

EVALUATION REPORT ON THE UNIT:

LPCA - Laboratoire de physique de
Clermont Auvergne

UNDER THE SUPERVISION OF INSTITUTIONS AND RESEARCH BODIES:

Université Clermont Auvergne - UCA,
Centre national de la recherche scientifique -
CNRS

EVALUATION CAMPAIGN 2025-2026
GROUP A



On behalf of the committee of experts:

Luciano Musa, Chairman of the committee

For Hcéres:

Coralie Chevallier, President

In accordance with articles R. 114-15 and R. 114-10 8° of the Research Code, evaluation reports drawn up by the committees of experts are signed by the chairpersons of these committees and countersigned by the president of Hcéres.

To facilitate the reading of the document, the terms used in this report to designate functions, occupations or responsibilities (expert, researcher, teacher researcher, professor, lecturer, engineer, technician, director, doctoral student, etc.) are generic and gender neutral.

This report is the outcome of an evaluation by a committee of experts the composition of which is specified below. The assessments it contains are an expression of the independent and collegial deliberation of the committee. The data within it are the certified accurate data extracted from the application forms submitted by the supervising bodies on behalf of the unit.

This version of the report is public under Article R. 114-23 of the Research Code. Sections of the report considered confidential, and responses to points of attention from supervisors are not included in it.

MEMBERS OF THE COMMITTEE OF EXPERTS

Chair:

Mr. Luciano Musa, CS, CERN, Genève

Experts:

Mr. Damir Becirevic, DR, CNRS, Saclay

Ms. Marie-Laure Gallin-Martel, DR, CNRS, Grenoble (representative of CoCNRS)

Ms. Regine Gschwind, PR, Université Marie et Louis Pasteur, Besançon (representative of CNU)

Mr. Philippe Laborie, IR, CNRS, Caen (representative of supporting personnel)

Ms. Simona Mei, PR, Université Paris Cité, Paris

Mr. Roberto Salerno, DR, Ecole Polytechnique, Palaiseau

HCÉRES SCIENTIFIC ADVISOR

Philippe Moretto

REPRESENTATIVES OF THE UNIT'S SUPERVISING INSTITUTIONS AND BODIES

Mr. Christophe Balland, CNRS Nucléaire & Particules

Ms. Vanessa Prévot, Université Clermont Auvergne

UNIT CHARACTERISATION

- Name: Laboratoire de Physique de Clermont Auvergne
- Acronym: LPCA
- Label and number: UMR6533
- Number of departments: 3
- Composition of the executive team: Mr. Jean Orloff: Director; Mr. David Calvet: Deputy Director; Mr. Vincent Breton: Deputy Director; Mr. Nicolas Pillet: Technical Director; Mr. Cyril Galpier: Administrative and Financial Manager

SCIENTIFIC PANELS OF THE UNIT

ST Sciences et technologies
ST2 Physique

THEMES OF THE UNIT

The Laboratoire de Physique de Clermont Auvergne (LPCA) is structured into three complementary departments that together cover a broad scientific spectrum from fundamental to applied physics.

The experimental and observational fundamental physics (PU) department conducts experimental and observational research in fundamental physics. Its activities encompass collider physics at the LHC, with participation in the ALICE, ATLAS, and LHCb experiments, as well as studies of rare processes such as muon-electron conversion (COMET). It also develops research in observational astrophysics and cosmology through participation in wide-field surveys such as LSST and ZTF and in the Fink broker project for transient-event analysis. Detector development, electronics, data-acquisition systems, and large-scale data analysis are integral parts of its programme.

The Theory (TH) department carries out research in theoretical and phenomenological physics, closely connected with the experimental activities of the unit. Its research focuses on phenomenology beyond the Standard Model, with particular emphasis on flavour physics as a probe of new physics, including charged-lepton flavour violation and CP-violation mechanisms beyond the Standard Model relevant to the matter-antimatter asymmetry of the Universe, as well as dark-sector studies. This work is complemented by the development of effective field-theory and quantum-dynamics approaches. The department contributes to the interpretation of collider and astrophysical data and participates in international theory networks and collaborative projects.

The Multidisciplinary research for Health, Environment and Energy (SE) department groups LPCA's interdisciplinary research lines in health physics, radiobiology, environmental radioactivity, and energy. Its work focuses on interactions between ionising radiation and matter, combining experimental measurements and Monte Carlo (GATE and backward MC) simulations. Research themes include medical imaging, radiation dosimetry, radiotherapy modelling, biomaterials development, and the measurement and modelling of environmental radioactivity and pollutant transport. The department operates the PAVIRMA irradiation platform and participates in national and European networks devoted to environmental observation and sustainable-development instrumentation.

The unit's activities are supported by several technical platforms, MiCA, E2CA, LCG and PAVIRMA, which provide expertise in microelectronics, electronics characterisation, computing and irradiation studies. Cross-departmental initiatives such as the Projects Day foster coordination between teams, and common tools in simulation, instrumentation and data science create links across the unit's three main research domains.

HISTORIC AND GEOGRAPHICAL LOCATION OF THE UNIT

The LPCA is a joint research unit under the supervision of Université Clermont Auvergne (UCA) and CNRS (CNRS Nucléaire & Particules Institute). The current LPCA structure was formed on 1 January, 2017, in the context of the creation of UCA (merger of the two universities), when the Laboratoire de Physique Corpusculaire (LPC) and three associated teams joined forces: Physical Chemistry of Nanostructured Surfaces (PCSN), Mitochondrial Genome Repair (RGM) and Electrical Arcs and Thermal Plasmas (LAEPT). This reorganisation broadened the laboratory's scope and reinforced its multidisciplinary orientation, in particular towards health and the environment, alongside its long-standing activities in fundamental physics.

Historically, the laboratory was founded in 1959, initially to develop nuclear physics within the university, and rapidly oriented its research programmes towards high-energy physics, with early and sustained involvement in national facilities and in international programmes, in particular at CERN. Over time, its scientific programme expanded to encompass particle physics and observational cosmology, ... with both experimental and theoretical components, while extending into health and environmental domains through multidisciplinary work combining radiation physics, experimental measurements, and numerical modelling, supported by dedicated technical platforms.

Geographically, since summer 2019 the LPCA has been distributed over three areas on two sites. The main premises, historically occupied since the 1960s, are located in the pôle physique building on the Cézeaux campus in Aubière, where most offices, laboratories and common facilities are installed. A second area on the Cézeaux campus is hosted within the Clermont IUT premises (former PCSN team), under the administrative responsibility of the IUT. A third area is located at the Montluçon IUT, about 100 km northwest of Clermont-Ferrand, where part of the laboratory's activities is based.

The LPCA technical platforms are distributed across these sites: the MiCA microelectronics platform, the Tier-2 LCG computing centre and the PAVIRMA irradiation platform are located on the Cézeaux campus, while part of the EC2A electronics-characterisation platform operates from the Montluçon site. Together, these facilities contribute to the laboratory's spatial organisation across the Clermont-Ferrand metropolitan area and Montluçon.

UNIT RESEARCH ENVIRONMENT

LPCA is part of the UCA and the CNRS Nucléaire & Particules institute. It belongs to the Sciences et Technologies (ST) pole of UCA, which brings together physics, chemistry, mathematics, on the Cézeaux campus. LPCA participates in the coordination bodies of this pole and contributes to the university's scientific activities and doctoral training.

At the local level, LPCA is associated with several federative research structures. It is a member of the Fédération de Recherche Energie, Environnement et Systèmes (FR EES) and of the Fédération de Recherche Eau et Environnement (FR Eau), both under UCA, which connect laboratories active in environmental and energy studies. The unit also contributes to the Fédération de Recherche Environnement (FR Environnement), which became FR Eau (Fédération de recherche sur l'Eau, Environnement et Territoires), supporting shared infrastructures and data management for environmental monitoring.

LPCA is involved in several PIA (Programme d'Investissements d'Avenir) initiatives. It participates in the ISITE CAP 2025 programme led by UCA, particularly within the 'Physics for Health and Environment' axis, and in the CPER IDEAL project for instrumentation and data-science development in the Auvergne-Rhône-Alpes region. The unit is a partner in the EQUIPEX+ Terra Forma programme and contributes to the LabEx PRIMES network (Physics, Radiobiology, Medical Imaging, and Simulation) and to the EUR CAP GS Graduate School, which supports training through research at master's and doctoral levels.

