LULI - Laboratoire pour l'utilisation des lasers intenses

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 d'Utilisation des Lasers Intenses

LULI

Under the supervision of the following institutions and research bodies:

École Polytechnique

Université Pierre et Marie Curie - UPMC

Centre National de la Recherche Scientifique - CNRS

Commissariat à l'Énergie Atomique et aux Énergies Alternatives - CEA

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. Marc SENTIS, 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 d'Utilisation des Lasers Intenses
Unit acronym:	LULI
Label requested:	UMR
Present no.:	UMR
Name of Director (2013-2014):	Mr. François AMIRANOFF
Name of Project Leader (2015-2019):	Mr. Patrick AUDEBERT

Expert committee members

Chair:	Mr Marc SENTIS, LP3 Laboratory
Experts:	Mr. Robert CAUBLE, Lawrence Livermore National Laboratory, US
	Mr. Juan FERNANDEZ, Los Alamos Natl. Lab, USA
	Mrs. Cristina HERNANDEZ-GOMEZ, STFC Rutherford Appleton Laboratory, GB
	Mr. Serge HUANT, Institut Néel (CoNRS representative)
	Mrs. Pascale MONIER-GARBET, CEA Cadarache
	Mr. Gerhard PAULUS, Institut für Optik und Quantenelektronik, DE
	Mr. Luis SILVA, GoLP/Instituto de Plasmas e Fusão Nuclear, PT
	Mr. Charles SIMON, Institut Néel

Scientific delegate representing the AERES:

Mr. Charles HIRLIMANN

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

Mr. Philippe CAVELIER, CNRS

Mr. Paul INDELICATO, UPMC

Mr. Patrick LE QUERE, École Polytechnique

Mr.Thierry MASSARD, CEA/DAM

Mr. Didier NORMAND, Institut Rayonnement Matière de Saclay, CEA/DSM

Mr. Guillaume PETITE, École Polytechnique

Mrs. Pascale ROUBIN, Institut de Physique, CNRS

Mrs. Chantal STELHÉ, UPMC

1 • Introduction

History and geographical location of the unit

Laboratoire pour l'Utilisation des Lasers Intenses (LULI) is a joint research unit created in 1994 between CNRS (Centre National de la Recherche Scientifique), École Polytechnique and UPMC (Pierre & Marie Curie University) extended to CEA (Commissariat à l'Énergie Atomique et aux Énergies Renouvelables) in 1998. LULI is located on the campus of École Polytechnique at Palaiseau.

LULI hosts 66 permanent staff members mainly from CNRS (~70 %) and from École Polytechnique (~21 %) with a strong presence of technicians and engineers (~71 %). This very unusual personnel distribution is related to the fact that LULI operates a very large research infrastructures (TGIR: Très Grande Infrastructure de Recherche) thanks to the LULI 2000 laser facility and thus offers open access to the laser to the national and European academic communities. The main research activity of the six teams that form LULI is on laser plasma physics and laser source development.

Since 2011, LULI is responsible of the APOLLON project, a 10 PW laser system: 150 J – 15 fs. This facility will be located at l'Orme les Merisiers (beginning of 2014) within the Interdisciplinary Centre Extreme Light (CILEX, EQUIPEX - Equipement d'excellence - 2011). It aims at being a world-leading facility, open to the international academic community. This is a strategic project of prime importance which will impact, for the next decade at least, the structuring of the academic community in the field (Laboratoire d'Utilisation des Lasers Intenses, LULI, Laboratoire d'Optique Appliquée, LOA, Institut Rayonnement Matière de Saclay IRaMIS, Laboratoire Charles Fabry de l'Institut d'Optique, LCF-IO, Fédération LUmière MATière,-LUMAT-LASERIX, Laboratoire de Physique des Gaz et des Plasmas, LPGP, Synchrotron SOLEIL, …) located in Île-de-France.

Management team

Director: Mr. François AMIRANOFF

Deputy directors: Mr. Patrick AUDEBERT and Ms Sylvie JACQUEMOT

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	4	4
N2: Permanent researchers from Institutions and similar positions	15	14
N3: Other permanent staff (without research duties)	47	47
N4: Other professors (Emeritus Professor, on-contract Professor, etc.)	3	2
N5: Other researchers from Institutions (Emeritus Research Director, Postdoctoral students, visitors, etc.)	3	2
N6: Other contractual staff (without research duties)	23	4
TOTAL N1 to N6	**95**	**73**

Unit workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	16	10
Theses defended	23	10
Postdoctoral students having spent at least 12 months in the unit	3	3
Number of Research Supervisor Qualifications (HDR) taken	4	
Qualified research supervisors (with an HDR) or similar positions	8	

2 • Assessment of the unit

Laboratoire d'Utilisation des Lasers Intenses is a leading laboratory in the international community dealing with high intensity laser plasma physics, due to its contributions in the following fields: inertial fusion science, high energy density, warm dense mater, high energy particles, planetary physics, laboratory astrophysics and intense sources of radiation. Due to the presence of highly qualified researchers, engineers and technicians, the development of unique laser facilities like LULI-2000 and ELFIE, and an important set of international collaborations with the leading institutes in the field of high intensity laser physics, LULI has produced numerous publications (>230) in international peer reviewed journals during the 2008 – 2013 period of time, including a large number (> 18 %) in very high ranking reviews (IF > 7). In addition to this research activity, LULI, as a large-scale facility, provides access to a broad national and European researcher community with a high success and a high degree of reliability (~23 projects/years) thanks to the quality of the technical teams.

LULI is strongly involved since 2011 in the development of the Centre Interdisciplinaire Lumière Extrême CILEX-APOLLON project. The committee considers this project as a unique opportunity for LULI to provide a world leading capability in the field of laser plasma interactions and an exciting era of new scientific discovery.

Strengths and opportunities related to the context

• A high scientific expertise in laser and plasma physics with highly qualified personnel; an international scientific recognition in all the research topics developed by the scientific teams; a very large and high quality scientific production.

• A strong experience and demonstration of its strong ability to develop, operate and offer access to large scale laser facilities for a large international scientific community.

• LULI2000 and ELFIE support a broad range of experiments with a user policy that permits effective training of young researchers in high energy-density science. [There are only a handful of facilities like LULI in the world.] The Facility is fairly and transparently managed, enjoys a high scientific standard, and is attractive to scientists who want to perform first-rate experiments and/or develop techniques that will be used on larger-scale laser facilities (like OMEGA {at LLE, Laboratory for Laser Energetics, Rochester, USA}, LMJ {Laser MégaJoule, Bordeaux}, NIF {National Ignition Facility, Lawrence Livermore Facility, USA}).

• A very large number of national, European and international collaborations; the coordination of the (Centre Interdisciplinaire Lumière Extrême) CILEX-APOLLON project and its active participation to ILP (Institut Lasers et Plasmas) and the European projects LASERLAB, ELI, HiPER and EURATOM.

• A continuous support, in term of funding and hiring of permanent staff members, from the main supervising authorities; a quite young and dynamic staff.

