LPS - Laboratoire de physique des solides

Rapport Hcéres

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

Section des Unités de recherche

Evaluation report

Research unit :

Laboratoire de Physique des Solides (LPS) – UMR 8502

University Paris 11

february 2009

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(LPS) – UMR 8502

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Le Président
de l'AERES

Jean-François Dhainaut

Section des unités
de recherche

Le Directeur

Pierre Glorieux

february 2009

Evaluation report

The research unit :

Name of the research unit : **Laboratoire de Physique des Solides (LPS)**

Requested label : **UMR**

N° in case of renewal : **8502**

Head of the research unit : **Mr Jean Paul POUGET**

University or school :

University Paris 11

Other institutions and research organization:

CNRS

Date(s) of the visit :

November 12th and 13th of 2008

Members of the visiting committee

Chairman of the commitee :

Mr Marco GRIONI, EPFL Lausanne Suisse

Other committee members :

Mr Pietro CARRETTA, Université de Padova Italie

Mr Dominique GIVORD, Institut Néel CNRS Grenoble

Mr Martin HYTCH, CEMES CNRS Toulouse

Mr Bahram HOUCHMANDZADEH, Spectrométrie Physique CNRS Grenoble Universités

Mr Jean-Paul KAPPLER, IPCMS CNRS, Université de Strasbourg

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Mr Timothy ZIMAN, ILL Grenoble

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

Mr Marc DE BOISSIEU, LTPCM CNRS INPG, CoNRS

Mr Gerard MARIN, IPREM Université de Pau et pays de l'Adour, CNU

Observers

AERES scientific representative:

Mr Claude LECOMTE

University or school representative:

Mr Jacques BITTOUN, Université Paris 11

Mr Alexandre REVCOLEVSCHI, Université Paris 11

Research organization representative (s) :

Mr Dominique CHANDESRIS, DSA CNRS INP

1 • Short presentation of the research unit

- Effectif : 30 enseignants-chercheurs, 56 chercheurs + 8 DR émérite et 1 chercheure contractuelle, 45 ingénieurs techniciens et administratifs dont 34 CNRS et 11 université de Paris 11 (1 HdR) permanents + 4 contractuels CDD (3 paris 11, 1 CNRS) ; 54 doctorants ; 105 post doc ou invités sur la période du contrat ayant sejourné au moins 3 mois dans l'unité
- Nombre de HDR 16 EC + 2 Pr émérites, 32 C + 8 DR émérites, 27 HDR encadrent des thèses
- 30 thèses soutenues, aucun docteur du LPS chômeur, durée moyenne 42 mois, 47 thèses en cours, toutes financées (18 allocations ministère, 14 bourses Marie Curie, 3 CIFRE)
- 13 EC bénéficiant d'une PEDR
- 81 publiants sur 86 EC-C

2 • Preparation and execution of the visit

The visit of the Laboratory took place on November 12-13, 2008 under excellent conditions. The Committee thanks and congratulates the whole LPS personnel – scientific, technical, and administrative - for their active involvement. Special thanks are due to the Director and his Direction team for their hospitality, for the excellent organization, and for the quality of the reports and of the ancillary material which were made available to us before the visit and at the site.

The visit started with a closed session where the Director presented his report on the past contract period, illustrated his strategic vision for the Laboratory. It was followed by a well-attended general session, which included summary presentations of the activities of the three "Axes of research" of the LPS by "young senior" researchers, and more specialized short talks by young scientists. The Committee has been impressed by these presentations, reflecting the quality and the diversity of the science, as well as the enthusiasm of the scientists. The Committee then split according to a dense program of visits of the research groups, which included presentations of the recent achievements and future projects. Unfortunately, albeit very interesting, these presentations sometimes left little time for more informal discussions. We suggest for a future similar visit to reserve more time for an informal exchange of ideas, and for "hands-on" visits of the often unique experimental facilities. The program also included short but very informative meetings with the representatives of the researchers, of the technical staff, and of the graduate students. Finally, the Committee had the opportunity to hear from the representatives of the UPS and CNRS about their view of the present status and the future of the LPS.

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

The general impression which emerged from the written documents, from the oral presentations and reports, and from the group visits, is one of a very productive and successful Laboratory, which lives up to its tradition and to the expectations of the international scientific community. The quality of the results clearly reflects the quality and the strong motivation of the scientists, but also the active participation and professionalism of the technical personnel. The scientific project, although somewhat conservative in its guidelines, sets a good basis to extend these excellent results into the next contract period. More specific remarks and recommendations are made below.

The LPS enjoys a very high national and international visibility, and is part of various networks. In particular, its role in the "Triangle de la Physique" is of strategic importance for the numerous scientific and technical/technological synergies. The choice to participate in the development of end stations at the SOLEIL synchrotron is also seen as a very positive scientific investment. The LPS personnel is heavily involved in teaching activities at various levels. Special initiatives to reach out to the community and to high schools are especially noteworthy.