At the national and international levels, LPCA participates in several CNRS Nucléaire & Particules and CNRS infrastructures. It contributes to the LCG Tier-2 grid infrastructure for high-energy-physics computing. The MiCA (Microelectronics Clermont Auvergne) platform received CNRS Nucléaire & Particules label certification in January 2024. The E2CA (Électronique et Caractérisation Clermont Auvergne) and PAVIRMA (Plateforme Auvergnate d'IRradiation et de Mesures de radioactivité) platforms are labelled by UCA and integrated into national and European networks. The unit also participates in international research infrastructures such as FAIR-EASE and FAIR-IMPACT, linked to the European Open Science Cloud (EOSC), and in the RAMONES and CEBA Cloud projects dedicated to environmental radiation measurements.

Regionally, LPCA is integrated within UCA research site and contributes to its CAP 2025 and CPER 2021–2027 programmes. It collaborates with industrial and institutional partners through initiatives such as UCA PARTNER, LabCom IoTAE-Lab, and joint projects in instrumentation and environmental monitoring. LPCA benefits from its location on the Cézeaux campus in Aubière, where most of its facilities, platforms, and administrative services are concentrated, forming an integral component of the Clermont site's research landscape in physics and applied sciences.

UNIT WORKFORCE: IN PHYSICAL PEOPLE AS OF 31/12/2024

Catégories de personnel	Effectifs
Professeurs et assimilés	12
Maitres de conférences et assimilés	28
Directeurs de recherche et assimilés	12
Chargés de recherche et assimilés	6
Personnels d'appui à la recherche	56
Sous-total personnels permanents en activité	114
Enseignants-chercheurs et chercheurs non permanents et assimilés	8
Personnels non permanents d'appui à la recherche	8
Post-doctorants	2
Doctorants	21
Sous-total personnels non permanents en activité	39
Total personnels	153

BREAKDOWN OF THE UNIT'S PERMANENT STAFF BY EMPLOYER: IN PHYSICAL PEOPLE AS OF 31/12/2024. NON-SUPERVISING EMPLOYERS ARE GROUPED ON THE HEADING 'OTHERS'.

Nom de l'employeur	EC	C	PAR
AUTRES	1	0	0
CNRS	0	18	41
UCA	39	0	15
Total personnels	40	18	56

GLOBAL ASSESSMENT

LPCA is a joint CNRS-Université Clermont Auvergne unit whose mission is to conduct fundamental and applied research in physics, ranging from the study of the elementary constituents of matter and the large-scale structure of the Universe to physical processes relevant to health and the environment. Created in 2017, it consolidated during the evaluated period a coherent structure organised into three complementary departments, Particle and Universe (PU), Theory (TH), and Multidisciplinary research for Health, Environment and Energy (SE), supported by shared technical services and labelled platforms (MiCA, E2CA, PAVIRMA, LCG Tier-2). Together, they cover a broad scientific spectrum while remaining aligned with the strategic priorities of CNRS Nucléaire & Particules and Université Clermont Auvergne's CAP 2025 programme.

The unit's scientific policy over the contract period has been characterised by consolidation and strategic focus. The PU department has maintained major commitments to the LHC programme through ALICE, ATLAS, and LHCb, while developing activities in observational cosmology and data science via the LSST/ZTF collaborations, the Fink broker programme, and exploratory work for future facilities such as FCC-ee. This portfolio ensures continuity from the HL-LHC to the post-LHC era. The TH department has pursued a focused research agenda in flavour physics, CP violation, and dark-sector phenomenology, supporting the experimental activities of the PU department and contributing to international theory networks. The SE department has achieved integration of its health- and environment-oriented teams, combining irradiation studies and Monte Carlo simulations to address radiation effects in biological systems and ecosystems, supported by the PAVIRMA platform and the equipex+ Terra Forma network.

At the national and international levels, LPCA contributes to major scientific collaborations and infrastructures. It plays recognised roles within the CNRS Nucléaire & Particules network, contributes to the LCG Tier-2 computing grid, and participates in international projects such as FAIR-EASE, FAIR-IMPACT, and RAMONES, linked to the European Open Science Cloud. Through labex PRIMES, ISITE CAP 2025, and equipex+ Terra Forma, it is embedded in national programmes funded by the PIA. Collaborations with hospitals, environmental agencies, and industrial partners illustrate strong links between fundamental physics and societal applications.

The unit's technical and instrumental expertise is a major asset. The MiCA and E2CA platforms provide recognised microelectronics and electronics characterisation capabilities, while Tier-2 and PAVIRMA facilities support data processing and experimental studies. These infrastructures, combined with skilled engineering staff, ensure autonomy and visibility in detector development, computing, and radiation-physics applications.

During the period, LPCA's governance evolved towards greater coordination and transparency. The annual projects day has become a moment for collective discussion of scientific strategy and cross-departmental activities. Regular exchanges between department heads and technical services have improved coordination and the visibility of decision-making processes. The unit follows CNRS and UCA frameworks for safety, radioprotection, ethics, and open science, with near-complete compliance in open-access publication and data management.

Among the unit's research themes, those with the highest national and international visibility include collider physics and detector R&D, phenomenological work in flavour and dark-sector physics, the Fink broker, and irradiation and simulation platforms for medical and environmental research. The applied-physics line within the SE department has reached structural maturity, while weaker points concern limited participation in European funding programmes and reliance on short-term technical contracts.

The main structural constraints remain the teaching load of university staff and ageing building infrastructure, which depend on UCA investment plans. These factors limit, but do not compromise, the unit's development.

In summary, LPCA has established itself as a major physics laboratory in the French and international landscape, combining long-term engagement in fundamental research with an expanding interdisciplinary scope. Its strategy, technical resources, and governance provide a solid basis for the coming decade.

DETAILS OF THE EVALUATION OF THE UNIT

A – CONSIDERATION OF THE RECOMMENDATIONS IN THE PREVIOUS REPORT

The unit has provided a clear and structured response to the recommendations made in the previous Hcéres evaluation. Each major point has been explicitly addressed, showing that the unit took the feedback seriously and integrated it into its management and scientific planning.

Scientific production and activities. The unit has maintained its high level of output and international visibility. Stable publication indicators and continued participation in major collaborations confirm that scientific excellence has been preserved. The combination of fundamental research with strong technical and instrumental expertise reflects a coherent strategy across all three departments.

External funding. The unit has diversified its financial base through national and regional programmes such as CPER IDEAL, ISITE CAP 2025, EQUIPEX+ Terra Forma, ANR and LabEx PRIMES. These schemes support infrastructure and interdisciplinary projects, particularly within the SE department. However, heavy teaching duties still limit staff participation in competitive European programmes (ERC, MSCA). While progress at national and site level is clear, European-level success remains limited mainly for structural reasons.

Organisation and life of the unit. Most previous recommendations have been implemented. Measures to improve the integration of foreign members, define a teleworking framework, optimise technical-resource allocation, and involve physicists in instrumentation have been put in place. The Projects Day now serves as key coordination tools promoting transparency and cross-departmental interaction.

Infrastructure. Management has introduced a ticketing system and a campus maintenance team that improved daily logistics and technical interventions. Despite these efforts, the main buildings still suffer from poor insulation and ageing facilities, which depend on UCA for major renovation.

Scientific strategy. The unit has clarified its long-term direction. The PU department maintains strong involvement in the LHC programme while developing astrophysics and data-science projects. The TH department continues its recognised work in flavour and dark-sector phenomenology. The SE department has integrated its health and environment research lines through shared use of the PAVIRMA platform and joint simulation tools.

Taken together, these developments show that the unit has effectively implemented nearly all previous recommendations, so consolidating its scientific programme and improving coordination and interdisciplinarity. The few remaining issues concern infrastructure and participation in European calls, which largely depend on external constraints rather than internal policy.

B – EVALUATION AREAS

EVALUATION AREA 1: THE UNIT'S SCIENTIFIC OBJECTIVES, ORGANISATION AND RESOURCES

Assessment of the unit's scientific objectives, organisation and resources

The LPCA pursues a coherent scientific project across three departments (PU, TH, SE), combining fundamental and applied physics within CNRS Nucléaire & Particules and UCA priorities. It relies on a stable and experienced staff, effective governance, and nationally recognised platforms (MiCA, E2CA, PAVIRMA, LCG) that ensure strong technical capacity. Diversified funding and transparent management support its objectives, despite constraints from infrastructure and staffing pressures.

1/ The unit has set itself relevant scientific objectives and is organised accordingly.

2/ The unit has resources adapted to its scientific objectives, profile of activities and research environment and mobilises them.

3/ The unit has premises, equipment and technical skills adapted to its scientific policy and research objects.

4/ The unit's practices comply with the rules and guidelines set by its supervisory bodies in terms of human resources management, safety, environment and data protection as well as scientific assets.