• The strong subscribing of the whole staff to LULI project.

• A proper guidance and monitoring of PhD students and a high attractiveness.

• Closing the long-pulse laser LIL (Ligne d'Intégration Laser) restricts the number of energetic long-pulse lasers in France to one, LULI2000 before the opening of LMJ.

• There is a strong international interest in APOLLON project. If successful, APOLLON will attract the best research in its area to LULI and CILEX-APOLLON Partners.

• The demonstration of the technology used to achieve 10PW would confirm the French position in high-power laser technology and bring France into a good position for the possible 4th ELI (Extreme Light Infrastructure) pillar.

Weaknesses and threats related to the context

• Weakening of some scientific topics in the midterm, mainly due to: teams with already sub-critical number of staff members, a retirement in the next future, splitting of one team into two teams.

• The partial involvement and interest of scientific teams in the future scientific program of the CILEX – APOLLON structure when the laser facility will be available (2016).

• The localization of the laser facilities in two different geographic sites (Campus de Palaiseau and l'Orme des Merisiers) making the daily management of human resources more complex.

• With budgets at present levels, the direction will be forced to curtail some aspects of LULI operations, giving priority to APOLLON. They will have to make these decisions on fairly short notice.

• Delays are frequent in cutting-edge high-power laser developments like APOLLON.

• Funding agencies may put too much pressure on LULI to focus on the construction of APOLLON at the expense of LULI's in-house research program. This would dramatically reduce LULI's attractiveness for its best scientists.

• The LULI management has the difficult task to coordinate the interests of all CILEX partners. If this coordination fails, the situation will be critical.

Recommendations

The future direction should maintain the focus of scientific LULI teams on the area of UHI (Ultra High Intensity) physics, which should be developed within the APOLLON project. LULI must not only be very active in the development of the APOLLON facility but it should also act as a think tank for its scientific program.

The panel is greatly confident that the staff has the ability to build up the APOLLON facility, and that the Director has the ability to coordinate the APOLLON project. The candidate future director is currently a technical director at the APOLLON project; this charge/responsibility is too heavy to be added to the charge of LULI director. The CILEX-APOLLON project is of great importance and should continue as planned. But that should not be at the detrimental expense of the LULI 2000 system, which is very productive, acts as a complementary scientific community, and is absolutely necessary to keep up a world-class in-house research program at LULI. With regard to choices that must be made about short-term priorities, the sooner the direction can make these decisions, the better it will be.

To the supervising institutions: LULI has to face simultaneously the development of APOLLON, a beacon project for the international community and the pursuing of its "traditional activity" essentially based on experiments carried out on LULI 2000 and ELFIE facilities. The challenge is high and the stakes very important for the coming years not only for LULI but also for the entire French community of high power lasers. About LULI2000 and ELFIE, the institutions should establish, as soon as possible, a clear roadmap for the next ten years with an appropriated support in terms of founding and staff recruitment. The committee advises to maintain LULI2000 operational at list for the next five years until the LMJ, PETAL and APOLLON projects will be open and fully operating for plasma physic experiments.

3 • Detailed assessments

Since its creation, LULI is one of the world leading laboratories for high intensity laser plasma physics and in the R&D of large-scale high power laser facilities, due to its contributions in the following fields: inertial fusion science, high energy density, warm dense mater, high energy particles, planetary physics, laboratory astrophysics and intense sources of radiation. The research, mainly academic in nature, is both experimental and theoretical and developed using the ELFIE and LULI2000 facilities. The combination of these two large-scale instruments facilitates very high quality high-energy-density experiments. Most experiments are national, European or international collaborations. LULI is in charge of the CILEX-APOLLON project (one of the larger EQUIPEX projects within the "Investissement d'Avenir" program). When operational, it will be, as the most powerful system in the world, a world-leading platform in the field of laser plasma interactions.

LULI hosts 15 researchers (14 CNRS and 1 CEA), 4 professors or assistant-professors (3 UPMC and 1 EP), 47 technicians and engineers (32 CNRS, 13 EP, 1 UPMC and 1 CEA) and a large number of non-permanent staff (23). This unusual number of administrative and technical staff is related to the support required for running ELFIE and LULI2000 and for developing APOLLON. This highly qualified staff provides support for optics and laser technologies, command-control and supervision, high voltage electronics, information systems, experimental techniques and instrumentation, mechanical engineering, and administrative and financial management. During the period of assessment LULI has been strongly supported by its supervising institutions in term of recruitment of technical staff member mainly for the APOLLON project. The consolidated budget of LULI was ~10 M€ in 2011 and ~13.3 M€ in 2012, the wage share being ~4.6 M€.

Assessment of scientific quality and outputs

LULI is internationally recognized for its contributions to fundamental physics of laser-target interaction and matter at high energy density or in extreme states such as out-of-equilibrium time-dependant non-Maxwellian plasmas for inertial fusion, astrophysics and planetary science, particle and radiation sources and their applications. Very significant progress has been achieved in the past five years, like the discovery of an Auger electron heating mechanism in solids (Al) irradiated by intense XUV FEL radiation (X-UV, free-electron laser), the demonstration of photo-excitation and X-ray fluorescence for a large series of charge states in Al, the observation of the non-metal-metal transition during the unloading of laser-shocked Al, the demonstration of the formation of strong magnetic fields around laser-produced shock waves and of their turbulent amplification, the role of plasma dynamics and magnetic field generation on the propagation of fast electrons in hot plasmas, …

During the 2008 – 2013 period of time, LULI has produced numerous publications (>230) in international peer reviewed journals, a large number of which (> 18 %) were published in very high ranking reviews (IF > 7) like Physical Review Letters (36), Nature Physics (6) and Nature (1). As a national large-scale facility, LULI offers worldwide access to its laser facilities. Users of ELFIE and LULI2000 are responsible for more than one-third of the ~400 LULI-wide publications (over five years) and more than half of the experimental publications. Scientific output is broad, encompassing the range of high energy-density subject areas; the number of laser users is large, about 500 individual users in five years; the lasers are heavily utilized, since significantly more experiment time is requested than can be accommodated; and the quality and diversity of the research is exceptional, as can be seen from the number of citations per publication (~6) and the mean impact factor of the journals (~1.5).

LULI was commissioned as the leading institution for the advanced 30 M€ APOLLON, a future world leading facility, because, thanks to its experience in operating ELFIE and LULI2000 as an efficient user facility will ensure that APOLLON functions the same way. The APOLLON system is expected to achieve 10 PW of power delivering 150 J of energy in 15 fs pulses and intensities greater than 10^{22} Wcm^{-2}. This represents a major technological advance in the field of laser physics as a whole. It will provide the plasma physics research community a unique ability and open an exciting era of new scientific discoveries. This unique laser facility has been designed to use two complementary types of amplification: OPCPA and CPA in Ti:Saphire. The design of the laser architecture demonstrates the innovative spirit that came out from strong interactions of the team with various Institutes in the Palaiseau and Saclay environment, like IRAMIS (Institut rayonnement-matière de Saclay, CEA), LOA (Laboratoire d'Optique appliquée), LCFIO (LAboratoire Charles Fabry de l'Institut d'Optique). The site of the facility, a former accelerator complex at l'Orme des Merisiers near Saclay, is ideally suited for the demands of the different applications of APOLLON. The design of APOLLON takes full advantage of these opportunities by incorporating two experimental platforms to enlarge the variety of possible experiments. One platform will be dedicated to electron acceleration and X-ray sources, and the second one will be devoted to X-rays and ions sources and ultra-high intensity physics. In addition to the 10 PW

beam the system will deliver additional short or long lasting pulse beams to complement the main short pulse beam. The choice of two different optical geometries (short and long focal lengths) reflects the demand of the scientific community, and will allow the researchers to make the best possible use of the facility.

