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## Laboratoire Charles Fabry de l'institut d'optique

Rapport Hcéres

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

Section des Unités de recherche

Evaluation report

Research unit :

Laboratoire Charles Fabry de l'Institut d'Optique  
(LCFIO) – UMR 8501

Institut d'Optique Théorique  
Appliquée



March 2009



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## Evaluation report

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Le Président  
de l'AERES

Jean-François Dhainaut

Section des unités  
de recherche

Le Directeur

Pierre Glorieux

march 2009



# Evaluation report

## The research unit :

Name of the research unit : Laboratoire Charles Fabry de l'Institut d'Optique

Requested label : UMR

N° in case of renewal : 8501

Head of the research unit : Mr Pierre CHAVEL

## University or school :

Institut d'Optique Théorique Appliquée

## Other institutions and research organization:

University of Paris 11

CNRS

## Date(s) of the visit :

December 9<sup>th</sup> and 10<sup>th</sup>, 2008

# Members of the visiting committee



## Chairman of the committee :

Mr Anton ZEILINGER, University of Vienna and Austrian Academy of Sciences

## Other committee members :

Mr Sune SVANBERG, University of Lund, Suède

Mr Gerd LEUCHS, University of Erlangen, Allemagne

Mr Taha BENYATTOU, Institut des Nanotechnologies de Lyon

Mr Philippe BALCOU, Université de Bordeaux 1

Mr Eric ZIEGLER, ESRF Grenoble

Mr Jean Claude FONTANELLA, Thalés Optronique

## CNU, CoNRS, CSS INSERM, (représentant INRA, INRIA, IRD...) representatives :

Mr Claude AMRA, representative of CoNRS

Mr Bruno DESRUELLE, representative of CoNRS

Explanation: Due to an injury shortly before the evaluation, Clauda Amra was only able to participate in part, and it was possible to involve Mr Bruno Desruelle in the last moment as a substitute.

Mr André MONTEIL, representative of CNU

# Observers

## AERES scientific representative:

Mr Jean-Michel ROBBE

## University or school representative:

Mr Jean Louis MARTIN, Directeur Général de l'Institut d'Optique

Mr Alexandre REVCOLEVSKI, Vice Président Recherche de la Faculté d'Orsay

## Research organization representative (s) :

Mr Christian CHARDONNET, DSA CNRS MPPU

Mr Sylvain ALLANO, DSA CNRS ST2I

## 1 • Short presentation of the research unit

- Numbers of lab members including researchers with teaching duties and full time researchers (48 + 1 emeritus), engineers (15), PhD students (40), technicians and administrative assistants (29)
- Numbers of HDR (28) and of HDR who are PhD students advisors (15)
- Numbers of PhD students who have obtained their PhD (35) and average length of a PhD during the past 4 years( 40 months); Numbers of PhD students currently present in the research unit (40); Numbers of PhD students with fellowships (40)
- Numbers of lab members who have been granted a PEDR (10)
- Numbers of “publishing” lab members (48 researchers with teaching duties and full time researchers + 1 emeritus)

## 2 • Preparation and execution of the visit

The *Comité d'évaluation du LCFIO* on 9-10 of December has reviewed the activities of LCFIO. After a short welcome and presentation by the Director of the laboratory, the committee listened to oral presentations about the various research activities carried out by the laboratory. Then the committee split in subgroups and visits of experimental setups were organized such that each group was seen by at least three committee members and each committee member visited at least three groups.

The committee also met with the PhD students and the ‘conseil de laboratoire’ where it discussed with representatives of the various technical areas different aspects of the working life of the lab. The committee discussed with the representative of Institut d’Optique, University Paris XI and CNRS, and then held a closed session dedicated to the preparation of the evaluation report based on the committee findings.

During that close session the committee talked in detail both with the present director and with the designated new director.

The meeting was declared closed at 18:00.

The committee suggests in future evaluations to foresee more time for internal discussions of the committee.

All material presented to the committee was of excellent quality and so was the organization of the day: the atmosphere was optimal in order to allow the committee to work with maximum effectiveness.