Context-related strengths and opportunities for the four references above

Coherent and complementary scientific structure. LPCA's three-department organisation forms a coherent and complementary structure that ensures a balanced distribution of expertise. The PU department covers experimental high-energy physics at colliders and observational astrophysics and cosmology; the TH department provides theoretical and phenomenological support closely connected to experiments; and the SE department leads interdisciplinary research on health and environmental applications. This structure encourages collaboration between domains and gives the unit a stable and flexible framework for future strategic choices.

Effective and transparent governance. The management team, including the director, deputy director, administrative and technical managers, operates through regular meetings and collective decision-making. In addition, structured exchanges between the management and laboratory staff provide recurring opportunities to inform staff, gather feedback, and incorporate input into decision processes. The projects day has become an important means for laboratory-wide coordination, offering a comprehensive overview of ongoing activities and enabling a fair allocation of engineering and technical resources. This governance model directly addresses concerns raised in 2020 regarding internal communication and project visibility.

Diversified and well-managed resources. The unit demonstrates a strong capacity to attract funding from national and site-level programmes. Participation in CPER IDEAL, CAP 2025, and equipex+ Terra Forma has enabled major investments in equipment and computing infrastructures. Complementary support from ANR, CNRS-MITI, CNRS-IEA, and Labcom IoTAE-Lab reinforces the SE department's projects and the laboratory's expertise in data analysis and AI. This diversified funding portfolio ensures the unit's financial stability and resilience against fluctuations in institutional or programme funding, while maintaining coherence with national and site-level priorities.

Recognised technical and instrumentation expertise. LPCA's technical infrastructure is one of its major assets. The MiCA, E2CA and PAVIRMA platforms, the Tier-2 centre, and the laboratory's mechanical workshop give the unit autonomy in detector R&D, data acquisition, and applied radiation imaging. Several engineers hold CNRS Nucléaire & Particules technical qualification labels, confirming national-level recognition of their skills. These capabilities consolidate LPCA's leading role in both fundamental and applied research.

Strong culture of compliance, safety, and open science. The unit rigorously applies CNRS and UCA regulations on human resources, safety, and data management. Annual safety audits, radioprotection training, and up-to-date risk registers are maintained, and open-access publication compliance is nearly complete. The QVCT/Eco-Responsibility group promotes staff involvement in sustainability and workplace-quality initiatives, strengthening cohesion and shared responsibility across the unit.

Context-related weaknesses and risks for the four references above

Heavy teaching and administrative loads. The high proportion of university staff creates a persistent structural overload, reducing the time available for research, proposal preparation, and long-term planning. Despite the regular use of CNRS delegations and CRCT leaves to compensate for teaching duties, this imbalance continues to limit the unit's capacity to participate in competitive European calls such as ERC and MSCA.

Aging building and unresolved infrastructure issues. Thermal discomfort, outdated facilities, and delays in renovation work by UCA remain major concerns. Although day-to-day maintenance has improved thanks to the ticketing system and follow-up meetings with DPIE, large-scale refurbishment remains outside LPCA's control and continues to affect staff well-being and environmental performance.

Concentration of expertise among a few key individuals. Several senior engineers and researchers hold unique know-how in areas such as ASIC design, detector mechanics, and high-rate data acquisition. The absence of a structured succession plan exposes the unit to potential loss of expertise as retirements approach.

Dependence on short-term project funding in the SE department. Collaborations with industrial and medical partners bring strong visibility but rely heavily on temporary contracts and external funding. Ensuring more permanent technical posts will be essential to ensure the continuity of these activities.

Fragmentation risk due to disciplinary diversity. The broad range of topics, from collider physics to environmental radioactivity, creates natural compartmentalisation. While transversal initiatives such as the Projects Day, shared technical platforms and services, and laboratory-wide collective governance bodies help to maintain cohesion across departments, preserving a unified scientific identity will require continued attention to shared communication and common objectives.

EVALUATION AREA 2: THE UNIT'S SCIENTIFIC RESULTS, IMPACT AND ATTRACTIVENESS

Assessment of the unit's scientific results, impact and attractiveness

The LPCA produces high-quality and diversified research consistent with its profile. The PU department contributes to major results within international collaborations ALICE, ATLAS, LHCb and LSST; the TH department is internationally engaged and maintains strong output in flavour and dark-sector phenomenology; and the SE department achieves visible impact in medical and environmental physics through PAVIRMA and Terra Forma. The unit is active in coordination roles and open-science practices, with sustained doctoral and postdoctoral attractiveness.

- 1/ The unit is recognized for its scientific achievements that meet quality criteria*
- 2/ The research activities of the unit result in quality scientific production.*
- 3/ The unit participates in the coordination and management of its community*
- 4/ The unit's scientific production respects the principles of scientific integrity, ethics and open science. It complies with the guidelines applicable in this field.*

Context-related strengths and opportunities for the four references above

High-quality and visible scientific output within major international collaborations. The LPCA contributes extensively to international research through its three departments. The PU department gave major contributions to twelve ALICE, 21 ATLAS, thirteen LHCb and CKMfitter, and fifteen LSST/ZTF/Fink papers during the period of reference, along with numerous conference presentations and 23 PhD theses. This demonstrates the unit's ability to cover the entire research chain, from detector development to analysis and publication, within competitive international environments with rigorous internal review procedures.

Active and internationally engaged theory team. Although small, the TH department publishes regularly on peer-reviewed journals and maintains a strong presence at leading international conferences (ICHEP, TAUP, Rencontres de Moriond). Its members play active roles in European and CNRS structures, including co-direction and convenorship in IRN Terascale and IRN Neutrinos, participation in EU ITN 'Hidden/Elusives', and scientific secretary for the 2020 European Strategy flavour-physics group. These activities give LPCA international visibility in a domain where Clermont-Ferrand has no large local theory community.

Clear progress and impact of the SE department. Since 2020, the SE department has evolved from a 'promising but under-equipped' into an 'operational and networked' research area. The modernisation of PAVIRMA platform, integration into labex PRIMES and MI2B, involvement in Equipex+ Terra Forma, and participation in FR Environnement, which became FR Eau in 2025, demonstrate strong institutional embedding. The development of open-source simulation tools (GATE, backward Monte Carlo) now used by external groups confirms tangible impact in hospital, environmental and industrial contexts. This trajectory directly addresses the 2020 recommendation to consolidate the 'third pole'.

Strong participation in scientific coordination and community service. LPCA members hold a wide range of recognised coordination and convenership roles within major collaborations and research networks. In the PU department, several researchers have served as project leaders and Run Coordinators in ALICE, upgrade and analysis conveners in ATLAS and LHCb, and representatives in the LHCb France committee and the LSST France board. The TH department contributes to community leadership through co-direction of the IRN Terascale and IRN Neutrinos, participation in theoretical working groups for the European Strategy update, and editorial responsibilities in international journals. Within the SE department, staff coordinate the PAVIRMA platform and participate in the management of national networks such as PRIMES, MI2B, and FR Eau, as well as the EQUIPEX+ Terra Forma steering committees. This collective involvement demonstrates LPCA's active role in the governance of its research communities and its sustained contribution to scientific coordination at national and international levels.

Engagement in open science and research integrity. All SE outputs are deposited in HAL, and software developments are shared via the LPCA or OpenGATE GitHub repositories. The PU department follows CERN and LSST policies for version control and data archiving. A dedicated welcome day introduces newcomers to integrity and safety practices, and one LPCA member serves on both UCA Open Science Working Group and the EOSC network. LPCA is therefore not only compliant but proactive in promoting transparency, reproducibility, and ethical research conduct.

Context-related weaknesses and risks for the four references above

Uneven publication outputs across and within departments. The production is lower for experimental teams in preparatory or commissioning phases, and the SE department was particularly affected by the Covid-19 (interrupted measurements, delayed theses) and by the late availability of premises (2017–2019). As a result, scientific output remains uneven across LPCA, with PU and TH showing steadier results than parts of SE. These variations mainly reflect the different research timelines and external constraints of each domain, but they can make the unit's overall productivity appear less homogeneous from the outside.

Limited participation in competitive European funding programmes. Although the unit is present in European collaborative and infrastructure projects (FAIR-EASE, FAIR-IMPACT, RAMONES, LSST ecosystem), it lacks a corresponding portfolio of individual excellence grants (ERC, MSCA PF/DT, EIC Pathfinder) that reflects the quality of its research. The unit itself attributes this to time constraints and limited preparation capacity for such demanding calls. This limits international attractiveness, especially for postdoctoral researchers and visiting scientists.

Visibility still largely mediated by large collaborations. Most of the unit's highly visible publications are produced within CERN or LSST frameworks. While this ensures scientific quality, it tends to dilute individual recognition and makes it harder to highlight LPCA's specific contributions, particularly for early-career researchers whose names appear in long author lists. The PU team's involvement in the ECFA-NuPECC-APPEC working group on individual visibility shows awareness of this structural issue, which nonetheless remains a challenge.