Assessment of the unit's academic reputation and appeal

The academic reputation and appeal of LULI are related both to the very high scientific qualification of the various teams and to the international reputation of the ELFIE and LULI2000 facilities. As already mentioned, LULI has many collaborations with almost all of the best international teams that work in the field of high energy physics. The various teams at LULI are involved in many local and national structures and/or networks like the RTRA (Réseau Thématique de Recherche Avancée) "Triangle de la physique", the LabEx PALM, the EquipEX CILEX-APOLLON, l'Institut Laser et Plasmas and GdR "APPLIX"). At the European level, LULI is part of the European project LASERLAB EUROPE "The Integrated Initiative of European Laser Research Infrastructures" bringing together 30 leading organizations in laser-based inter-disciplinary research from 16 countries. LULI is among the 20 facilities offering access to their labs for European research teams. It actively participates to the GDRi "The French X-ray Free Electron Laser community – XFEL". LULI also contributes to the ELI ("Extreme Light Infrastructure") project, a European ESFRI project for the investigation of light-matter interactions at the highest intensities and shortest time scales, and is very active in the HiPER project (the European High Power laser Energy Research facility project dedicated to demonstrating laser driven fusion as a future energy source).

ELFI and LULI2000 attract - and retain - highly qualified personnel, both scientific/academic and technical. The former ensure state-of-the-art experiments and the training of competent, ready-to-work scientists. The latter ensure the reliability of the systems, which further attract scientists. The lasers are fully operational and the systems are monitored in real time. Over half of the experiments at LULI2000 and ELFIE produce at least one publication, an achievement when some of the experiments entail considerable scientific risk [The fact that users themselves can operate a 100-TW, 3-shot-per-hour laser with high reliability is simply extraordinary]. There is considerable competition to obtain time on LULI2000 or ELFIE (30-50 % of proposals are rejected). One-third of LULI users are from outside France. Although the systems are representative of "old" laser-building technology, the LULI2000 architecture is fundamentally similar to LMJ, NIF and other energetic long-pulse lasers, and still vigorously robust.

The CILEX-APOLLON project has to be seen in the international (in particular European) context. On the one hand, France has been the nucleus of high-power lasers since the 1970s, and also at the origin of the ELI idea. On the other hand, it is exactly the ELI project that challenges the French position in the field with two 10-PW facilities in the Czech Republic and Romania. Given the fact that hardly anywhere else one would find a density of research institutes and optics companies in the field of high-power lasers similar to that of the Palaiseau - Saclay plateau, the CILEX-APOLLON project makes a lot of sense. Provided that the partners supporting APOLLON continue to work together in a constructive manner, the chances of success of a 10-PW facility are nowhere greater than here.

Finally the scientific personnel has: i) contributed to many international conferences with 147 regular contribution (oral and poster) and at least 33 invited talks ii) participated to numerous scientific committees (DAM, PETAL, RDHMD, EURATOM IFE, EPS Plasma Physics Division), organization committees (ICAP 2012, SFP 2009, IZEST, IFSA, WDM 2013, ICHED 2013) and program committees (CLF, EMMI, ...), and were granted 3 scientific awards (Grand Prix Carnot de l'Académie des Sciences, Teller Medal of ANS, Yves Rocard, Rix Thématique "fondé par l'Etat" de l'Académie des Sciences).

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

LULI has many relationships with private companies, most of the time as an outsourcer. During the last period, the various teams have taken nine patents. People involved in the LUCIA project (Laser pompé par diode, operating a Solid-State Diode-Pumped Laser (DPSSL) system at high energy (100 J) at 10 Hz) are on the forefront of the development of intellectual properties on such a driving project.

Physicists at LULI promote Sciences by outreach activities and general public communications like "Fêtes de la Science", "Les 50 ans du laser", "Laser Fusion", and giving interviews to national radios or/and TV channels.

Assessment of the unit's organization and life

The UMR agreement is placing the laboratory under the supervision of a governing council (Conseil d'Administration – CA) made of eight members (4 from CNRS, 2 from CEA and 2 from EP) and one observer from UPMC. The CA usually meets once per year (in December) to follow the progress of the on-going projects.

LULI is organized with a management team (one Director and two Deputy Directors) and a "Mini-bureau" made of the team leaders and that meets once a month. A "Conseil de Laboratoire" meets, a least, three times a year. The "Mini-bureau" acts as a scientific internal committee debating of the scientific policy of the laboratory and on its evolution, including facility improvements, distribution of the direction beam time and on specific applications for targeted budget and/or applications (ANR, PhD and Post-doc grants,). A general assembly is organized annually by the direction. A "PhD day" is also organized every year as well as regular seminars (internal and external). Due to its research activities on inertial fusion science and technologies, and although none of them is confidential allowing full publication of the results, the laboratory is access-restricted and labelled as a ZRR (Zone à Régime Restrictif). This restricted access seems to be a handicap for PhDs and post-docs.

About the organization of the large-scale infrastructure, the lasers are used for a variety of high energy-density and fusion-related experiments; some experiments are standard and others are risky; facility committees maintain an appropriate balance. Most experiments are collaborations. Rules for access and governance of ELFIE and LULI2000 are reasonable and transparent. Access is based on the merit of proposals, where the concept for an experiment must be carefully planned and explained. Proposals are reviewed are conducted by several reviewers ahead of the scheduled beam-time, and feedback is enforced through post-experiment briefings. The process is well established, published, available online, and understood by users. The number of weeks per year for experiments and for maintenance has been roughly constant over the past five years.

During the committee visit at LULI, the committee did not notice any problem about the unit organization and life, excepted the high pressure for the technical teams to run the facilities without delays, and the technical organization of the APOLLON project with its localization at l'Orme des Merisiers. A proof of the good quality of the internal organization is the existing collaborations between the various teams (excepted LUCIA), demonstrated by common publications (42 arise from at least two teams).

Assessment of the unit's involvement in training through research

LULI hosts only three assistant professors and a professor. So its involvement in teaching and training undergraduate students is not very important excepted for the PAPD team which is strongly engaged in the management of the Ile-de-France Master in Fusion Science, in the definition of teaching modules on plasma and inertial fusion physics, in the supervision of trainees at various levels, and in the organization and evaluation of courses at UPMC (Université Pierre et Marie Curie).