During the past four years the laboratory has pursued the reorganization of its internal structure into three Axes of research. As noted in the previous audit report, this process aims to a consolidation of the research groups, and to the development of stronger coherent units. The Director and his Direction team must be warmly congratulated for successfully driving the laboratory along this path, while preserving the scientific quality and output, and without raising noticeable conflicts, in a complex local and national environment. It is our opinion that the potential of the Axe structure could be even further exploited, and that a stronger sense of belonging should be fostered, e.g. within Axe I. If the opportunity is taken to overcome traditional barriers between groups, the Axes could become real scientific powerhouses. Such evolution should not be seen as a way to dissolve the groups, which remain effective units to organize the day-by-day research. Nevertheless, strengthening the Axes will be beneficial in two important ways. On the one hand, it will help define priorities and common strategies. It will contribute to make the most of existing financial resources, and to leverage new resources for ambitious projects. On the other hand, closer contacts between researchers will stimulate new lines of research and complementary efforts to tackle interesting problems. In this perspective, "transversal" initiatives like that on graphene are very positive and must be supported.

The boundary conditions which the Laboratory must cope with are similar to those of other Laboratories of similar size and ambition. Still, the Committee could not help but notice that the LPS must face some specific obstacles. First of all, there are substantial changes in the scientific personnel. Half of them have joined the LPS in the past 10 years, and a staggering 25% since 2005. It is remarkable that a revolution of this scale is taking place successfully. The Committee was pleased to see that a new and very active generation has already taken the lead in many groups. This is very promising for the future of the Laboratory. That the total number of researchers could be kept constant is reason for satisfaction. The Direction plans to take advantage of the turnover to reshape the distribution of resources: namely by increasing the number of experimentalists in Axe I, and of enseignants-chercheurs in Axe II and III, in order to cover the increasing teaching tasks in these domains. The Committee supports this vision.

The situation of the technical personnel is less satisfactory. The total number has decreased from 70 in 1991 to 45 today, a reduction which essentially follows the reduction of CNRS personnel. In spite of positive efforts to pool resources in shared "services" this trend could not be sustained much longer before a substantial reduction of the infrastructure is required, with dangerous consequences on the quality of research. We can only hope that CNRS recognizes this alarming situation. The Committee is also concerned by the anomalously high turnover, corresponding to a complete renewal of the technical personnel in only 7 years. Leaving the laboratory is apparently seen as a necessary step to obtain a promotion. While there is a positive side to the mobility of technical personnel, the support of crucial parts of the common infrastructure and the development of new experimental facilities may suffer. We understand that this problem has a more general nature, but suggest that it is considered by CNRS and by UPS. We also noticed that more transparency in the evaluation procedure of the University technical personnel would be welcome.

The less than ideal recruitment of graduate students by the LPS was a matter of concern in the previous audit report, and has been pointed out again by the Director. The Laboratory has enjoyed a very successful parenthesis thanks to the European Marie Curie initiative which has now come to an end. For different reasons, the Physics Doctoral School of the Paris region and the local Chemistry Doctoral School do not provide the support permitting the development of a clear scientific policy, nor do they necessarily attract students to the most active groups and promising research topics. The Committee takes notice of these difficulties and hopes that solutions can be identified and implemented in the future. It also notices that the motivation of the graduate students at LPS seems to be quite good, even if their perception of career options is perhaps not always very clear. We suggest that, in the future, the LPS is associated with a Paris 11 doctoral school in physics which should be extended to condensed matter physics.

If abstraction is made of the important singularity represented by the Marie Curie initiative, the budget of the Laboratory has remained essentially constant over the last two contract periods, which seems acceptable considering the national and international landscape. The internal evolution of the budget presents positive and negative aspects. On the positive side, the LPS has been successful in attracting funding for specific

projects, both at the national and at the international level. The increase of these categories has compensated a reduction of state funds (which also included, however, funds for specific actions). The shift in funding sources privileges competitive research, and the LPS is well equipped to thrive in the new environment. However, resources for the common infrastructure and equipment are dwindling. In the long run this situation may have dangerous consequences for the LPS. The Committee strongly supports the Director's request that a major fraction of the “preciput” of the ANR projects be returned by the University to the Laboratory, and takes notice that the UPS is willing to take action in this sense. The Committee also noticed that the income from private contracts has significantly decreased from 2001-2004 to 2006-2008. This reduction may reflect a growing reticence of industry to be involved in more fundamental research projects. Nonetheless we believe that LPS researchers should be encouraged to explore the opportunities for new partnerships.

