# LAPP - Laboratoire d'Annecy-le-Vieux de physique des particules

Rapport Hcéres

HCERES

High Council for the Evaluation of Research and Higher Education

Research units

# HCERES report on research unit:

## Laboratoire d'Annecy-le-Vieux de Physique des Particules

## LAPP

# Under the supervision of the following institutions and research bodies:

## Université Savoie Mont Blanc

## Centre National de la Recherche Scientifique – CNRS

Evaluation Campaign 2014-2015 (Group A)

# HCERES

High Council for the Evaluation of Research and Higher Education

## Research units

*In the name of HCERES,*[1]

Didier HOUSSIN, president

*In the name of the experts committee,*[2]

Eckard ELSEN, chairman of the committee

Under the decree N°.2014-1365 dated 14 november 2014,

[1] The president of HCERES "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 expert committee". (Article 11, paragraph 2)

# Evaluation report

This report is the result of the evaluation by the experts committee, the composition of which is specified below.

The assessments contained herein are the expression of an independent and collegial deliberation of the committee.

| | |
|---|---|
| Unit name: | Laboratoire d'Annecy-le-Vieux de Physique des Particules |
| Unit acronym: | LAPP |
| Label requested: | UMR5814 |
| Present no.: | |
| Name of Director (2014-2015): | Mr Yannis KARYOTAKIS |
| Name of Project Leader (2016-2020): | |

# Expert committee members

Chair: Mr Eckhard ELSEN, DESY, Germany

Experts:

Mr Paschal COYLE, CPPM Marseille

Ms Delphine HARDIN, LPNHE (representative of the CoNRS)

Mr François LE DIBERDER, LAL Orsay (representative of the CNU)

Mr Martin POHL, Geneva University, Switzerland

Ms Claudia-Elisabeth WULZ, Institute of High Energy Physics, Austria

## Scientific delegate representing the HCERES:

Mr Cristinel DIACONU

## Representatives of the unit's supervising institutions and bodies:

Mr Johan COLLOT (Representative of the Doctoral School n°47)

Mr Serge KOX, IN2P3/CNRS

Mr Denis VARASCHIN, Université de Savoie Mont-Blanc

Mr Jerôme VITRE, CNRS

# 1 • Introduction

## History and geographical location of the unit

The Laboratoire d'Annecy-le-Vieux de Physique des Particules (LAPP), is a combined research unit of CNRS and the Université de Savoie Mont Blanc since 1995. It is located at Annecy-le-Vieux, 50km away from CERN, and It has been founded in 1976 by a group of experimentalists and theorists (they created their own laboratory LAPTh later) from Paris, who were attracted by the CERN vicinity. The main field of research is the physics of elementary particles, their interactions, and their impact on the universe we live in today. Both laboratories, LAPP and LAPTh, share the same premises, ~8500m$^2$ built on 40000m$^2$ of land. Between 2009 and 2014, a total of ~140 people worked at LAPP, 30 CNRS researchers, 9 faculty, 75 engineers, technicians and administrative staff, 8 postdocs, 12 students, and many visitors.

The history of LAPP is strongly correlated with CERN's activities. It begins at the end of the 70's with experiments at the PS, the ISR and the SPS (EMC, GAMS, …), followed by UA1 at the proton-antiproton collider in the 80's, and the discovery of the W and Z bosons. At the same time, the neutrino physics has been initiated and the laboratory played an important role on the Bugey experiment followed later by CHOOZ and NOMAD. In the 90's, the laboratory focused on the ALEPH and L3 experiments at LEP, and participated in many high precision measurements. In parallel an important R&D program on LAr calorimeters is launched, for the LHC. During the same period the laboratory opens a new domain, astroparticle physics, and initiates new programs on gravitational waves (Virgo), and charged and neutral cosmic ray observations (AMS, HESS) and measurements. By the end of the 90's the laboratory joins BaBar at SLAC and OPERA at the Grand Sasso. By that time about half of the scientific activity is not related to CERN. After a long investment in R&D, construction and commissioning of the LHC experiments ATLAS, LHCb and initially CMS, came the time for the first discovery, the Higgs boson, and high precision measurements. The contribution of LAPP to all these experimental programs is important and renowned worldwide.