LULI is highly connected to École Polytechnique (EP) and its doctoral school (EDX, École Doctorale n°447), and UPMC ED389 Doctoral Schools. 23 PhDs have been defended during the ongoing contract. Training in high energy-density research is thorough and the overall quality of PhD students from LULI/École Polytechnique is excellent. This is partly due to young researchers having access to the LULI lasers; all experimental students utilize ELFIE or LULI2000 and often both. When utilizing lasers with energy and intensity sufficient for frontier high energy-density experiments, students receive hands-on instruction and experience necessary to developing their own research. Access to the lasers is determined on the merit of proposals; experiments are focused. Students and LULI postdocs are strong support to the laboratory research programs (many of them are supported by CEA). Post-docs use they acquired experience to very often start their own research activity. As an example, LULI does not have a free-electron laser, but recent exciting high-impact experiments at the SLAC and DESY free-electron lasers [Phys. Rev. Lett. 102, 165004 (2009), Nature Phys. 5, 693 (2009), Phys. Rev. Lett. 104, 225001 (2010), and Phys. Rev. Lett. 106, 164801 (2011)] involved LULI-trained researchers in key roles. In a near future, the CILEX-APOLLON project will offer an excellent opportunity for the training of PhD students. It is likely that, when this facility will start operating, it will become a true centre of excellence offering young researchers great opportunity to conductive innovative research.

Assessment of the strategy and the five-year plan

For the next five years, LULI intends to pursue its actual research program in the domain of laser-generated plasma. The main evolutions are: the split of the SPRINT team into two new teams: APOLLON that should be operational in 2016; and new access to very large-scale facilities like, LMJ and PETAL in France and ELI sources, FEL sources and NIF within the world.

The APOLLON project will stress the ability of LULI to maintain its present operational model while leading the construction and commissioning of an ELI-class laser that will actually be built before the ELI facilities. While LULI management is aware of the primacy of its leadership in the APOLLON project, given the importance that LULI2000 and ELFIE have demonstrated for the HED community, the strategy is to continue to operate as much of the Facility as possible during the APOLLON construction phase. The path forward is unclear because maintaining both present-dayoperations and APOLLON requires funding that is not yet identified. The short-term LULI infrastructure strategy cannot be fixed; it will evolve as the funding authorities develop policy. Upgrades of ELFIE and LULI2000 are planned that could be curtailed. Continuation of the short-pulse laser ELFIE, while a superb training tool, could conceivably be reduced if APOLLON emerges as a reliable facility. Possibly more critical is the fate of the long-pulse LULI2000, important for many high energy-density applications. LULI2000 was planed to be a bridge between closing PHEBUS and commissioning LIL. With the demise of LIL, LULI2000 is now the only high-energy, long-pulse in France other than LMJ.

4 • Team-by-team analysis

Team 1 : ILP (Interaction Laser Plasma)

Name of team leader: Mrs. Christine LABAUNE

Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
N1: Permanent professors and similar positions		
N2: Permanent EPST or EPIC researchers and similar positions	1	1
N3: Other permanent staff (without research duties)		
N4: Other professors (PREM, ECC, etc.)		
N5: Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)		
N6: Other contractual staff (without research duties)		
TOTAL N1 to N6	1	1

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	2	1
Theses defended		2
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions	1	

• Detailed assessments

Assessment of scientific quality and outputs

The team is small but very efficient in terms of research quality. The work addresses both longstanding issues and emerging ones. The focus is on experimental work on laser-plasma interactions relevant for inertial fusion. It is carried out both at onsite and at offsite experimental facilities, an indicator of flexibility and priority on science rather than bolstering onsite facilities. Some more fundamental work on fundamental plasma physics, and the exploration of novel fusion concepts have also led to publications with high visibility, and with potential important impact. The team has a good per-capita rate of refereed publication (4,7) output and several of their publications appear in top journals in the field and reach an international audience.

Assessment of the unit's academic reputation and appeal

The team leader has a high reputation internationally, demonstrated by several high profile roles and prizes at the European and international levels. Some of these roles have involved large collaborations, such as the HiPER laser facility. The development of the experimental program of this team requires access to laser time in several facilities; the diverse range of campaigns is a further recognition of the academic reputation of the team and its ability to pursue national and international collaborations. The team has attracted post-docs and students, which is impressive with regard to its small size.

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

The team (especially its leader) has demonstrated a significant level of outreach, especially to the French community, as well as technology transfer, such as in a patent on neutronic nuclear reactions and its involvement in fiber lasers. Its partners are distributed within France, Europe and iworld-wide.

Assessment of the unit's organization and life

This team has a traditionally well-defined focus on inertial fusion, especially laser-plasma interactions and laser-plasma instabilities relevant to inertial fusion. It has recently ventured into other related areas, such as fusion reaction research. The role of the team leader is strong for educating the young scientists (PhDs).

Assessment of the unit's involvement in training through research

The team has been successfully seen through two defended PhDs.

Assessment of the strategy and the five-year plan

The strategy and plans presented for the next five years are sound, and reflect the direction in which the field is going, especially laser-plasma interactions and laser-plasma instabilities relevant to inertial fusion. This is an important issue for "Laboratoire d'Utilisation des Lasers Intenses". A threat for this team is the failure of the NIF (National Ignition Facility) to achieve ignition, which impacts its main focus area, the prospects of a main partner (CEA) and its main European partnership, HiPer.

Conclusion

The team has a recognized expertise and reputation and during the evaluation period, the international standing and results of the team remain at a high level. A closer coupling between their experimental capabilities and more support from theory could improve their research impact on the international community. The size of this team may be subcritical, which must surely impact on its performance in the context of the relatively large scope that it tackles. It would be wise to carefully consider which of the many interesting problems it could tackle would have the biggest impact, scientifically and programmatically, and thus focus the efforts. A threat for this team is the failure of NIF to achieve ignition, which impacts its main focus area, the prospects of a main partner (CEA) and its main

European partnership, HiPer. This makes it even more important, in collaboration with its partners, to focus its efforts for maximum impact. Another threat to this team is its small cross section with two increasing "Laboratoire d'Utilisation des Lasers Intenses" initiatives: involvement in x-ray FELs (XFEL and LCLS) and APOLLON.

Strengths and opportunities

- S1: strong recognized expertise and reputation;
- S2: large international recognition;
- S3: An important topic for Laboratoire d'Utilisation des Lasers Intenses.
- O1: better links with theory and experimentalists can improve the efficiency.

Weaknesses and threats

- W1: too small size of the team for long-term development and for the scope of the topic;
- W2: quite far from Appolon and Xfels projects of the Laboratoire d'Utilisation des Lasers Intenses, which will grow in importance within the next years.
- T1: A threat for this team is the failure of the NIF to achieve ignition, which impacts its main focus area, the prospects of a main partner (CEA) and its main European partnership, HiPer.

Recommendations

- It would be wise to consider carefully which of the many interesting problems the team could tackle with the biggest impact, scientifically and programmatically, and focus their efforts accordingly.