A major source of concern for the Committee is the general infrastructure of the LPS buildings. While the University and the CNRS are justifiably proud of the role of the Laboratory in the nurturing of research leading to two Nobel prizes in the past, it is sad to note that this does not translate into appropriate support even in terms of basic infrastructure in the present. In a context of increasing support from short term proposals this is especially serious in that money for new research projects, which may involve higher risks, is being diverted to short term maintenance. The UPS representatives are well aware of this anomaly. Unfortunately, no clear solutions are in sight. This appears to be a campus-wide problem, but the situation is especially dramatic for the LPS. If interventions required to comply with security standards are not urgently performed, it could be closed by the local authorities, with catastrophic consequences on its research and on its image.

We notice that the financial means available to the Director to initiate new ambitious projects and to stimulate the coherence of research within the Axes are rather limited. A pooling of resources has been made for specific actions. The creation of a common fund by “taxing” individual projects, as already suggested in the previous audit report, is supported by the Committee. Such actions are a natural consequence of the shifting weight from the groups to the Axes. They should further stimulate a constructive discussion within each Axe to define clear priorities. We believe that the Comité scientifique which complements the conseil de laboratoire can play a very important role in defining the medium-term strategy, and in monitoring its implementation. Both are prerequisites for such pooling of resources to work effectively.

Finally, the role of LPS in the future evolution of the Orsay campus is unclear. We understand that this uncertainty cannot by lifted until a plan is developed at a higher level. However, according to fragments of information already available, the project is within the horizon of the long-term strategy of the LPS. The Laboratory should be put as soon as possible in a situation where the various options can be evaluated. In any case, we suggest that the long-term strategy of the LPS, and the possible synergies with other laboratories of the Plateau de Saclay, are reviewed in due time by an ad-hoc panel. At this time we notice that, understandably, the lack of information is a reason for concern within the LPS personnel. We also point out the danger that long term ambitions may do harm in diverting attention from the material situation of the laboratory on the timescale of the current project.

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

AXE I : Nouveaux états électroniques de la matière

The quality, visibility and impact of the research performed within Axe I are on the average very high, with peaks of absolute excellence. This is especially remarkable in view of the ratio of chercheurs to enseignant/chercheurs, which is much less favorable (by roughly a factor 4) than for the other Axes. Axe I has made impressive efforts in renewal of existing groups and ensuring their continuation. All groups have seen or will soon see a change of leadership from the historical leaders who made their international reputation, to a younger generation of scientists. This transition is generally working well, and most groups will continue to benefit from the interaction with their senior members. However it is important that the new leaders feel free to set their own scientific agenda, and to reshape the activities as necessary.

Axe 1 has been less successful in attracting teams with newer techniques. One of the areas of investment, and success, is in X-ray scattering, where the proximity of SOLEIL gives a natural advantage. We feel that the Axe could realistically attempt to increase its involvement with other large instruments, namely in neutron scattering, taking advantage of the expertise present in the RIX group, and high magnetic field measurements. Both subjects provide complementary information and have similar demands in terms of access to high quality crystals as X-ray studies, and would deepen as well as broaden the overall activity. Sample environments are not identical, but similar enough, that the laboratory would benefit from economies of scale by the presence of more experimental groups in these areas. Attempts to create a group in low temperature STM have, despite considerable effort, not yet succeeded but it is clearly an excellent idea to continue, if finances permit.

While the theorists in Axe I will be discussed more generally with those of the other Axes, it should be reiterated that there has also been a welcome renewal with recruitment of younger researchers and the group is strong. It is not a criticism of the theorists that we feel that the highest priority in the Axe is to increase the number of experimentalists as this would seem more urgent.

Finally, while the activity of Axe I is mainly devoted to the study of fundamental aspects of physics, a greater involvement in subjects of fundamental interest but with more direct technological relevance could increase its external impact. Systems of current interest like the metallic (and superconducting) layers at the interface between insulating oxides, or novel materials with a high thermoelectric power are two obvious examples.

Equipe HP: Conducteurs moléculaires et hautes pressions

The research on low-dimensional molecular conductors has been for many years one of the flagships of the Laboratory. Recent work focused on the microscopic origin of superconductivity and the coexistence of various phases in the Bechgaard salts. In parallel, new activities have been initiated, on specific aspects of the metal-insulator transition in the model compound V_2O_3, and on the properties of carbon nanotubes. The group takes advantage of unique expertise, combining very low temperatures, high magnetic fields and pressure. Besides the traditional transport measurements, new developments are under way to enable new thermodynamic and ultrasound measurements under pressure.

