LLR - Laboratoire Leprince-Ringuet

Rapport Hcéres

agence d'évaluation de la recherche
et de l'enseignement supérieur

Department for the evaluation of research units

AERES report on unit:

Laboratoire Leprince-Ringuet

LLR

Under the supervision of the following institutions and research bodies:

Centre National de la Recherche Scientifique - CNRS

École Polytechnique

December 2013

agence d'évaluation de la recherche
et de l'enseignement supérieur

Department for the evaluation of research units

On behalf of AERES, pursuant to the Decree of 3 november 2006[1]*,*

– Mr. Didier HOUSSIN, president
– Mr. Pierre GLAUDES, head of the evaluation of research units department

On behalf of the expert committee,

– Mr. Eckhard ELSEN, chair of the committee

[1] The AERES President "signs [...], the evaluation reports, [...] countersigned for each department by the director concerned" (Article 9, paragraph 3 of the Decree n ° 2006-1334 of 3 November 2006, as amended).

Evaluation report

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

The assessment contained herein is the expression of independent and collegial deliberation of the committee.

Unit name:	Laboratoire Leprince-Ringuet
Unit acronym:	LLR
Label requested:	
Present no.:	
Name of Director (2013-2014):	Mr Jean-Claude BRIENT
Name of Project Leader (2015-2019):	Mr Jean-Claude BRIENT

Expert committee members

Chair:	Mr Eckhard ELSEN, DESY, Germany
Experts:	Mr David BRASSE, Institut Pluridisciplinaire Hubert Curien, Strasbourg
	Mr David D'ENTERRIA, CERN, Switzerland
	Mr Jean-Marie HAMEURY, Observatoire Astronomique Strasbourg
	Mr Arnaud LUCOTTE, LPSC (representative of CoNRS)
	Mr Thomas PATZAK, Laboratoire APC, Paris
	Mr Sylvain TISSERANT, CPP Marseille (representative of CNU)

Scientific delegate representing the AERES:

Mr Cristinel DIACONU

Representative(s) of the unit's supervising institutions and bodies:

Mr Philipe CAVELIER, CNRS

Mr Pierre LEGRAIN (École Doctorale de l'École Polytechnique EDX n°447)

Mr Patrick LE QUERE, École Polytechnique

Mr Jacques MARTINO, IN2P3 CNRS

1 • Introduction

History and geographical location of the unit

The Laboratoire Leprince-Ringuet (LLR) is the first laboratory that was founded by its namesake out of the research centres of École Polytechnique with the purpose to engage in cosmic ray research as early as 1936. The research evolved to accelerator based particle physics, where the institute looks back to important contributions in establishing the current basis, the Standard Model. Examples are the discovery of the neutral currents and significant contributions to ALEPH at LEP and H1 at DESY. Astroparticle physics received significant boosts with the development of large ground and space-based detectors. In 1976 the École Polytechnique and the laboratory, then known as LPHNE-X, were relocated to Palaiseau, south of Paris. In 2002, the laboratory reassumed its original name, Laboratoire Leprince-Ringuet.

To date LLR focuses on contributions to the CMS experiment at the LHC both in proton-proton and heavy-ion physics and on the study of the origin of high-energy gammas at FERMI, HESS and the future CTA experiment. At the same time, there is a significant contribution to flavour physics through engagement in the BaBar experiment at SLAC and the T2K experiment in Japan, which recently contributed to establishing the possibility for CP-violation in the leptonic sector of the Standard Model and thus gave a considerable boost to planning experiments searching for the effect.

The laboratory profits from its special role as part of the École Polytechnique, which provides a sound engineering basis and excellence in research. École Polytechnique is one of the founding members of the emerging University Paris-Saclay.

Management team

Mr Jean-Claude BRIENT: directeur

Mr Pascal PAGANINI: directeur adjoint

Mr Marc ANDUZE: responsable technique

Mr Thu BIZAT: responsable administratif et financier

AERES nomenclature

ST2

Unit workforce

Unit workforce	Number as at 30/06/2013	Number as at 01/01/2015
N1: Permanent professors and similar positions		
N2: Permanent researchers from Institutions and similar positions	27	27
N3: Other permanent staff (without research duties)	46	44
N4: Other professors (Emeritus Professor, on-contract Professor, etc.)	6	
N5: Other researchers from Institutions (Emeritus Research Director, Postdoctoral students, visitors, etc.)	9	
N6: Other contractual staff (without research duties)	5	
TOTAL N1 to N6	93	71

Unit workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	11	
Theses defended	14	
Postdoctoral students having spent at least 12 months in the unit*	9	
Number of Research Supervisor Qualifications (HDR) taken	5	
Qualified research supervisors (with an HDR) or similar positions	13	13

2 • Assessment of the unit

The Laboratoire Leprince-Ringuet (LLR) was founded as a research laboratory of the École Polytechnique in 1936 to support the research of cosmic rays, which, since then, has naturally evolved to accelerator-based research. LLR physicists successfully participated in prominent research activities at various facilities and contributed decisively to the establishment of the Standard Model of Particle Physics. Today the focus of particle physics is placed on the engagement in the CMS experiment at the LHC at CERN. Astroparticle physics is rigorously pursued, particularly in high-energy gamma ray detection.

One of the keys to success for the laboratory has been the highly skilled technical expertise, which is also attracting application-oriented students. As a result LLR has been an important contributor to various highly sophisticated detector developments and so plays a key role in the advancement of detector concepts for LHC, ILC and beyond.

Strengths and opportunities related to the context

The vicinity of the École Polytechnique guarantees an influx of highly educated and gifted students. The research programme thus largely builds on engaging these students in research, often with very visible success. Likewise, these students feel welcome and supported during their research programme, which is a testimony both to the high scientific standards in the laboratory and to the respect the students experience as part of the research team.

Success can also be attributed to the highly motivated engineering department, which is available to the physicists as a whole. It is impressive to recognise how the technical staff is committed to contributing and finding adequate technical solutions as required.

Weaknesses and threats related to the context

LLR is placed in a highly competitive environment with several other research laboratories nearby. It is important that LLR maintains and further develops its distinction, which relates technical expertise with advanced physics analyses, so that students can be attracted specifically. A natural source of students is the École Polytechnique from which most students can be recruited. However, some topics may need extra engagement for which lectures of LLR staff play an important role.

Recommendations

Overall the committee is very impressed by the high scientific standards reached in all research activities, much of which owed to the vicinity of the École Polytechnique.