Team 2 : LUCIA (Laser Ultra-Court Intense & Applications)

Name of team leader: Mr. Jean-Christophe CHANTELOUP

Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
N1: Permanent professors and similar positions		
N2: Permanent EPST or EPIC researchers and similar positions	1	1
N3: Other permanent staff (without research duties)		
N4: Other professors (PREM, ECC, etc.)		
N5: Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)		
N6: Other contractual staff (without research duties)	1	1
TOTAL N1 to N6	2	2

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	1	1
Theses defended		1
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken	1	
Qualified research supervisors (with an HDR) or similar positions	1	

• Detailed assessments

Assessment of scientific quality and outputs

LUCIA is a key laser research project that develops the next generation of high average power laser systems via the diode pumped solid-state laser (DPSSL) technology. It aims at delivering 100 J at 10 Hz repetition rate. LUCIA is

one of the few DPSSL systems around the world that is developped to try to reach this energy level. During the last period, this Yb:YAG diode pumped laser system has clearly demonstrated that it can be operated at 13.9 J at 2 Hz so far, and that it is significantly more efficient and can operate at higher repetition rate than the conventional flash lamp laser systems. This achievement already represents a major step forward in DPSSL technology. The highly competent team behind this development has tackled and solved practical problems with high-average-power laser systems. The novel design for the cryogenic amplifier is a significant step to achieve the 30 J level of amplification which will be the next milestone. The resulting research has been published in relevant scientific journals, with 21 publications in referred journals and the research and technical progress made by the LUCIA team has been presented in major international conferences and workshops.

Assessment of the unit's academic reputation and appeal

LUCIA has been an important partner in the European HiPER laser project being responsible of the work package for coordinating the research activity into efficient high repetition laser drivers for a future power plant based on laser fusion. The LUCIA team has also been heavily involved in HAPPIE and EURO-LITE Joint Research Activities of LASERLAB EUROPE II and III respectively, having in charge the coordination of the two activities.

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

The LUCIA project has filed three patents; this is a strong indicator of the economic impact resulting from the innovative research conducted by the research team. The LUCIA team has established links with other Institutes, the collaboration with the Institute of Nanosciences and Cryogeny (CEA/INAC) concerning the cryogenic amplifier, is a clear example of technology transfer in this project.

Assessment of the unit's organization and life

The unit is small but well organised and has quantifiable goals. It has achieved part of the goals that were set several years ago. Good progress has been made through the leadership of the senior researcher; clearly the team is relatively small compared to other development activities.

Assessment of the unit's involvement in training through research

The LUCIA project has enabled the training of several PhD students, three PhD theses have been defended as part of the research conducted by the team. Although the team is small, the senior researcher and post docs provide good guidance and supervision to the students.

Assessment of the strategy and the five-year plan

The LUCIA project has the clear goal to deliver 100 J at a 10 Hz repetition rate. The next milestone is to achieve higher energies (30 J) and increase the repetition rate. The team has a well-defined technical plan to meet this specification by the implementation of a new cryogenic amplifier and the development of a new preamplifier in collaboration with CEA/INAC. The midterm plan also includes frequency doubling the output wavelength. To ensure high efficiency in the frequency conversion, the Lucia Front End will be replaced to incorporate the ability to control the temporal pulse shape. Financial and human resources at the moment are decreasing, which may be a major difficulty to achieve such a five-year plan.

Conclusion

Demonstration of 100 J at 10 Hz would ensure that "Laboratoire d'Utilisation des Lasers Intenses" retains a world leading position. The LUCIA project is defined as of high importance in the strategic five-year plan of LULI. Nevertheless, the team should take a step back to: 1) Compare its technological approach to the ones developed in other large facilities, 2) take into account future developments and take steps to stay competitive, 3) prospect on relevant applications for such laser sources and their implementation as an experimental application platform, 4) adapt their objectives to the resources available.

Strengths and opportunities:

• S1. LUCIA team has a strong and recognized expertise to develop DPSSL technology and is a leader in France on this topic;

• S2. LUCIA has good collaborations with other institutions to help deliver some of the technology required for the project, and benefits of a good network in Europe through EUROLITE.

• O1. Demonstration of 100 J at 10 Hz would ensure "Laboratoire d'Utilisation des Lasers Intenses" that retains a world leading position;

• O2.The LUCIA project is defined as of high importance in the strategic five-year plan of LULI.

Weaknesses and threats:

• T1: Slower progress due to limited resources;
• T2: The uncertainty concerning the future funding of the HiPER project.
• W1: Compared to the other teams, LUCIA team has little internal collaboration due to the nature of the research.

Recommendations:

• The team should critically compare its technological approach to the ones developed in other large facilities;

• prospect on relevant applications (beside laser fusion) for such laser sources and their implementation as an experimental application platform;

• adapt their objectives to the resources available.

Team 3 : Physique Atomique des Plasmas Denses (PAPD)

Name of team leader: Mr. Frank ROSMEJ

Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
N1: Permanent professors and similar positions	2	2
N2: Permanent EPST or EPIC researchers and similar positions		
N3: Other permanent staff (without research duties)		
N4: Other professors (PREM, ECC, etc.)	3	2
N5: Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)		
N6: Other contractual staff (without research duties)		
TOTAL N1 to N6	5	4

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	2	
Theses defended		2
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions	3	

• Detailed assessments

Assessment of scientific quality and outputs

The PAPD team has a strong international activity in hot plasma physics and plasma atomic physics in dense matter. These topics are of major importance for the overall laboratory activty. Its approach is both experimental and theoretical, or numerical, using homemade codes. The team uses high-resolution spectroscopic techniques to address hot-plasma related issues, both in local (LULI-2000, ELFIE…) and abroad-located laser facilities (PALS Prague ASTERIX Laser System) in Czech republic, LCLS (SLAC Linac Coherent Light Source) in the US, Free-electron laser FLASH in Germany…).

Very significant progress has been achieved in the past five years, with regard to international visibility. Over this period, the team has discovered an Auger electron heating mechanism in solids (Al) irradiated by intense XUV FEL radiation; has achieved state-of-the-art spatially and spectrally resolved x-ray imaging of energetic-electrons-induced volume radiation emitted by Cu irradiated with intense visible pulses; and has realized the first high-energy-density x-ray pump-probe experiment at LCLS, which has led to the demonstration of photo-excitation and x-ray fluorescence for a large series of charge states in Al. Given the size of the team, its scientific output is excellent with 32 original papers in peer-reviewed journals, including 2 Phys.Rev.Lett. and 1 well-cited *Nat. Phys.* papers, as well as 16 invited conferences at the international level, mostly presented by the team leader.

Assessment of the unit's academic reputation and appeal

The very high standard of the scientific production of the team results in an excellent academic reputation. The team leader has been awarded honorary professorship at the Moscow Institute of Physics and Technology, and is a member of several committees or editorial boards. Apart from a large number of invited talks at conferences, the team leader has been involved in scientific councils, in two editorial boards, and he drives a formal collaboration between UPMC (Université Pierre et Marie Curie) and the Kurchatov Research Center in Moscow. The team has attracted several PhD students and post-docs over the period. It has conducted many experiments in laser facilities abroad and participates in an extended collaborative network.

