LCF - Laboratoire Charles Fabry

Rapport Hcéres

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

Department for the evaluation of research units

AERES report on joint research unit:

Laboratoire Charles Fabry

LCF

Under the supervision of the following institutions and research bodies:

Centre National de la Recherche Scientifique - CNRS

Institut d'Optique Graduate School Paristech

Université Paris-Sud

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. Robin KAISER, 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 assessments contained herein are the expression of an independent and collegial deliberation of the committee.

Unit name:	Laboratoire Charles Fabry
Unit acronym:	LCF
Label requested:	UMR
Present no.:	8501
Name of Director (2013-2014):	Mr Pierre CHAVEL
Name of Project Leader (2015-2019):	Mr Patrick GEORGES

Expert committee members

Chair:	Mr Robin KAISER, Institut non linéaire de Nice (representative of CoNRS)
Experts:	Mr Franz KÄRTNER, DESY Hamburg and University of Hamburg, Germany
	Mr Gerd LEUCHS, University Erlangen-Nürnberg / Max Planck Institute for the Science of Light, Germany
	Mr Eric MEVEL, Université de Bordeaux 1, CELIA
	Mr Mark NEIL, Imperial College, London, UK
	Ms. Anne SENTENAC, Institut Fresnel, Marseille
	Mr Lluis TORNER, ICFO-Institut de Ciències Fotòniques, Barcelona, Spain

Scientific delegate representing the AERES:

Mr Charles HIRLIMANN

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

Mr Jean-Louis MARTIN, Institut d'Optique Graduate School Paristech

Ms Pascale ROUBIN, CNRS INP

1 • Introduction

History and geographical location of the unit

The "Laboratoire Charles Fabry" was created in 1998 when the structure "UMR" was first established, based on previously existing structures operated jointly by CNRS and by the "Institut d'Optique". Located on the premises of the Institut d'Optique (IOGS), now the headquarters of the Institut d'Optique at Palaiseau on the campus of École Polytechnique, with a small part remaining, to the present day, in the former headquarter building at Orsay. During the five-year period considered, another CNRS/IOGS UMR was created at Bordeaux while a new building was being built for the further development of IOGS.

Management team

Mr Pierre CHAVEL replaced Mr Christian CHARDONNET as director in February 2013. His designated successor, who had not yet been identified on 15 October 2013 when the report of the UMR was first filed onto the AERES server, is Mr Patrick GEORGES, currently the head of one of the teams.

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	26	26
N2: Permanent researchers from Institutions and similar positions	20	20
N3: Other permanent staff (without research duties)	44	44
N4: Other professors (Emeritus Professor, on-contract Professor, etc.)		
N5: Other researchers from Institutions (Emeritus Research Director, Postdoctoral students, visitors, etc.)	14	1
N6: Other contractual staff (without research duties)	1	1
TOTAL N1 to N6	**105**	**92**

Unit workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	46	
Theses defended	80	
Postdoctoral students having spent at least 12 months in the unit	66	
Number of Research Supervisor Qualifications (HDR) taken	9	
Qualified research supervisors (with an HDR) or similar positions	30	30

2 • Assessment of the unit

Strengths and opportunities related to the context

The Laboratoire Charles Fabry has continuously pursued outstanding research in optics at the highest international level. Several teams of Laboratoire Charles Fabry are among the leaders in their field and play pioneering roles in developing modern aspects of optics. This excellence in research is acknowledged by the international recognition, number of prizes and awards obtained by the various teams and an outstanding scientific output in a large variety of fields in optics.

LCF has been able to develop an excellent evolution of themes in optics, as witnessed by the topics of the groups such as atom optics, quantum optics and nanophotonics. Furthermore Laboratoire Charles Fabry has an exceptional interaction with training at Institut d'Optique – Graduate School, with mutual benefit for training and research. Laboratoire Charles Fabry is a leading research unit in France and at the international level, maintaining close contacts with many industrial partners. The various teams of Laboratoire Charles Fabry have shown their excellent fund raising capability, a point that is important for maintaining research at the highest level.

The Laboratoire Charles Fabry benefits from excellent technical support, an essential point in that it allows maintaining the outstanding quality of research in the different fields of optics that are covered.

Weaknesses and threats related to the context

The close interlacement of Laboratoire Charles Fabry, with a parent organization (Institut d'Optique – Graduate School, which has now also created a new subsidiary laboratory in Bordeaux) provides a unique situation that needs particular attention in terms of scientific as well as resource management.

The recruitment of permanent staff in section 08 of CoNRS has been very low over the reported period.

Recommendations

The Laboratoire Charles Fabry should maintain its excellent environment for research in terms of training, exploitation and technical support, a rare situation in the French research environment.

The Laboratoire Charles Fabry should clarify its administrative situation, paying particular attention to the impact that the new planned "Unité Mixte de Support" could have on its management, on the necessary close interactions and flow of information between research and administrative support, as well as the impact it could have on the personnel of this "Unité Mixte de Support".

The internal budget committee recently created inside the Conseil de Laboratoire should help increasing the transparency of the financial situation of Laboratoire Charles Fabry and its relation with Institut d'Optique – Graduate School.

Long-term strategy of scientific orientations should be addressed in connection with the newly established laboratory in Bordeaux.

3 • Detailed assessments

Assessment of scientific quality and outputs

The Laboratoire Charles Fabry performs research over an excellent range of scientific topics, spanning from the traditional laser and optical components that was at the origin of its creation to the more recent activities in the fields of atom and quantum optics, nanophotonics and biomedical photonics. This large range of research topics allows Laboratoire Charles Fabry to be present, pioneering and leading in several areas of modern optics. The total number of peer reviewed papers over the reporting period is 525, including 3 papers in Nature, 8 in Nature Physics, 6 in Nature Photonics; in each of the high ranking following journals: Optics Letters, Phys. Rev. Let., Optics Express, Phys. Rev. A, about 50 papers have been published, and in: Applied Optics, Appl. Phys. Let., Phys. Rev. B, JOSA B, about 20 per journal. These papers have been cited 4763 times between the year 2009 and the end of the year 2013. Among the scientific highlights of the period one finds: (i) observation of Anderson localization in matter waves and comparison with ab initio calculations, (ii) Rydberg blockade in two atoms, (iii) radiative heat transfer at the nanoscale, (iv) theory of extraordinary optical transmission, (v) coherent combining femtosecond CPA pulses or (vi) attosecond pulse compression by multilayer's, that all are high level achievements.