The committee acknowledges under-staffing of some projects and encourages the laboratory to define a recruitment policy both for attracting the best researchers and to prioritise in case of limited funds. The groups should engage actively in attracting students from the École Polytechnique. Specifically, a plan should be developed jointly with École Polytechnique. This plan should include a planning of the number of HDR etc.

The committee is truly impressed by the individual scientific activities. The committee made a few observations on the long-term perspectives, which however do not affect the quality at the current time:

The heavy-ion programme at CMS is highly successful and very impressive. The committee also acknowledges a very active research programme over the next few years, which will help to conclude the current research. The committee failed to recognise the long-term physics plans for the CMS HI group. Such plans should be consolidated before the start of run 2.

The gamma astronomy group has earned a high reputation in its engagements at FERMI and HESS. The commitment for the CTA experiment, which is advancing on a European scale, is still small. It is important that the group engages in the conception of the experiment for which basic design decisions are taken now. Given the complexity of the experiment and collaboration one should not assume that late design changes would be respected.

The heavy flavour experiments are flourishing. One constraint is arising from the need of extended research stays in Japan. Given the long-term plans of the group and the engagement for Hyper-Kamiokande an adequate solution for support needs to be found.

On the scale of the engagement for large experiments, a common position should be developed jointly with IN2P3 to prepare for the major decisions concerning the LHC physics programme and the engagement for ILC and CTA.

Since LLR is a founding member of the University Paris-Saclay with a broad range of assets for research and education, the committee suggests intensifying the engagement of the laboratory as a whole in shaping the structures of the emerging institution. The broader the engagement of the laboratory, the easier will it be to maintain the scientific standards of École Polytechnique and to make synergistic use of the talents of all partners involved.

3 • Detailed assessments

Assessment of scientific quality and outputs

LLR has an impressive record of physics achievements, which can be related to the physics groups and strong individuals. The list of recent achievements includes the thorough understanding and operation of the electromagnetic calorimeter of CMS, leading contributions to the analysis of the Higgs signal in ZZ* (4 leptons) and tau-tau decays, the observation of Upsilon-suppression in heavy ion collisions, the initiative of creating a catalogue of ultra-high energy gamma rays and understanding the infrared background and the measurement of the neutrino mixing angle in transitions between the first and third generation, all of which are true flagship contributions.

In recent years an interesting opportunity has opened up for ground-laying experiments in laser plasma wakefield acceleration. Here, the availability of high-power lasers at École Polytechnique, of a skilled engineering group and of high-level expertise in detection devices enable significant steps in the understanding technique, which may have far-reaching applications.

The engagement in detection devices may lead to applications in hadron therapy, where both a technology transfer has been initiated and demands for new implementations have been received.

Assessment of the unit's academic reputation and appeal

LLR is a distinguished laboratory located in a very competitive environment, a feature, which by itself fosters a very high academic standard. The distinction of LLR amongst its peer institutes derives mainly from the excellent engineering base and the open access to the workshop infrastructure. Such an environment regularly attracts excellent students and visitors from other laboratories. Specifically, direct exchange programmes have been negotiated with ETH Zurich. The number of annual visitors is large. Several prizes have been won.

Assessment of the unit's interaction with the social, economic and cultural environment

LLR physicists regularly pay visits to French universities to hold seminar and colloquia. The discovery of a Higgs signal at the LHC has led to a particular peak in such activities. Mayors of regional communities have been invited to a “journée des maires” and other regional contacts have been made. The committee notes that, despite of such successes, the impact could still be strengthened with an improved appearance on the internet.

LLR has attracted an ERC and industrial contracts.

Assessment of the unit's organisation and life

The committee was given the opportunity to discuss with several groups separately. In conversations with the “Conseil de Laboratoire” the committees noted an apparent lack of discussions on the strategy of the laboratory. At the dawn of fundamental rearrangements at the level of research institutions and the foundation of the University Paris-Saclay, one would expect considerate input from this assembly of scientists. Once a strategy is defined, it should be exposed to the external scientific advisory board to seek further input. Overall the role of the external advisory board should be better defined and be contrasted with the role of the Comité Technique de Revue de Projet (CTRP).

The research groups are sometimes too small and should be embedded in a larger context, as indicated in the thematic discussion. Synergies should be recognised early; examples noted by the committee were in the context of calorimetry, the planning of CHIC and the engagement in GEANT.

LLR has not recovered from an earlier decrease of the research staff (since 2005), which, due to a particular age structure, was more pronounced at LLR than elsewhere and amounted to a level of 1/3. This reduction rendered some groups too small (single individuals), as is indicated in the thematic discussion. Support of EP for technical staff and infrastructure is welcome and acknowledged.

The interviews with the specific groups revealed a pleasant working atmosphere throughout and reflected the working conditions in a prestigious laboratory. Staffs enjoy the working environment and the open interaction with various groups. The increasing number of projects creates an extra workload, which, however, at this time is competently handled. The technical groups are also proactive in adopting new technologies and tools, a prerequisite to the continued high standards. The administration group has been reorganised and provides the support for day-to-day demands in addition to the rather newer support for external contracts.

Assessment of the unit's involvement in training through research

There is a continuous influx of students from the École Doctorale (EDX n°447), whose student selection is entirely based on scientific excellence. In the absence of thematic quota, there is no guarantee to attract a student matching to the project demands. The committee supports this policy at the fundamental level. On the one hand, thesis work has to appear sufficiently attractive to support a rather long-term engagement of the student. On the other hand it is important that the breadth of the scientific programme – at LLR and elsewhere – be advertised to the students early on. The committee did not identify such a mechanism.

Teaching is well supported at the master and PhD level. There is a specific contribution to the organisation of the admission competition “Concours entrée X”.

LLR has extended its engagement to ETH Zurich, where an international master degree can be obtained. There are joint initiatives with Scuola Normale Superiore di Pisa. Promising contacts have been made to Asian institutes notably in China.

The committee encourages a forthcoming engagement in the shaping of the emerging University Paris-Saclay, which is expected to lead to fundamental changes. These changes will affect the established interaction with students; such changes should be anticipated and discussed at large.

Assessment of the strategy and the five-year plan

The strategy at LLR is based on the combination of scientific and engineering excellence, which, for fundamental physics, has led to important detector developments and breakthroughs in analyses. The high-standards are readily visible. This well-established tradition, meanwhile, has to be extended, as larger collaborations and centres of excellence were formed. One example is the establishment of the “Physique des 2 Infinis et des Origines” (P2IO) at the campus of Paris-Saclay University. Such elements and the formation of University Paris-Saclay deserve wider discussion than was apparent for the committee. The committee noted little engagement of the staff in shaping the new structures, and even a lack of information. Immediate changes will affect the Ecole Doctorale; the implications should be anticipated, and this process has started.