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

The team has patented its method and code (MARIA) to model complex phenomena in non-equilibrium radiation physics, which is quite unusual. It has led informal scientific discussions with high school students and given two interviews to non-specialized journals.

Assessment of the unit's organisation and life

The team appears to be well organized with coherent and ambitious goals in mind that are supported by its know-how in hot plasma physics and related topics. The team is part of an extended fruitful collaborative network. The team leader has been elected member of the laboratory council, and is an *ex-officio* member of the laboratory scientific office. The different geographical localisations of the team members at quite long distances from the Palaiseau Campus certainly weaken the daily operation of PAPD team.

Assessment of the unit's involvement in training through research

The team's involvement in training is very strong. In addition to its regular teaching duties, the team is strongly engaged in the management of the Ile-de-France Master in Fusion Science, in the definition of teaching modules on plasma and inertial fusion physics, in the supervision of trainees at various levels, and in the organization and evaluation of courses at UPMC. This activity has highly contributed to increase the flow of very high-level students to plasma and energy production related Master programmes in Ile de France. It also had, so far, a very good record in PhD supervision.

Assessment of the strategy and the five-year plan

The team's project is ambitious and in line with its former achievements. It will make use both of local laser facilities (LULI-2000, APOLLON) and other facilities abroad like PALS (Prague ASTERIX Laser System), as well as of the MARIA code, which will be further developed. The plan looks as feasible and consistent with the overall objectives of the laboratory. The expected results will provide even more solid bases to the atomic physics diagnostics of dense plasmas. The realization of the project might be affected by the recent retirement of the only one CNRS researcher of the team and the leave of a university assistant professor, so that it presently relies on two university researchers and is under-critical since 2012.

Conclusion

The reputation of the team stands from its high quality and internationally recognized scientific production. Its main strengths are (i) that its expertise covers both theoretical description and detailed measurements of the physics phenomena, and (ii) its strong involvement in teaching activities and organisation of education programmes that certainly contribute very significantly to the attractivity for young researchers. These two points should be continued in the future. Following the recent departure of two staff members, the team is under-critical in manpower. This could impact negatively its future research plans.

Strengths and opportunities

- S1: Strong expertise in atomic physics, covering both theoretical description and detailed measurements;
- S2: strong involvement in teaching activities and organisation of education programmes.
- O1: new facility (APOLLON) with unique performances;
- O2: strong expertise to address new research fields, as magnetized plasmas.

Weaknesses and threats

- W1: Following the recent departure of two staff members, the team is under-critical in manpower. This could impact negatively its future research plans.
- T1: localization on three different sites (lot of time lost in travelling between the sites).

Recommendations

- Proceed with the ambitious project that has been presented, making good use both of local laser facilities (LULI-2000, APOLLON) and other facilities abroad (PALS, Prague ASTERIX Laser System), as well as of the MARIA code, to be further developed.

Team 4 : PHYsique de la matière à haute Densité d'Energie par Laser (PHYHDEL)

Name of team leader: Mrs. Alessandra BENUZZI MOUNAIX

Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
N1: Permanent professors and similar positions		
N2: Permanent EPST or EPIC researchers and similar positions	4	4
N3: Other permanent staff (without research duties)		
N4: Other professors (PREM, ECC, etc.)		
N5: Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)	1	
N6: Other contractual staff (without research duties)		
TOTAL N1 to N6	5	4

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	2	2
Theses defended		1
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions	1	

Detailed assessments

Assessment of scientific quality and outputs

The activity of the PHYHDEL team is organized in three main topics: warm dense matter physics, planetary science, and laboratory astrophysics. The team also develops dedicated X-ray sources. Several breakthroughs have been achieved since 2008, such as the observation of the non-metal-metal transition during the unloading of laser-shocked Al, or the demonstration of the formation of strong magnetic fields around laser-produced shock waves and of their turbulent amplification. This gives insight into the origin of galactic magnetic fields. The use of different facilities around the world is very efficient and collaborations with active groups are very strong. The scientific output is at the highest level with 65 original papers in peer-reviewed journals, including 1 Nature, 2 Nature Physics and 8 PRL papers, as well as 13 invited conferences at the international level.

Assessment of the team's academic reputation and appeal

The group has a well-established reputation. It has recruited one CNRS junior scientist (2008) and has attracted two post-docs from abroad. All members are enrolled, often as PIs, in numerous on-site collaborations and in campaigns on external sites (VULCAN laser facility, UK; GEKKO XII laser facility, Japan…). They lead, or participate in, working groups, "Agence Nationale de la Recherche" projects, or conference organization committees. One member has been enrolled in the European Physics Society, Plasma Physics Division.

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

The team has participated to dissemination actions towards a non-specialized public such as exhibitions at "Cité des Sciences et de l'Industrie" and edition of files for the TV channel France 5.

Assessment of the unit's organization and life

The team is organized with coherent, ambitious, and timely goals in mind. The team's head has been transferred recently from a senior scientist to a junior researcher. The publications are shared among team members in a coherent way. Overall, the team's life appears to be very healthy and unite.

Assessment of the unit's involvement in training through research

The training activity relies on the supervision of PhDs. There were 6 PhD defences since 2008, and there are two on-going thesis. This is good, considering that only one team member over four has the HDR accreditation.

Assessment of the strategy and the five-year plan

The project is in line with the existing strengths. The recent installation of a 40 T pulsed field on the ELFIE laser opens the possibility to build a similar system on LULI-2000 to study magnetized plasmas. The physics of the radiative shocks is very important for the future. The collaboration with teams of the PlanetLab network in planetary science should be very fruitful.

Conclusion

PHYHDEL is a very good and well-structured group of physicists that uses different existing facilities and develops diagnostics tools and new sample environments. The project is very interesting and should deliver nice physics. PHYHDEL greatly contributes to the scientific reputation of LULI. Recruiting an assistant professor would reinforce the team's training capabilities and junior scientists are recommended to defend their HDR as soon as entitled.

Strengths and opportunities

• S1: Strong expertise in warm dense matter physics, planetary science, and laboratory astrophysics;

• S2: very broad range of collaborations and large international recognition;

• S3: efficient use of the existing facilities;

• S4: very good team's organization;

• S5: development of dedicated diagnostics tools and new sample environments.

• O1: installation of a pulsed magnetic field on the ELFIE laser;

• O2: start-up of the APOLLON facility.

Weaknesses and threats

• W1: only one team member has the HDR accreditation.

• T1: links with the university are not very strong so that this could weaken the training capabilities of the team in the future.

Recommendations

• Proceed with the proposed project that should deliver nice physics. Try to integrate the future APOLLON facility in the mid-term vs long-term project. Try to recruit a University assistant professor to reinforce the team's training capabilities. Encourage the team's junior scientists to defend their HDR accreditation as soon as entitled.

