESA solicited F–mission (fast development, wet mass below 1000 kg, ESA cost capped at 150 M€) proposals to be implemented as a co-passenger on M-missions, such as Ariel or Plato, to the second Lagrangian point. The final selection of proposals will be announced at the end of July. Six proposals have been preselected during phase 1, including a reduced version of eASTROGAM. If not selected during this call, eASTROGAM will continue to compete for an M-mission slot. FLUO should foresee how to accommodate this kind of project within its organization and planning.

Theme 7: Theoretical Physics

Theme leader: To be defined

THEME SCIENTIFIC DOMAINS

This theme covers almost all the aspects of theoretical physics dealing with nuclear, hadronic, particle physics standard model and its extensions, cosmology, mathematical physics, and interfaces with life science.

THEME WORKFORCE

	TH8	
	Theoretical Physics	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	5	5
Assistant professors and similar positions	9	9
Full time research directors (Directeurs de recherche) and similar positions	13	13
Full time research associates (Chargés de recherche) and similar positions	12	12
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	0	0
Permanent staff	**39**	**39**
Non-permanent professors and associate professors, including emeritus	2	
Non-permanent full time scientists, including emeritus, post-docs, PhD students	33	
PhD Students	19	
Non-permanent supporting personnel	0	
Non-permanent staff	**35**	
Total	**74**	**39**

Global assessment of the theme

The "Theory Theme" analyzed here, regroups theoretical activities from different laboratories: the four teams from LPT, the "Theory" team from LAL, the "Theoretical Physics" theme from IPNO and the team "Modélisation des Systèmes Biologiques" from IMNC. Overall, these teams produced research of excellent quality, impact and productivity (>800 articles), over a wide and multi-disciplinary range of topics at the forefront of theoretical physics, including: mathematical physics (LPT), cosmology (LPT), QCD and flavour physics (LPT, IPNO, LAL),Higgs and BSM particle physics (LPT), hadronic and nuclear physics (IPNO), statistical physics (LPT) and (T7) interfaces with life sciences (IMNC). There are outstanding contributions made to flavour physics (fits and leptoquark interpretations of b-decay anomalies), effective field theory approaches to Higgs couplings, and ab initio and beyond-mean field approaches in nuclear physics.

Strengths

The group has excellent national connections and international visibility through numerous international collaborations, prizes and reviews, strong involvement in European projects (1 ERC, 5 EU Networks and Joint research activities), and leading roles in worldwide prospective studies (LHC working groups, Belle Physics Book) and averaging/fitting groups (FLAG, UTFIT CKMfitter). There is also strong engagement in training and development of young researchers, which creates a very attractive scientific environment for PhD students and postdocs, with excellent career prospects after Orsay. Where relevant, there are excellent local connections with experimental groups.

Weaknesses

Retirements without replacement have resulted in a significant decrease in staff (-30%) over the previous review periods, and new hiring during the last research period halted further decline, but did not compensate the earlier decrease. While emeriti (7) are temporarily alleviating the impacts to some degree, further retirements (15%) are expected in the near future, and certain subgroups (T1 & T6) will be left subcritical as a result. For other subgroups (T5), the number and fraction of University staff is particularly low, which might hinder the attraction of Master and PhD students. It is thus essential to reinforce this pole by recruitments. Despite a good overall grant application and success rate, the completion of some grants and the increasing difficulty of obtaining new ones have reduced the Ph.D. and postdoc hiring capability down to disturbingly low levels (0.25-0.5 PhD/permanent staff depending on the topics). Internal collaboration among different subgroups and common projects could be greater.

Recommendations

Among the various themes emerging from the merger of the Orsay laboratories, theory is the theme undergoing the deepest restructuring. Care should be taken to ensure that the important potential benefits from this major evolution towards the largest theory group of its kind in France are fully realized. In particular, it might help the success of future grant applications to seize any opportunity to build the visibility of this new group and to advertise the excellent success record of its former students and postdocs.

Also, refining the convincing and impactful strategy described for the new group and actively participating in its articulation within the anticipated global strategic planning for FLUO might help to reverse the long-term trend of staff decrease and to anticipate coming retirements.

Where applicable, enough priority should be given to preserve the very good existing links with local experimental groups. Researchers interested in more theoretical topics (T1, T6), with fewer connections to local experiments, should keep their excellent links with neighbouring groups with similar interests (T1: CPhT, IHES, etc.), or might on the occasion of the merger extend their interfaces with life sciences (T6-T7).

Theme 8: Health Physics

Theme leader: To be defined

THEME SCIENTIFIC DOMAINS

This theme is focused on developing new approaches to explore living organisms and also to improve diagnosis and treatment on oncology.