In contrast, the strategy for most of the on-going flagship projects was clearly spelled out and is sound.

4 • Theme-by-theme analysis

Theme 1: Energy frontier

Manager's name: Mr Vincent BOUDRY / Mr Yves SIROIS

Workforce

Theme workforce in Full Time Equivalents	As at 30/06/2013	As at 01/01/2015
FTE for permanent professors		
FTE for permanent EPST or EPIC researchers	10.1	9.6
FTE of other permanent staff without research duties (IR, IE, PRAG, etc.)		
FTE for other professors (PREM, ECC, etc.)		
FTE for postdoctoral students having spent at least 12 months in the unit	7	
FTE for other EPST or EPIC researchers (DREM, etc.) excluding postdoctoral students	3	3
FTE for other contractual staff without research duties		
FTE for doctoral students	6	
TOTAL	26.1	12.6

• Detailed assessments

Assessment of scientific quality and outputs

CMS group: The LLR is one of the founding members of the CMS experiment, contributing strongly to the original concept, the construction and the commissioning of the electromagnetic calorimeter (ECAL), its triggering and data acquisition electronics. The reduction of staff observed at LLR in the middle of the past decade has also affected this group, although during the last four years new positions have been filled. The group activities have evolved around a coherent strategy based on the expertise developed for the EM calorimeter: first level triggering system design and implementation, electron, photon and tau reconstruction and identification, search for the Higgs boson and now determination of its properties.

The engagement focused on the mechanical frame for the crystals of the EM calorimeter, the data acquisition electronics, which includes the responsibility of the design and implementation of the trigger boards as well as the responsibility for the L1 ECAL trigger, which was commissioned from 2009 on. In 2012, the group contributed to providing a solution that eliminated the signal spikes seen in the calorimeter APD, which could have saturated the available bandwidth of the L1 trigger during collisions.

The group developed and refined several algorithms that aimed at improving electron and photon identification using the GSF filter for electrons, track and calorimeter association and bremsstrahlung recovery for electrons, which also had to be immune against the rising pile-up. The group also developed τ-analysis tools largely referring to Particle Flow techniques. The activities were widely acknowledged in responsibilities for the collaboration: e/gamma

working group, electron and calibration tools commissioning, tau identification, tau triggering working groups and the overall tau lepton working group from 2014 on.

The strategic expertise in lepton identification led to a natural leadership in the search and the discovery of the Higgs boson in the H→ZZ*→4 leptons channel, where the group significantly helped to defined the selection strategy, the background estimate and attempt a first measurement of the spin/parity of the newly discovered particle. The group also took advantage of this expertise in the publication of the ZZ- and WZ-cross-section measurement, which was used to constrain anomalous 3-boson couplings and the existence of new high-mass resonances. The τ-identification expertise naturally led to a heavy involvement in the search in the H→ττ in Standard Model or Supersymmetric Model (MSSM) frameworks, which included trigger and mass reconstruction tools and was recently awarded a paper on the first evidence for the decay.

The group also built and maintains its Tier-2 site, which is included in the Ile-de-France GRID effort GRIF. This site constitutes a major asset for analyses contributing to the Higgs boson studies conducted in this group. Members of the group are responsible for GRIF and CC of the CMS-France computing effort.

LLR projects for the imminent LHC Run-2 are well defined and consistent with the group's current expertise and leadership. The key physics topic is the further exploration of the Higgs boson. Long-term plans for phase 2, scheduled for 2025, foresee the measurement of the Higgs self-coupling, a crucial ingredient of the understanding of the EW spontaneous symmetry breaking, which will be performed in the pp→HH→bbττ channel. In addition the group will measure the tri- and quartic-gauge boson anomalous couplings. From the detector standpoint, the consolidation of the TCC trigger boards for high pile-up operation has strong implications on the offline trigger software, due to the firmware implementation of improved electron/photon/tau identification algorithms. The new architecture will be commissioned in parallel with the existing readout, using parallel optical connections, with LLR responsible for test bench and validation.

The engagement for LHC phase-2 (from 2025 on) is presently being discussed at the highest level of IN2P3. The LLR group foresees participation in two major fields, jointly with IRFU and IPNL: the upgrade of the barrel EM calorimeter electronics and the design of a forward high-granularity calorimeter. In parallel, the LLR group envisages collaboration with the computer science group on the use of GPUs for the high-level trigger.

The group's visibility has been consistently excellent with, during the past five years, major contributions to 34 publications, 55 presentations at conference and 15 PhD theses.

ILC Group: LLR is a key player in the ultra-high granularity EM calorimetry R&D for a future linear collider. The activities can be traced to original contributions in 1998 to Particle Flow Algorithms (PFA), which optimally relate high-granularity calorimeter with tracking information. Since 2005 LLR is leading the international CALICE collaboration with the goal to develop high-resolution calorimetry primarily for application in experiments at the International Linear Collider (ILC) and to advance proto-collaborations for the ILD-detector. Contributions to ILD consist of a letter of intent (LoI) in 2009 and a Detailed Baseline Design (DBD) in 2012 with the goal of a full-blown Technical Design Report around 2016. The ILD group at LLR is presently composed of three permanent researchers, one post-doc and one PhD student.

The LLR group focuses on three topics: R&D on calorimetry, design studies for ILD detector integration, simulation studies of PFA reconstruction and optimization for physics application. Developments led by the LLR group at IN2P3 specifically address a silicon/tungsten (SiW) detector for the electromagnetic part, and a semi-digital calorimeter (SDHCAL) based upon gaseous detector for hadronic calorimetry. Prototypes of the mechanical structure of the SiW detector using honeycomb carbon fibre and tungsten have been built along with the front-end electronics and the data acquisition system. The group is also heavily involved in the R&D efforts around the silicon wafers (optimization and industrialization tests) taking advantage of intense collaborations with Japan. The SDHCAL activities span from concept and test bench to DAQ. The new version, common to different prototypes, is functioning since February 2013 for the ECAL test bench, which receives significant attention from both calorimeter technologies technologies.

As one of the main actors in calorimetry, the LLR group has had a significant contribution to both the LoI and DBD for the ILD detector. CAD tools have also been developed for dedicated integration studies in the ILD project with specific contributions to the cooling and electrical power distribution designs. The LLR group is also involved in the development of software tools for detector optimization, via relevant physics use-cases. Examples are detailed simulation, parameterised simulation and the software library for PFA reconstruction that is used for optimisation of calorimeter segmentation and costs.