Uneven attractiveness across departments. The PU and TH teams maintain a good flow of PhD candidates, international internships and postdoctoral fellows (with former students now placed in Valencia, Zurich, Ljubljana). In contrast, recruitment in the SE department remains more dependent on project funding and external collaborations with hospitals or industry. While the SE pole has grown considerably since 2020, the predominance of short-term contracts and fluctuating project timelines can make it harder to maintain a regular flow of early-career researchers. Securing more permanent positions and greater participation in European projects would help stabilise this progress and strengthen long-term attractiveness.

Strategic prioritisation of event organisation. The unit demonstrates remarkable dynamism in the organisation of scientific events, national meetings, international workshops, thematic schools, and outreach initiatives, which greatly enhance its visibility and collaborative network. To sustain this positive impact over time, it would be useful to prioritise events offering the highest added value in terms of visibility, partnerships, and opportunities for young researchers, and to adjust the level of engagement, according to the laboratory's overall workload.

EVALUATION AREA 3: INCLUSION OF RESEARCH ACTIVITIES IN SOCIETY

Assessment of the inclusion of the unit's research activities in society

The LPCA effectively connects its research with societal needs through projects in medical physics, radiation protection, and environmental monitoring. Collaborations with industry and hospitals (Eaton/EDF, Siemens Healthineers, Centre Jean Perrin (Unicancer), CHU) support technology transfer via the IoTAE-LAB LabCom and PAVIRMA platform. Active participation in Terra Forma, FR Eau, together with extensive outreach and education, reinforces its societal engagement.

- 1/ *The unit stands out for the quality of its interactions with the cultural, and socioeconomic world.*
- 2/ *The unit develops products and services for the cultural, socioeconomic world.*
- 3/ *The unit shares its knowledge with the general public and participates in social debates.*

Context-related strengths and opportunities for the three references above

Strong technology transfer and industrial partnerships. LPCA maintains active collaborations with industry and healthcare institutions, in particular through the IoTAE-Lab LabCom with Linxens on smart sensor networks, and contracts with Siemens Healthineers and Unicancer on medical imaging and radiation-dose assessment, or in the field of electrical safety with SOCOMEC, EATON and EDF. These collaborations have generated joint research outputs, co-supervised theses, and direct applications of LPCA's detector and simulation expertise in industrial and clinical contexts.

Active role in environmental and territorial programmes. Through its participation in equipex+ Terra Forma, FR Eau, , the unit contributes to large-scale environmental monitoring and sustainable-development initiatives. The deployment of sensor networks for atmospheric and hydrological studies shows how LPCA instrumentation is used beyond academia, promoting collaboration with regional authorities and agencies.

Societal relevance embedded in research themes. Several of LPCA's core research axes directly address societal needs: medical imaging and radiation protection, environmental radioactivity and monitoring, and AI-based data analysis tools developed in both PU and SE departments. This structural connection between fundamental research and applied outcomes ensures long-term societal impact.

Strong outreach and science-communication culture. The unit has a continuous and visible presence in public events such as the Fête de la Science, Nuit des Chercheurs, CERN Masterclasses, and local school visits. Researchers from all departments contribute, covering topics from fundamental physics to health and the environment. This broad involvement promotes scientific culture in the region and enhances the visibility of the Université Clermont Auvergne (UCA) site.

Context-related weaknesses and risks for the three references above

Nothing to mention.

ANALYSIS OF THE UNIT'S TRAJECTORY

Since the 2020 Hcéres evaluation, LPCA has followed a trajectory of consolidation and increased strategic focus.

On the fundamental physics side, the unit has maintained its broad engagement in the LHC programme (ALICE, ATLAS, LHCb) and in observational cosmology (LSST/ZTF/Fink), while reorganising this engagement to ensure its sustainability in view of manpower prospects, as recommended by the 2020 committee. A key element of this evolution concerns the future of the ALICE group. The DAE clearly states that 'the physics programme with ALICE will end with LHC Run 4' and that, until then, the group 'shall and will continue' to operate and analyse Run 3–4 data. In parallel, several ALICE members have co-signed the LHCb Upgrade II Framework TDR and LOI and, in agreement with the local LHCb team, will join the Phase II upgrade activities during LS4 (after 2033). This represents a planned and gradual convergence of the ALICE and LHCb activities, endorsed by the LPCA Scientific Council, which prioritised a CNRS recruitment request to secure this transition. This evolution is driven by human-resource considerations: three ALICE members will retire before the end of Run 4, and two others shortly thereafter, making large contributions to new detector developments such as ALICE 3 unrealistic. The move towards LHCb Upgrade II therefore provides a technically and scientifically coherent continuation of LPCA's expertise in heavy-flavour, heavy-ion, and detector physics.

Regarding technical staff, the forthcoming retirements in IT infrastructure and support represent a significant concern, compounded by persistent difficulties in attracting qualified candidates for these positions.

More generally, the age structure of the unit will require close attention. The average age of permanent staff is 50.5 years, reaching 52 years in the PU department, with several key scientists and engineers in the 50–60 age range. While not critical in 2025, this demographic profile will coincide with the major ATLAS LS3 and LHCb LS4 phases (2026–2033), making timely replacement and mentoring essential. The unit has already taken action by requesting a CNRS position to support the ALICE-LHCb transition and a maître de conférences post to strengthen instrumentation activities and reduce teaching load; however, the success of this trajectory remains sensitive to the timing of recruitments by CNRS and UCA.

In terms of diversity, the unit reports 23% women overall (19% in PU, 25% in TH). Broader national data show that women constitute a minority of researchers in France, with approximately one-third of R&D personnel being women and women's representation in physics institutes often in the 20–25 % range, depending on the specific field and organisation. The nomination of parity correspondents and the integration of gender considerations

into the QVCT and eco-responsibility framework demonstrate that the issue is recognised institutionally. Future recruitments, particularly in the PU department where the average age is higher and retirements are near, offer an important opportunity to further improve gender balance and promote diversity across career stages.

On the interdisciplinarity side, the SE department has evolved from an emerging activity to a structured one, supported by major national programmes (EQUIPEX+ Terra Forma, FR Eau, LabCom IoTAE-LAB). The unit has also strengthened internal coordination through the Projects Day initiative, improving technical arbitration and visibility across departments. These developments illustrate LPCA's ability to take into account the 2020 recommendations and translate them into concrete operational improvements.

The main external constraints remain the renovation of buildings under UCA's responsibility and the limited availability of staff time to prepare European funding proposals due to teaching loads. These constraints are clearly identified and documented and do not call into question the overall direction of the unit.

In summary, LPCA has stabilised its scientific perimeter, anticipated demographic transitions, and established a credible plan for its LHC-related activities beyond 2033, while consolidating its interdisciplinary research and societal partnerships. Its trajectory reflects a mature and adaptive institution, capable of evolving within structural constraints while maintaining strategic coherence and scientific excellence.

RECOMMENDATIONS TO THE UNIT

RECOMMENDATIONS REGARDING THE EVALUATION AREA 1: SCIENTIFIC OBJECTIVES, ORGANISATION AND RESOURCES OF THE UNIT

Maintain alignment with European and national strategies. LPCA should continue to structure its roadmap around the European Strategy for Particle Physics and CNRS Nucléaire & Particules plans, ensuring exploitation of ALICE Run 3–4, sustained involvement in ATLAS and LHCb during HL-LHC, and preparation for the post-LHC era through FCC-ee studies. The strategic plan should be updated after the 2026 ESPPU and CAP 2025 renewals.

Anticipate human-resource transitions. In view of forthcoming retirements, the unit should implement succession and mentoring actions to safeguard key expertise in instrumentation, electronics, IT and data analysis. Recruitments should restore age balance and improve gender diversity, particularly in the PU department.

Reinforce internal coherence. Collaboration between the PU and TH departments, notably in flavour physics, dark-sector phenomenology and data interpretation, should be consolidated to ensure continuity.

Strengthen funding diversification. While national and regional funding has been effective, LPCA should increase participation in European competitive programmes (ERC, MSCA, EIC, INFRA-Tech), with institutional support to improve proposal preparation.

Support infrastructure renewal and workplace quality. The unit should continue dialogue with UCA and supervisory bodies on building renovation, while documenting the impact of ageing infrastructure on research and staff well-being.

RECOMMENDATIONS REGARDING THE EVALUATION AREA 2: THE UNIT'S SCIENTIFIC RESULTS, IMPACT AND ATTRACTIVENESS

Consolidate scientific exploitation. Each department should maintain a clear strategy to complete ongoing programmes and maximise scientific return. For PU, this includes full exploitation of ALICE Run 3–4 data and continuity of ATLAS and LHCb analyses during HL-LHC. SE should stabilise publications by consolidating tools and methods into peer-reviewed outputs, while TH should sustain its phenomenological production and participation in European theory networks.