Assessment of the unit's academic reputation and appeal

The international reputation of Laboratoire Charles Fabry is on the same level as the best optics centers in the world and is witnessed by the impressive number of prestigious international prizes that were acknowledged to researchers of the laboratory (Frederic Ives Medal/Jarus Quinn Prize of the Optical Society of America, the Einstein Medal of the Albert Einstein Society, the Herbert Walther Award, the Wolf Prize in Physics, the Quantum Electronics Prize, the Charles Hard Townes Award of the Optical Society of America, four Doctor honoris causa, etc), as well as by the number of very selective awards that were granted to other members (4 European Research Council grants, 3 positions at Institut universitaire de France). The members of Laboratoire Charles Fabry are also involved in a number of international collaborations and they do benefit from national and local research structures such as Centre de competences en nanosciences (C'Nano), Triangle de la Physique, 2 Laboratoires d'excellence (Labex): Palm and Nanosaclay and 3 Équipements d'excellence (Equipex): Morphoscope, Attolab and Centre Interdisciplinaire Lumière Extrême (CileX). This situation allows LCF attracting the most dynamical researchers at each level: PhD, post-doc and permanent staff.

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

The Laboratoire Charles Fabry benefits from strong industrial partnerships through its strong connection with Institut d'Optique – Graduate School, being therefore a dynamic actor in its economic environment; it contributes to 3 startup companies (Muquans, SeQureNet, LLCTech), 2 joint research laboratories with the companies Amplitude Systems and Fibercryst that are located at Laboratoire Charles Fabry. It has filed 24 patents over the assessment period. Laboratoire Charles Fabry also has a long-term involvement in high power lasers (Cilex-Apollon du Centre Interdisciplinaire Lumière Extrême) and with the development of the Centrale d'Elaboration et de Métrologie des Optiques XUV (CEMOX) platform for the X-ray and UV community. Via its interactions with Institut d'Optique – Graduate School, Laboratoire Charles Fabry has an outstanding connection to industrial partners, and plays a crucial role in this unique partnership between the economic environment and the research and teaching expertise at Institut d'optique – Graduate school. Laboratoire Charles Fabry is active in national and international outreach activities. It has been a founding member of the European Centers for Outreach in Photonics (ECOP) alliance.

Assessment of the unit's organisation and life

The various teams of Laboratoire Charles Fabry are well structured and a new team has recently emerged (biophotonics) that corresponds to a natural evolution of the internal research topics. One team will split, in line with the coherence of the scientific directions of the sub-teams.

The committee appreciates the role of the younger permanent researchers who are taking up their position and are gaining academic reputation.

The departure of the former unit director has been related to internal difficulties, and the new planned "Unité Mixte de Support" (UMS) is supposed to provide a partial remedy to the circumstances that lead to the situation. The

Conseil de Laboratoire (laboratory council) and the teams' heads, through frequent meetings, are informed of the decisions taken by the directorate of the laboratory and Institut d'Optique – Graduate School; the flow of information and reciprocal consultation could certainly be improved.

The close connection to Institut d'Optique – Graduate School, which allows for the excellent research environment of Laboratoire Charles Fabry, has the consequence that the share of responsibilities between the director and the Institut d'Optique – Graduate School directorates, for scientific matters as well as for resources, could be clarified.

Optics being central in all research aspects at Laboratoire Charles Fabry, many resources are pooled. Even though only a few common papers with authors from different teams have been published, the outstanding expertise of the various teams on technical aspects and on details in fundamentals optics is routinely shared between the teams. The committee clearly found this to be a very important asset of Laboratoire Charles Fabry.

The premises of the unit are adequate and will allow for future development if required.

Assessment of the unit's involvement in training through research

The Laboratoire Charles Fabry is amongst the institutions having the best training involvement at national and international level. This unique situation stems from the close connection to the training mission of Institut d'Optique – Graduate School. The broad range of training in many aspects of optics that is provided by the school is made possible by its close relationship with the research performed at Laboratoire Charles Fabry. This involvement needs to be preserved because it affects interests that go well beyond those of Laboratoire Charles Fabry and of basic research in France.

The Laboratoire Charles Fabry is a consortium member in an Erasmus Mundus program (OpSciTech) and in two Initial Training Networks (Coherence and Adopsys). Unique opportunities are available with the "Filière Innovation & Entrepreneurs" in connection with Institut d'Optique – Graduate School. PhD students and post-docs appeared to be pleased with their research conditions and supervision. Because of the strong ties of Laboratoire Charles Fabry with the industry, they do not worry about their future if they decide to leave academia.

Several staff members at Laboratoire Charles Fabry do teach at École Polytechnique, a first ranked "Grande École" of France.

The Laboratoire Charles Fabry is an essential member of one doctoral school "Ondes et matière" EDOM (ED288) and is also part of the doctoral school "Sciences et technologies de l'information des télécommunications et des systèmes", STITS (ED422). Staff members of Laboratoire Charles Fabry do actively participate in the EDOM management and one member is the head of the doctoral school.

Assessment of the strategy and the five-year plan

Having established a leading position in research in optics, Laboratoire Charles Fabry does not face any threat in terms of scientific strategy. The short and medium term plan is thus to pursue the development of the existing projects on which the various teams have acquired an excellent expertise at international level and should be able to maintain their pioneering position in their respective fields of research. The long-term strategy for novel scientific directions will depend on the evolution of the laboratory of Bordeaux, with close scientific connections with the teams at Laboratoire Charles Fabry.

The recognition of its scientific excellence and its outstanding research environment should allow Laboratoire Charles Fabry to attract new researchers to develop complementary aspects of optics.

Even though a new support unit is in preparation for performing the administrative tasks of the laboratory, the related aspects concerning the transparency and day-to-day life of all of the researchers and technicians need specific attention for the years to come. The new director, Mr. Patrick GEORGES, will closely work with the outgoing director Mr Pierre CHAVEL during the year 2014, allowing him to take on the details of all aspects of the management of Laboratoire Charles Fabry. The short period of time available between the decision that Mr Patrick GEORGES will take over the direction of Laboratoire Charles Fabry and the visit of the committee did not give him the opportunity to develop a detailed personal plan for the years to come.

4 • Team-by-team analysis

Team 1 : Atom Optics

Name of team leader: Mr Christoph WESTBROOK and Mr Laurent SANCHEZ-Palencia succeeded Mr Alain ASPECT in 2012

Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
N1: Permanent professors and similar positions	3	3
N2: Permanent EPST or EPIC researchers and similar positions	5	5
N3: Other permanent staff (without research duties)		
N4: Other professors (PREM, ECC, etc.)		
N5: Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)	3	1
N6: Other contractual staff (without research duties)		
TOTAL N1 to N6	**11**	**9**

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	13	
Theses defended	21	
Postdoctoral students having spent at least 12 months in the unit	15	
Number of Research Supervisor Qualifications (HDR) taken	4	
Qualified research supervisors (with an HDR) or similar positions	6	6

• Detailed assessments

Assessment of scientific quality and outputs

The Atom Optics team of Laboratoire Charles Fabry is a pioneer and leader in his field of research, with world-class results of prime importance. The outstanding international recognition of this group is the indicator of the results obtained, which are of prime importance to a large community, beyond the scope of ultracold atoms. Their experimental observation of localisation in three dimensions is a fundamental contribution to the long-standing question of the Anderson transition in real space. Having focused important part of their experimental and theoretical effort on wave transport in disordered potential using ultracold atoms, the team has established itself as a key player with international leadership in this interdisciplinary topic, initially studied in condensed matter and more recently in optics and acoustics.