The future of the group depends on the prospects for realising the ILC in Japan. To date, a site has been identified and discussions are taking place at the highest political levels. A decision could be taken within the next

two years. The implications of a decision to build the ILC must be carefully evaluated in terms of human and technical resources for the LLR, even though a large part of the detector construction will be performed in the industry. On the other hand, the LLR group – in coherence with the IN2P3 strategy – considers stopping its activities if no decision were taken on the ILC/ILD project by the end of 2016.

Thanks to their leading role in CALICE, the group members have acquired a high reputation, which is reflected by their numerous responsibilities in the international ILC community: coordination of ILC-France, ILD-France, ILD-ECAL; member of ILD Joint Steering Board, ILD Executive Board, ILD Costing, ILC Research Directorate, ILC-CLIC Joint working group; responsibility for ECAL and DAQ within the CALICE collaboration.

CMS and ILC: The expertise developed in PFA algorithms, although technically different between CMS and ILD, is a clear asset to both groups. The highly visible role in the ILC-ECAL design studies may provide a link to the CMS community, in view of the development of a high-granularity calorimeter, for which concepts are under study for the LHC phase 2 upgrade. These developments could lead to a reinforcement of the synergies between the two groups.

Assessment of the unit's academic reputation and appeal

The CMS group has been a key player in the Higgs boson discovery through its contribution and leadership role in the H→ZZ→4 leptons search. This contribution has been rewarded through their role as coordinators and editors of the corresponding papers (discovery papers, performance and support documents). This visibility was also obvious in the object reconstruction and performance contributions, for which LLR group members have assumed the roles of coordinator in the electron/photon as well as tau ID working groups. The group also played a key role in the first levels of electron and jet triggering using the calorimeter, including a highly visible contribution to the treatment of accidental spikes, which resulted in a “CMS achievement award” for a LLR PhD student. The LLR team leader is at the same time the CMS France leader. The group showed a strong engagement in the computing grid, with the installation of a Tier-2 at LLR, and played a leading role in the development of the GRIF initiative.

The ILC team has historically played a leader role in the calorimeter group of ILC, within the CALICE collaboration. The team members are organizers of large instrumentation conferences. It is clear that, once the decision about the ILC/ILD project is launched, the group will be in a position to seek an international role.

Assessment of the unit's interaction with the social, economic and cultural environment

The CMS team has nationally played a leading role in physics outreach following the Higgs boson discovery, with members involved in public media coverage. The specific outreach activities of group for the ILC have been rather limited.

Assessment of the unit's organisation and life

The CMS team shows strong leadership. A consistent strategy has been developed which allowed the team members to take profound and interesting responsibilities and have a clear impact on the CMS collaboration, both in object reconstruction and in physics. The team leader conveyed a proactive attitude among the researchers and technical staff, and managed to promote young researchers. Effective communication inside the group (as well as the technical divisions) is key to the consistency of the physics programme, the overall strategy and the promotion of individual members in the collaboration.

The ILC team is composed of well-motivated members. The permanent researchers have assumed important and visible responsibilities in the calorimeter group. Despite the uncertainty of the project, they succeed in constituting a small but robust team, in tight contacts with the technical divisions, which allowed them to contribute to a consistent and very relevant R&D programme for ECAL, SDHCAL DAQ and their integration. The team has also developed an expertise in simulation software and object reconstruction optimization, based on Particle Flow Algorithm and on innovative reconstruction and simulation tools.

Assessment of the unit's involvement in training through research

Several members of the CMS team have teaching engagements at the master level. A total of 15 theses were completed (CMS). The number of PhD theses is less prominent for ILC but still significant given the situation of the project. Interesting theses were completed based on test-beam data and physics cases used as figure of merit for the detector simulation design.

Assessment of the strategy and the five-year plan

The CMS group presented clear plans for run 2 and 3 based on the continuation of measurements of the Higgs boson and the search for new high mass resonance (run 2) and Higgs boson self-coupling determination (run 3). The team proposed adaptations of the trigger for high-luminosity phase, which will already be tested in phase 1 as a preparatory step for the high luminosity run. The team recognizes the financial constraints and is thus developing a coherent strategy in order to overcome this problem. The overall strategy is, again, coherent with the expressed research interests, and includes prospects on a forward high granularity calorimeter.

For the ILC/ILD project, the strategy is clearly laid out and depends on the Japanese decision, which is expected within two years. The team also plans on engaging a PhD student to explore joint applications of calorimeter expertise with CMS.

Conclusion

- **Overall opinion of the theme:**

The CMS activity constitutes a flagship activity. Composed of excellent researchers, the team has acquired an international recognition in calorimeter hardware, triggering and object reconstruction and simulation. The team has also had a clear impact in key analyses in an ultra-competitive environment. This activity has lead to deep influence within the collaboration and is reflected by numerous scientific leadership positions, both at the international and at the national levels.

The ILC group has assumed for a long time a clear leadership position in CALICE. Team members are considered world experts on calorimeter, which is reflected in highly visible leadership positions in France.

- **Strengths and opportunities:**

The strength of both teams is based upon excellence of the physicists. They benefit from clear strategies based upon expertise in all key aspects covering the full chain of analysis: from sophisticated hardware contributions, which were possible owing to excellent and dedicated engineering departments, to the development of software and analysis tools, and, finally, to the consistent expertise developed within physics groups. This constitutes with no doubt the key to success.

- **Weaknesses and threats:**

The weakness of the ILC team results from the yet uncertain future of the ILC project. The group would certainly benefit from clear plans considering all possible outcomes, including the possibility to consider the developments on a high-granularity calorimeter towards the CMS upgrade.

- **Recommendations:**

Although highly dependent upon political decision of IN2P3, the CMS team should clearly prepare for LHC phase 2 engagements following the strategy presented.

Regarding ILC, it seems important to prepare options for ILC in the international context.