## 3 • Overall appreciation of the activity of the research unit, of its links with local, national and international partners

The Laboratoire Charles Fabry de l’Institut d’Optique (LCFIO) is a joint research unit (UMR) between the Institut d’Optique (IO) Graduate School, the CNRS and the Université Paris 11. This combination of three parent organizations is very fruitful for LCFIO, as it allows both combinations of different goals and the combination of different infrastructure and support necessary to achieve these goals. Particularly, the combination of the IO Graduate School and the doctoral schools of Univ. Paris 11 with the research funding through Institut d’Optique and CNRS appears to be an excellent basis.



It is also appreciated by the committee that the mission of LCFIO to provide, as a public research laboratory, both research in fundamental aspects and in its applications. The dissemination of knowledge is very timely and important. The fact that the research is focused on optics in a very broad way and that it has a strong emphasis on experimental and technological aspects is an ideal basis both for world-renowned fundamental physics research all the way to applications in modern optical high-tech and engineering.

LCFIO is very well embedded in its various environments, all the way from the local community to a world-wide scale. On a local scale, the Orsay-Palaiseau-Saclay community provides many opportunities for mutual benefit, support and exchange of ideas and technologies such as the RTRA “Triangle de la Physique” and the Extreme Light Infrastructure (ELI) project, the connections with the research and technology grant of THALES, with ONERA and many other laboratories and associations. The committee is very impressed and fully supports the ambitious “campus” concepts for 2009 and onwards. The “Fédération LuMat” has a number of very interesting topics, goals and activities which provide a perfect background for LCFIO. These are not only focusing on development of new technologies, like position and time-resolved detectors, or new ideas for frequency-comb instrumentation for high precision experiments, it also supports infrastructure in the form of a computing cluster and provides seminars, both on the scientific level and topical workshops. The interactions between various technical services seem to be particularly fruitful.

On a broader level within the Ile de France Region, LCFIO laboratory enjoys significant support from local authorities, both from the Region and from the Essone department. Within this support, the activities of the Institut Francilien de Recherche sur les Atomes Froids, C’nano, a regional Nano initiative, the activity PRISME on metrology and other activities should be mentioned. The laboratory is also a member of various University organization consortia, and of the Pôle de Compétitivité System@tic.

On the national level, the embedding of LCFIO within CNRS is important on very different levels including, but not limited to, ISIS, IMCODE, APPLIX and various technology competence centers. The laboratory also enjoys support by the Société Française d’Optique and the Société Française de Physique and is a member of the “Institut Carnot” .

LCFIO is also a member of twelve European Framework Program Projects of which it coordinates three, and of bilateral programs or specific research activities with many countries including the US, Vietnam and Russia.

This connectivity of the laboratory on many levels clearly signifies and supports the outstanding scientific and technological position of LCFIO. Another observation is that there exist a high number of significant collaborations with industry.

It is very impressive and important that the laboratory also contributes in a broad way to teaching. It assumes responsibility for most of the teaching at Institut d’Optique. It supports joint Masters Programs with University Paris 11, École Polytechnique, and other institutions, and it participates in two Univ. Paris 11 doctoral schools, one on waves and matter and the other one on science and technology of information and signal processing. Thus the institute provides very important contributions for the education of young scientists and engineers at a very high level of current science and technology. This is very important as optical technology is certainly key technology for modern industry.

The institute has an outstanding publication record. Of the more than 300 articles in peer-reviewed journals, a significant number was published in high-level media like Nature, Science, and Physical Review Letters. There were more than 100 invited presentations at national and international conferences and 10 patents were filed. Taken altogether, the laboratory belongs to the handful of world leading institutions of its kind. It competes particularly well with comparable institutions in the US.

In summary, the Laboratoire Charles Fabry de l’Institut d’Optique (LCFIO) is a top institution both on a world-wide scale and with respect to its contributions to French industry and science and technology community.



## 4 • Specific appreciation team by team and/or project by project

### Report on the Atom Optics Group

The group is headed by one of the top leaders world-wide in fundamental quantum and atom optics. Effectively, there are two experimental subgroups, one on “Quantum atom optics and nanomanipulation” and one on “Coherent atomic sources and atom interferences”.