The group has produced in the recent past scientific results of very high quality. It has been able to set up collaborations, namely with renowned chemists. Funding has been secured through national and European projects. For the future, it is nonetheless in a challenging situation. With one Directeur de Recherche emeritus, two enseignant/chercheurs, and a research engineer its size is subcritical. Moreover, its traditional research field is a mature one. Increasingly sophisticated experiments and new compounds will almost certainly reveal unexpected aspects of the physics of these materials, but it is not obvious that this will have a growing impact within the international community. The group should respond to the danger of isolation by looking for opportunities to apply their unique expertise to a broader range of problems. In this perspective, existing collaborations with other components of Axe I should be strengthened. Closer ties, with the RMN group in particular, would provide a broader basis for discussion, and an opening towards new materials and scientific challenges. We believe that such a two-way exchange of ideas and know-how would have a very positive impact on the ensemble of activities on strongly correlated systems.

Equipe RIX: Organisation et dynamique de la matière condensée.

The activities developed within the team « *Organisation et dynamique de la matière condensée* » are distributed within the three laboratory thematic axes. They are centred on the analysis of complex systems, whether these belong to condensed matter or to soft matter (molecular conductors, charge ordering waves systems, colloids, etc…) and reveal real global coherency. The part of the RIX group that belongs to Axe I has fulfilled the objectives defined in the previous 4-year period. It pursued the study of charge-density-waves (CDWs) in VO_2, the Mo blue bronze, the organic conductors. It obtained original new results on the pinning of the CDW by defects or magnetic impurities, and on the inhomogeneities of a sliding CDW in coherent diffraction experiments. The same novel technique has been utilized to reveal a magnetic defect in the spin-density-wave of chromium, and to investigate the effect of defects on the displacive transition in $SrTiO_3$.

The group is directly involved in the construction of beamlines at SOLEIL, and in the definition of their scientific program. This was made possible through the relocation of one LPS scientist to the CRYSTAL beamline, and by a strong collaboration between a newly recruited professor and the team of the GALAXIES

beamline. The goal of this collaboration is the design of a resonant inelastic X-ray scattering (RIXS) experiment, and of pump-probe experiments, in a collaboration involving SOLEIL and the Ecole Polytechnique. As an immediate result of these new ties with SOLEIL, three experimental theses on the metal-insulator transitions in V_2O_3 and $BaVS_3$ – utilizing as probes coherent diffusion, RIXS, and ARPES – have been launched under the joint direction of scientists from the two laboratories. The considerable technical investment made by this group will undoubtedly improve its experimental capabilities, and will eventually benefit to the laboratory as a whole. It is important that it also rapidly yields corresponding scientific advances, in order to guarantee the future visibility of this part of the group, whose size will be reduced to 3 members in a not-too-distant future.

Equipe RMN: Nouveaux états électroniques

The RMN group has a well established expertise in the study of strongly correlated electron systems by means of solid-state NMR and μSR. The results obtained on high-T_c superconductors, cobaltates, frustrated magnets and on carbon nanotubes have enjoyed a high international visibility. Collaborations with the other groups within the Axe I are being promoted and the group is now also involved in the setup of novel techniques, like ARPES, and in the upgrade of the NMR facilities. In particular, the group activity will benefit from the acquisition of a 14 Tesla NMR magnet and of a dilution fridge, which allow to span the phase diagram of different materials over a wide range of physical parameters. The group has a renewed vitality also thanks to the very positive activity of its younger members. It should be noticed that the RMN group is now composed of five members, one of them emeritus, and that three others are deeply involved in teaching activities. Hence, in order to keep the group activity to a high level, we support the group's desire to recruit a new researcher in the near future. Furthermore, the group relies on the availability of high quality materials. In this respect, it seems very natural to plan collaborations with the laboratories of the RTRA network involved in material synthesis.

Equipe SUMAG: Supraconductivité

This group has obtained significant results in the study of the superconducting fluctuations and of the effect of disorder in high quality thin films of high-Tc cuprates, either doped with holes or electrons. Although the study of the transport properties of thin films is its main research activity, this group is now developing novel techniques, like point contact spectroscopy, which allows to probe excitations within the thin film. In the near future the group will suffer from the departure of its more experienced member, who has been leading the demanding activity of synthesis of high-quality thin films. Accordingly, the group will lose its specificity and reach a subcritical size, with just two members. If the Laboratory wishes to continue the research on superconducting films it should consider the employment of a material scientist, specialist in thin film growth. If a suitable person cannot be found, the group might better be merged with other groups of the LPS working on superconducting materials.

Team : Nouveaux états électroniques de la matière

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+	Non noté	A

Axe II – Physical phenomena in reduced dimensions

For several years now, LPS has been developing a remarkable expertise in the analysis of physical phenomena at reduced dimensions (mesoscopic physics, nanomagnetism, nanotubes). The continuous development of this expertise is in particular based on the use of exceptional experimental tools such as highly specialised electron microscopy. This strategy has led to important achievements during the last 4 years (see below).