Theme 2: Gamma astronomy

Manager's name: Mr Berrie GIEBELS

Workforce

Theme workforce in Full Time Equivalents	As at 30/06/2013	As at 01/01/2015
FTE for permanent professors		
FTE for permanent EPST or EPIC researchers	7	6
FTE of other permanent staff without research duties (IR, IE, PRAG, etc.)		
FTE for other professors (PREM, ECC, etc.)		
FTE for postdoctoral students having spent at least 12 months in the unit		
FTE for other EPST or EPIC researchers (DREM, etc.) excluding postdoctoral students	2	2
FTE for other contractual staff without research duties	1	
FTE for doctoral students	2	
TOTAL	12	8

• Detailed assessments

Assessment of scientific quality and outputs

The advent of large and sensitive instruments such as HESS and Fermi has recently changed the landscape of high-energy gamma-ray astrophysics. The LLR has played a significant role in building the Fermi calorimeter, and is now involved in the last and final event-level analysis of Fermi LAT, Pass 8. Pass 8 will be a major endeavour, as it will enable the full realization of the Fermi-LAT scientific potential. Similarly, after having built the mechanical part of the HESS telescope, the team is contributing in a very active way to the calibrations, operations and data analysis of HESS. These technical contributions enabled the team to lead several, very visible, publications of the HESS and Fermi collaborations. Just as an illustration, one can mention the determination of the intensity of the extragalactic infrared background, which is very difficult to measure directly, or several pioneering studies of supernova remnants. The team has also seized the opportunity of combining HESS and Fermi data to constrain the physical mechanisms at work in extragalactic sources; this also resulted in several high impact papers which the team has lead. Finally, one should mention the production of catalogues of high energy sources: one team member is one of the two authors of the on-line catalogue of TeV sources (TeVCat), the reference catalogue widely used by the high energy gamma-ray community; LLR also had a very significant contribution to several Fermi catalogues, including the Fermi Large Area Telescope second source Catalogue, which is the most quoted astronomical paper in 2012.

LLR is also part of CTA collaboration, with important contributions on the mechanical aspects of the telescopes, and on Monte Carlo simulations of the array and event reconstruction, in line with its past contribution on HESS; the present technical developments on this top-priority project are key for preparing the future. On a much smaller scale, LLR is also engaged in an interesting R&D activity on gamma-ray polarimetry in space.

Assessment of the unit's academic reputation and appeal

From an historic perspective, LLR has played a key, pioneering role, in developing high-energy gamma rays, with several leaders at the international level. This longstanding reputation in gamma-ray astronomy has continued with a few hiring of young researchers of international calibre, indicating both the excellence of the team, and its attractiveness. The influence and recognition of the role of the team both at the national and international levels can be measured by e.g. the fact that one of the team members has been deputy spokesperson of the HESS collaboration, and another one is currently president of the PNHE (Programme National Hautes Energies, a program jointly set by INSU, IN2P3, CEA/IRFU and CNES). Prizes also measure the international recognition of the LLR team, even though they are often attributed to a whole collaboration, and the individual role of various teams is sometimes difficult to ascertain. As a minor point the committee suggests to TeVCat to acknowledge the LLR origin and support on its web page. The scientific appeal of the group can also be judged by the number of visitors joining the group and the significant contributions to publications in the field.

Assessment of the unit's interaction with the social, economic and cultural environment

The field benefits from an obvious support of the general public for this fascinating domain; this clearly helps to develop outreach activities, which include conferences and articles for the general public, participation in radio and TV programmes, etc. These activities are good, although somewhat standard, and given the interest of the public, should be strengthened.

Assessment of the unit's organisation and life

The group combines two different experimental approaches, and has been quite successful in functioning as an integrated team. This has a strong coherence from the scientific point of view, and has undoubtedly played an important role in extracting the best science from Fermi and HESS, by enabling to combine the data from both instruments; hence the success and visibility of the team. The internal functioning appears to be quite lively, and the support to post-docs and students is good, a condition required to maintain the attractiveness of the team on the long term.

Assessment of the unit's involvement in training through research

There is no university staff in this team – as for all LLR teams; teaching is therefore on an individual, voluntary basis. Several researchers of the team do provide courses to students of the École Polytechnique; moreover, one member of the team has been for years one of the persons responsible for the organisation of the competition for hiring students at the Ecole, which represents a very significant workload. One should also note some teaching involvement at the master level. The involvement in training is therefore good, but does not go beyond expectations.

Assessment of the strategy and the five-year plan

The strategic plan is sound, especially for Fermi and HESS – i.e. continue the scientific exploitation of these two facilities. The team has the capacity to lead (and not only to contribute to, as is written in the report) several important projects using data from HESS and/or Fermi. CTA is clearly a priority at the national and European level; the participation of LLR in the developments of CTA is certainly welcome and should continue to be supported by the funding agencies. Some flexibility is needed in the implementation plan, as the timescale developed by the project is unrealistic; the team is well aware of this, but the extent to which the milestones will be reached (or not) is difficult to estimate, and longer delays than expected today would be a challenge for keeping the momentum in the project. This is of course not a specific problem to the LLR team, but difficulties might be exacerbated for teams with small or modest sizes. Also, as for many other teams involved in CTA, the implications of a transition from an experiment type facility (such as HESS) to an observatory type facility, has not been fully recognized. The experience with Fermi, which is also an observatory, is clearly an asset. Harpo is a small R&D project, which has been given much (too much?) emphasis in the current plans. If the feasibility study is successful, major efforts will be needed on the (very) long term, in particular for developing the scientific case and implementing this project.

Conclusion

- **Overall opinion of the theme:**

The gamma-ray astronomy team is excellent, and its strategy is sound.

- **Strengths and opportunities:**

The team is science driven and hence fully engaged in ground- and space-based observatory. It has an excellent scientific record and prominent leadership. Its involvement in CTA, a major, top priority project for astronomy prepares well for the medium and long-term future.

- **Weaknesses and threats:**

Given the past achievements, the team is clearly too modest. The aims should be to lead several scientific and technical developments, and not only to contribute to them. Given the records of several of the team members, this will be beneficial to the projects they are involved in.

- **Recommendations:**

The CTA team should apply for extra funding from various sources (at local, national and European level). More outreach would also be beneficial, and there is clearly some margin for progress here.

Given the broad impact of high energy gamma-ray observations on astrophysics in general, it is important that the team maintains and develops collaborations with other laboratories in France and elsewhere in order to exploit the full potential of the current and future instruments. This will be key for future facilities organized as observatories.

The team should also develop strategies to attract more students from École Polytechnique, both at the master and doctorate level.