Strengthen scientific visibility. LPCA researchers should continue assuming coordination and convenership roles within major collaborations (ALICE, ATLAS, LHCb, LSST). Institutional communication channels (CNRS Nucléaire & Particules, UCA, CAP 2025) should be used more systematically to highlight scientific contributions and leadership.

Enhance international attractiveness and renewal. Recruitments should prioritise early-career profiles, gender balance, and interdisciplinarity. LPCA should expand international postdoctoral and visiting-scientist programmes using CNRS Nucléaire & Particules and European mobility schemes, and maintain strong involvement in doctoral training and co-supervision.

Increase participation in European excellence funding. Building on experience in EU infrastructure projects, LPCA should develop PI-driven proposals in Horizon Europe (ERC, MSCA, EIC).

Maintain high standards in open science and integrity. Open-access publication, software dissemination, and data deposition should be systematically enforced.

RECOMMENDATIONS REGARDING EVALUATION AREA 3: INCLUSION OF RESEARCH ACTIVITIES IN SOCIETY

Consolidate and structure institutional and industrial partnerships. LPCA should build on its collaborations with industrial and medical partners (e.g. Eaton/EDF, Siemens Healthineers, Unicancer, CHU Clermont-Ferrand) by formalising long-term framework agreements and clarifying intellectual property and contract-management procedures with CNRS Innovation and UCA Partenariats. This would improve continuity, visibility, and technology transfer.

Sustain engagement in environmental and territorial initiatives. The unit should maintain its active role in major environmental programmes (Terra Forma EQUIPEX+, FR Eau) and seek involvement in emerging national or regional sustainability projects. Linking sensor development and radiation monitoring to public-policy needs would strengthen LPCA's position in applied environmental research.

Reinforce outreach and education activities. LPCA's strong outreach activities (Fête de la Science, CERN Masterclasses, school visits) should be sustained with greater institutional recognition. Appointing an outreach referent could improve coordination, ensure balanced departmental involvement, and support quality assessment.

Strengthen institutional visibility and societal communication. The unit should work with CNRS, CNRS Nucléaire & Particules, and UCA communication services to better highlight its societal impact, industrial partnerships, and medical and environmental contributions through targeted communication actions.

DEPARTMENTS ANALYSIS

Department 1: Theory

Name of the supervisor: Ms Ana Teixeira

THEMES OF THE DEPARTMENT

The Theory Department focuses on the phenomenology of physics beyond the standard model (BSM), with emphasis on flavour physics and dark-matter (DM) studies. Its work covers quark and lepton flavour physics, including neutrino-mass generation, through models addressing tensions between Standard Model predictions and experimental data. Sterile-lepton scenarios are explored, leading to charged-lepton flavour violation and CP-violating effects, with original results on the role of lepton phases. Low-energy observables are studied using effective field theory, complemented by collider-oriented BSM scenarios. DM studies address freeze-in mechanisms and collider constraints, in close connection with the ATLAS group at LPCA. The team contributes to open-source tools such as micrOMEGAs and to interdisciplinary projects such as PERCOVID.

CONSIDERATION OF THE RECOMMENDATIONS IN THE PREVIOUS REPORT

Most of the recommendations in the previous report were general in nature and did not specifically target the Theory Department (TH). In this context, the department's research activities are fully aligned with the CNRS Nucléaire & Particules roadmap (2023), in particular with key scientific drivers such as New Phenomena, Flavor Physics, Neutrinos, and Dark Matter. It is worth emphasizing the significant contribution of a TH member to the preparation of the update of the European Strategy for Particle Physics.

The department is also highly active at both the national and international levels. It plays a leading role in the two current International Research Networks (IRN Neutrino and IRN Terascale) and in the Groupement de Recherche (GdR) Intensity Frontier, and is involved in the European International Training Network (ITN) Elusives/Hidden. In addition, a TH member holds a coordinating responsibility for theory and phenomenology at the CNRS Nucléaire & Particules level.

This highly active team also maintains strong collaborations with the other two LPCA departments, illustrating the excellent integration of theoretical activities within an experimental laboratory.

DEPARTMENT WORKFORCE: IN PHYSICAL PEOPLE AS OF 31/12/2024

Catégories de personnel	Effectifs
Professeurs et assimilés	2
Maitres de conférences et assimilés	0
Directeurs de recherche et assimilés	1
Chargés de recherche et assimilés	1
Personnels d'appui à la recherche	0
Sous-total personnels permanents en activité	4
Enseignants-chercheurs et chercheurs non permanents et assimilés	1
Personnels non permanents d'appui à la recherche	0
Post-doctorants	1
Doctorants	2
Sous-total personnels non permanents en activité	4
Total personnels	8

EVALUATION OF THE DEPARTMENT

Overall assessment of the department

Although small in size, the Theory Department is remarkably active and highly visible. Its members publish regularly in prestigious scientific journals and attract and train Master's students, PhD students, and postdoctoral researchers. They are deeply involved in numerous national and international research networks, and their research themes are aligned with European, and therefore CNRS Nucléaire & Particules, strategic priorities. Their main research topics include the phenomenology of physics beyond the Standard Model, with a particular focus on flavour physics processes and dark matter searches. Their scientific output is strong and highly regarded both nationally and internationally, and they maintain close collaborative links with the other LPCA departments.

Context-related strengths and opportunities

Coherence and complementarity of the research expertise. The umbrella of 'Phenomenology of physics BSM' is very broad and there is an inherent risk that the research focus of individual members could drift apart. Despite their differing areas of expertise, the team has succeeded in maintaining strong internal coherence. They effectively capitalize on their complementary skills in order to pursue sound, timely and impactful research.

Visibility and Attractiveness. The strong national and international visibility of the department is reinforced by the thematic coherence among its members, which enhances the overall value of their already high individual scientific quality. Combined with their active participation in numerous national and international research and training networks, this coherence has earned them an excellent reputation within the flavour physics community (particularly in the lepton sector) and in the field of dark matter phenomenology. The training by research throughout the department's most active research topics is a source of attractiveness to younger scientists, PhD students and junior postdocs, as well as in the hosting of international PhD internships. The permanent members of the TH department are regularly invited to present their work, or carry out reviews in renowned international conferences and workshops. This includes the ICFA seminar series, HEP-EPS, Neutrino, NuFact, LHCP, DM@LHC, among others.

Implication in life of the laboratory. Another strength of the department is their deep engagement in all aspects of the laboratory's functioning. Scientifically, they maintain active connections with other laboratory departments, especially PU, organise joint seminars, participate in shared student supervision, and occasionally collaborate in research projects. This underscores the essential role of the TH department within an experimental laboratory environment. At the organisational level, TH members are highly engaged in shaping and steering laboratory's programme. One of the current TH members has taken on the role of LPCA director.

Context-related weaknesses and risks

Critical mass. Although the TH department will soon welcome a new CRCN, one current TH member has taken on the role of LPCA director, which will substantially reduce his dedicated research time. Combined with the recent retirement of another member, this situation places the department close to the threshold of a critical personnel mass. Moreover, while the involvement of several members in the organisation of research at the national and international levels is commendable, it further limits the time they can devote to scientific work. It is therefore important to recognise that the TH department remains fragile in terms of staff size, research availability, and sustainability; consequently, its excellent current standing within LPCA could change rapidly if this balance is not maintained.

ANALYSIS OF THE DEPARTMENT'S TRAJECTORY

Over the past four years, the TH department has strengthened its position in both flavour physics and dark matter (DM) phenomenology at the national and international levels. Its members have demonstrated strong reactivity to new and puzzling experimental results. In this context, they not only examined existing beyond the Standard Model (BSM) scenarios, but also proposed new models capable of explaining apparent discrepancies between theory and experiment. They subsequently identified observables whose measurement would confirm or exclude these proposed scenarios. Many of their models naturally include a new particle that can serve as a viable dark matter candidate. In flavour physics, their research has primarily focused on the lepton sector, particularly on scenarios where the Standard Model is extended with an additional neutral lepton (sterile neutrino). Through extensive phenomenological investigations of this framework, the TH department has gained international recognition for its contributions to the study of cLFV processes (constraining lepton flavour violating). In DM phenomenology, they have made substantial contributions to the development of open-source software that plays a key role in advancing the field. Specifically, they have compiled and implemented low- and high-energy constraints from collider searches and combined them with non-collider bounds, enabling

users to assess the viability of BSM models designed to explain the observed dark matter abundance in the Universe.