THEME WORKFORCE

	TH9	
	Health Physics	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	1	1
Assistant professors and similar positions	9	9
Full time research directors (Directeurs de recherche) and similar positions	1	1
Full time research associates (Chargés de recherche) and similar positions	3	3
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	1	1
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	1	1
Permanent staff	**16**	**16**
Non-permanent professors and associate professors, including emeritus	0	
Non-permanent full time scientists, including emeritus, post-docs, PhD students	16	
PhD Students	10	
Non-permanent supporting personnel	0	
Non-permanent staff	**16**	
Total	**32**	**16**

Global assessment of the theme

The main objective of the health physics theme, mainly driven by the IMNC unit, is to develop innovative instrumental, methodological and theoretical approaches to improve the exploration and understanding of living organisms, but also to strengthen the diagnosis and treatment of diseases in oncology. The scientific team presents expertise in disciplinary fields such as radioisotope imaging instrumentation, radiotherapy, modeling and simulation of biological processes dedicated to multidisciplinary scientific questions.

The presented strategy is mainly based on potential technological or methodological breakthroughs and new modelling approaches of complex biology systems. The research activities are well organized around four thematic research components that are i) Instrumentation & radioisotope preclinical and clinical imaging, ii) In vivo biophotonic imaging, iii) modeling of biological systems, and iv) the new approaches in radiotherapy.

The valorization of knowledge is done through industrial partnerships, maturation of scientific projects and software licensing. The staff of the unit is by nature strongly involved in teaching and taking responsibilities in different educational structures of the Universities.

IMNC laboratory is well recognized and a key player on the national level in physics applied to life science. The structure put in place by the unit has been able to bring out major scientific projects such as spatial dose splitting in proton therapy, a young laureate of the ERC grant.

Strengths

The research team has developed strong skills and recognized expertise at the crossroad between physics and health science. They demonstrated originality on methodological approaches and ability to attract excellent PhD students in a conductive environment. One of the reasons is a strong involvement in different educational structures of the Universities. The development of specialized instrumentation dedicated to clinical investigations reinforced the collaborations and partnerships with the clinical and socio-economic world. The proposed environment is very conducive to the emergence of innovative projects.

Weaknesses

IMNC laboratory is segmented in four distinct teams with excellent scientific output. However, there are few cross-cutting projects involving members of different teams. The team has already developed innovative instrumentation in collaboration with technical groups from other labs. However, the technical staff acting as a communication channel between the physicists and the specialized engineers is sub-critical. The overall number of permanent people compare to larger local structures working in the same scientific domains could represent a weakness.

Recommendations

Spatial dose splitting in proton therapy represents one of the major scientific projects of the group. In order to have a global vision on innovative therapy approaches using ionizing radiation, the team should push forward the development of internal therapy as a complementary approach.

The merger of the Orsay Valley laboratories will bring together skills and expertise in instrumentation that should lead physicists to think about and get involved in new technological challenges such as the required improvement in time of flight PET to reach 10ps.

The management of the health component should be vigilant to maintain a fair balance with other strong disciplines such as optical imaging.

The health component will also need to maintain visibility and readability within this larger organizational structure to keep its attractiveness, particularly in terms of discipline such as biology.

A close connection between core engineers and physicists will be needed to optimize the development and delivery of specialized technical services and the proposed commercialization structure.

Due to the specificity of the proposed developments, the team will have to strengthen collaborations with other local laboratories presenting complementary approaches in the fields of therapy and medical imaging. They will be able to rely in particular on the diversity of platforms such as ALTO, THOM X and PRAE to jointly propose major and innovative scientific projects.

The presence of researchers from the Paris Diderot University is crucial for the smooth running of the health component scientific program which seems to be perfectly in line with the multidisciplinary scientific objectives of the University. The strengthening of the University's support is fundamental and complementary to the development of Paris-Saclay University.

Theme 9: Energy and Environment

Theme leader: To be defined

THEME SCIENTIFIC DOMAINS

The theme concentrates on nuclear energy issues, nuclear wastes, and radiochemistry.