The Committee noted that very positive changes have taken place in science management. The scientific groups are larger than in the past and they have coherent research projects. The IDMAG team, constituted by the merging of the two former groups, « micromagnétisme et microscopies électroniques » and « optique des solides », reveals real scientific unity. The scientific recognition reached by the STEM team is impressive. This team is well prepared to pass responsibilities on to the newly designated team leader. The contribution of the group « *Organisation et dynamique de la matière condensée* » to the coherence of the research performed at the LPS has been already pointed out. One notes that NS2 and STARTIF have a smaller size than other teams within Axe II. The NS2 group was created when two very active young seniors joined the Laboratory. It shares with the MESO group common scientific topics, and collaborations already exist between the two. STARTIF constitutes a specific case. This group has lost recently its leader, unfortunately deceased, and possible evolutions are suggested below.

Equipes MESO-NS2: Physique mésoscopique – Nanostructures à la nanoseconde

The research activity and the scientific production of these two very dynamic teams led by young senior researchers of international reputation, is excellent. Very promising permanent junior researchers as well as students and post-docs of outstanding quality are also part of the groups. The detection and the investigation of quantum noise in transport through nanosystems, and of the dependence of the phase coherence length on sample geometry are examples of recently emerging new research directions. The Committee appreciates the combination of experimental studies of novel quantities with theoretical analyses, often in collaboration with the theory group, which allows progress to be made in the understanding of subtle and quite complex phenomena. The opportunity to use common equipment of the LPS, like the SEM-FEG for nanofabrication and sample characterization, is of great importance. The Committee encourages the groups to continue their investigation of the consequences of electronic correlations in the transport through nanostructures.

Equipe RIX: Organisation et dynamique de la matière condensée

Within Axe II, the group is studying nanotubes and peapods. The steric effect on the chemistry of C60 and C70 molecules, when inserted inside a nanotube, has been nicely revealed. This also influences their dynamical properties, as evidenced by inelastic neutron scattering. Studies on the electronic properties of nanotubes have been carried out in the STEM group. In the last two years an original program on the toxicity of nanotubes has started in collaboration with the group 'Tissus et fibres biologiques' and the INSERM. The first results are very encouraging and the committee strongly supports this new activity. The team has a broad range of versatile diffractometers. Some of the generators are old, and the proposed investment in a new generation rotating anode is strongly supported.

Equipe STARTIF: Structures artificielles et auto-organisation

The group investigates artificial structures. Instrumental developments have been carried out on their main tool, a FIB. Interesting results on light localization in quasi-periodic media have been obtained. The team is also developing oscillating low-energy diffraction on surfaces, a technique with interesting perspectives.

The Committee is anxious that this team does not seem to have the necessary size to develop fruitful research in the long term. The Committee strongly recommends that solutions are sought, either within the Laboratory (e.g. collaborations with other teams, exploiting the expertise with FIB, or a merger with other teams on the basis of defined scientific projects) or beyond.

Equipe IDMAG: Imagerie et dynamique en magnetisme

This group has unique expertise in magneto-optical measurements of magnetic systems of reduced dimension. A very convincing analysis of domain-wall dynamics has been performed in Pt/Co/Pt trilayers and domain-wall motion has been observed in Ga(Mn)As films. A micromagnetic analysis of domain-wall motion in nanostripes, by spin transfer torque (STT), has been performed, in which the so-called non-adiabatic contribution to STT was introduced for the first time. In a very competitive international context, this study constitutes one of the few which really stand out. On these aspects, the fruitful collaboration with members of the theory team must be noted.

The group develops ground-breaking instrumentation, e.g. a high resolution Kerr magnetometer with exceptional sensitivity, which should permit magnetization processes to be analysed in individual nano-objects at room temperature. In contrast, the Micro-SQUID is restricted to low-temperature measurements. Magnetic BEEM is a magnetic microscopy technique with an ultimate resolution approximately one order of magnitude worse than SP-STM. The constraints in sample preparation are less severe than with SP-STM and this may constitute an important benefit of the technique. The Committee supports the group's aim of evaluating more precisely the potential of Magnetic BEEM. The group envisages developing an activity in sample preparation. This may be justified by the fact that two young scientists in the group have experience in film growth. Before any decision is made, a careful analysis of the level of the activity needed and of its financial and personnel impact is highly recommended.

Equipe STEM: Microscopie électronique

This is one of the leading international groups in electron microscopy, with an outstanding reputation, more specifically in electron spectroscopy. Its success is based both on remarkable developments in instrumentation and analysis, and on the intelligent choice of highly appropriate research topics. The newly acquired ultra STEM gives the team the means to stay at the forefront of international research.