Thanks to the strong visibility of its members, the department has successfully attracted excellent PhD students and postdoctoral researchers. This influx has supported the growth of their research activity and facilitated closer collaborations with the PU department. In addition, a study on the propagation of respiratory viruses using percolation theory, conducted by one TH member, has enabled concrete collaboration with the SE department.

TH research is fully aligned with the CNRS Nucléaire & Particules roadmap (2023) and the prospective EPPSU 2026 strategy. Their future activities are projected to remain in close contact with experimental developments, pursuing phenomenological studies of physics beyond the Standard Model through flavour physics and dark matter searches. They plan to strengthen exchanges with the ATLAS, LHCb, COMET, and FCC-ee groups at LPCA, and contribute to the physics programmes of future experimental facilities. Their strong involvement in multiple national and international research networks has further enhanced their scientific profile and facilitated cooperation with other theory groups. Such collaborations are crucial, as they enable joint applications for funding opportunities essential for recruiting PhD students and postdoctoral researchers and supporting travel and operating costs. For example, their work in flavour physics has been continuously supported by CNRS Nucléaire & Particules through the Theory Master Project programme.

RECOMMENDATIONS TO THE DEPARTMENT

Maintain scientific reactivity and the research excellence. The arrival of the new CRCN will be instrumental in helping the theory group maintain its high level of scientific excellence in the phenomenology of flavour physics and dark matter. To sustain this excellence, it is important for the department to remain responsive to new experimental results and to continue fostering strong communication with the PU department. The participation of TH members in national and international scientific networks is essential and is further encouraged. The new CRCN should also be supported to apply for an ERC Starting Grant and ANR funding, efforts that will require the active backing of the other TH members.

Thematic coherence. Research of the formal aspects of field theory, previously pursued by a now-retired TH member, is likely to come to an end. The permanent TH members, including the CRCN expected to join by the end of the year, possess complementary expertise in flavour physics and dark matter phenomenology. This thematic complementarity forms a scientific coherence that is vital to preserve, particularly given the department's subcritical size, as discussed above. It is clear that the department needs to grow, and the governing bodies are encouraged to consider the creation of a new position for another junior scientist to join the team in order to maintain the scientific excellence of TH in flavour physics and in DM phenomenology.

Department 2: Experimental and observational fundamental physics
 Name of the supervisor: Messrs. Eric Cogneras and Philippe Crochet

THEMES OF THE DEPARTMENT

The Experimental and observational fundamental physics (PU) department gathers LPCA's activities in experimental and observational fundamental physics, from collider studies of the Higgs boson, top quark, flavour physics and CP violation (ATLAS, LHCb) to heavy-ion physics and the quark-gluon plasma (ALICE). It also contributes to astrophysical surveys and data-driven cosmology (LSST, ZTF), including machine-learning developments and a leading role in the Fink broker for transient classification. The department has made key contributions to the LSST camera and observing strategy. Additional activities include searches for rare processes such as muon-electron conversion (COMET). PU combines long-term commitments to the LHC programme with FCC-ee studies, in line with the European Strategy for Particle Physics. These themes rely on strong expertise in detector development and data acquisition and analysis.

CONSIDERATION OF THE RECOMMENDATIONS IN THE PREVIOUS REPORT

Overall, the PU department has responded effectively to the recommendations issued by the 2020 Hcéres committee, particularly regarding workforce balance, strategic scope, and data-analysis coherence.

Human-resource monitoring has been strengthened through the introduction of the annual Projects Day, which provides a global overview of activities and supports collective prioritisation and allocation of person-power. This mechanism has improved coordination and reduced the risk of dispersion.

The department has maintained a sustainable presence in its main LHC experiments, ATLAS, ALICE, and LHCb, through coordinated planning of technical and physics activities. In response to the recommendation to reassess commitments, a clear long-term strategy has been adopted: participation in ALICE will continue through Run 4, after which resources will be focused on ATLAS and LHCb.

Data-analysis coherence has also improved. Regular internal analysis meetings are now held within ATLAS and LHCb, supported by shared tools and closer interactions involving doctoral students. Joint use of software frameworks with the Theory Department strengthens interpretation.

Diversification has been kept at a sustainable level. The SoLID project has been completed, with no further commitments planned. Activities are now focused on the LHC, COMET, and cosmology programmes. Contributions to COMET and to LSST/ZTF and the Fink broker are well established and recognised.

DEPARTMENT WORKFORCE: IN PHYSICAL PEOPLE AS OF 31/12/2024

Catégories de personnel	Effectifs
Professeurs et assimilés	5
Maitres de conférences et assimilés	12
Directeurs de recherche et assimilés	11
Chargés de recherche et assimilés	4
Personnels d'appui à la recherche	0
Sous-total personnels permanents en activité	32
Enseignants-chercheurs et chercheurs non permanents et assimilés	4
Personnels non permanents d'appui à la recherche	3
Post-doctorants	1
Doctorants	16
Sous-total personnels non permanents en activité	24
Total personnels	56

EVALUATION OF THE DEPARTMENT

Overall assessment of the department

The PU department is the backbone of LPCA's fundamental-physics programme, combining strong participation in ATLAS, ALICE, LHCb, LSST/ZTF, the Fink Broker, and COMET with recognised leadership in detector development (ALICE, ATLAS and LHCb upgrades, and LSST instrumentation) and transient science software development. Its activities are well aligned with European strategies and supported by fruitful links to theory. The department maintains high scientific visibility and output, with future priorities focused on personnel succession planning and continued technical excellence.

Context-related strengths and opportunities

Strong and coherent scientific programme aligned with European priorities. The PU department maintains a well-structured and coherent research programme centred on ALICE, ATLAS, and LHCb, with forward-looking involvement in FCC-ee preparatory work and complementary activities in LSST/ZTF/Fink and COMET. This balanced combination allows the department to cover a broad range of physics topics, from precision measurements and searches for new physics to flavour and heavy-ion studies, while keeping a clear strategic focus. The collider activities are fully aligned with the European Strategy for Particle Physics (ESPPU 2020), ensuring visible contributions until the end of the High-Luminosity LHC programme (HL-LHC) and active preparation for future accelerators projects. The astrophysics and rare-processes lines enhance interdisciplinarity, linking LPCA to national initiatives such as LSST-France and Fink-France and to site-level expertise in data science developed under CAP2025.

Recognised leadership and technical expertise in major experiments. LPCA staff hold visible roles in detector development and experiment coordination, including the ALICE MFT project Leader, leadership in the ATLAS TileCal upgrade and HGTD upgrade programmes, and coordination roles in the LHCb Upgrade II R&D. These responsibilities confirm LPCA's international visibility and reinforce the department's influence within large collaborations. The combination of expertise in detector systems, data-analysis capability, and project-management experience represents a long-term asset for the laboratory.

Successful integration of diverse physics domains. The department effectively connects collider physics, time-domain astrophysics, and data-science activities through its involvement in the LSST/ZTF/Fink projects. This diversification broadens the department's scientific scope, promotes interdisciplinary exchanges within LPCA, and strengthens its capacity to contribute to emerging cross-disciplinary initiatives in AI-based data analysis and multi-messenger astrophysics.

Synergy with theory and cross-departmental cooperation. Collaboration with the Theory (TH) department has intensified, particularly on topics such as BSM and dark-sector phenomenology, and on the interpretation of collider measurements. Regular joint seminars and exchanges involving doctoral students reinforce intellectual coherence across LPCA and enhance the connection between theoretical and experimental research.

Strong potential for renewal through national and international programmes. The department's high-profile contributions to HL-LHC upgrades and to the FCC study create favourable conditions for future recruitments and funding opportunities. It also benefits from institutional support provided by CAP 2025 and CPER IDEAL, which reinforce the laboratory's computing and data-science infrastructure and encourage collaborations across the Clermont site.

Context-related weaknesses and risks

Upcoming retirements and succession challenges. Several key physicists and engineers involved in ATLAS, ALICE and LHCb are approaching retirement age. Without timely recruitment, there is a risk of losing essential expertise in detector operation, detector electronics, and data analysis. A structured succession plan and early mentoring of younger staff will be essential to secure the department's long-term continuity.

Uneven age and gender distribution. The average age of the PU department's staff is above 50, and the proportion of women (around 19%) remains below the national average for physics research units. This demographic imbalance poses a risk for the long-term renewal and diversity. Efforts to improve gender balance and to integrate early-career researchers into visible and leadership roles would strengthen the department's vitality and ensure continuity across generations.

Limited participation in European competitive funding. Although the PU department has succeeded in securing national and site-level support through programmes such as ANR, CPER, and CAP 2025, its participation in European competitive schemes (e.g. ERC, MSCA) remains limited. Increased engagement in such calls would enhance the department's international visibility, foster new collaborations, and increase its financial flexibility.