Theme 3: Heavy ions

Manager's name: Mr Raphael GRANIER/ Mr Frédéric FLEURET

Workforce

Theme workforce in Full Time Equivalents	As at 30/06/2013	As at 01/01/2015
FTE for permanent professors		
FTE for permanent EPST or EPIC researchers	3	3
FTE of other permanent staff without research duties (IR, IE, PRAG, etc.)		
FTE for other professors (PREM, ECC, etc.)		
FTE for postdoctoral students having spent at least 12 months in the unit	2	
FTE for other EPST or EPIC researchers (DREM, etc.) excluding postdoctoral students	3	2
FTE for other contractual staff without research duties		
FTE for doctoral students	2	
TOTAL	10	5

• Detailed assessments

Assessment of scientific quality and outputs

The LLR team is the most important European group (both quantitatively and qualitatively) carrying out the heavy-ions (HI) physics programme of the CMS experiment at CERN. Such leadership position is exemplified by the various CMS management roles taken by different members of the group during the last four years: two HI-Physics convenerships, plus various subgroups coordinators (dileptons, HI software, muon reconstruction). The work of the experimental team has strategically focused on interesting perturbative probes of the Quark-Gluon-Plasma (Upsilon states, W/Z bosons, and b-jets), which were for the first time accessible to measurement in heavy-ion collisions at the LHC. The research choice and expertise of the group has paid off with a number of interesting observations (e.g. Upsilon family suppression) resulting in highly cited publications.

In addition to the experimental activities, two members of this topical activity at the laboratory have published several timely phenomenological studies on initial- and final-state nuclear effects, which influence quarkonia production in HI collisions. The experimental-theoretical collaboration in this front is positive and fruitful. One member of this group is also leading a feasibility study for a fixed-target experiment (CHIC) at the CERN SPS aiming at novel measurements of $X_c' \to J/\psi+\gamma$ and $\psi' \to J/\psi+X$ in heavy-ion collisions, using ultra-granular calorimeters such as those considered in the CALICE prototype.

Assessment of the unit's academic reputation and appeal

The reputation and appeal of the group is very high as illustrated by the ERC starting grant achieved by the group leader in 2010, as well as by the additional three Marie-Curie postdoctoral fellowships attracted to the group. Two of the group researchers have also been (or are currently) conveners of the CMS-HI physics group, which guarantees an excellent visibility within the CMS experiment as well as within the international heavy-ion physics community at large.

Assessment of the unit's interaction with the social, economic and cultural environment

There does not seem to be a dedicated outreach activity of this group, which is mostly focused on research activities due to its relatively modest size.

Assessment of the unit's organisation and life

The group is well connected with the rest of the laboratory and with the CMS collaboration at large, and the working environment is attractive. There are positive cross-talks with the bigger CMS p-p (energy frontier) group, and with the CALICE efforts (for the CHIC calorimeter). The experimental-phenomenological connections, with researchers at the lab and with other external collaborators, constitute an interesting added value.

Assessment of the unit's involvement in training through research

The student and postdocs of the group are all proactive and motivated. The number of theses completed is 3+1 (jointly supervised). The group has maintained a small teaching connection with École Centrale.

Assessment of the strategy and the five-year plan

The group is very actively focused on the on-going and upcoming CMS heavy-ion activities but strategic planning beyond the duration of the ERC-grant (ending in ~2 years) is lacking. There is a clear and well-defined physics programme for LHC Run-2 concentrated on the same measurements carried out for Run-1, but the group should exploit the potentialities and the know-how to carry out a more « aggressive » and original approach aiming at the measurement of other « new » particles (e.g. top-quark, tau, MET ...) in heavy-ion collisions, so as to keep their leadership position within the field. The group would also need to start more carefully assessing the longer-term perspectives of the heavy-ion discipline (beyond 2020). The involvement in the CHIC studies should be reoriented towards other activities if this project does not finally take off within ~1 year by lack of critical mass from other institutions.

Conclusion

- **Overall opinion of the theme:**

The quality of the Heavy-Ion research activities at the lab is excellent. The experimental measurements carried out for the first time ever (Upsilon family, electroweak bosons, and b-jets) are of key importance in the field and of high impact. The phenomenological work is also timely and important.

- **Strengths and opportunities:**

CMS: The group has a very strong impact and a leading role at the international level. The quality of the work carried out is world-class and the number of researchers (permanent, postdoctoral and students) is modest but well balanced today. The opportunities generated by the ERC Starting Grant funding provide an extra pole of attraction. The phenomenological activities are timely and well connected to the experimental analyses.

CHIC: This is an original and high-risk project with a well-defined engagement. The physics potential is interesting as recognized by the SPS committee at CERN, and there are clear synergies with highly granular calorimeters being developed by other groups (CALICE) at the lab.

- **Weaknesses and threats:**

The number of permanent researchers of the group is moderate (2 in CMS, 1 CHIC, 1 phenomenology) and the current postdoc and students are mostly dependent on external funds (ERC grant), which poses a potential risk at the end of the project if not properly anticipated. The participation in uncertain projects (CHIC) tends to dilute the strength of the group further. The group needs to more carefully reflect about the long-term future research activities.

- **Recommendations:**

The group needs (i) to anticipate a clear manpower planning after the ERC grant end, (ii) to develop more original and « aggressive » ideas for Run 2 PbPb collisions so as to keep their leadership role within the European heavy-ions community, (iii) to prepare for the reorientation of activities if the CHIC project does not finally materialize, and (iv) to get involved with the starting discussions of the very long-term plans for heavy-ion physics (HL-LHC, FHC, ...).

Theme 4: Applications

Manager's name: Mr Arnd SPECKA/ Mr Marc VERDERI

Workforce

Theme workforce in Full Time Equivalents	As at 30/06/2013	As at 01/01/2015
FTE for permanent professors		
FTE for permanent EPST or EPIC researchers	2	2
FTE of other permanent staff without research duties (IR, IE, PRAG, etc.)		
FTE for other professors (PREM, ECC, etc.)		
FTE for postdoctoral students having spent at least 12 months in the unit		
FTE for other EPST or EPIC researchers (DREM, etc.) excluding postdoctoral students		
FTE for other contractual staff without research duties		
FTE for doctoral students		
TOTAL	2	2

• Detailed assessments

Assessment of scientific quality and outputs

Medical applications: LLR has concentrated on a very specific project in medical instrumentation namely the profiler for a hadron beam for medical therapy. This initiative profits directly from the high-level engineering support available at LLR and the specific expertise in beam simulation. During the period under consideration the goal was to transfer the developed technology to a company for application and use at the MedAustron facility. The technology transfer is cumbersome and tied up resources at the laboratory.

LLR hosts one of the world experts for the development of Geant4, which is testified by the position of deputy spokesperson of the collaboration. This effort is fundamental for the field and led to further refinements with techniques such as event biasing and reverse MC techniques, both of which hold great potential to increasing the effectiveness of the simulation. These developments represent major advances in the field of simulation and are key contributions with large international impact.

LLR has engaged in measuring the neutron flux distribution at ATF2. This activity depends on detailed simulation studies that are to be reconciled with the measurements made at ATF2. The experimental activities have now been concluded. The results should be made available publicly.