The “Quantum atom optics and nanomanipulation” subgroup has developed an impressive experiment with He atoms allowing 3-D detection with high spatial and temporal resolution. This has led to landmark observations of bosonic bunching for He-4 atoms as signified by the Hanbury Brown and Twiss effect, and of its fermionic counterpart for He-3. That subgroup also works on developing atomic chip technology and applying it to 1-D and 2-D quantum gases and on exploring complex quantum correlations.

The most impressive achievement of the “Coherent atomic sources and atom interferences” subgroup is the first experimental observation of Anderson localization of cold atoms in a controlled disordered field. That subgroup also has significant results in guiding atom lasers and works on atomic interferometry, on exploring connections of BEC with condensed matter physics and on establishing atomic interferometry in space with the aim at testing the equivalence principle to very high precision.

The groups may split into these two subgroups after the senior scientist’s retirement. The decision should be made by the groups themselves. The committee supports the outlook of both subgroups to combine their fundamental work with possible future applications.

There is also an emerging theory activity, which has already established itself very well with a significant publication record. There is a perspective of becoming a separate team within atom optics, yet the strong and very successful coupling of this group to the experimental teams should not be given up.

There is also a biophotonics group which is still in the beginning phase. That group has an ambitious program. It will be important to carefully gauge the success of that group within the next three to four years. If the group is successful, it could become an independent entity. Otherwise, one should consider possibilities of associating the team to another group, or maybe even another laboratory in the Paris area.

The group has an excellent publication record, it produced very good PhDs and it received very high national and international recognition, including the “Médaille d’or du CNRS” in 2005. Altogether the Atom Optics group has an international standing that would grace any laboratory anywhere. LCFIO would be well advised to take all measures necessary to secure that position in the future.

Note de l'équipe	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l'environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
A+	A+	A+	A+	A+

### Report on the Quantum Optics Group

The group covers experimental work ranging from fundamental tests of quantum physics to quantum engineering applications which by now have reached the real world, such as quantum key distribution, which is becoming more and more important for the secrecy of our future communication. The group is running a very competitive research program which was presented in a clear and impressive way.





The group was the first to demonstrate experimentally the power of single photon subtraction leading to a state of light with a negative going Wigner-function. During the reporting period they perfected this simple yet experimentally challenging scheme. The generation of single photons by nitrogen-vacancy centres in diamond, was also pioneered by the group and was then exported to ENS Cachan. This started a fruitful collaboration between the two laboratories culminating in a most impressive demonstration of J.A. Wheeler's delayed choice experiment. On the more applied side the group pushed quantum key distribution using the readily available coherent states of light in combination with continuous variable measurements. In October 2008 in the framework of the EC funded Integrated Project SECOQC, their set-up performed favorably well, also in comparison to the discrete variable systems. The group's next goal is to develop a prototype ready for the market place. In a third project single rubidium atoms are trapped in focused light beams. This experimentally difficult project has also progressed very well during the reporting period.

Looking at the outstanding achievements, the group's challenging goals for the next years do not come as a surprise. Based on the superposition "cat" state generation the group plans to generate larger cat-states and Fock-states with higher photon numbers and to perform process tomography on novel quantum gates.

The group performs in an outstanding fashion and is highly recognized internationally. After moving to the new laboratory the experiments were soon again operational and already produced striking new results. Many of the group's results pioneered and pushed the field of quantum optics. Publications appear in the most renowned journals and numerous invited talks and prizes are an indication of the excellent quality of research.

The number of tenured scientists in the quantum optics group is small in view of the several challenging projects. With regard to the group's outstanding performance, the committee recommends granting one more institutional scientist position to this group.

Note de l'équipe	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l'environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
A+	A+	A+	A+	A+

#### **Report on the Nanophotonics and Electromagnetism Group (NAPHEL)**

The "Nanophotonics & Electromagnetism" (NAPHEL) group was founded in 2005 and consists of two teams:

- One team devoting most of its studies to the electromagnetic theory and modeling of nanophotonic structures.
- The second team which is more involved in the physics of devices for optoelectronic applications.