THEME WORKFORCE

	TH10	
	Energy and Environment	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	2	2
Assistant professors and similar positions	8	8
Full time research directors (Directeurs de recherche) and similar positions	2	2
Full time research associates (Chargés de recherche) and similar positions	9	9
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	0	0
Permanent staff	**21**	**21**
Non-permanent professors and associate professors, including emeritus	0	
Non-permanent full time scientists, including emeritus, post-docs, PhD students	19	
PhD Students	11	
Non-permanent supporting personnel	1	
Non-permanent staff	**20**	
Total	**41**	**21**

Global assessment of the theme

The fields covered by theme 10 "(Nuclear) Energy and Environment" are many: they concern radiochemistry applied to the nuclear fuel cycle, nuclear physics applied to nuclear reactors, and material science coupled to irradiation. This theme addresses many of today's key issues in the nuclear energy field (especially in a country exploiting 58 reactors) such as waste management, the future of nuclear energy or related materials. The teams take advantage of the specific unique skills of their scientific and technical staff and the facilities at their laboratories to carry out research at an excellent level, collaborating with the CEA and the major French industrial partners involved in nuclear energy (EDF, ANDRA, AREVA, …). Most of the studies rely on fundamental research, which is the specialty of CNRS and the Universities, and therefore is a legitimate and appropriate contribution to this theme. The partnership with industries is testament to the specific academic skills provided by the Orsay laboratories. CNRS and Universities also offer a good framework for interdisciplinary approaches to some topics (nuclear scenarios, actinide speciation, material science and the like).

Strengths

Several research topics are conducted in collaboration with the main French nuclear energy partners (CEA, IRSN as well as industries) which demonstrates the relevance of the projects at a national level. It also offers good opportunities of funding (contracts and PhDs). Some projects are also funded thanks to the European programs EURATOM, and EUROfusion, showing their importance at the international level.

75% of the permanent staff (University or CNRS) is involved in teaching activities: some are also involved in the supervising of a bachelor and 3 masters on energy science. 38 PhD thesis were supervised in the teams during the 2013-2018 period. This involvement with developing future young scientists is excellent and of prime importance for the sustainability of the topic.

The great originality in the approach to scenario studies should be noted in particular: thanks to new and efficient calculational techniques, many fuel cycle scenarios can be explored, integrating many parameters and their possible variations: with this understanding of scenarios it is possible to identify the parameters relevant to reach a given objective and also to study the possibility of reaching a new objective on the path towards the initial goal. This methodology proposes a unique tool adapted to long-term strategy where disruptions may happen.

IPNO has specific skills and equipment for radiochemistry which allow experiments with actinides and some radioactive lanthanides. It is one of the few places at CNRS where practical works in aqueous solution can be performed combined with nuclear techniques (alpha and gamma spectrometry) to study radionuclides interactions with natural or anthropogenic species present in the environment. It brings new chemical data helping to improve the modelling of radionuclides migration, a topic well anchored in today's challenging issues.

The important effort put into ion beam interactions with matter both for fundamental and modelling purposes and for the study of radiation effects in materials of interest for the nuclear energy should also be recognized. This work serves many fields with applications like the fuel itself, reactor structural materials, nuclear waste confinement matrices, all of which are particularly relevant and topical for new reactor design, waste storage or reactor dismantling.

Weaknesses

The growing part of the external funding could weaken long-term academic research (risk of a research steered by external resources only).

Some skills in the radiochemistry and materials and irradiation teams will be weakened by 4 upcoming retirements. The pursuit of many different topics with slightly decreased manpower could lead to reductions in some activities. The observation is also applicable to the nuclear data activity.

Due to the breadth of the theme it is difficult to define common research projects which could maximize the impact of manpower.

The labs are partners on several projects in the NEEDS CNRS program: the end of this program could affect the future of these efforts.

Recommendations

In the merged lab the theme « nuclear energy and environment » is proposed to appear as a whole unit, which will give it visibility; however it should not be forgotten that it is composed of different domains (nuclear physics, radiochemistry, solid state physics) having their own specificities, techniques and experts, which could make it difficult to define unified projects or to share manpower: each domain should then concentrate on topics where it excels, limiting scattering if manpower decreases, but taking benefit from exchanges inside the theme and with associated external disciplines (economics, solid state physics, earth sciences,...).

It is crucial to maintain the JANNuS/SCALP platform as a leading facility for irradiation and characterization, as well as the hot cells (dedicated to actinide chemistry): projects making use of these techniques and relying on radiochemistry and physics experience should be made high priority as they would help to keep the expertise of the staff and enhance the renown of the lab in that field (inscribed in the specific features of IN2P3).

The several years' investment of IPNO at n-tof (CERN) in the fission activities gave it a visible and leading position, especially in operating the PPACs detection system. This work has produced significant results for several isotopes. Its value would be much increased by coupling these new data and the ones to come to an effort towards nuclear data evaluation, to benefit to the nuclear reactor community.

Theme 10: Solid-state Physics

Theme leader: To be defined

THEME SCIENTIFIC DOMAINS

The theme focuses on material science and solid-state physics with an emphasis on developing new detectors for particle detection.