Laser-driven plasma wakefield acceleration (LPWA) is carried out in the GALOP group: LLR has early recognised the potential for particle beam acceleration provided by an excited plasma, for which the electric fields may locally and temporarily exceed 10 GV/m and more. After key demonstrator experiments at SLAC, Berkeley and Ile de France the group was one of the instigators of Europe-wide activities in the field of plasma wakefield acceleration that has now been adopted in several laboratories. The initial goals are to create monoenergetic beams of low emittance in one acceleration stage. Follow-up experiments envisage acceleration through a cascade of plasma cells, which inevitably implies external injection into the plasma itself.

LLR profits from the vicinity of the high-power laser available at LOA at École Polytechnique. LOA have demonstrated in several key experiments the ability to focus one or several intense laser pulses into a very small area. In particular the colliding beam technique has been used to provide intense fields in the focal area. They have also demonstrated very good energy resolution in this setup. The GALOP group supplies a wide-energy spectrometer for the analysis of the accelerated particles.

Several follow-up experiments are planned or on their way. For example, the injection into an undulator will immediately demonstrate the quality of the accelerated beam. If eventually fully successful the beam could even generate monochromatic X-rays. An X-ray mapping technique has been patented at LOA-LLR. Self-injection of liberated electrons has been monitored by the emitted betatron oscillation.

The CILEX facility will provide significantly boosted laser power in the 1-10 PW-range in a facility that will be available starting end of 2015. LLR will essentially be responsible for electron acceleration in this facility, to assess the beam dynamics and to provide the electron diagnostics.

Assessment of the unit's academic reputation and appeal

Concerning medical applications, the group highly contributes to the dissemination of the Geant4 know-how through teaching at the national level and leading tutorials at the international level.

LPWA for extreme particle acceleration is inherently appealing to young physicists and thus readily adopted by students. Members of the GALOP group engage strongly in teaching and thus provide the bridge for students to start engaging. Nonetheless, currently, the number of active students is too small. The reputation of the group is very good.

Assessment of the unit's interaction with the social, economic and cultural environment

In the field of medical applications, LLR received excellent feedback from Centro Nazionale di Adroterapia Oncologica (CNAO), where the first prototypes of the beam profiler were installed. It also shows that the technological development is sound, a fact that may be demonstrated by the fact that MedAustron is now asking for the beam profilers.

This LLR activity is now well recognised by the main actors in the field. Recent contacts with IBA Molecular may lead to a joint thesis with additional funding.

For LPWA the group has early recognised the potential for particle physics and beyond. If successful there will be numerous applications for light sources and in diagnostics environments.

Assessment of the unit's organisation and life

The theme comprises two vastly different activities, which however both fall under the title “Applications”. We have refrained from grading this aspect.

The activities in the field of medical applications are related to one eminent scientist, who receives technical and engineering support.

In the field of laser plasma wakefield acceleration it is noted that the current size of the group is too small for the challenges ahead. Since the “simple” experiments have been carried out the follow-up experiments require considerable efforts in preparation. Fortunately, the group has recently been able to attract an expert in the field of plasma wakefield simulation. This addition is highly welcome. However, to fully plan e.g. a staged LPWA experiment, considerable attention has to be given to understand the beam dynamics at all stages and in particular for the injection into a prepared plasma. This aspect is currently not addressed.

Assessment of the unit's involvement in training through research

For the medical topic, there is no PhD student. The contact with industrial partners may result in thesis support, which would form a welcome addition to the group and lead to reinforcement.

Assessment of the strategy and the five-year plan

The strategy of the group is to place the focus of their future activities on the field of radiotherapy, which corresponds to their expertise. The team has demonstrated its will to join the French network "Modélisation et Instrumentation pour l'Imagerie Biomédicale" (MI2B), dedicated to medical applications, with the goal to exchange experience and to be involved in larger projects at the national and European level.

LPWA: The group comes with a clear strategy, which addressed topical and important challenges and thus is highly welcome. However, the current level of engagement needs to be increased to be successful. Some goals seem optimistic on the time scale indicated and failure due to lack of preparation is likely. Given the opportunities with LOA and CILEX such failure should be avoided but proper counter measures today.

LLR is fully embedded in the plasma wakefield research in Europe through its coordinating role in the EuroNNAc network. It has thus ensured efficient exchange of experience so as to be able to respond to the rapid developments in the field.

Conclusion

- **Overall opinion of the theme:**

The medical activity is currently in a transition phase. The group is concluding the technology transfer on the beam profiler and is determined to be fully involved in the field of radiotherapy. The high visibility and the expertise in the Geant4 collaboration give the group a high standing for applications in various environments. The group could also seek further involvement with the software groups at LLR to increase its impact.

The engagement in beam profile simulation at ATF2 has come to an end; the results should be published.

The LPWA activity is highly welcome and fairly unique in France. Similar and complementary activities are on their way in other laboratories in Europe to which LLR is well connected. The activity should be continued and needs to be augmented to be successful. The prospects are high and include applications even in the medical area.

- **Strengths and opportunities:**

The medical application group clearly relies on the high engineering profile in instrumentation at LLR. For future activities in the field of radiotherapy, the group will benefit from the proximity to the "Centre de protonthérapie d'Orsay" (CPO) and the engagement with the company IBA. The high level of expertise in Monte Carlo simulation is a great asset; the involvement in national and international collaborations may result in additional financial support.

The LPWA profits from the vicinity of the LOA laboratory. The CILEX facility will give a boost in laser intensity and quality and thus provide another boost to the topic. Such opportunities are rare and should not be missed.

- **Weaknesses and threats:**

In hindsight it becomes evident that for the technology transfer of a successful product (beam profiler) better institutional support is required. An adhoc approach requires a lot of dedication from the technical groups, which in the end is less efficient than an experienced central support.

The group engaged in medical activities is small, which is unfortunate given the fact that activities in medical instrumentation enter a new era. The group should seek to set up additional collaborations.

Staffing at the postdoc and student level needs to be improved for the LPWA activities. The LPWA group needs to develop a more detailed and longer-term plan of the detailed engagement. At the time of the review several areas seemed to be insufficiently covered. While there is excellent expertise and support on the detector side the beam dynamics seemed rather weakly addressed. Fortunately, at least the plasma simulation part has been better staffed recently. However, this will not be sufficient to implement the entire plan.

- **Recommendations:**

The medical group should apply, directly or as partner, for extra funding for which various sources are available both at local, national and European level. The staffing has to be increased to be effective.