The studies of carbon and boron nitride nanotubes have been very fruitful, and the results obtained go much beyond structural characterisation, however sophisticated. The development of theoretical analysis and modelling, initially through collaborations and now performed in-house, is fully integrated into the research activity. This approach is supported by the Committee. The TEM study of optical properties at the nanoscale constitutes a very original and promising emerging topic. The group is a partner in international networks, European microscopy platforms (ESTEEM) and national platforms (METSA). This should give excellent conditions for the group to maintain a dynamic scientific activity and for long-term development of original research.

Team : Physical phenomena in reduced dimensions

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+	Non noté	A

AXE III : Matière molle et interface physique-biologie

Soft condensed matter research at LPS has very positively evolved from mostly structural studies based on a recognized expertise in X-ray (and neutron) scattering, to new studies of soft matter interfacial properties, dynamics, rheology and biomimetic interactions, on the basis of innovative instrumental developments. Furthermore, new fields of research at the interface of physics-biology and physics-health sciences are under development. What is remarkable is that living systems are considered here within their high complexity, but investigated using tools and methods that are direct products of physics research. This coherent evolution has been made possible thanks to an increasing number of interactions between the various groups, a common seminar and several cooperative projects for the use of synchrotron and neutron facilities (namely SOLEIL and LLB). The creation of a small sub-unit within the Theory group, acting as a bond between different groups, could increase even further the cohesion of Axe III. Such need was collectively expressed. We support this request, but suggest that this development should take place in steps, as discussed in the section of this report specifically addressing the Theory group.

In the near future, several senior scientists will retire and the loss of their competence will hinder the dynamics of this research axis. To partly compensate for this loss, different groups with complementary expertise and clear research projects will merge. Nevertheless, this Axe should be specifically reinforced through the opening of several positions of Professeur and Maître de Conférences, in order to increase the impact of soft condensed matter physics and biophysics among the University curriculum. This is of prime importance in order to attract PhD students to LPS and ensure the permanence of this field in the "Triangle de la Physique".

Within this Axe, several experimental groups of the laboratory have developed cooperative works and initiatives in the neighbouring fields of soft condensed matter physics and of physics at the interface with biology.

Team : Matière molle et interface physique-biologie

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	Non noté	A

1- Soft condensed matter physics

Equipe DYPO: Phases moléculaires partiellement organisées

This group, which is now reduced to two permanent staff, recently obtained original results on the formation and structure of polyelectrolyte complexes, using neutron small angle scattering, in collaboration with the University of Evry. Their present efforts are devoted to the development of a new apparatus for pulsed field gradient NMR, for the analysis of diffusion phenomena in polymer membranes. After the retirement of the group leader, the research projects of this group should merge with those of the group AFPO.

Equipe AFPO: Adhesion, friction et polymères

This group moved from the College de France to LPS in 2005. It has taken advantage of the expertise of the technical services of the LPS to upgrade several innovative instruments for the study of friction and adhesion phenomena on soft surfaces. One should mention a special JKR test apparatus, the analysis of capillary bridges between hydrophobic surfaces, the instrumented observation of peeling phenomena, and the use of Fluorescence Recovery after Photo bleaching (FRAP). These instrumental developments have been used for addressing new problems, such as the modulated adhesion on microstructure surfaces, the interfacial adhesion between semi-crystalline layers and the rheology of a semi-dilute polymer solution facing a grafted surface. This group has a high international visibility and a recognised expertise in soft condensed matter, which is based upon original experimental and instrumental approaches and a long-standing partnership with industry. Special attention must be paid to the evolution of the new joint group "POLYCAP", in terms of recruitments and scientific directions after the retirement of the two group leaders within the 4 coming years.

Equipe MOUS: Interfaces liquides

This group investigates the structure and the stability of water/surfactant/polymer systems such as emulsions, micro-emulsions, foams and liquid films. Various types of foams stabilized by different kinds of surfactants (amphiphilic polymers, biopolymers and solid particles) are studied in view of controlling water draining and stability. A spectacular achievement is an apparatus producing foams with monodisperse bubble size for the investigation of coalescence phenomena. Another original result concerns foams stabilized by amphiphilic colloids which can be considered as model systems of metallic foams. Beyond the characterization studies of liquid films and foams, fundamental investigations of their interfacial rheology, physical properties and stability, contribute to a large extent to the visibility of this research group, which is confirmed by numerous international collaborations and by an active partnership with industries.