THEME WORKFORCE

	TH11	
	Solid-state Physics	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	0	0
Assistant professors and similar positions	3	3
Full time research directors (Directeurs de recherche) and similar positions	0	0
Full time research associates (Chargés de recherche) and similar positions	1	1
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	1	1
Permanent staff	**5**	**5**
Non-permanent professors and associate professors, including emeritus	0	
Non-permanent full time scientists, including emeritus, post-docs, PhD students	1	
PhD Students	1	
Non-permanent supporting personnel	0	
Non-permanent staff	**1**	
Total	**6**	**5**

Global assessment of the theme

This theme is covered by two teams, "Matériaux et Irradiation" (MIR, Materials and Irradiation) and "Physique du Solide" (PS, Solid state physics), which belongs to only one of the research units involved by the fusion of Orsay labs, the CSNSM. Most of the research topics involved have interdisciplinary links with the main IN2P3 research direction. In developing new instrumentation, for example, advanced materials for detectors physics and electronics for astroparticle physics in the PS team, or irradiation studies of materials relevant for nuclear reactor engineering for the MIR team are very valuable and relevant. At the same time, some research topics are specific to material science and solid state physics, although with potential interest in the long term for, e.g. detector physics. The group's activities will continue through the merger although some reorganization of the theme is foreseen, with the activity of the MIR team joining the "Energy and Environment" theme, while the one of the PS team will join the "Neutrino/Dark matter" on one side and a more focussed "Solid-State Physics" theme on the other, with the latter covering both fundamental aspects of Solid-State Physics as well as detector applications. In the following we will refer in particular to the latter, as relevant for the merged unit.

Strengths

The theme has an excellent research record, with activity covering also teaching and outreach that is internationally recognized, and a remarkable capability to attract funds at all the levels (regional; national; European). Its unique know-how has been pivotal in the outstanding results obtained in detector physics for WIMP and double beta decay searches (see Section 7. Neutrino/Matière noire).

Weaknesses

This is a rather isolated theme, which has limited synergies with the other units involved in the merger, and with specific technical abilities and research approaches necessary for the solid-state-physics field.

Recommendations

This activity must be conserved in the merged laboratory; both for short term and potential long term benefits to the field of detector physics, in particular for weakly interacting particles. It constitute a fundamental pillar of the "Centre de sciences nucléaires et de sciences de la matière" (CSNSM) i.e. the "Centre of nuclear and material science", that, as its name states, is characterized by a multidisciplinary approach that allows fruitful interdisciplinary research projects while maintaining visibility and recognition of each thematic component. As this theme will be further diluted in the new research unit merging the different IN2P3 Labs of the Orsay valley, particular care will be necessary to support and sustain its amazing scientific and technical achievements and to maintain its exceptional research and technical capabilities. Apart the activities strictly covered by the "Solid-State Physics" theme, it is important also to mention the research platform allowing in-situ analysis of irradiated materials and irradiation process: the JANNuS/SCALP, which also has important applications in material science (e.g. in semiconductors and metallurgy), beyond application for energy and environment.

Theme 11: Accelerator Physics

Theme leader: To be defined

THEME SCIENTIFIC DOMAINS

The theme deals with all aspects of accelerators physics and future acceleration technics.

THEME WORKFORCE

	TH12	
	Accelerator Physics	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	1	1
Assistant professors and similar positions	3	3
Full time research directors (Directeurs de recherche) and similar positions	2	2
Full time research associates (Chargés de recherche) and similar positions	7	7
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	26	26
Permanent staff	**39**	**39**
Non-permanent professors and associate professors, including emeritus	0	
Non-permanent full time scientists, including emeritus, post-docs, PhD students	19	
PhD Students	14	
Non-permanent supporting personnel	1	
Non-permanent staff	**20**	
Total	**59**	**39**

Global assessment of the theme

The superconducting expertise in low-beta accelerating cavities in IPNO is outstanding. The group has developed, produced, and delivered all of the high beta QWR cavities for the SPIRAL- 2 project at GANIL, all of which met specification. Seeing this success, the European Spallation Source (ESS) has placed an order for all the spoke cavities with IPNO; MYRRHA has signed a contract for the development of a spoke cavity prototype; and Fermilab is in negotiations for spoke cavities for their PIP-II Project. This places IPNO in the select club of laboratories in the world that are able to design and produce the cavities that are required for low-velocity particles. For example, IPNO is in a key position for the 100 MeV MYRRHA linac construction.

In a similar vein, the coupler expertise at LAL is also outstanding. LAL was responsible for designing, producing and delivering 800 input couplers for the X-FEL Project at DESY. The HOM couplers for the same project were assigned to a different lab and failed to meet specifications so that the contract had to be cancelled and re-assigned. The fact that LAL was able to deliver all of the input couplers and to meet the tight specifications is therefore a clear demonstration of world-class performance. With a unique platform in the world, LAL reached a production rate of 8 couplers per week in the nominal phase, which is a real success.