During the reporting period, the results of the team related to wave transport in disordered systems is impressive and the team has acquired in the last year a strong expertise in this field of research. This progress has been made possible by a joint experimental and theoretical effort performed in the group, allowing for efficient understanding of the observed experimental features.

Furthermore, the team has also obtained important results with metastable Helium thanks to an efficient detection technique, Bose-Einstein Condensation on chip (for the study of 1D physics), precise studies of coherence properties in 2D and atom interferometry experiments aimed at high precision measurements. In parallel to this experimental effort, the team has gained important expertise in the theory of wave transport in disorder potential and has recently developed large scale Quantum Monte Carlo codes to study interactions in disordered systems. The team has invested in a variety of experimental techniques, crucial for the past achievements and laying the ground for future results.

This scientific productivity has lead to the publication of 90 papers, 1 book chapter and 211 invited presentations, with 1 in Nature, 2 in Nature Physics, 17 in Phys. Rev. Lett. and 2 in EPL.

Assessment of the unit's academic reputation and appeal

The excellence of the research of the Atom Optics group and its high international visibility is recognized via its success in 2 European Research Council grants, 6 Agence Nationale de la Recherche grants, 1 European Strep grant in FP6 and several local grants (Institut Francilien de Recherche sur les Atomes froids (IFRAF), Laboratoire d'excellence PALM). Several staff members of the group are involved in steering committees of important local funding structures (Laboratoire d'excellence, DIM NANO-K, Triangle de la Physique), the Comité National of CNRS. Many prestigious awards have been attributed to members of the group (Optical Society of America, Frederic Ives Medal / Jarus Quinn Prize 2013, Einstein Medal of the Albert Einstein Society (2012), Optical Society of America / Deutsche Physicalische Gesellschaft, Herbert Walther Award (2011), Wolf Prize in Physics (2010), Eurpean Optical Society, Quantum Electronics Prize (2009), Doctor honoris causa of four universities, Prix Servant, Prix Leconte, Prix Jerphagnon, one Junior position at the Institut universitaire de france).

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

The atom interferometry component holds 2 patents that lead to a spin-off company. Members of the team do participate in public outreach programs (Fête de la Science, toutestquantique) and written comments on recent developments in research.

Assessment of the unit's organisation and life

The group runs several cold atom experiments and a theory unit, with well-structured responsibilities. With the former head of the group retired since 2012, the group has smoothly managed the transition in terms of responsibilities and scientific goals. The complementary experimental and theory efforts performed on focused topics allow for mutual benefit. Experimental expertise is shared among the different setups, increasing the efficiency of scientific progress. Even though the scientific output of the team is at the best of the international level and all permanent staff have important scientific results, 2 PhD (out of 21) have defended their PhD without a published

paper and some of the permanent staff members seem to lack international exposure, probably due to the extreme visibility of the former head of the group.

Assessment of the unit's involvement in training through research

The group has attracted many doctoral students (21 defended PhDs and 13 currently running PhDs) and 15 post-docs/visitors, and is involved via the permanent staff in teaching at the Institut d'Optique – Graduate Scholl and École Polytechnique. During this period 4 permanent members of the team have defended their Habilitation à Diriger des Recherche (HDR), increasing the potential of student supervision of the team.

Assessment of the strategy and the five-year plan

Based on the expertise on matter waves in disordered potential, utracold metastable Helium and Bose-Einstein Condensations on chip, the team has an excellent strategy in reinforcing their fields of expertise as well as investing in new experiments allowing to move on to the study of novel phenomena with ultracold atoms, such as the interplay of disorder, wave propagation and interactions or lattice physics.

Conclusion

- **Strengths and opportunities:**

The team is among the leading teams in ultracold atoms at the international level;

Focused effort on transport of matter waves in disordered potential;

Investment in new techniques (experiments and theory);

Good equilibrium between permanent and non-permanent staff.

- **Weaknesses and threats:**

4 permanent staff on He* (2 setups, 1 to be closed?);

Interferometry experiments without primary Principal Investigator at Laboratoire Charles Fabry (departure of one member to Bordeaux).

- **Recommendations:**

Address medium term strategy for atom interferometry to be maintained at Laboratoire Charles Fabry.

Team 2 :

Quantum Optics

Name of team leader:

Mr Philippe GRANGIER. In addition, Ms Rosa BROUIRI-TUALLE and Mr Antoine BROWAYES contribute leading the group.

Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
N1: Permanent professors and similar positions	3	3
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.)	2	
N6: Other contractual staff (without research duties)		
TOTAL N1 to N6	**9**	**7**

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	7	
Theses defended	8	
Postdoctoral students having spent at least 12 months in the unit	13	
Number of Research Supervisor Qualifications (HDR) taken	2	
Qualified research supervisors (with an HDR) or similar positions	4	4

• Detailed assessments

Assessment of scientific quality and outputs

The quantum optics team of Laboratoire Charles Fabry is enjoying highest international recognition. A number of the research results achieved belong to the "first world-wide" category. This judgement holds for both families of projects: (1) quantum optics, communication and cryptography with continuous variables and (2) manipulation of individual atoms in microscopic optical dipole traps.

In the first project family, the team leads in the areas of pulsed quantum homodyne detection and pulsed quantum tomography. This work has practical relevance and resulted in a patent and a spin-off company. In the reporting period the team demonstrated continuous variable quantum key distribution over close to 100 km propagation distance in an optical fibre with competitive secure key rate generation, published in 2013 in Nature Photonics. They also succeeded in developing quantum-processing algorithms needed to expand the range as published in Physical Review Letters in 2009. These algorithms require so-called non-Gaussian operations. The team is one of the worldwide pioneering groups in this field, and had demonstrated free-space optical Schrödinger cat states in the previous reporting period. In the current reporting period, they used these cat states to demonstrate that optical amplification can be noiseless if one accepts to experiment with heralded signals (Physical Review Letters in 2011). In addition they contributed to the understanding of the complex issue termed quantum discord (Physical Review Letters 2012). Deterministic and efficient interaction at the few photon level is likewise important for the quantum processing algorithms. Very promising results on the way towards achieving this challenging goal were obtained using Rydberg-Rydberg interactions in a dense cloud of atoms (Physical Review Letters 2012).

The second project family employs atoms in optical tweezers. The demonstration of the Rydberg blockade between two atoms trapped in two nearby tweezers has been a highlight published in 2009 in Nature Physics. The demonstration of the effect was challenging and was ultimately possible by measuring the characteristic change in the value of the Rabi frequency. Closely related was the first generation of entanglement between ground state atoms (Physical Review Letters 2010). Efficiency is most important in quantum processing, hence the demonstration of the lossless detection of the internal state of a single atom in Physical Review Letters in 2011 is highly relevant. The measurement of the temporal dynamics of the elastic scattering of near resonant light is another worldwide first achievement, published in Optics Letters in 2013.