Infrastructure and resource constraints. The laboratory's ageing infrastructure and limited space for new instrumentation continue to constrain the development of experimental activities. While routine maintenance has improved thanks to the introduction of a ticketing system, major renovation depends on UCA's investment decisions and remains a structural vulnerability for the coming decade.

Dependence on large collaborations for visibility. A substantial fraction of the department's publications and citations come from collective papers within LHC and LSST collaborations. This structure, while ensuring high scientific quality, can make it difficult to highlight individual and institutional contributions, particularly for early-career researchers. Strengthening leadership in analysis coordination and communication, and promoting LPCA's specific achievements within these collaborations, would help maintain both personal and institutional visibility.

ANALYSIS OF THE DEPARTMENT'S TRAJECTORY

Since the 2020 Hcéres evaluation, the PU department has followed a clear trajectory of consolidation and strategic focus. In response to the previous recommendations, the department rationalised its commitments within the LHC programme, ensuring that its resources remain consistent with its scientific ambitions. It maintained strong involvement in ATLAS, ALICE, and LHCb, but redefined their relative weight. ALICE now concentrates on the full exploitation of Run 3 and Run 4 data, maximising the physics output from the Muon Forward Tracker (MFT). The ATLAS group focuses on the HL-LHC detector upgrades (TileCal and HGTD) and precision measurements of the Higgs and top sectors. The LHCb team has strengthened its role in flavour and CP-violation studies and is already contributing to R&D for Upgrade II, in collaboration with members of the ALICE group who will join during LS4. This adjustment demonstrates careful long-term planning, balancing scientific ambition with realistic human-resource management.

Beyond the LHC programme, the PU department has successfully expanded its scientific horizon while maintaining coherence with LPCA's overall strategy. The LSST/ZTF/Fink activity is now a stable and visible component, connecting particle physics, astrophysics, and machine learning; it now represents one of LPCA's key interdisciplinary bridges.

The department also initiated a cross-departmental FCC group, aligning its preparatory work with the European Strategy for Particle Physics (ESPPU 2020), and the upcoming 2026 update. This ensures a smooth transition towards the post-LHC era and maintains LPCA's presence in strategic R&D networks. Collaboration with the Theory (TH) department has intensified, linking experimental measurements to phenomenological studies of BSM and dark-sector physics.

Overall, the department has preserved scientific excellence, reinforced internal coherence, and aligned its roadmap with both national (CNRS Nucléaire & Particules, CAP 2025) and European priorities. The main challenges for the coming decade are succession planning, gender balance, and participation in European competitive funding, which will be decisive for maintaining leadership through the HL-LHC and future FCC phases.

RECOMMENDATIONS TO THE DEPARTMENT

Long-term scientific strategy. The PU department should maintain its strong alignment with the European Strategy for Particle Physics by ensuring the full exploitation of the HL-LHC programme until 2041. In particular, the ALICE group should ensure the full scientific return of Run 3 and Run 4 by prioritising analyses that maximise the impact of the Muon Forward Tracker (MFT), a detector almost entirely developed within CNRS Nucléaire & Particules and currently led at LPCA. The department should continue its active role in the ATLAS upgrades and in the LHCb Upgrade II R&D. In parallel, the newly formed FCC group should pursue its involvement in physics studies and detector R&D for the FCC-ee, ensuring that LPCA remains well positioned scientifically for the post-LHC era and the upcoming 2026 ESPPU update.

Integration and synergy. Collaboration with the Theory Department should be strengthened, particularly in flavour physics, dark-sector searches, and data interpretation. Shared analysis meetings and joint seminars should continue. The LSST/ZTF/Fink activity should be stabilised through long-term funding and closer integration with AI and data-science initiatives at the Clermont site.

Renewal and diversity. Given forthcoming retirements, a structured succession plan should preserve expertise in detectors, software, and analysis. Future recruitments should improve gender balance and support early-career researchers.

Competitive funding and visibility. Beyond national funding, the department should increase participation in European calls (ERC, MSCA, EIC), with support from UCA structures. Coordinated communication should better highlight LPCA's contributions.

Department 3: Multidisciplinary research for health, environment and energy
Name of the supervisor: Ms Lydia Maigne

THEMES OF THE DEPARTMENT

The Multidisciplinary research for Health, Environment and Energy (SE) department brings together LPCA's interdisciplinary activities addressing societal challenges in health, environment, and energy. It comprises two teams whose work is closely connected through the study of interactions between ionising radiation and matter, combining experimental measurements with Monte Carlo and GATE simulations.

In the health and medical-physics domain, the department develops and validates models for radiation dosimetry, medical imaging, and radiotherapy, and designs innovative sensors and biomaterials for diagnostic and therapeutic use. In the environmental and energy domain, it studies the effects of radiation and pollutants on ecosystems and materials, contributing to radioecology, radiation protection, and environmental monitoring.

CONSIDERATION OF THE RECOMMENDATIONS IN THE PREVIOUS REPORT

The recommendations issued in the previous Hcéres evaluation have been effectively taken into account by the SE department. The two teams, previously operating with limited interaction, now collaborate closely through shared simulation tools (notably GATE and backward Monte Carlo codes) and the joint use of experimental facilities.

The integration of activities has clearly progressed. The department now combines radiobiological and environmental studies through common modelling frameworks and cross-cutting projects, including the European RAMONES project on marine radioactivity and international collaborations on environmental radioactivity. The teams co-author publications, share students and technical staff, and hold regular joint scientific seminars.

The PAVIRMA irradiation platform, which was still under development in 2020, is now fully operational and serves both medical and environmental applications. It provides advanced experimental capabilities and has become a central hub for departmental collaboration.

Beyond internal integration, the SE department has strengthened its participation in national and European networks, contributing to FR Eau, EQUIPEX+ Terra Forma, and the Brown-Bear programme. Its involvement in EOSC-related FAIR data projects illustrates a strong commitment to open science.

Overall, the SE department has evolved into a coherent and interdisciplinary structure with solid experimental and simulation capabilities.

DEPARTMENT WORKFORCE: IN PHYSICAL PEOPLE AS OF 31/12/2024

Catégories de personnel	Effectifs
Professeurs et assimilés	4
Maitres de conférences et assimilés	15
Directeurs de recherche et assimilés	0
Chargés de recherche et assimilés	1
Personnels d'appui à la recherche	13
Sous-total personnels permanents en activité	33
Enseignants-chercheurs et chercheurs non permanents et assimilés	3
Personnels non permanents d'appui à la recherche	3
Post-doctorants	0
Doctorants	3
Sous-total personnels non permanents en activité	9
Total personnels	42

EVALUATION OF THE DEPARTMENT

Overall assessment of the department

The SE department has developed into a coherent interdisciplinary structure addressing health and environmental challenges. It combines expertise in radiobiology, dosimetry, and environmental radioactivity, supported by the PAVIRMA platform and participation in PRIMES, MI2B, and Terra Forma. Close collaboration between physicists and biologists has strengthened and is expected to continue in future projects, including the FLASH Master Project. Its work links fundamental and applied research with societal impact, though renewal of technical posts and sustained recruitment remain key for long-term stability.

Context-related strengths and opportunities

Strong interdisciplinary positioning and societal relevance. The SE department addresses major societal challenges in health and environment through a combination of experimental and computational approaches. Its research benefits from the complementary use of the PAVIRMA irradiation platform and GATE Monte Carlo simulations, which together enable studies of radiation effects on living organisms, ecosystems, and materials. This dual capability reinforces the department's interdisciplinary identity and its ability to respond to national and European priorities in environmental sustainability and medical physics.

Diverse and competitive funding base. The department has secured a variety of financial resources, including ANR, CNRS-MITI, H2020, and industrial contracts, demonstrating strong project-management capacity. Its integration in excellence projects such as LabEx PRIMES, EQUIPEX+ Terra Forma, and FR Eau strengthens institutional visibility and access to national infrastructures.

Active participation in scientific networks and collaborations. SE researchers play leadership roles in organisation and training within the OpenGATE Collaboration, contribute to the GDR MI2B (two coordinated research axes), and participate in FAIR-EASE and FAIR-IMPACT projects linked to the European Open Science Cloud (EOSC). These activities demonstrate the department's capacity to integrate into international initiatives and promote open, FAIR-compliant research.

Recognition and regional integration. The renewal of the ZATU label for five years underlines the department's recognised expertise in environmental radioactivity monitoring and its strong links with local and regional authorities. The development of distributed sensor networks within Terra Forma and the CEBA cloud platform provides new opportunities for visibility and technology transfer in data-driven environmental science.