There are other activities which are at an international level. The LAL team played a central role in the development of nanobeams at the ATF facility at KEK, Japan. The development of sub-picosecond beam diagnostics was carried out at the FACET facility at SLAC, the SPARC facility at INFN, Frascati and two French labs (SOLEIL and CLIO).

The work on laser-plasma acceleration at LAL is on the cutting edge of accelerator R&D; however, the limited investment in staff and budget makes it hard to be a leader in the field. Integration at LAL of the laser facility LASERIX and associated group could move the group to a competitive position internationally, but only if the theme is given sufficient resources.

Of particular interest is the new THOMX facility, which is under construction, as it will be a demonstrator of an innovative concept. However, THOMX was initiated as a project to build a prototype accelerator. Unlike PRAE or PERLE, it is not clear if there is an internal user community. The market research should have been performed earlier and the project should have been co-developed with an internal user community.

Regarding work on electron-laser interaction performed at LAL, the development of the optical circulator for ELI-NP is particularly impressive, as attested by the low power results.

PRAE has been established as a multi-disciplinary project between several laboratories which is a real asset. However, the schedule presented seems too optimistic.

It should be noted that there was a clear absence of coordination between the 2 labs for the reports.

Strengths

The accelerator reports are detailed and demonstrate that LAL and IPNO have internationally recognized strengths. The overall assessment is that accelerator physics is excellent, but it must be noted that the activities related to superconducting RF at IPNO and RF coupler at LAL are outstanding.

Among the five laboratories, there are seventeen large scale dedicated platforms on site, all of which are doing excellent work in their respective areas: 6 of them are accelerators.

The model selected for PRAE, multi-disciplinary project involving between several laboratories, is excellent and should be followed in all of the local projects.

PERLE is an excellent new opportunity with the potential to integrate both the accelerator staff in LAL and IPNO as well as attracting an internal user community from the five laboratories. However, it is not presented as a flagship project for the new laboratory; the Reviewers believe that it should be. Of all the projects presented, PERLE would be the most likely to place the integrated laboratories squarely at the forefront of modern accelerator R&D and position them to have a world-leading impact on future accelerator options at CERN.

Weaknesses

The engineering and technician support seems to be insufficient to address the very large number of projects and in addition, the number of support staff is decreasing with time. The integration of the support staff in the five laboratories is proving difficult (see later in the report) and this could have a strong, negative impact on the ability of the combined laboratories to attain the international leadership that is the goal of the integration.

When operating accelerators, the questions of operators and running costs are essential, but there was no evidence that this matter was considered carefully.

As with all accelerator groups world-wide, there is a difficult balance between R&D and construction. It is hard to maintain the skills of the staff during the long gaps between projects. It will therefore be extremely important to develop management tools that enable (and encourage) flexibility – and there was little evidence of that in the review.

It will prove vital for the new Directorate to make difficult choices and focus on fewer, but world-leading, projects. There is no indication as to how to motivate researchers to change field, and there was little evidence that the staff would be willing to branch out. This is probably less important for the accelerator staff than the other scientific staff since they have a history of working for other projects and they will now have on-site projects to work on.

Recommendations

Define the vision for the Accelerator Pole: will it support projects inside the lab proposed by users or do they initiate projects?

Theme 12: Multidisciplinary

Theme leader: Mr Philippe MORETTO

THEME SCIENTIFIC DOMAINS

This theme combines all the interdisciplinary subjects covered by the new laboratory.

THEME WORKFORCE

People working in this Interdisciplinary theme are primarily assigned in other themes and thus cannot be accounted twice here. Furthermore, the number of people in this theme may thus constantly vary depending on the scientific projects in progress.

Global assessment of the theme

The main multidisciplinary themes covered by the merged lab will be: (1) health physics; (2) solid state physics and radiation effects in materials; (3) energy & environment (including radiochemistry); and (4) laser interaction for the production of X- and gamma-rays. Note that there is significant overlap in this report between this section and reports of the individual scientific themes. . This part of the report is thus limited to general aspects. Multidisciplinary themes are not uniformly developed in the five existing Orsay labs but rather in a more historical but complementary manner: Health Physics is mainly developed at IMNC (with some additional technical development at LAL), solid state physics and radiation effects in materials at CSNSM, nuclear energy & environment at IPNO (and CSNSM regarding the irradiation of materials), and laser interactions at LAL.