This scientific productivity has lead to the publication of 45 papers, 1 book chapter and 60 invited presentations, with many highest-level publications, 1 in Nature, 2 in Nature Physics, 1 in Nature Photonics, 7 in Phys. Rev. Lett. and 10 in New Journal of Physics.

Assessment of the unit's academic reputation and appeal

The excellence of the research of the Quantum Optics group and its high international visibility is recognized via its success with 1 European Research Council advanced grant, 1 European Research Council starting grant, 2 ANR grants, 6 European projects, 1 US grant (Intelligence Advanced Research Projects Activity) and several local grants (Institut Francilien de Recherche sur les Atomes Froids, C'Nano - Ile de France, Réseau Thématique de Recherche Avancée). Many prestigious awards have been attributed to the group leader (Optical Society of America, Charles Hard Townes Award and Société Française de Physique Grand Prix Jean Ricard), as well to a junior staff: position at the Institut Universitaire de France.

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

Based on several patents in the previous reporting period, a start-up company, SeQureNet, has been supported. Members of the team participate in public outreach programs (Fête de la Science, conferences in secondary schools, and Nuits Blanches 2012) and written comments in Science (Perspectives) as well as in Nature (News & Views).

Assessment of the unit's organisation and life

The group has a clear structure with the long-term group leader. Two more senior scientists have taken over more responsibility in the group. The group has a remarkably high number of foreign Ph.D. students and international post-doc and visitors, demonstrating how attractive the group is for the international community.

Assessment of the unit's involvement in training through research

The group has attracted many doctoral students (7 defended PhD and 8 current PhD) and 13 postdocs/visitors and is involved via the permanent staff in teaching at École Polytechnique and at École Normale Supérieure de Cachan.

Assessment of the strategy and the five-year plan

Several challenging projects lasting several years are in the middle of their development. Continuing these experiments, which are successfully on track, is a very good strategy.

Conclusion

- **Strengths and opportunities:**

The team is one of the leading teams in quantum optics, and quantum information processing and communication internationally.

As compared to the last reporting period the number of permanent staff increased to currently 7 scientists, so that there is now a good relation between supervisors and doctoral students and ample opportunity for the development of early career scientists.

Team 3 : Nanophotonics and Electromagnetism

Name of team leader: Mr Jean-Jacques GREFFET and Mr Henri BENISTY

Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
N1: Permanent professors and similar positions	3	3
N2: Permanent EPST or EPIC researchers and similar positions	2	2
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	
N6: Other contractual staff (without research duties)	1	1
TOTAL N1 to N6	**8**	**6**

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	8	
Theses defended	8	
Postdoctoral students having spent at least 12 months in the unit	17	
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions	3	3

• Detailed assessments

Assessment of scientific quality and outputs

With pioneering works on plasmonics, coherent thermal emission, quantum and guided nanophotonics, the team is a major player in the international arena.

In the last five years, the Nanophotonics and Electromagnetism team of Laboratoire Charles Fabry has obtained impressive results on both fundamental issues and practical applications of the nanophotonics domain. Among its many achievements, one can quote the experimental realization of state-of-the art single photons sources; the electrical modulation of thermal flux; the microscopic theory of enhanced transmission; the theoretical and experimental analysis of the radiative heat transfer at the nanoscale… The originality of the proposed concepts and the research activity, which spans from fundamental physics to important applications (solar cell, detectors, quantum sources), are remarkable.

This scientific productivity led to the publication of 138 papers, among which 2 in Nature, 2 in Nature Photonics, 2 Nano Letters, 1 Surface Science Reports, 1 Rep. Prog. Phys., 18 in Phys. Rev. Lett. ; 6 book chapters and 82 invited presentations, and 9 patents.

Assessment of the unit's academic reputation and appeal

The excellence of the research of the Nanophotonics and Electromagnetism team of Laboratoire Charles Fabry and its high international visibility is evidenced by more than 8000 quotations of the team papers in the last five years, by the publishing of reviews articles in highly ranked Physics journals, and by numerous invited conferences in the most important international congresses of the domain. Several members of the team have received important prizes, namely iXCore Foundation fellow, Institut Universitaire de France Fellow, Fellow Society of Photo-Optical Instrumentation Engineers, Médaille de Bronze du CNRS, Carl Zeiss visiting Professor, prix IBM de la thèse. They participate to the scientific committees of major conferences, the editorial boards of highly ranked journals (Laser & Photonics Reviews) and to the steering committees of important funding structures (Laboratoire d'Excellence, Agence Nationale de la Recherche). The success of the team in gathering money (about 2.8 M€ in the last five years, from public (essentially Agence Nationale de la Recherche) and private funding sources (essentially Total), is a marked evidence of their appeal.

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

The team has a solid interaction with the industrial world through important private funding and public funding involving private companies. It has also a long-term experience in the creation and management of private companies (one member of the team is a founding member of Genewave). It has filed 9 patents during the last five years.

The team actively participates to outreach activities: conferences for high school students, exhibition at the Palais de la Découverte, fête de la sciences, articles for lay public.

Assessment of the unit's organisation and life

The Nanophotonic group has undergone major evolutions since 2010. Basically four researchers (out of 8) left the team and one arrived. Presently, the group gathers two junior and three senior researchers. The changes are too recent for providing any relevant opinion on the unit organization. It seems however that a synergy between the different senior researchers is underway, as witnessed by the first common publications.

Assessment of the unit's involvement in training through research

The group has attracted many doctoral students (9 defended PhD and 7 current PhD) and 17 postdocs/visitors. It is involved, via the permanent staff, in the teaching at IOGS. One member of the team is head of the doctorate school.

Assessment of the strategy and the five-year plan

The team plans to reinforce its research strengths, in particular in the field of heat transfer, and considers opening new exciting routes in quantum plasmonics, plasmonic sources and the study of PT symmetry in guided photonics. It seems a nice combination of novel risky research activities and better established ones.

Conclusion

- **Strengths and opportunities:**

The team is a key player in the domain of nanophotonics. It is wealthy and has a high appeal among students.

It presents a very good balance between fundamental research and applications with strong industrial connections.

It has an important potential for pursuing and extending its pioneering activity on radiative heat transfer (thanks to the integration of two senior researchers specialists of the field).

- **Weaknesses and threats:**

The team faces an important reorganization.

The group suffers from the lack of a full-time scientist specialized in optical instrumentation and nanofabrication (and as such depends strongly on collaboration with other labs for the experimental work).

- **Recommendations:**

The synergy between the different actors of the team has begun and should be fostered.

The recruitment of a young researcher is necessary for strengthening the team, in particular on the experimental aspects.