Strategic opportunities for growth. The SE department is now in a favourable position to expand its collaborations with hospitals, cancer therapy centres (e.g. MedAustron) environmental agencies, and industrial partners. Its interdisciplinary skills, open-science tools, and participation in high-level networks create strong potential for future European project leadership and innovation-oriented partnerships.

Context-related weaknesses and risks

Dependence on temporary technical positions. The end of the CNRS Nucléaire & Particules-funded engineering contract dedicated to the GATE simulation platform represents a clear vulnerability for the department. This expertise is essential for maintaining software developments and supporting both medical and environmental applications. A similar dependence on fixed-term contracts for the operation of the PAVIRMA irradiation platform and for data-processing activities could compromise the long-term stability of these key infrastructures.

Limited renewal capacity and demographic risks. The permanent staff of the department is mainly composed of assistant professors and professors, with an average age of around 52 years. While this ensures strong teaching integration, it also reduces flexibility and research availability. The low ratio of PhD students and postdoctoral researchers to permanent staff limits renewal and slows the development of emerging topics such as biomaterials, AI-based image analysis, and environmental monitoring. In addition, forthcoming retirements may accentuate demographic imbalance if not anticipated through proactive recruitment and mentoring policies.

Sustainability of growth and diversification. The recent expansion of activities, particularly in environmental monitoring and sensor networks, relies on short-term project resources. Without consolidation through permanent technical staff and new doctoral positions, there is a risk of excessive workload and difficulty in sustaining the current momentum.

ANALYSIS OF THE DEPARTMENT'S TRAJECTORY

The SE department's trajectory over the coming period is characterised by a clear consolidation of its multidisciplinary research and a progressive shift toward digital health, advanced radiobiology, and environmental monitoring.

On the health-physics side, the department plans to extend its dosimetry and simulation studies to innovative radiotherapy in collaboration with the Jean-Perrin Cancer Centre, Inserm partners, and in connection with the forthcoming cyclotron facility in Auvergne. Participation in the 2025 PEPR 'Digital Health' programme will further strengthen its national integration. Building on its recognised expertise in the GATE and backward Monte Carlo simulation tools, the group aims to create digital twins for radiotherapy and natural-radioactivity studies within European networks.

In parallel, the team will pursue the development of nanoparticles for medical diagnostics and the study of TiO_2 -related toxicological mechanisms, linking physical modelling to biological impact. These research lines, together with work on mitochondrial DNA maintenance and hadron-therapy radiobiology, reinforce the long-term interface between physics and biology.

On the environmental side, the department will continue operating its instrumented observatories (ZATU, Becquerel Network) and expand measurements across different ecosystems. Data management will increasingly follow FAIR principles, with integration into national infrastructure such as Terra Forma, FR Eau, thereby ensuring visibility and long-term accessibility of environmental datasets.

Overall, the SE department's trajectory is coherent and promising. It leverages existing strengths in simulation, instrumentation, and biological modelling to open new perspectives in health and environmental physics. Its main challenge will be to maintain technical and human resources at a level compatible with these ambitions, ensuring continuity of expertise and sustainable growth.

RECOMMENDATIONS TO THE DEPARTMENT

Consolidate integration between the Health and Environment teams. The department should continue strengthening scientific and technical links between its two teams in order to maintain coherence and avoid dispersion of efforts. Shared projects based on the PAVIRMA platform and GATE simulations should be further developed to encourage cross-fertilisation between radiobiology, dosimetry, and environmental radioactivity studies.

Secure long-term technical and engineering positions. Given the department's dependence on fixed-term contracts, priority should be given to obtaining permanent technical posts dedicated to the operation of the PAVIRMA platform and the maintenance of GATE developments. This is essential to ensure the sustainability of infrastructure and data production.

Reinforce recruitment and generational renewal. Forthcoming recruitment should aim to strengthen expertise in simulation, instrumentation, and biology-physics interfaces, while attracting early-career researchers. The department should work with CNRS and UCA to anticipate staff replacement.

Maintain and strengthen open-science and data-management leadership.

The department should continue to play an active role in the FAIR-EASE, FAIR-IMPACT, and OpenGATE collaborations, ensuring that data from medical and environmental studies follow FAIR principles and remain accessible through national and European infrastructure.

Clarify strategic prioritisation and strengthen institutional and interdepartmental links.

The department should further clarify the prioritisation of its scientific activities in order to optimise the use of available resources. Increased engagement in ASN/ASNR-supported agreements would strengthen institutional anchoring and long-term support. Closer collaboration with the PU department, particularly in Monte Carlo simulations and data analysis, would reinforce coherence across LPCA.

CONDUCT OF THE INTERVIEWS

DATES

Beginning: 24 November 2025, 08:30 a.m.
Ending: 26 November 2025, 01:00 p.m.

Interview conducted: on-site

PROGRAMME OF THE INTERVIEWS

The interviews were organised over three days, and combined plenary sessions, thematic presentations, and dedicated meetings. The programme included presentations by the unit management, the TH, PU and SE departments, as well as discussions on technical strategy and infrastructure. The committee also met separately with researchers, technical and administrative staff, doctoral and postdoctoral researchers, and supervisory bodies. Time was allocated for internal committee discussions, site visits, and closed working sessions, ensuring a comprehensive assessment of the unit's scientific activities, organisation, and resources. The committee thanks the laboratory's management and all staff members for their warm hospitality, their availability in providing all requested information, and the open and constructive discussions throughout the visit.

Lundi 24 novembre	9:00 - 9:15	Huis Clos: Réunion de préparation du comité
	9:15 - 9:20	Session plénière : présentation des membres du comité
	9:20 - 10:10	Session plénière : présentation du directeur (50 min)
	10:10 - 10:40	Session plénière : questions (30 min)
	10:40 - 11:00	Pause café
	11:00 - 12:00	Pôle Physique fondamentale Théorique 40 min + 20 min de questions
	12:00 - 13:15	Déjeuner
	13:15 - 15:45	Pôle Physique fondamentale expérimentale et observationnelle ATLAS(30 min), Alice(20 min), LHCb(25 min), Comet(10 min), FCC(15 min) + 50 min de questions
	15:45 - 16:00	Pause café
	16:00 - 17:30	Pôle Physique fondamentale expérimentale et observationnelle LSST/ZTF(35 min), FINK(25 min) + 30 min de questions
	17:30 - 18:30	Visite
	18:30 - 19:00	Session fermée du comité
	19:30 - 22:00	Dîner à huis clos du comité
Mardi 25 novembre	8:30 - 10:25	Pôle Physique pour la santé, l'Environnement et l'énergie 15 min intro. globale + 50 min par équipe
	10:25 - 10:40	Pause café
	10:40 - 11:40	Présentation de la direction technique et discussion
	11:40 - 12:40	Rencontre avec les chercheurs
	12:40 - 13:50	Déjeuner
	13:50 - 14:50	Rencontre avec les personnels techniques et administratifs
	14:50 - 15:50	Rencontre avec les doctorants et post-doctorants
	15:50 - 16:05	Pause café
Mercredi 26 novembre	16:05 - 17:30	Réunion avec l'équipe de direction de l'unité
	17:30 - 18:45	Réunion avec les tutelles
	19:30 - 22:00	Dîner à huis clos du comité
	8:30 - 13:00	Session de travail du comité

GENERAL OBSERVATIONS OF THE SUPERVISORS

Direction de la Recherche et des Études Doctorales

Dossier suivi par : Thomas AREAL

hceres.dred@uca.fr / thomas.areal@uca.fr

La Vice-Présidente Recherche de l'Université
Clermont Auvergne

à

Madame la Présidente du HCÉRES,
Les Conseiller scientifique et membres du
Comité d'Experts

Clermont-Ferrand, le 21/04/2026

Objet : Observations de portée générale – Unité de Recherche LPCA

Chères et chers collègues,

A la suite de l'envoi du rapport de visite du LPCA, nous n'avons pas d'observations de portée générale à vous indiquer concernant le rapport de visite de cette Unité.

Nous tenions à remercier le HCÉRES, les Conseillers Scientifiques et les membres du Comité d'Experts pour le travail réalisé qui sera une contribution précieuse pour la définition de notre politique scientifique et l'accompagnement spécifique de chacun de nos laboratoires.

Bien cordialement,

**La Vice-Présidente Recherche
de l'Université Clermont Auvergne**

Vanessa Prévot

La Vice-Présidente Recherche



Vanessa PRÉVOT

Evaluation of universities and schools
Evaluation of research units
Evaluation of the academic formations
Evaluation of the national research organisms
Evaluation and International accreditation



19 rue Poissonnière
75002 Paris, France
+33 1 89 97 44 00