In the theme energy & environment, the common thread is the radiochemistry, where the methods and expertise play a key role in the design of innovative energy systems (actinides, molten salts...), nuclear waste and to some extent for isotope/speciation in environmental applications (mainly in the survey of the nuclear industry impact). These environmental aspects may appear rather limited in impact, but the expertise available is crucial.

Themes such as solid state physics and radiation effects in materials are linked to the IN2P3 main topics in two ways. They contribute in very important ways to breakthroughs in the design and the construction of innovative instrumentation (new concepts for advanced detection systems) and they take advantage of the expertise developed in the use of methods and techniques from the core discipline (ion beam characterization, facilities, etc.). This fully justifies the existence and the continuation of these efforts in the IN2P3 labs.

Strengths

Multidisciplinary research offers the potential of wider integration into the scientific policy of the University (P2IO vallée, labex, équipex,) and the local ecosystem of innovation. It also offers a route to access and use facilities supported by the different labs (Andromede, JANNuS/SCALP...). This constitutes a relevant and important added value, beyond the expertise and the instruments offered by CNRS-IN2P3. The group provides access to strong technical support for the development of specific instrumentation (advanced detection systems, beamlines, electronics, data management, etc.). This type of multidisciplinary work has good potential for technology transfer and licensing (medical imaging, detectors, electronics ...), partnership with socioeconomic actors (ANDRA, EDF, AREVA, etc.). It also connects the Orsay labs to European networks and infrastructures opportunities and in general the capacity to apply to other funding agencies and specific calls for projects at different levels. It broadens societal impact for the community and openness of the labs towards society, particularly in the fields of energy, health and environment. Finally, it provides attractive research opportunities for students, beyond nuclear and particle physics.

Weaknesses

The different interdisciplinary themes are not universally found across all the Orsay labs; often they are addressed in only one of the five labs at this time. The merger is an opportunity to better structure these efforts, but it also constitutes a potential threat in the context where the main IN2P3 research topics will increase in their relative size and weight, leaving a concern of resources and priorities associated with smaller programs. The small size of some of the theme efforts in terms of dedicated personnel is thus a concern, with potential future consequences in terms of loss of know-how, poor attractiveness for students and new staff, and the like. The risk of competition with much larger merged thematic poles resulting of the merger could result in a poor

visibility and low priority for the access to hiring new personnel. Some of these interdisciplinary research topics that are not in the mainstream of IN2P3 could be hampered, particularly in the context of an approach that emphasizes priorities based on cost over potential impacts for such small research groups. The necessity for interdisciplinary research to comply with the scientific policies and strategies of several institutions (University Paris Sud/Paris Saclay, Paris Diderot) or several CNRS Institutes (IN2P3, INC, INSB,...) adds to this complexity. There may also be a risk of low priority for the access to technical support from common departments in competition with large IN2P3 core thematic groups.

Recommendations

We suggest favoring greater integration of interdisciplinary research teams from the various labs during the merger process. The task is complex and it may not always be possible since some topics are only addressed in one lab/one team at this time. Associating technical resources from one of the other labs in a project may be a good way to overcome this difficulty.

The merged institution needs to maintain the openness provided by interdisciplinary research activities, which is also an excellent way for efficient integration of the future merged structure into the research policy of the University. Providing the access to relevant facilities may be a good way for a lab to provide broad support for such an interdisciplinary theme. For instance, the access to ThomX and Andromede facilities would allow the possibility for LAL and IPNO to collaborate with IMNC in the framework of health physics projects. This is also true for the access to technical departments. These kinds of cross-cutting collaborative steps should be encouraged.

Theme 13: Technical Services

Theme leader: To be defined

THEME SCIENTIFIC DOMAINS

The theme covers all the technical aspects in support to experiments.

THEME WORKFORCE

	TH15	
	Technical Services	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	0	0
Assistant professors and similar positions	0	0
Full time research directors (Directeurs de recherche) and similar positions	0	0
Full time research associates (Chargés de recherche) and similar positions	0	0
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	216	216
Permanent staff	**216**	**216**
Non-permanent professors and associate professors, including emeritus	0	
Non-permanent full time scientists, including emeritus, post-docs, PhD students	3	
PhD Students	1	
Non-permanent supporting personnel	26	
Non-permanent staff	**29**	
Total	**245**	**216**

Global assessment of the theme

The technical staff includes approximately 180 people. Three main fields are roughly equally populated with about 50 people each: mechanics, electronics and IT, with additional resources in detectors (23) and biology (2). It is worth noting that at IPNO, dedicated technical staff is administratively housed in the accelerator division. The excellent level of technical expertise over a very large set of skills is widely recognized.

Given the proposed structure for the future merged laboratory, the degree to which ITA is represented in governing boards is questionable. The choice of the technical director is of particular importance.