Team 4 : Nonlinear Materials and Applications

Name of team leader: Mr Gilles PAULIAT

Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
N1: Permanent professors and similar positions	3	3
N2: Permanent EPST or EPIC researchers and similar positions	3	3
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	**6**	**6**

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	2	
Theses defended	6	
Postdoctoral students having spent at least 12 months in the unit	5	
Number of Research Supervisor Qualifications (HDR) taken	1	
Qualified research supervisors (with an HDR) or similar positions	4	4

• Detailed assessments

Assessment of scientific quality and outputs

The group is active in several topics within nonlinear optics, holds a solid experience, and produces high-quality results. It works in classical and quantum nonlinear optics, including phenomena, materials and devices. Specific topics addressed by the group include different areas of Raman scattering and its applications; nonlinear phenomena in one-dimensional and two-dimensional photonic crystal geometries, optical cavities (including nano-cavities) and different types of optical fibers (including photonic crystal fibers filled with liquids); nonlinear properties of optical materials, including semicondutors, photorefractive materials, silicon waveguides, and liquids; electro-optics and acousto-optics; Lippmann phenomena; and optical parametric oscillators, among others. The group conducts interesting activities in SBN thin films for electro-optic applications.

The group publishes well in good journals such as the Journal of the European Optical Society, Journal of the Optical Society of America B, Optics Communications, Optics Express, Journal of Applied Physics, Applied Optics, Journal of Physics D, Applied Physics B, and Optical and Quantum Electronics. One paper was published in a journal of the Nature group (Nature Communications). Some papers were published in the top top journals for the research areas addressed by the group, such as Optics Letters and Applied Physics Letters. The report includes 31 journal publications and 74 contributed papers to conferences.

Assessment of the unit's academic reputation and appeal

The group participated in several regional activities, is an active member in committees of the European Optical Society and the Societé Française d'Optique, and participated in the organization of colloquia. The group produced 6 doctoral theses, of which 2 were presented in English. The leader of the group participated in the editorial committee of the Journal of the European Optical Society, and participates in Holo3 (Saint Louis, France) a centre of technology transfer specialized in optical metrology [http://www.holo3.com/optical-measurement.html].

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

The group participated actively in dissemination activities at the Palais de la Devouverte (Paris), Fête de la Science, exhibits and popularization articles in magazines. Six Non-disclosure Agreements (NDAs) were signed with companies (Essilor, Bayer, Horiba Jobin-Yvon, Opton, LMDC and Doremi) and a prototype device was presented in the OptDiag conference in Paris in 2012. During the period assessed, the group secured a number of grants from local and regional sources (Conseil Régional Ille de France, Campus Paris) with a grand total of about 100 kEuro, as well as a similar amount from private sources. The team is active in national and international outreach activities, including being a founding member of the European Centers for Outreach in Photonics (ECOP) alliance.

Assessment of the unit's organisation and life

The group includes 6 permanent members, of which 2 are Directeur de Recherche CNRS, 1 is Chargée de Recherche, 1 is Professeur and 2 are Maître de Conférences at Institut d'Optique – Graduate School / Université Paris Sud. Three senior members (two at the level of Directeur and one at the level of Ingénieur CNRS) retired during the period that is assessed. The group hosted a number of post-doctoral researchers and visitors. The group is well organized.

Assessment of the unit's involvement in training through research

During the period assessed, the group trained 6 doctoral students. At this point the group hosts 2 doctoral students, who started in 2010 and 2011. Several members of the group contribute to teaching management at different levels (École Supérieure d'Optique, Optique Matière Plasma).

Assessment of the strategy and the five-year plan

The proposed plan is a continuation of several of the current activities and also addresses new areas. The suggested topics are well established within the group. A number of collaborations with external partners are foreseen, including a partner in China and the company GLAZT, as well as a number of domestic laboratories.

Conclusion

- **Strengths and opportunities:**

The group holds a solid experience in a variety of topics, including material preparation and characterization, an important asset for several of the programs envisaged for the future.

- **Weaknesses and threats:**

The group's research scope appears to be too large for the resources available, limiting its clear potential of being a major player internationally on a research topic. The funding attracted from external sources may be improved.

- **Recommendations:**

Increase the number of people affiliated to the group to the extent possible, in particular increase the number of doctoral students and in-coming post-doctoral researchers. Leverage the overall reputation of the Laboratoire Charles Fabry to attract more national and international members.

Leverage the experience of the group to focus on a few cutting-edge research topics, and seek higher external funding, e.g., national funding from Agence Nationale de la Recherche and Association Nationale de la Recherche et de la Technologie as well as European funding from Horizon 2020.

Team 5 : Biophotonique

Name of team leader: Mr Michael CANVA

Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
N1: Permanent professors and similar positions	3	3
N2: Permanent EPST or EPIC researchers and similar positions	2	2
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	**5**	**5**

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	4	
Theses defended	10	
Postdoctoral students having spent at least 12 months in the unit	5	
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions	3	3

• Detailed assessments

Assessment of scientific quality and outputs

The biophotonics area is currently seeing rapid development internationally, and the biophotonics group is well positioned in the field. As benefits such a highly interdisciplinary field, the group has built up successful working relationships with a range of life scientists as end users of their technology, as well as with technolgy providers from chemistry, microelectronics and nanofabrication. The result is a strong portfolio of research following several promising themes.

A particular strength of the group is an emphasis on perfecting rigorous techniques that enable well quantified data to be taken, which is becoming ever more important as these techniques move from proof-of-principle to real biomedical and clinical application. Examples where their research is finding application outside optics and photonics are highlighted as protein synthesis at the ribosome, screening for markers of disease and in-vivo 3-dimensional optical imaging. The ribosome work stands out as being a particularly challenging project that has taken many years to come to fruition. It now looks as though it will result in high impact publications and holds the promise of being a route to studying several important biological problems. The work on full-field Optical Coherence Tomography (OCT) is world leading, and that on plasmonics is also of high quality as recognised by its strong connections to industry.

The group is relatively small and is reflected in the number of 25 journal publications. Approximately half of these (13) are in respectable optics journals (Optics Letters, Optics Express, Applied Optics, Optics Communications, Journal of Optics A), which cater well for interdisciplinary science. The rest is in a wide range of multi-disciplinary journals including ChemPhysChem, Analyst, Nanotechnology, Micro-electronic Engineering, Ingenierie et Recherche BioMedicale reflecting well the wide scope of their research. Contributions are made to five book chapters and there are 134 conference presentations including 18 invited, many to multi-disciplinary audiences. Ten completed doctoral theses have been defended over the reporting period.

Assessment of the unit's academic reputation and appeal

The group was constituted only in 2011 from the merger of members from pre-existing “lasers and biophotonics” and “atom optics” groups at Laboratoire Charles Fabry; however the academic reputation of its members is strong and the formation of a dedicated biophotonics group has great appeal. Members of the group are well linked internationally, including leading the hub of French participation in the EU Photonics4Life network of excellence, and a member of the group recently spending a year at the Fitzpatrick Institute for Photonics at Duke University (USA) as invited researcher. The group is also involved in four other national or international networks, and regularly contributes to scientific committees of major international conferences in the field.