Today the laboratory addresses most of the fundamental problems of physics: is there any new physics and new phenomena beyond the Standard Model, what is the nature of dark matter, neutrino oscillations, mass hierarchy and CP violation, gravitational waves. The scientific program is very rich and promising for the future.

## Management team

The laboratory management team is composed of four persons: the director, the deputy director, the technical director, and the administrative director. The team is supported by a personal assistant. A laboratory and scientific council advise the director on important or daily issues and scientific matters.

## HCERES nomenclature

ST2 Physics; Elementary particles, Fundamental interactions, Astroparticles, New Physics, Dark Matter

PE2: Fundamental constituents of matter: particle, nuclear, plasma, atomic, molecular, gas, and optical physics

## Unit workforce

| Unit workforce | Number as at 30/06/2014 | Number as at 01/01/2016 |
|---|---|---|
| **N1**: Permanent professors and similar positions | 9 | 9 |
| **N2**: Permanent researchers from Institutions and similar positions | 29 (28.8) | 29 (28.7) |
| **N3**: Other permanent staff (without research duties) | 67 (64.3) | 62 (59.9) |
| **N4**: Other professors (Emeritus Professor, on-contract Professor, etc.) | 1 | 1 |
| **N5**: Other researchers (Emeritus Research Director, Postdoctoral students, visitors, etc.) | 15 | 13 |
| **N6**: Other contractual staff (without research duties) | 5 | 2 |
| **TOTAL N1 to N6** | **126 (123.1)** | **116 (113.6)** |

| Unit workforce | Number as at 30/06/2014 | Number as at 01/01/2016 |
|---|---|---|
| Doctoral students | 12 | |
| Theses defended | 16 | |
| Postdoctoral students having spent at least 12 months in the unit | 23 | |
| Number of Research Supervisor Qualifications (HDR) taken | 6 | |
| Qualified research supervisors (with an HDR) or similar positions | 21 | 22 |

# 2 • Overall assessment of the unit

## Global assessment of the unit

The research unit has successfully established and maintained a high-level research programme that capitalises on the technical excellence of the laboratory. The technical expertise is also supported by the regional prevalence of schools and companies specialising in mechanics and controls. The research unit also profits from the vicinity to CERN that both provides excellent science opportunities and inspires advanced technical and scientific developments to the mutual benefit of both institutions. These were the arguments that led to founding the institute in 1976 and they continue to be valid at the time of modern communication tools where seemingly distance matters less.

The research unit is tightly linked to the Université de Savoie Mont Blanc, which supports a number of staff positions at the laboratory and provides teaching opportunities albeit typically at the bachelor level for physics. The Doctoral School is realised with the slightly more distant Université de Grenoble. The unit is a partner in the newly created excellence cluster ENIGMASS which includes the LAPP and the LAPTh (Annecy), the LPSC (Grenoble) and the LSM (Modane), joining their scientific efforts to focus on the origin of the mass and its diverse implications.

The strategy of the research unit is well developed and centres around two flagship projects at CERN (ATLAS and LHCb), complemented by existing and emerging projects in neutrino physics and a possible linear collider. The laboratory has also expanded into astroparticle physics notably gamma-ray detection (HESS&CTA) and cosmic rays (AMS) where the mechanical and controls expertise is superbly applied and where the physics provides opportunities for collaboration with the theory department – as it does for the LHC experiments. In addition there has been a longstanding activity in gravitational wave detection in the Pisa-based experiment Virgo, which is now entering the commissioning phase of its advanced state, which requires meticulous attention. For the future there may be excellent opportunities for well-measured contributions to cosmology, which arise from the availability of world-experts and interests in theoretical developments.

On the experimental side the contributions evolve from the expertise on calorimetry, best demonstrated in the contributions to the ATLAS experiment where the responsibility for the LAr calorimeter has been systematically applied and benefited respective physics analyses.

Overall, the physics programme is broad and well balanced. It promises rewarding results for the future and fosters a sound education of young researchers.