The committee took note of the high research level of these two teams that is recognized both at a national and international scale. The first group has developed a powerful modeling tool (the aperiodic Fourier Modal Method) that benefits to the whole nanophotonics community. They have introduced the use of PML (Perfectly Matched Layer) in the framework of the Fourier Modal Method, allowing the modeling of open scattering problems. Moreover, using this tool they have contributed to the understanding of the rich physics of the photonic crystal (PC) Bloch mode. Thanks to this deep understanding, they have designed and demonstrated high Q (60000) & low modal volume resonators in 1D PCs on SOI. This value was two orders of magnitude higher than the best results previously reported in the literature. This team has also brought a significant contribution to the nanoplasmonic field. They are at the origin of a microscopic model giving a complete description of the extraordinary optical transmission that occurs in subwavelength perforated metal film.



The other team is known worldwide for its work on photonic crystal structures and devices. They have obtained impressive theoretical and experimental results on light extraction using PC structures in GaN based LED. They have shown how guided modes can be tailored by a shallow grating for enhanced emission near the surface. Another important result has been obtained on GaAs membrane PCs. A L3 nanocavity has been realized in collaboration using the technological shared facilities with THALES TRT. A world-record Q value of 730 000 has been obtained. This important result paves the way to nonlinearity at the microwatt level. Another important point to stress is that unexpected results obtained in the framework of the European project FUNFOX stimulated them to explore the so-called Littrow mode in multimode devices. They predicted that for a critical corrugation value, modes are collectively slowed down. These effects have very interesting applications such as lasers or solar cells where slow modes are needed in a wide structure. The scientific indicators concerning these activities are very good. However, it has been stressed that the interactions between the two teams are too few and should be improved.

The quality of the future prospects have been quoted as very good by the committee, also considering that a new team is about to join and to help this group to reach a critical size. In this context the committee wonders that the main motivation to join LCFIO is to be closer to a quantum optics group. The committee highly recommends seizing the unique opportunity to reinforce the interactions and collaborations between each team. This effort is crucial to fully take advantage of the new group configuration. The committee supports the proposal of the recruitment of a research engineer in technology, to enable the development of new processes for the realization of nanophotonic devices using the shared facilities with THALES TRT. This proposal is legitimate since it meets similar needs in other groups of the laboratory, especially the quantum optics group.

Note de l'équipe	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l'environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
A	A+	A	B	A

### **Report on the Nonlinear Materials and Applications Group (MANOLIA)**

The “Nonlinear materials and applications” group presents several activities related to the nonlinear optical properties of materials. The research line of the group is to take advantage of nonlinear optical properties in nanostructured materials and epitaxial thin films for novel functionalities and thus to propose new devices.

The main research activity of the group is focused on properties of micro- or nano-structured materials (microstructured fibers and photonic crystals). Carrying their interest on such materials was an evolution proposed in the previous contract and there are elements in their new report showing that they succeed in their evolution.

- They have demonstrated, for the first time, the possibility of Raman conversion in liquid filled micro structured fibers. The efficiency is good and emission limited to the first Stokes order. Promising applications are proposed based on multi-wavelength sources.
- They have also evidenced the enhancement of optical nonlinearities by the optical resonances in photonic crystals. Several applications of this effect studied in collaboration with the NAPHEL group are proposed and could lead out to compact Raman laser.

The group continues to work on ferroelectric thin films for nonlinear optic. With strontium barium niobate (SBN) thin films, they try to benefit both of the electro-optic properties of the material and of the optical guiding in thin films. This work requires a complete investigation of the structure and of the different properties (optical, electro-optical, ...) of thin films. This task is not completely achieved, though progresses have been done, particularly using microscopic probes.



For several years the MANOLIA group is working on holographic data storage based on Lippmann interference photography. Their developed model has shown that the replication of data from one medium to another is possible. The challenge now is to demonstrate it and to test its feasibility with industrial partners. The question addressed is also to find the better material for data storage. The group proposes to use nanoparticles in polymer presenting photoinduced phase transitions instead of photopolymers. They did the first observation of the spin transition of a single particle using a home-tailored differential interference microscope.

Several of the researchers in the group will retire soon. The group has anticipated the movement by recruitments in the last period and renewing research subjects. The committee acknowledges the effort of the MANOLIA group to renew its thematic orientation.

However it could suffer a decrease in size and production. To avoid such a tendency, the committee suggests the group should continue to focus more on the projects where they are internationally competitive and propose novel subjects with young researchers. They are also encouraged to increase its internal, national and international collaborations.