The group participates in outreach activities such as "Fête de la science", summer schools for PhD students or secondary school teachers, and wrote a popularization article in Techniques de l’Ingénieur.

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

While there are no patents filed in this reporting period there is clear evidence that the unit is continuing to support exploitation of previous patents through interactions with Horiba (as leading partner in the Agence Nationale de la Recherche PIRANEX project) and transfer of two patents to LLTech. In addition the group has secured CIFRE (Convention Industrielle de Formation par la Recherche) funding for three doctoral students. Over 21 different research projects have also been funded over the period with a total income to the Laboratoire Charles Fabry of over €1.2M. Members of the unit lead 75% of these funded projects, and two of the funded research projects are with industrial partners.

Assessment of the unit's organisation and life

The unit was formed in 2011 from members already in two other groups at Laboratoire Charles Fabry, and its activities are distributed amongst three sub-themes led by the three senior members of the group. There is already interaction between these themes, and this is expected to grow in coming years, an aspect for which members of the group show great enthusiasm. With the two more junior permanent staff members currently working alongside senior ones in two of the sub-themes, there is clearly opportunity for the range of activities within the unit to grow, particularly in this interdisciplinary area. The group makes good use of the local engineering support infrastructure and facilities.

Assessment of the unit's involvement in training through research

Members of the group are actively involved in a number of multi-disciplinary teaching and research initiatives, contributing to the production of new courses particularly at the physics/biology interface and at the master level. The completion of ten doctoral theses over the reporting period shows their commitment to doctoral training, and a further four are currently in progress. The majority of the students completing their masters have gone on to take up research positions in France or abroad. The unit has also hosted 17 master internships who would typically be working on research projects. Members of the team have also been involved in the Opscitech Erasmus Mundus Masters programme that includes significant research project elements.

Assessment of the strategy and the five-year plan

Current strategy is based on consolidating the formation of the new unit, including increasing interactions between the themes in which new opportunities are already being explored, and great benefit is being gained from the shared facilities available. New funding, including leading a six-partner four-year Agence Nationale de la Recherche project consortium, and high quality doctoral students are presented as evidence of a strong perspective over the next five years.

Conclusion

- **Strengths and opportunities:**

The unit is working in a dynamic and growing research area.

A broad range of optical approaches is being covered, and the unit clearly has the expertise to address a wide range of biomedical and clinical problems.

- **Weaknesses and threats:**

So far the unit seems to be missing the opportunity for high impact publications in biomedical areas.

- **Recommendations:**

Increase publications in journals specifically catering for biophotonics, or in high impact biomedical journals.

Junior permanent staff should seek an HDR qualification and increase their own independent research programmes, perhaps through European Research Council grants.

Look for opportunities for joint supervision of PhD students with life scientists.

The Laboratoire Charles Fabry could provide more core funding to help cover consumable costs of running biomedical handling facilities, in order to enhance the environment for working with life scientists.

Team 6 : Lasers

Name of team leader: Mr Patrick GEORGES

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	3	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.)	2	
N6: Other contractual staff (without research duties)		
TOTAL N1 to N6	**7**	**6**

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	7	
Theses defended	14	
Postdoctoral students having spent at least 12 months in the unit	4	
Number of Research Supervisor Qualifications (HDR) taken	2	
Qualified research supervisors (with an HDR) or similar positions	4	4

• Detailed assessments

Assessment of scientific quality and outputs

The laser group of Laboratoire Charles Fabry has achieved widely internationally recognized technological breakthroughs, such as a compact high power amplifer based on crystal fibers, coherent pulse synthesis and a 10-fs short pulse front end for the worldwide first 10 PW laser, the Apollon facility. These results support greatly the continued leadership of France in high-energy lasers and pushes towards the new direction of providing simultaneously high energy and high average power.

The research activity of the laser group aims at the development of novel diode-pumped solid-state lasers utilizing various novel gain media ranging from crystals (Yb:YCOB, Yb:CaF2), crystal fibers, fibers to semiconductors. Over the last five years the group has achieved impressive results on crystal fiber lasers providing energies up to 5 mJ and up to 200 W of average power from a very compact (few cubic-centimeter) device. Approaches reaching the kW level based on thin-disc lasers are pursued.

A high energy Yb:KYW amplifier with 27 mJ energy was demonstrated and approaches to cryogenic CaF2 lasers are pursued. Novel amplification architectures for scaling of fiber lasers are introduced, divided pulse amplification and coherent pulse synthesis.

The team plays a key role in the development of the front-end for the Apollon 10 PW laser, the highest peak power laser in the world. The laser group is unique in the French research panorama and is very well known internationally.

The group's research during the last review period has been widely published in over 96 peer reviewed journal papers, of which 33 articles are in Optics Letters - the leading journal in laser research, and in 164 conference presentations. 14 PhD thesis and 2 habilitations have been produced.

Assessment of the unit's academic reputation and appeal

The group is international very well known for its research in novel solid-state laser materials and laser systems, in particular ultrafast laser systems. The group is also involved in several large European programs, like ELI (Extreme Light Intensity), BRIGHTER, BRIDLE and ICAN, underscoring the excellent international reputation of the group. The group is also active in two Équipement d'Excellence (Equipex) programs: CILEX (Centre Interdisciplinaire Lumière extrême) and MORPHOSCOPE. The group and team leader are active in many national and international review committees for large scale science projects such as LUNEX, Synchrotron SOLEIL and the European Synchrotron XFEL. These activities provide the necessary additional resources to the group. In the current review period, over 2 Million Euros of additional money has been brought in via national and international research and development projects.

The group also provides leadership to several international conferences such as CLEO Europe, EOS Topical meetings and Europhoton Solid-State and Fiber Lasers conference. The group leader is ranked 1st in France for publishing in Optics Letters since 1983 (ISI Web).

Several group members received prizes: Jerphagnon Prize in 2011, Prix Perrissin-Pirasset en Sciences de la Chancellerie des Universités de Paris en 2009, Georg-Simon-Ohm Award of the German Physical Society for best Diploma Thesis.

The group is very active in developing intellectual property. Six patents have been filed in the last 5 years in collaboration with Amplitude Systems and Fibercryst.

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

The lasers group develops a unique laser technologies. The latest in this series is the crystal fiber amplifier. Its inventions are commercialized with the spin-off company Fibercryt. The lasers group blends in perfectly into the many laser companies in the area. Exceptionally strong synergies between the Laboratoire Charles Fabry, the many Ecoles of the area and leading French laser companies are forged leading to a number of joint PhD projects. Most

importantly, this symbiosis helps generating the next generation leaders in research and industrial development that is necessary to secure French leadership in laser technology.