## Strengths and opportunities in relation to the context

The ATLAS and LHCb activities are well imbedded in all aspects of the experiment from conceiving a detector component, building and commissioning it and analysing the data. Similar ownership of the experimental analysis is realised in the research unit's contribution to the Alpha Magnetic Spectrometer (AMS), where the fruits of the longstanding contribution can now be reaped. The AMS control centre is at CERN. The research unit has been instrumental in the measurement programme of the gravitational wave experiment Virgo, both in continuously optimizing the sensitivity and in proposing technical innovations. With its technical expertise the team holds a prominent position amongst other French Virgo collaborating institutes; this position could be even strengthened by closer collaborating with their partners in France to minimise the overall effort.

Accelerator instrumentation R&D has only been added relatively recently (in 2002) to the portfolio of activities. The topic is well supported by an adequate number of engineering staff and has attracted an outstanding fraction of third party funding. The research activities have been wisely selected and naturally evolved from their beginnings. The contributions to the topic of ultra-precise mechanical stabilisation of accelerator components in particular are renowned and meanwhile called for by groups outside of accelerator applications. The vicinity to CERN is an asset.

The research unit has recently profited from the establishment of two new additions, a joint computing infrastructure (MUST) and a new building (Maison de la Mécatronique) successfully established a high-level research programme that capitalises on the technical excellence of the laboratory.

The technical expertise is also fostered by a number of regional schools, which provide for teaching opportunities, which possibly could be intensified. The lack of Doctoral Schools at Université de Savoie Mont Blanc, however, calls for additional flexibility, as is, e.g. realised with the Université de Grenoble.

### Weaknesses and threats related to the context

The technical expertise at the research unit is outstanding and the fraction of engineer and technician personnel is high. In contrast it is not always obvious that this high-level of expertise is sufficiently exploited in physics analyses. In fact, often only one single research physicist is available for a specific topic; a risky situation since the layout and optimisation of experiments should be guided by the physics requirements.

There are common topics between the experiments; a trivial one to be named is the analysis of heavy flavours at the LHC by the ATLAS and LHCb groups. In such cases, an open exchange of ideas and analysis techniques could be beneficial.

Progress in physics is often driven by the motivation of young researchers; in fact, a healthy mix of young and experienced physicists is most important. Given the limitations of higher physics education at the Université de Savoie Mont Blanc and the distance to Université de Grenoble a special effort has to be made to attract students. Such an effort is underway.

### Recommendations

The research unit has an outstanding and sound strategy, which was arrived at through an internal consultation process. New opportunities through the COMUE (Communauté d'Universités et Établissements) Université Grenoble Alpes (UGA) need to be seized to position the research unit for successful applications in competitive IDEX excellence programmes. In fact the PAGE research pole (Particles Astrophysics Geoscience and Ecology) initiative already made a good start and is driven by the research unit. The relevance of this engagement is emphasised both to maintain the excellent standing in France and worldwide but also to attract students on a national scale. The research at the unit is internationally renowned and highly competitive and this excellence should not be dampened by its peripheral position in France. In fact, the vicinity to CERN and universities in Switzerland may help to improve the embedding in high-level physics teaching and strengthen the position in the competitive process of student recruitment. Given its location in France the laboratory has to apply unusual methods to attract young researchers and not to suffer from a position of isolation. The contact to other French laboratories should be maintained at all levels.

Research projects have been carefully selected and there is a healthy mix of increasing and declining engagements as the experiments go through their life cycles. The engineering and technical staffs are fully engaged in this process and often drive the success of existing projects and help develop realistic new projects. Matrix organisation is at life, both for engineers and scientists. The large group of technicians and engineers is a bonus and a distinction. This level should be maintained.

The university department supports post-doc positions, which is much appreciated. Actively guiding students towards such positions would create even bigger benefits for the university and the laboratory itself. The Labex-ENIGMASS initiative helps already.

To date the research unit does not host regular external scientific reviews (apart from this HCERES review which is rare). Other laboratories call for a review of their programme by external experts once or twice a year. It should be considered whether such an initiative would strengthen the coherence of the activities and help arrive at critical decisions.