Note de l'équipe	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l'environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
A	A	A	B	A

#### **Report on the Lasers and Biophotonics Group (LASBIO)**

The LasBio activity is pursued by two groups, ELSA and a smaller one, MaCSyBio. Comments will be made separately for these two groups.

The ELSA activity is focused on the development of novel solid-state lasers with applications demonstrated, mostly in the field of biophotonics. The systems studied range from high-power diode-pumped lasers with kW CW power, to femto-second pulsed systems. In order to reach high CW powers the group has learned how to master the thermal load, which can be studied in a special optical bench where the crystal end surfaces are imaged and the temperature distribution can be studied. Single-crystal fiber lasers constitute another specialty, where 10 W near-IR output power has been reached in Nd-doped fibers. The group also develops visible lasers with stable frequency for metrology and medical use. Diode pumping in novel three-level materials is also being investigated. In the ultrafast regime diode-pumped ytterbium-doped materials and also fiber amplifiers have been studied. A fs source at 1.6 microns is a special development for eye corneal surgery, while other sources are used for supercontinuum generation for fluorescence lifetime imaging (FLIM) in biology.

Laser research is also being pursued regarding diode-pumping of VCSEL structures with very attractive properties. A high-light is a stable source for pumping cesium cold atom clocks. Also the external-cavity work is impressive. The laser research of the group is pursued in a wide collaboration with institutes, in particular with crystal-growth specialization, and with companies, including Amplitude Systems, CILAS, Eolite, Lascad etc.

The group is very dynamic and has an excellent international visibility through a very large number of high-class publications and conference presentations. Clearly, the group belongs to the leading ones in the world within the field of advanced laser development.

The biomedical applications include total internal reflection imaging microscopy, multi-focal two-photon-induced fluorescence imaging microscopy, and full-field optical coherence tomography, where a very high spatial resolution is combined with spectroscopic diagnostics. By the coupling between laser expertise and biophotonics, provided through the Centre de Photonique Biomedicale, co-founded by the group, high level work in this highly competitive field is being pursued; however, so far with limited publication records. Overall, the committee was quite impressed by the achievements of the ELSA group and commends its dynamic leadership.



The Materials, Components and Systems for Biophotonics team (MaCSyBio) devotes its activities to the use of plasmonic resonance imaging and its implementation in biochip systems for studying biomolecular interaction kinetics. The plasmon resonance frequency is shifted due to biomolecules depositing on the surface of the resonant structures (functionalized surfaces). The work is multi-disciplinary and is carried out in several collaborations. A considerable development of techniques and instruments is being pursued. Applications include studies related to cystic fibrosis.

The committee was less convinced about the excellence of this group, which has a somewhat limited exposure in terms of publications. While quite useful, the activities seem isolated from the other activities at the LCFIO.

Note de l'équipe	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l'environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
A+	A+	A+	A	A

### Report on the Optical Systems and Components Group (SCOp)

The group “Optical Systems and Components” is presently composed of three teams dealing with I) manufacturing and metrology of optical surfaces, II) design and realization of XUV optics, III) development of multi-spectral imaging and polarization methods.

The committee highlights the following achievements: 1) development of metrology instruments and methods that allowed the optics workshop to realize excellent optical surfaces, e.g., a Fresnel bi-mirror that lead to a Fourier transform spectrometer with a resolving power of 500000 at  $\lambda = 60$  nm, a world record obtained at the synchrotron Soleil, 2) the realization of multilayer-coated XUV optics for telescopes, for the manipulation of attosecond pulses and for resisting the harsh environment encountered in space as well as in EUV lithography, 3) the development of Fourier transform spectral imaging (optical concepts and signal processing) for remote sensing.