Assessment of the unit's organisation and life

The lasers group has managed to build itself up as an internationally very visible and vibrant top laser research group, essentially within the last review period. Besides the group leader, it comprises 4 highly qualified faculties and research faculties, 2 research engineers from Fibercryst and Amplitude Systems and currently about 13 PhD students of whom 5 are newly hired. An additional Assistant Professor is currently searched to strengthen the staff for the challenging research projects ahead.

Assessment of the unit's involvement in training through research

Twenty-one students have been trained over the last 5 years, and 14 graduated. Currently, 3 students are supported by CIFRE fellowships. Three postdoctoral associates are trained. Students are jointly supervised with industrial researchers, and work on a number of industrially supported research projects. Two industrially sponsored research engineers from Laboratoire d'Utilisation de lasers Intenses/École Polytechnique participate in the laboratory.

Assessment of the strategy and the five-year plan

For the next five-year period the group plans to start new programs in LED (Light Emitting Diodes) pumped solid-state lasers, new configuration for phase matched non-linear optics and CEP (Carrier-envelope phase stabilization) stabilized infrared OPCPAs (Optical Parametric Chirped-pulse Amplification). These are novel approaches to laser sources, are well aligned with the previous research directions of the group and build upon the strength of previous work, such as the Apollon front-end and the fiber crystal amplifier. The plan is well designed.

Conclusion

- **Strengths and opportunities:**

The laser group is an internationally renowned top research group in laser physics.

It develops widely applicable laser technologies, most recently the crystal fiber technology, which promises to have a major impact in solid-state laser power scaling.

It has strong contacts to and synergies with the French laser industry, carries out numerous joint research collaborations.

It invests in new laser technologies and novel nonlinear optical sources.

- **Recommendations:**

The group is well positioned to apply for European Research Council grants in the future and should use this opportunity to foster its financial support. Especially high-energy laser development is rather expensive due to the large size, high quality optical components necessary for this research.

Team 7 : Optical Systems and Components

Name of team leader: Mr Pierre CHAVEL (to be replaced by Mr François GOUDAIL and Mr Franck DELMOTTE, with the group being split into two groups)

Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
N1: Permanent professors and similar positions	9	9
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.)	5	
N6: Other contractual staff (without research duties)	1	1
TOTAL N1 to N6	**16**	**11**

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	7	
Theses defended	13	
Postdoctoral students having spent at least 12 months in the unit	7	
Number of Research Supervisor Qualifications (HDR) taken	1	
Qualified research supervisors (with an HDR) or similar positions	5	5

• Detailed assessments

Assessment of scientific quality and outputs

The SCOP (Systèmes et composants Optiques) group is composed of two teams “SPIM” (Equipe Systèmes d'imagerie et physique des images) and “XUV Optics and Optical Surfaces”. They have respectively developed innovative optical imaging systems and rare and unique expertise in designing EUV and X-ray optics with unprecedented quality and properties. The SCOP provides advanced imaging processing with high industrial transfer potential and short wavelength optics for frontier applications with high international visibility.

The SPIM team has accomplished major breakthroughs such as fully adaptive polarimetric imaging, depth of field enhanced thermal imaging, and adaptive optics for wide-field aberration correction enabling a spectacular resolution improvement for large telescopes. These original approaches have been awarded 3 PhD prizes.

The scientific productivity consists in 51 publications with a substantial fraction in top ranked optical journals (14 Optics Letters, 5 Optics Express), and has lead to 6 patents.

The XUV Optics and Optical surfaces team has realized challenging EUV mirrors with record reflectivity and surface quality for the telescopes of the Solar Orbiter satellite due to be launched by the European Space Agency in 2017. Another striking contribution is a spectral phase designed XUV multilayer mirror promising to achieve world record compression of attosecond XUV pulses, which is a key issue of the ATTOLAB project. It must be stressed that such know-how and expertise is absolutely unique in France and extremely rare worldwide.

The XUV Optics and Optical surfaces team contributed to 48 papers including high impact journals in optics (2 Nature Photonics, 2 Optics Letters, 6 Optics Express) that were reflected in 80 conferences with 18 invited presentations.

Assessment of the unit's academic reputation and appeal

The reputation of the SCOP group is asserted by its implication in 7 Agence Nationale de la Recherche, 2 Équipement d’excellence projects (MORPHOSCOPE2 and ATTOLAB), in 2 Conseil Régional de l’Essonne projects including the CEMOX (Centrale d'Elaboration et de Métrologie des Optiques XUV) platform led by Franck Delmotte within the LUMAT (Lumière Matière) federation and in 2 FP6-7 European projects (ACTMOST and the starting ITN ADOPSYS).

The group members are strongly involved into managing of academic Institutes (CNRS scientific council), networks (2 GDR), steering committees (CNES, Centre National d’Etudes Spatiales), scientific societies (Optical Society of America chair) and editorial work (Applied Optics). Two Phd students were awarded prizes from EADS (European Aeronautic Defence and Space company), ParisTech and ONERA (Office National de l’Espace et de la Recherche Aéronautique) for the exceptional quality of their work.

The group has attracted 9 visiting scientists and post-doctoral fellows and 20 PhD students.

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

Research has been undertaken in close collaboration with several industrial partners or non-academic research institutions. Up to 6 patents have been filed. Some of the partnerships were operated through research contracts with leading companies of the fields investigated (Thalès, SAGEM, Essilor) and often at their demand. Six PhDs have been co-funded (Contrat industriel de formation par la recherche) by an industrial partner (Thalès, Renault, Essilor) and 6 other PhDs have been supported by Direction Générale de l’Armement, i.e. identified as strategic for the Army.

The SPIM team has collected about 0.8 M€ of funding, mostly from private sector or through projects involving an industrial partner such as the European program ACTMOST that stimulates joint research with industrial partners on innovative micro-optics. The XUV group is also efficiently attracting resources through funding with non academic research institutions (Commissariat à l'énergie atomique et aux énergies alternatives, Centre National d’Etudes Spatiales) or private sector partners (ESSILOR, EADS-SODERN) amounting to a total of about 3 M€. A very important contribution is the CEMOX platform playing a major role in the success of large and ambitious projects such as “Solar

Orbiter Mission" (CNES), ATTOLAB Équipement d'Excellence, LMJ (30 multilayer coatings provided) or large-scale facilities (SOLEIL synchrotron).

The head of the group and group members have also promoted science to large audiences within the 50th anniversary of the laser celebration, by participating to a holography exhibition at the CNAM Museum and to annual "Journées de la science". Finally, the head of the group currently chairs the French physics Olympiads.

Assessment of the unit's organisation and life

The SPIM and XUV optics and optical Surfaces teams clearly appear as independent entities with distinct sites. Each sub group is organized with well-identified, specific objectives and a coherent strategy. The context will be different in the future since the XUV Optics and Optical Surfaces team will move from a separated building in Orsay to a brand new clean room in the IOGS building in Palaiseau before the end of 2014.

The XUV Optics team receives a considerable and essential support from engineers and technicians in Laboratoire Charles Fabry.