The organization of the engineering pole is under study by WP3. This encompasses a challenging set of tasks, since the new scheme must ensure contributions to both large and small projects, while also maintaining flexibility to respond to short term needs, an appropriate range of expertise, identifying and developing new skills, ensuring communication between actors, and much more. Many multi-disciplinary laboratories struggle with long-term planning and delivery of such technical services and there are many organizational examples to be considered, with varying degrees of demonstrated effectiveness. During the merger, additional levels of management should be kept minimal to maintain proximity between technical staff. The question of redundant positions will be raised and must be treated carefully, case by case. It is of crucial importance to make sure that ITA support the new scheme in order to prevent potential additional departures. Given the difficulty and the impact of this re-organization process, it should be accompanied by a negotiator.

In addition, working groups are beginning to consider harmonizing the tools used in the different labs for similar tasks, but the timeline will not enable a full completion in January 2020.

The HR situation in the technical services is tight: the decrease of workforce over the past 5 years is most significant among ITA. In addition, projections for the next 5 years also exhibit a large amount of departures: approximately 30 people, including 6 "high level" engineers (IRHC). Merging of the labs will help gather technical force and reduce single-person expertise. However, it will not create additional resources. Based on the analysis of the anticipated departures, a strict recruitment plan must be implemented as soon as possible in order to maintain the variety of expertise required by the science performed at the lab..

Platforms

As part of the existing five labs, 17 platforms are supported, among which four are formally labeled as such by IN2P3. The variety of equipment and available capabilities addresses a large range of science and is a great asset to the labs. However the platforms presented range from large scale infrastructure (ALTO, SCALP, virtual data, etc.) to smaller scale equipment. It may prove useful to introduce subdivisions, since all platforms cannot be treated equally and some may be considered more as lab equipment than a facility. An effort towards harmonizing the management of the different platforms would be useful: this may encompass technical aspects, especially command-and-control or maintenance, as well as administrative matters.

A large fraction of these platforms is composed by accelerators (6 machines), having specific needs in terms of operation. Indeed, accelerators are costly to run and require dedicated trained operators. In the proposed organization scheme, platforms are nevertheless fairly independent of the accelerator pole. This may lead to a risk of high turn-over in operators if their jobs remain limited to just one platform: of course, operating and maintaining platforms must be their first priority, but keeping a R&D activity on the side seems important to maintain people's motivation.

Theme 14: Research Support

Theme leader: Mr Maud BAYLAC

THEME SCIENTIFIC DOMAINS

The theme covers all the administrative aspects in support to all the activities of the future laboratory.

THEME WORKFORCE

	TH16	
	Research Support	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	0	0
Assistant professors and similar positions	0	0
Full time research directors (Directeurs de recherche) and similar positions	0	0
Full time research associates (Chargés de recherche) and similar positions	0	0
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	93	93
Permanent staff	**93**	**93**
Non-permanent professors and associate professors, including emeritus	0	
Non-permanent full time scientists, including emeritus, post-docs, PhD students	0	
PhD Students	0	
Non-permanent supporting personnel	8	
Non-permanent staff	**8**	
Total	**101**	**93**

Global assessment of the theme

Activity support encompasses 110 people, including 60 people in administrative services.

Within the five existing laboratories, with different scientific goals, facilities and workforces, the organization of the administration varies dramatically. Even if some activities can be combined as part of the merger, the workload devoted to placing orders and managing employment contracts will not decrease dramatically and will need to be addressed continuously. A potential decrease in staffing may impact the responsiveness of the service.

In the new laboratory, it will still be crucial to maintain a good level of responsiveness to everyday business in order to keep up with scientific planning, especially for small projects and platform operation.

Recommendations

The committee supports an organization of the administrative services ensuring: An administrative head (secrétaire général), supported by at least one deputy a centralized management, able to deal with complex business practices and proximity services, able to keep a close connection between scientific and technical staff and ensure a good responsiveness.

The reorganization of the administrative services will strongly benefit from a professional help in the field of change management. In addition, a personal support (accompagnement individuel) of ITA staff should be put in place by CNRS, for example.

The safety groups are presently spread out among the different laboratories and after the merger, they will need to maintain some form of local deployment in each laboratory. On the other hand, the merger will also certainly provide a great opportunity to establish common skills and people to support large-scale local accelerator facilities, such as PRAE or PERLE.

CONDUCT OF THE VISIT

DATES

Start: 14 January 2019 at 9.00 a.m.

End: 17 January 2019 at 6.00 p.m.