Team I is carrying forward the key role his optics workshop has had in France since its creation, i.e., to fabricate and to measure optical systems with specifications generally exceeding the current state of the art. These are often unique pieces requiring substantial manufacturing time thus preventing their fabrication by industry. The workshop is also able to provide measurements to customers who do not have the metrology instrumentation necessary to qualify their optics. A method to produce aspherical surface shapes preserving surface roughness using ion beam profiling has been pioneered and led recently to the manufacturing of aspherical mirrors for high power lasers and of ellipsoidal mirrors for the STEREO satellite project, demonstrating world class performance. Similarly, the experience accumulated over the years by team II allowed to successfully coat the ellipsoidal mirrors of the STEREO project (manufactured by team I). It also led the development of the Fourier-transform interferometer and of innovative tri-layer components for the spectral range 20-40 nm. The performance of nanometer multilayers depends critically on the quality of the substrates. It is therefore important to realize that the XUV optics activity of SCOP requires that teams I and II both remain fully staffed and operational. Finally, team III has developed Fourier-transform based hyper spectral imaging and polarimetric imaging systems. The real performance of the interferometry methods were demonstrated in flight, in collaboration with ONERA, thus proving the potential interest of this technique for remote sensing.

The future projects of SCOP are very challenging. The development of solar spectral imaging and “atto” mirrors will require high precision optics with nanometer figures errors. Team I + II is encouraged to develop collaborations with the large projects that currently need an expertise in multilayer-coated XUV optics, particularly in astrophysics, EUV lithography, and related to the development of laser (e.g., HHR, Laserix, FEL) and synchrotron sources. However, the committee also expresses worries about the manpower available to address the above challenges, which suggests to either reduce the SCOP portfolio of activities or to recruit more people (e.g., a design/coating engineer and an engineer/technician for the optics workshop).



The development of IR Fourier transform spectral imaging in collaboration with ONERA is seen as a very promising project related to remote sensing (earth resource and security related applications) both from the experimental and theoretical point of views. Polarimetry and wavefront coding are also promising subjects. However, considering the limited size of the three groups and the workload generated by the experiments, the committee recommends to reduce the number of topics from 3 to 2 while reinforcing external cooperation and keeping the human resources and technical infrastructure..

The skills, the know-how, the high precision metrology and prime quality manufacturing of the optical workshop is unique in France competing favorably with the best groups worldwide. After the cuts in the past any further cutting of human resources will endanger the operation of the work shop of which so many groups in France do benefit.

Note de l'équipe	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l'environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
A	A	A+	A+	A

## 5 • Appreciation of resources and of the life of the research unit

Effective July 2008, LCFIO has 23 faculty and 23 CNRS researchers. This is a slight and reasonable increase over the last few years. Open positions should certainly be re-filled and maybe re-allocated to new projects within a group, or maybe even transferred from one group to another when the scientific prospects make such a transfer advisable.

The situation is more worrisome with respect to support staff, specifically to technical staff. It appears that 11 engineers and technicians are either already retired in 2008 or are to retire in 2009. The committee very strongly suggests re-filling all these positions, as they are absolutely mandatory for keeping the high level of research and technical development at LCFIO.

LCFIO currently has 40 doctoral students. This compares well with the number of 35 theses defended in the interval between 2004 and 2008. The committee met the students informally, and it had the impression that all students really like to work at LCFIO. They particularly enjoy the atmosphere created by the high-level research and by the permanent personal interaction not only with their superiors and advisors, but also with other members of the laboratory. The committee noted one point which is uncharacteristic for a European laboratory, but maybe not so unusual in France, and that is that the fraction of PhD students coming from outside France appears to be rather low. This might not be a problem to worry about, but on the other hand, attracting more non-French top students might help LCFIO to profit from human resources possibly not completely utilized at present. An analogous situation was noted concerning the next steps in the career of doctoral students. Only nine chose a post-doc position outside France. Again, this might not be a situation to worry about, but opening up international careers for the students might also be beneficial in the long run for the French academic system, as these people would bring back unique experiences from top research places internationally.

The financial support of LCFIO appears to have been growing steadily over the last few years. This is seen by the committee as a very healthy development. A particularly important point is the funding available from ANR. This is money given out on a competitive basis to the very best researchers all over France. It is a high compliment for LCFIO that it was able to secure a significant part of its resources from ANR. Open applications to resources and international peer-reviewing by the best researchers is certainly one of the most important ingredients to high-level research. There is some worry on the side of the laboratory that to obtain funding might imply a too high investment in time on the side of the researchers and be too demanding on the management possibilities of the parent organizations of LCFIO. If this is a necessary consequence of competitive financing, then it is certainly an effort which is worth to be taken.