Given the excellent infrastructure at LLR it is important that the team maintains and develops collaborations with other French laboratories. The group should seek to get involved in large-scale projects. The beam profiler is a particularly successful example where the team should aim to take the lead of future developments.

The group should ensure proper scientific return from the activities at ATF2; a concluding publication is required.

In the field LPWA the group should take the leadership in planning the future experiment and make sure that sufficient number of staff is attracted. This additional staff may both be students (for the diagnostics part) and postdocs for the beam transport and staged acceleration. Without such improvements the scientific success may be at risk.

Theme 5: Heavy flavour physics

Manager's name: Mr Denis BERNARD / Mr Michel GONIN

Workforce

Theme workforce in Full Time Equivalents	As at 30/06/2013	As at 01/01/2015
FTE for permanent professors		
FTE for permanent EPST or EPIC researchers	3	3
FTE of other permanent staff without research duties (IR, IE, PRAG, etc.)		
FTE for other professors (PREM, ECC, etc.)		
FTE for postdoctoral students having spent at least 12 months in the unit		
FTE for other EPST or EPIC researchers (DREM, etc.) excluding postdoctoral students		
FTE for other contractual staff without research duties		
FTE for doctoral students	1	
TOTAL	4	3

• Detailed assessments

Assessment of scientific quality and outputs

The BaBar experiment is the world leading experiment in the CP violation measurement in the b-sector. The LLR group made very important contributions to the analysis of the experiment resulting in eight high-level publications lead by the group. The scientific quality is excellent. The data taking has ended in 2008; however the members of the group continue to assume high-level responsibilities for the forthcoming publications of the collaboration, speakers Bureau and Publication Board. These activities underline the appreciation of the LLR group in the experiment.

The T2K experiment is the pioneering long-baseline accelerator neutrino experiment measuring the very important mixing angle theta13 in electron-neutrino appearance mode. This experiment discovered a non-zero angle, complementary to reactor-based experiments, which in turn allows the search for CP violation in the lepton sector. This is so far the only experimental proof for non-standard model physics and could be the key to the matter-antimatter asymmetry in the universe. The LLR group made excellent contributions to the instrumentation, calibration and analysis of the experiment. The INGRID detector designed by LLR and constructed by LLR in collaboration with other institutes is highly important to characterize the beam to control systematic errors. A unique

achievement of the group is the participation in the calibration and analysis of the SuperKamiokande detector. The scientific quality and output are excellent.

Assessment of the unit's academic reputation and appeal

The academic reputation and appeal of the group are excellent.

The members of the BaBar group are members of the Publication Board and the Speakers Bureau. They conducted eight publications in refereed journals and made a large number of conference contributions. The group trained successfully PhD students. The last three students have permanent positions; one has been awarded with the thesis prize of École Polytechnique and one has been awarded the CNRS medal.

The members of the T2K group are heavily involved in teaching at the École Polytechnique. The group constantly supervises PhD thesis of very high quality. The collaboration was awarded the prize “La recherche 2012”.

Assessment of the unit's interaction with the social, economic and cultural environment

The interaction with the social and cultural environment of the group is of good quality. The group gives regularly outreach talks to large public. They provide articles and interviews in periodic journals for large public audiences and participate in radio and TV emissions.

Assessment of the unit's organisation and life

The group is very attractive for students; the continuous supervision of high-quality PhD theses and the successful integration of the students in the professional life are underlining the excellence.

The insufficient financial support, especially travel money to attend meetings and shifts in Japan, penalizes the group. This point should be adjusted according to the excellent scientific reputation and output of the group. At the same time the group itself could explore external funding sources for this specific purpose.

Assessment of the unit's involvement in training through research

The group has high-level involvement in teaching. Members of the group teach at the master of École Polytechnique and one member is the President of the concours for admission to École Polytechnique. The group trains regularly PhD students of excellent quality.

Conclusion

- **Overall opinion of the theme:**

The flavour physics group has achieved excellent scientific output. The group attracts very good students and is very active in teaching and training.

- **Strengths and opportunities:**

The future of the group clearly is on the forefront of neutrino research. The group has developed a clear and wise strategy to approach long baseline experiments in Europe or Japan. The participation in SuperKamiokande may open the door for important contributions as founding member of the HyperKamiokande activity

- **Weaknesses and threats:**

The limited travel budget prevents the group members to fully develop their strategy and is a threat to on going activities in Japan.

Recommendations:

The travel support should be enforced for T2K, according to the excellent scientific level of the group and their on-site activity. For future involvement we recommend to explore other funding alternatives, such as EU, JSPS, Japanese-French network or ANR.

The personnel of the group should be enforced with at least one more permanent physicist.

5 • Conduct of the visit

Visit dates:

Start:	11-12-2013 at 12:30
End:	13-12-2013 at 14:00

Visit site:	LLR
Institution:	LLR
Address:	Palaiseau

Specific premises visited: Mechanical and electronics workshop

Conduct or programme of visit

The presentation of the topics and the discussion with the proponents was very helpful to clarify issues that had remained unclear from the documentation supplied. The question and answer sessions proved particular useful. The visit of the laboratory as a whole made it possible to arrive at this conclusion; the visit was well organised.

Day 1: December 11th

12h30	Closed session
14h00-17h05	Plenary Session
14h00-15h00	Results & Projects (Director)
15h00-15h35	Energy Frontier: CMS and ILC
15h35-15h55	Gamma Astronomy
15h55-16h15	Heavy Ions
16h15-16h45	Applications: Medical+GEANT4+ATF2, Acceleration
16h45-17h05	Heavy Flavour Physics
17h05-18h05	Visits : laser, electronics, mechanics
18h05-19h05	Closed session

Day 2: December 12th

8h30-9h00	Closed session
9h00-12h00	Group meetings
9h00-10h00	CMS+ILC
10h00-11h00	Gamma Astronomy
11h00-12h00	Heavy Ions

12h00-12h30	Meeting with the Graduate Schools
12h30-13h15	Lunch
13h15-14h00	Meeting with technical staff
14h00-16h00	Meeting with research groups
14h00-15h00	Applications (Medical+ATF2+GEANT4+Acceleration)
15h00-16h00	Heavy Flavour Physics
16h00-16h30	Meeting with PhD students
16h30-17h15	Meeting with CNRS and École Polytechnique representatives
17h15-17h45	Meeting with temporary employees (Post-docs…)
17h45-18h30	Meeting with the laboratory's council
18h30-19h30	Débriefing de la journée, rencontre DU

Day 3: December 13th

8h30-14h00	Closed session

6 • Supervising bodies' general comments

Despite the AERES' requests, no comments are received by the time of the publication of this evaluation.