Equipe RIX: Organisation et dynamique de la matière condensée

Following a long tradition of pioneering structural studies in condensed matter physics (ferroelectrics, molecular crystals, liquid crystals, polymers, etc.) this group is nowadays involved in several projects associated with the 3 research axes of the LPS. As far as the activity within Axe III, the recent studies of the structure of lyotropic liquid crystals forming bicontinuous and tricontinuous cubic phases, and of faceted liquid crystals can be singled out. Cylindrical micellar phases are studied in situ to better understand the formation of mesoporous materials. Finally, lamellar phases based on tensioactiv molecules are systems where different inorganic molecules – polyoxometallates, magnetic nanoparticles, gold colloids, or clay platelets of nanometric thickness -- can be conveniently introduced. An X-ray scattering apparatus has been built, tested in the laboratory, and then installed by the RIX group at the SOLEIL small-angle scattering beamline, with the goal of studying the rheophysics of these doped layered phases. This project is a typical example of the long-standing involvement of the Laboratory in the design and construction of instruments at the large-scale facilities of the Orsay-Saclay area (LURE, LLB and SOLEIL).

Theory in the field of soft-condensed matter

The committee agrees with the view that there is strong potential for more extensive collaboration with theorists in the subject area of Axe III. We will come back to this issue in the general discussion on theory in the Laboratory, but we would encourage co-direction of thesis students or postdocs as a short term solution.

2- Interface Physics-Biology/Medicine

Equipe ADN: Analyse structurale et fonctionnelle de l'ADN

The dense phase of DNA, i.e. the phase that is generally found in nature, is the subjet of research of this group. The Committee has particularly appreciated that the group is equally composed of physicists and biologists, and the resulting coherence and complementarity of the research topics. Thanks to its structure and dynamism, this group can select problems that are really relevant for biology, and be successful in its research by efficiently combining techniques from biology and physics. The Committee takes notice of the high quality of the results, and strongly encourages the three CR1 members to pass their HDR.

Equipe FIBRES: Tissus et fibres biologiques

The FIBRES group pursues research topics that are closely connected with medical issues. This approach is rather uncommon, due to the difficulty of disentangling the multiple causes that may contribute to a given pathology. One declared goal is to develop advanced physical techniques which can discriminate, in various situations, between healthy and pathological tissues, and to reveal small scale structures related to illness. This could, in the long term, help understand the causes of the illness. The choice of topics and techniques is quite broad, and the Committee appreciates the group's willingness to take risks. Nevertheless it is necessary that, after an initial exploratory stage where options and opportunities are evaluated, a scientific strategy is defined around some fundamental questions combining the physical and biological approaches. The group has already achieved a significant success with the publication of an article in NEJM, the journal of reference for the medical community.

In summary, the Committee encourages the LPS to support and further develop the activities of these two very active groups.

Theory group

The theory group can be considered apart from the "Axes" as its activities cut across at least the Axes I and II both as a group and even for individuals. With more than 20 members the theory group is numerically strong, and continues to be a major presence in condensed matter theory in France, in correlated fermions and mesoscopic physics in particular. In the last four years, several recruitments of young theorists have helped maintain vitality and several subgroups of the new and the more experienced are apparently collaborating well. This is apparent in "Graphene'", one of the main new subjects which can conveniently be labelled "interdisciplinary", and which is successful both for its theoretical activity and for the excitement shared with the experimentalists in mesoscopics and even organic conductors. In terms of the age structure, perhaps the only concern is that several of the most experienced members are at or close to retirement age. As they are still active in their own right and helpful for younger members, they should be encouraged to remain in the laboratory as long as possible (either as *emerita*, or in one case by renewal of a temporary contract). This is especially true in that there is a slight lack of theorists in mid-career.

While the overall level of activity is high, and outside collaborations fruitful, the Laboratory still needs to encourage more in-house collaboration both among the theorists and between theorists and local experimental groups. That is not to say that there are not already good examples of this, including close collaboration with the team MESO on geometry-dependent phase coherence and recent new work with theorists and the team IDMAG on spintronics.

As the theory group is large by most standards, it would seem reasonable that future hiring, at least in the subjects related to Axe I and Axe II be considered less urgent than the experimentalists. In particular the numerical simulations group is small and appears to be fragile. It may be better not to invest in new positions until it stabilizes.

The situation in soft matter and biologically-motivated physics is rather different: there is a stated demand from the experimentalists in Axe III to launch what would be essentially a new sub-group in this area. Given the vitality of the experimental activity, this seems justified but should be handled with some care. It would seem judicious to start with a more senior person who would not suffer from the lack of close theoretical colleagues. Thus we support this idea with the proviso that there be careful search for suitable interested candidates who would, as is the wish of the experimentalists, take a strong interest in several of the current activities. This should precede any publication of posts.

Summary

In summary, the audit Committee has identified the following :

– **Strong points of the Laboratory :**

- The LPS is at the forefront of research in a broad range of topics, ranging from the microscopic properties of materials, to mesoscopic physics, to soft matter. It develops sophisticated experimental facilities in these domains.
- The LPS exploits its strong background in condensed matter to develop original research at the interface with biology and medicine.
- The presence of a strong Theory group with strong existing links to experimentalists, which should be even further developed.
- The strong involvement with the SOLEIL synchrotron.
- The strategic partnership with the "Triangle de la Physique".