VISIT SITE

Institution: LAL

Address: Bat 200 Amphi Pierre Lehman 91 ORSAY

CONDUCT OR PROGRAM OF THE VISIT

Monday 14 January 2019

08:00-09:00	Closed Session - 200-0-0 - Salle Bleue
09:15-11:10	Laboratory Reports - 200-0-Auditorium - Auditorium P. Lehman
11:30-13:30	Future Unified Laboratory - 200-0-Auditorium - Auditorium P. Lehman
14:45-17:25	Research Activities - 200-0-Auditorium - Auditorium P. Lehman
17:25-19:15	Closed Session - 200-0-0 - Salle Bleue

Tuesday 15 January 2019

09:00-17:20	Research Activities - 200-0-Auditorium - Auditorium P. Lehman

Wednesday 16 January 2019

09:00-10:30	Technical/Engineering Activities - 200-0-Auditorium - Auditorium P. Lehman
11:00-12:30	Platform Visits - 200-0-Auditorium - Auditorium P. Lehman
14:00-15:30	Miscellaneous - Amphi 1
16:00-17:45	HCERES meetings with Committees - Amphi 1 • 16:00 Researcher Representatives • 16:45 Tutelles
17:45-19:00	Closed Session - Amphi 3

Thursday 17 January 2019

09:00-10:30	HCERES meetings with Committees - 200-1-101 - Salle 101 • 09:00 ITA / BIATSS Representatives • 09:45 Postdocs and PhDs
10:45-12:30	Closed Session: with lab directors - 200-0-0 - Salle Bleue
14:00-17:00	Closed Session - 200-0-0 - Salle Bleue

SUPERVISING BODIES' GENERAL COMMENTS

Despite the Hcéres' requests, no comments have been received on the day of publication of this evaluation.

The evaluation reports of Hceres
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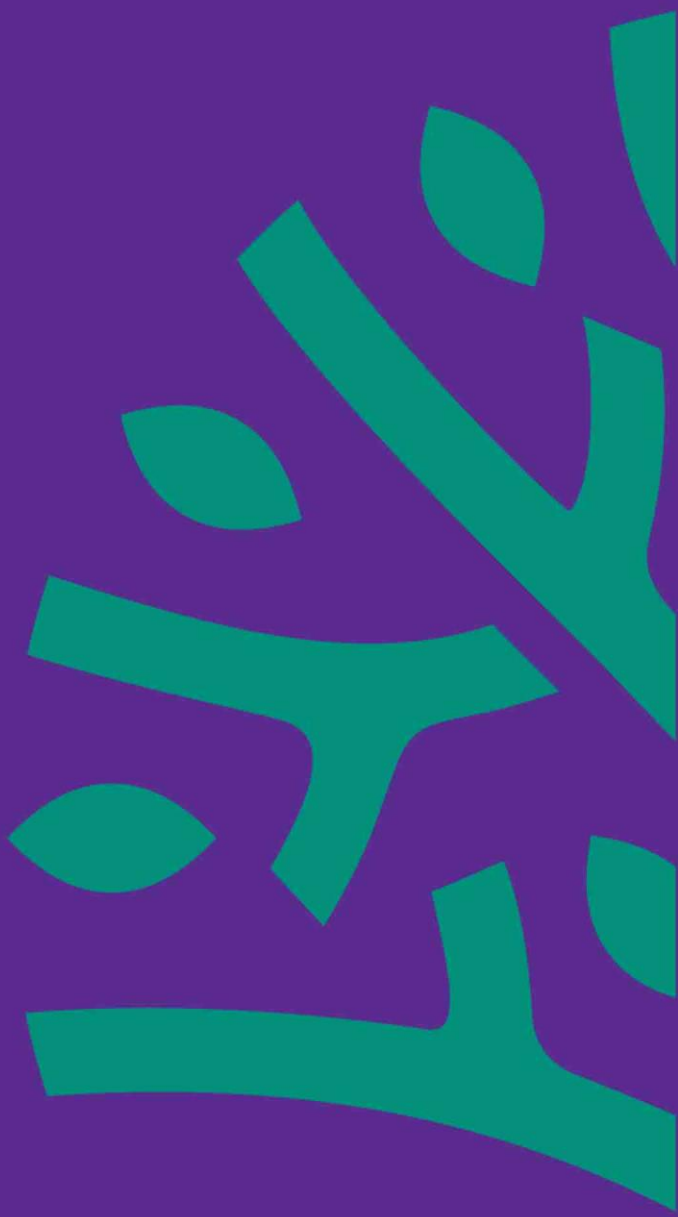
Evaluation of clusters of higher education and research institutions
Evaluation of higher education and research institutions
Evaluation of research
Evaluation of doctoral schools
Evaluation of programmes
International evaluation and accreditation



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