If this investment in time appears to become too big, it might be advisable to focus only on such applications and projects where the potential benefit clearly outweighs the necessary input. This is certainly the case for ANR and also for European grants.

The committee was very impressed by the good scientific atmosphere in the laboratory on many levels. This concerns not only the interaction of the students among themselves and of the students with supervisors, but it seems to include also the permanent researchers themselves, and even the technical staff. This is characteristic of a small institution with very active research and excellent teaching. It is one of the achievements of LCFIO that this happens, and it is one of the important bases on which future excellent research can be based.

## 6 • Recommendations and advice

### – Strong points :

The combination of fundamental and applied research at LCFIO is unique. The laboratory is both positioned in the top echelon of similar institutes world wide and provides very important service for France's industry, its high-tech sector and to other research institutions. It is important to have an institute of that kind which is not too large and therefore has the right size in order to remain flexible and thus competitive on an international level. On the other hand the diversity of the institute also provides the necessary broad technological and know-how background for successful collaboration with industry.

### – What needs to be improved :

There is some danger that the infrastructure of the institute may suffer in the future due to a large number of retirements of technical staff. This is a significant problem for a number of groups. Another problem concerns the observation that some recently hired researchers may have a too high teaching load.

### – Recommendations :

The Laboratoire should remain an independent unit. The trend of securing more funding through ANR should be further encouraged. The staff openings particularly those of technical staff should quickly be refilled. The groups should be encouraged to identify novel lines of research building on the current high level of know-how and, where appropriate, seek the possibilities to re-organize some activities among themselves, for example in the area of biophotonics. This will not only benefit the outstanding international position of the Laboratoire. It will also benefit enormously the interests of French industry as it will help staying significantly on top of current trends of high technology.

Note de l'unité	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l'environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
A+	A+	A+	A	A+

Palaiseau, le 23 mars 2009

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A l'attention de **M. Pierre GLORIEUX**

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Monsieur le Directeur,

Nous avons bien reçu le rapport d'expertise du laboratoire Charles Fabry rédigé par le comité d'expert à l'issue de la visite effectuée dans nos locaux en décembre 2008.

Vous trouverez ci-joint la réponse du laboratoire à ce rapport d'expertise.

Veillez agréer, Monsieur le Directeur, l'expression de mes salutations distinguées .

  
Jean-Louis MARTIN  
Directeur Général de l'Institut d'Optique




**REPLY OF THE LABORATOIRE CHARLES FABRY  
TO THE AERES EVALUATION REPORT**

The Laboratoire Charles Fabry de l'Institut d'Optique expresses its appreciation for the careful examination of its activities and the detailed report by the committee. The report clearly acknowledges the international recognition of the laboratory's achievements in various domains, as well as its scientific production and publication record, and its broad coverage of the domain of Optics.

The laboratory is happy to see that its good performance in prestigious journals has been explicitly mentioned. It wishes to add that depending on the domain, the most appropriate place to publish some noteworthy results is usually a topical journal such as, to cite a few "Optics Letters", the "Journal of the Optical Society of America", or "Biosensors and Bioelectronics", in the latter case for some biophotonics results.

The laboratory also wishes to emphasize its policy of promoting transverse fields such as research into optical materials and, more particularly, the fast growing domains of nanophotonics and of the interaction between Optics and the Life Sciences. It may have failed to appropriately stress the latter in its written report and during the panel visit, but the emergence of novel biophotonics research domains inside several groups is explicitly encouraged. As highlighted by the visiting committee report, most of these subjects are quite new, and are still in a growing phase as regards the publication output.

The case of the team entitled "Materials, Components and Systems for Biophotonics" deserves a special comment. During the four years reporting period, the team was comprised of two permanent research scientists only; specifically, only one full time researcher stayed over the 4 years period, another retired in 2004 and a assistant professor joined in 2006. It follows that the team's publication level is close to the laboratory's average. Indeed, some of the team's published articles during the reporting period have been extensively quoted already. Also, the team is coordinating one ANR project involving biology, and it is a member and the French contact point for the "Photonics for Life" Network of Excellence of the EU 7<sup>th</sup> Framework Programme. Its interdisciplinary activity pursuing collaboration with life science partners until fruition is therefore well recognized.

  
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