– **Weak points :**

- Novel lines of research - e.g. involving other large-scale facilities - could be initiated.
- Research at the LPS should put stronger emphasis on novel materials of current interest
- Traditional barriers between groups are not yet completely removed.
- Too long duration of the Ph D thesis compared to the ministry requirements

– **Finally, the Committee recommends :**

- To pursue the successful strategy of developing original and ambitious research.
- To further develop the internal links and the common strategies within each of the three research Axes.
- To renew the efforts to animate the scientific life of the Laboratory (e.g. encourage the attendance to general seminars, asking the Ph D students to organize in the LPS a 'journée des doctorants 'and to attend to thesis defences).
- To shorten the thesis duration (36 months).
- To develop an aggressive policy to attract the best students and post-docs, and to ensure the required funding while the thesis duration should be shortened.

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

UNIVERSITÉ
PARIS-SUD 11

Le Président de l'Université Paris-Sud 11

à

Monsieur Pierre GLORIEUX
Directeur de la section des unités de recherche
AERES
20, rue Vivienne
75002 Paris

Orsay, le 7 avril 2009.

N/Réf. : 88/09/GCo/LM/LS

Objet : Rapport d'évaluation d'unité de recherche
N° S2100012368

Monsieur le Directeur,

Vous m'avez transmis le vingt cinq février dernier, le rapport d'évaluation de l'unité de recherche « Laboratoire de Physique des Solides » - LPS - UMR 8502, et je vous en remercie.

L'université se réjouit de l'appréciation portée par le Comité sur cette unité et prend bonne note de ses suggestions.

Veuillez trouver ci-joint un message du directeur d'unité précisant des données factuelles et ajoutant quelques commentaires.

Je vous prie d'agréer, Monsieur le Directeur, l'expression de ma sincère considération.

Guy COURRAZE
Président

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P.J. : Commentaires de Mr POUGET

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Commentaires concernant le rapport du comité de visite du Laboratoire de Physique des Solides (UMR 8502) des 12 et 13 novembre 2008.

Le laboratoire remercie le comité d'évaluation de la teneur de son rapport en particulier au niveau de l'appréciation générale de son activité de recherche et de ses recommandations. Ce rapport constitue un élément de référence constructif au développement d'une politique de recherche par la future direction du laboratoire à la fois en cohérence avec celle définie par les précédentes directions mais aussi en tenant compte des inflexions apportées par les profonds changements du paysage de la recherche.

La direction tient aussi à ajouter un commentaire afin de corriger l'appréciation concernant les projets d'utilisation des grands instruments. Si un important effort, reconnu par le comité de visite, est fait au niveau de la conception de l'instrumentation sur SOLEIL dans sa phase d'ouverture à la communauté nationale, le laboratoire n'a pas pour ambition d'axer ses efforts futurs sur la seule utilisation du rayonnement synchrotron. La diffusion des muons continuera à être utilisée pour l'étude du magnétisme en complément de la RMN. La diffusion des neutrons sera aussi utilisée, en particulier par l'équipe RX, dans les 3 axes de recherche du laboratoire. Cela est implicitement indiqué au niveau des projets de matière molle. Dans les autres domaines la diffusion des neutrons participe à l'élaboration de projets plus exploratoires. C'est le cas pour l'étude de la dynamique d'objets confinés, comme le C_{60}, dans des nanotubes (thèse en cotutelle avec l'ILL à partir de septembre 2009). La diffusion des neutrons est actuellement utilisée en phase de test à l'ILL et au LLB pour l'étude du magnétisme dans les systèmes de fermions corrélés comme $BaVS_3$ et

les conducteurs et supraconducteurs organiques. A cause du faible volume des échantillons synthétisés l'emploi des neutrons est quasi inexistant au niveau mondial pour l'étude de ces systèmes. Il vient toutefois d'être observé par une collaboration LPS-LLB, et cela est une première mondiale, les excitations magnétiques de la phase spin-Peierls du composé organique $(TMTTF)_2PF_6$.

D'une manière générale le LPS utilise en poussant à leurs limites extrêmes et non pas de façon routinière, les méthodes et techniques spécifiques des grands instruments. A ce titre les résultats obtenus par les équipes du LPS figurent, pour la période 2005-2008, dans 4 faits marquants de l'ESRF, 2 faits marquants de l'ILL et 2 faits marquants d'ISIS. Parmi les 27 faits marquants figurant dans le bilan scientifique du laboratoire, 6 ont été obtenus en utilisant les grands instruments du domaine du rayonnement synchrotron, de la diffusion des neutrons et des muons.