The recruitment for the SPIM team shows excellent strategic vision, but is clearly an issue for the XUV Optics team, both concerning PhDs and permanent staff members (2 IR and 1 DR retired, versus 1 IR recruited and 3 current PhDs only). In contrast, the situation is highly favourable for the XUV Optics team in terms of funding since two big and long term projects (CEMOX and ATTOLAB) will contribute about 1 M€ for the next period.

Assessment of the unit's involvement in training through research

Thirteen PhD students have defended their thesis during the evaluated period, and there are 7 current PhD students. Integration into the job market is very good with 100% employment including 10 alumni entering a research engineer position in industry or in a non-academic research Institute. 3 HDR (Habilitation à diriger des recherches) retired during the evaluated period and one permanent member has obtained an HDR. The recruitment of 2 HDRs (1 PR, 1 MCF) maintains the potential for PhD supervision in the group. The head of the group has been deputy director of the doctoral school EDOM and head of Erasmus Master Course Optics in Science and Technology.

Assessment of the strategy and the five-year plan

The two teams will split over the next period.

The projects of the SPIM team are sound, based on specific expertise and target relevant objectives with high potential for industrial transfer (polarization imaging extended to civil domain applications, retinal and 3D imaging) and for adaptive optics control systems on forthcoming extremely large telescope facilities (on-going sky tests on the William Herschel telescope in La Palma).

The projects of the XUV Optics and Optical Surfaces team are sound, based on their unique expertise, and address challenging issues (EUV mirrors for Solar Orbiter Mission, soft X-ray microscope for biological applications, multilayer optics for ATTOLAB). They are realistic considering the new CEMOX platform, and the ATTOLAB Équipement d'excellence context, but fragile in term of manpower. The consolidation of their expertise, unique in France and rare worldwide is an obvious strategic issue. The favourable context and the perspectives implying spectacular and highly visible applications offer an appealing basis to attract skilled engineers and PhD students.

Conclusion

- **Strengths and opportunities:**

The SPIM team has developed innovative imaging control and architectures that open the way to relevant industrial applications.

The team has good connection with industry with high student attractiveness.

The team new recruited researchers enable to extent the range of applications.

The XUV Optics and Optical Surfaces team has reached a unique expertise with high national and international reputation and visibility.

The XUV Optics and Optical Surfaces team is in a favorable context with the new clean room, CEMOX platform, and ATTOLAB project.

- **Weaknesses and threats:**

Recruitment of permanent staff and PhD students in the XUV Optics and Optical Surfaces team had become an issue. There is an urgent need to ensure the transfer of unique skills and know-how to younger generations.

- **Recommendations:**

Strengthen the manpower in the XUV Optics team.

Develop collaborations at international level for the XUV Optics team.

5 • Conduct of the visit

Visit dates:

Start:	16 December 2013 9:00
End:	17 December 2013 17:00

Visit sites :	Palaiseau
Institution:	Institut d'Optique
Address :	2, avenue Augustin Fresnel 91127 Palaiseau cedex

Second site :	Orsay
Institution:	Institut d'Optique
Address :	bâtiment 503, centre scientifique, 91405 Orsay cedex

Specific premises visited:

Visit of Laboratoire Charles Fabry in Palaiseau and Orsay

Conduct or programme of visit:

The visit of the committee spanned over two days, which allowed satisfactory interactions with all components of Laboratoire Charles Fabry. The first day was mainly dedicated to scientific aspects. After a short closed session with the committee, a first introduction of the current Directeur d'Unité (Mr Pierre CHAVEL) was followed by a presentation of each of the seven teams of Laboratoire Charles Fabry. In the afternoon the committee split into two groups to visit in more detail the various teams and their experiments (including a visit of the unit component still located at Orsay). This part of the visit allowed to interact with more junior members of the research staff of Laboratoire Charles Fabry.

The first day was then completed with a meeting with the doctoral students and post-docs and finally a meeting with the current and future director of Laboratoire Charles Fabry.

The second day of the visit was focused on more administrative aspects of Laboratoire Charles Fabry and started with an interview with the supervising organisations (CNRS, Institut d'Optique – Graduate School) of Laboratoire Charles Fabry.

The committee then visited the technical workshops, with a short presentation of each component followed by a specific visit of the optical shop.

The committee then had several interviews in closed session with all technical support staff (including the administrative personnel), the laboratory council, the leaders of the research teams and groups, the direction of the Fédération Lumat, the representatives of the two doctoral schools (EDOM and STITS) and finally an interview with the representatives of Paris Sud University.

In the afternoon, the committee discussed, in a closed session, the visit and started the preparation of the report and grading of the teams.

Monday 16th, December

9h00 – 09h30	Committee organization	
9h35 – 10h30	General presentation by the director	
10h30 – 10h50	Coffee break	
10h50 – 13h00	Short presentation by the seven research groups	
13h00 – 14h00	Lunch	
14h00 – 15h45	Visit of the group	
	Committee group 1	Committee group 1
	Atom Optics	Biophotonics
	Quantum Optics	Non linear Materials and Applications
15h45 – 16h15	Coffee break	
16h15 – 18h00	Visit of the group	
	Committee group 1	Committee group 1
	Nanophotonics	Palaiseau part of Optical Systems and Components
	Lasers	Orsay part of Optical Systems and Components
18h00 – 18h30	Interview with the doctoral students and post-doctoral fellows	
18h30 – 19h15	Interview with the current and future directors	

Tuesday 17th, December

8h45 – 09h45	Interview with the parent organizations “tutelles”
9h45 – 10h10	Visit of the optics workshop
10h10 – 10h30	Coffee break
10h30 – 11h00	Interview with the support staff
11h00 – 11h30	Interview with the laboratory council
11h30 – 12h00	Interview with the research group and team leaders
12h00 – 12h20	Interview with the director of “Fédération de recherche LUMAT”
12h20 – 12h40	Interview with the representatives of the doctoral schools EDOM and STITS
12h40 – 13h00	Discussion with the associate partner organisations including Paris-Sud University
13h00 – 13h45	Lunch
13h45 – 17h00	Final discussion of the committee in private session

6 • Supervising bodies' general comments

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Section des Unités de Recherche
20, rue Vivienne
75002 PARIS

Palaiseau, le 30 avril 2014

Objet : Dossier Réf. S2PUR150008298-LCF-Laboratoire Charles Fabry-1910725U

Monsieur le Directeur,

Nous avons bien reçu le rapport d'expertise du Laboratoire Charles Fabry rédigé par le comité d'experts à l'issue de la visite effectuée dans nos locaux en décembre 2013.

Nous vous remercions pour ce rapport qui n'appelle aucun commentaire de notre part.
Conformément à votre demande, les corrections factuelles font l'objet d'un fichier séparé.

Je vous prie d'agréer, Monsieur le Directeur, l'expression de mes salutations distinguées.

Jean-Louis MARTIN
Directeur Général