Team 5 : Sources de Particules et de Rayonnements Intenses (SPRINT)

Name of team leader: Mr. Patrick AUDEBERT

Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
N1: Permanent professors and similar positions	1	1
N2: Permanent EPST or EPIC researchers and similar positions	6	6
N3: Other permanent staff (without research duties)		
N4: Other professors (PREM, ECC, etc.)		
N5: Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)	2	2
N6: Other contractual staff (without research duties)		
TOTAL N1 to N6	9	9

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	9	5
Theses defended		4
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken	3	
Qualified research supervisors (with an HDR) or similar positions	5	

• Detailed assessments

Assessment of scientific quality and outputs

The SPRINT team is the largest in Laboratoire d'Utilisation des Lasers Intenses, with a high reputation based on its long history of success in relativistic laser plasmas. The team remains among the best worldwide in this field. The team addresses a broad topical experimental portfolio within or related to relativistic laser plasmas. The team is also engaged in applying the tools developed with relativistic plasmas to address other physics (e.g. laser-driven ion beams used for isochoring heating to make Warm Dense Matter). During this period, the team has published 114 papers, of which ~37 were published in high-impact journals. SPRINT personnel publish as both lead supporting authors. Experiments are conducted both in onsite and offsite facilities, providing evidence of a healthy priority on science and on collaborative research. By supporting external users at LULI facilities with a high-degree of competence, the team provides a significant service to the external user community.

Assessment of the unit's academic reputation and appeal

Team members have several high international profile leadership roles and prizes at the national and European levels. Some of these roles have involved large collaborations, such as the Vice-Chairmanship of the European High Power laser Energy Research facility (HiPER). Team personnel are involved in many reviews, as well as scientific, organizing or program committees. Their continued participation in many collaborative experimental campaigns (at LULI and elsewhere) also reflects their high reputation. The vote of confidence represented by the request to manage the APOLLON project is very significant. The team has attracted young scientists, Post-docs and PhD students, from France and from abroad.

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

Team members have engaged the popular media in the promotion of science and technology. They have also filed two patents. The APOLLON project entails significant interactions with industry, especially the French laser industry, representing a significant push on laser technology.

Assessment of the unit's organization and life

This team has certainly demonstrated its ability to discuss and validate new topics in which to engage. Senior personnel in the team are clearly increasingly participating to the unit life and are becoming more and more influential within LULI management and slated for promotion. Team personnel also serve in the LULI Laboratory Council (CLabo).

Assessment of the unit's involvement in training through research

The team has successfully supervised eight PhDs that were defended in the units where they came from. Moreover, they have provided significant training to the students and early-career scientists in the collaborating external user groups coming to "Laboratoire d'Utilisation des Lasers Intenses". Team members also teach at École Polytechnique.

Assessment of the strategy and the five-year plan

The SPRINT team is s exceedingly well positioned strategically with the upcoming APOLLON laser facility, which promises to be a transformational capability providing a wealth of scientific opportunities. At the end of the current contract, this team will be split into two teams, headed by two senior scientists with excellent scientific reputations. The Sprint team, the largest at LULI by far, presents an administrative imbalance, which means that either the other teams are too small, or SPRINT is too large. There are positive aspects to the split. It could allow a sharper focus in their research portfolio. It provides more opportunities for leadership to LULI senior scientists. It may lessen the administrative burden on the team leader. The team members seem to be aware of the threats ahead of them. These include: 1) the temptation to engage on even more research topics, leading to a degree of superficiality that hinders

the opportunities for lasting contributions and breakthroughs; 2) a decrease in both scientific productivity and attention to students when APOLLON comes online, due to the facility growing burden and to the development of the scientific and diagnostic infrastructure.

Conclusion

The team has done very well scientifically, and remains one of the recognized premier groups worldwide in its field. Its members have had significant impact in the scientific community beyond "Laboratoire d'Utilisation des Lasers Intenses", and have been formally recognized. It has had a significant impact in its interactions beyond the scientific community. The team is well run and the morale is high. The team plays a significant role in training future scientists. It has many untapped research opportunities, which will grow further with APOLLON coming on line.

We conclude with a SWOT analysis for this team:

Strengths:

• S1) Sustained scientific excellence and performance over many years;

• S2) High production of completed PhD degrees;

• S3) Multiple PhD students who collaborate on the same experiments, which gives a critical mass to the projects (more diagnostics & measurements that benefit all participants);

• S4) Local research facilities available for internal projects, and for external projects that they enable as local collaborators.

Opportunities:

• O1) The APOLLON laser, with unique capabilities, coming on line soon at the Saclay valley under LULI management and control;

• O2) access to many experimental facilities and collaborations worldwide;

• O3) working in a scientifically vital field, with many R&D opportunities;

• O4) assisting external users on their experiments at the LULI facilities, which can enhance the team's scientific productivity, access to external ideas & methods, diagnostics, scientific connections, student mentoring, etc.;

• O5) the planned split of the team into two teams may facilitate a sharper scientific focus into fewer areas where they have the potential to become dominant.

Weaknesses:

• W1) Lack of theoretical and modelling support for their experimental projects;

• W2) Possibly too many simultaneous projects on too many topics at too many facilities;

• W3) Aging ELFIE laser and underperformance of the LULI-Pico facility.

Threats:

• T1) The team split may create two subcritical teams;

• T2) The team split may create a temptation to engage on even more research topics, leading to a degree of superficiality that hinders the opportunities for lasting contributions and breakthroughs, and decreases the possibility of leadership on any one topic;

• T3) APOLLON coming online may lead to a decrease in scientific productivity and attention to students, due to the facility growing burden and to the need to divert resources (funds & personnel time) towards the development of the technical and diagnostic infrastructure of the facility;

• T4) Too many administrative demands on the permanent scientific staff, taking too much time from research and student supervision.

Team 6 : Théorie Interprétation Plasmas Simulation (TIPS)

Name of team leader: Mrs. Caterina RICONDA

Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
N1: Permanent professors and similar positions	1	1
N2: Permanent EPST or EPIC researchers and similar positions	3	2
N3: Other permanent staff (without research duties)	1	1
N4: Other professors (PREM, ECC, etc.)		
N5: Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)		
N6: Other contractual staff (without research duties)		
TOTAL N1 to N6	5	4

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students		1
Theses defended		
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions	1	

• Detailed assessments

Assessment of scientific quality and outputs

The team presents a very good publication record for the number of permanent researchers in the team, with 27 publications in the top journals in the field. These works cover a diverse range of methodologies (in terms of numerical codes and simulation tools). The degree of involvement/leadership in the publications is also diverse, with publications sometimes driven by the scientific program of the team and other times driven by the experimental

programs developed by LULI teams. Care is taken of insuring the right position of the authors in these two contradictory situations. If, on the one hand, and given the strong experimental activities at LULI, the creation and support of a theory and modelling team to complement and to support the experimental efforts over the wide range of the activities of LULI should be recommended and can bring an important added value to the global activities of the laboratory, it is also important to create the conditions for the exploration of new theoretical/simulation avenues of research that can contribute new ideas and concepts to the experimental programs. The range of problems addressed might, however, require either additional focus or the expansion of the number of persons associated with the team.

Assessment of the unit's academic reputation and appeal

As a recently established team, the reputation of the team is high but still associated with the individual reputation of its researchers, with national and international recognition, as demonstrated by several prizes and honours, and their leadership in large-scale projects (e.g. HiPER, LaserLab) and organizations (e.g. EPS, Euratom). The team has been able to attract junior researchers and PhD students, but the potential to attract more scientists, engineers and students is very high and this should be actively pursued given the ambition and the plans of the team in connection with the projects and research direction in which LULI is involved.

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

The level of outreach is somehow limited, but this is not surprising given the recent establishment of the team. The individual team members are involved in several of these activities, in particular the team leader who plays an important educational role as a lecturer at the UPMC. The potential for stronger technology transfer activities exists and can be explored, in particular in connection with code development and high performance computing.

Assessment of the unit's organization and life

The team takes advantage of the expertise distributed across different partners (École Polytechnique, UPMC) that contribute to its core focus on simulations and theory in laser-plasma interactions. They seem aware of the difficulties of managing and operating a multi-site research team, and have taken positive measures to ensure success. The team leader serves in the LULI Laboratory Council (CLabo).

Assessment of the unit's involvement in training through research

The team has supervised one PhD. Given the potential of the team and the recognized expertise of the team members, it is envisaged that this number will be increased in the future.

Assessment of the strategy and the five-year plan

The strategy of the team follows two directions: the support of the experimental programs in which "Laboratoire d'Utilisation des Lasers Intenses" is involved (with the expansion and integration of existing numerical tools) and the development of a code infrastructure to tackle problems in Ultra High Intensity Laser-Plasma Interactions (with the development of a new numerical framework). The former is clearly positioning itself to service a future program centered on APOLLON, while the former is clearly geared to the collaboration with the LULI teams. Those are sensible priorities. It still represents a very large scope in code development that will likely need an increased personnel with that capability.

Conclusion

In all major laboratories in this field, it is clear that the role of a strong theory and simulation team is of paramount importance to the success of the experimental programs. The creation and the development of this team at LULI is, therefore, of relevance for LULI, its mission, and the role played by "Laboratoire d'Utilisation des Lasers Intenses" in APOLLON. Despite being just recently created, the team has already demonstrated its impact through publications in some of the more relevant research directions in the field. The size of this team still looks small given all the supporting and original research that increasingly it will be called to do. Their support of existing experimental campaigns is significant, but it could certainly be more. This is even more evident given the fact that the team is undergoing an ambitious code development program that may take up a significant part of the team resources.

Strengths and opportunities:

- O1: In a pivotal position for collaboration and interaction with experimental teams of very high quality, following a strategy similar to other equivalent teams;
- O2: Expertise of high relevance for APOLLON;
- S1: Recent new member with CNRS position and new permanent members to join team in next period;
- S2: Team with international visibility and with recognized impact;
- S3: Ambitious code development programme.

Weaknesses and threats:

- W1: Efforts dispersed over several topics, where code development can take up a significant component of the team resources;
- W2: Limited human resources to respond to the increasing number of requests for support and for original research.

Recommendations:

- Increase efforts in terms of human resources allocated to the activities of TIPS;
- Further strengthen the connections and networking with other similar groups in France and in Europe.

5 • Conduct of the visit

Visit dates:

Start:	Thursday, 12 December 2013 at 8:30.am
End:	Friday, 13 December 2013 at 5 pm.

Visit site(s):	Campus de Palaiseau
Institution:	Laboratoire d'Utilisation des Lasers Intenses
Address:	LULI, École Polytechnique
	91128 Palaiseau Cedex, France

Specific premises visited: laboratories, platforms, support departments

Conduct or programme of visit

Thursday, December 12th 2013

08:30-09:00 am	Committee member meeting (closed meeting)
09:00-09:40 am	Presentation, results and auto evaluation of Laboratoire d'Utilisation des Lasers Intenses Laboratory (Mr François AMIRANOFF)
09:40-10:10 am	Presentation of CILEX-APOLLON project (Mr François AMIRANOFF)
10:10-10:30 am	Coffee break
10:30-11:00 am	Laboratoire d'Utilisation des Lasers Intenses Project for the coming years (Mr Patrick AUDEBERT)
11:00-12:20 pm	Results, auto evaluation and projects of teams (SPRINT & PHYHDEL presentation + discussion; ILP presentation + discussion)
12:20-12:50 pm	Committee member meeting (closed meeting)
12:50-2h00 pm	Lunch: committee members, team leaders, deputy directors and directors.
2:00-3:00 pm	Results, auto evaluation and projects of teams (PAPD, TIPS & LUCIA15h00)
3:30 pm	Presentation of laser infrastructures (Ms Sylvie JACQUEMOT)
3:30-3:45 pm	Intervention of L. BERTHE, user facility representative
3:45-6:30 pm	Visit of laser infrastructures and teams by the experts
6:30-7:00 pm	Committee member meeting (closed meeting)
7:00-7:45 pm	Meeting with Laboratoire d'Utilisation des Lasers Intenses present and future directors

Friday, December 13th 2013

08:30-08:45 am	Committee member meeting (closed meeting)
08:45-09:15 am	Meeting with ITA/BIATOS representatives
09:15-09:45 am	Meeting with PhD and post-doc representatives
09:45h-10:15 am	Meeting with researchers, professors and assistant-professors
10:15-10:40 am	Committee member meeting (closed meeting)
10:40-11:00 am	Meeting with doctoral school representatives
11:00 am-1h30 pm	Meeting and lunch with contracting authorities
1:30-2h00 pm	Final meeting with the directors of Laboratoire d'Utilisation des Lasers Intenses
2:00-5:00 pm	Committee member meeting (closed meeting)

6 • Supervising bodies' general comments

Patrick Le Quéré
Directeur adjoint de l'Enseignement et de la Recherche

Madame Nathalie Dospital
Déléguée Administrative
Section des unités
AERES
20 rue Vivienne
75002 PARIS

Objet : Evaluation AERES du LULI
Référence : DAER /LL/14 – n° 96
PJ : Réponse au rapport d'évaluation du LULI - S2PUR150008467-005878

Palaiseau, le 30 avril 2014.

Chère Madame,

Le LULI (UMR 7605) n'a pas de remarque particulière à formuler sur le rapport AERES.

En tant que co-tutelle du LULI, nous n'avons pas de commentaire particulier à apporter, autre que vous faire savoir que nous avons été très sensibles à la qualité du rapport, et vous prions de remercier en notre nom l'ensemble des membres du comité et son président pour le temps qu'ils ont consacré à cette évaluation.

En vous souhaitant bonne réception de la présente, je vous prie de croire, Chère Madame, à l'assurance de mes meilleures salutations.

Patrick Le Quéré
Directeur adjoint de l'Enseignement et de la Recherche

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