



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

Section des Unités de recherche

Report from the visiting committee

Research unit :

Laboratoire de Physique Théorique de la Matière
Condensée – UMR 7600

University Pierre et Marie Curie



February 2008



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de recherche

Le Directeur

Jean-Jacques Aubert

February 2008



Report from the visiting committee

The research unit :

Name of the research unit : Laboratoire de Physique Théorique de la Matière Condensée

Requested label : UMR

N° in case of renewal : 7600

Head of the research unit : Mr Bertrand GUILLOT

University or school :

University Pierre et Marie Curie - Paris 6

Other institutions and research organization:

CNRS

Date(s) of the visit :

February, 19th and 20th of 2008

Members of the visiting committee



Chairman of the committee :

Mr David DEAN, IRSAMC Toulouse

Other committee members :

Mr Jean-Pierre HANSEN, Cambridge University

Mr Marek KUS, Polish Academy of Sciences, Warszawa

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

Mr Alain BARRAT, LPT, Orsay, CoNRS (section 02)

Mr Pierre PUJOL, Irsamc, Toulouse, CNU (section 29)

Observers



AERES scientific representative:

Mr Andre NEVEU

University or school representative:

Mr Paul INDELICATO

Research organization representative (s) :

Mr Christian CHARDONNET, DSA CNRS, MPPU

Mr Patricio LEBOEUF, DSA CNRS, MPPU

Report from the visiting committee



1 • Short presentation of the research unit

- Effectif :
 - enseignants-chercheurs : 21 (+ 2 EM)
 - chercheurs : 18
 - ingénieurs : 1
 - doctorants : 13
 - techniciens : 1
 - administratifs : 3
- Nombre de HDR : 27 (12 EC, 13 CNRS 2 ECEM)
- Nombre de HDR encadrant des thèses : 9 (currently) + 6 (during last 4 years)
- Nombre de thèses soutenues lors des 4 dernières années : 13
- Nombre de thèses en cours : 13
- Nombre de thésards financés : 13 (1AMX, 5 AC, 5 A, 2 ETR)
- Nombre de membres bénéficiant d'une PEDR : 8 (now and during last 4 years)(5 currently)
- Nombre de publiants : 38 (+2 EM) / 39 (+2 EM)

2 • Preparation and execution of the visit

The committee was very satisfied by the evaluation. The report was well written and the presentations were of a very high quality. The questions posed by the members of the committee were answered in a clear, detailed and honest fashion.

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

The LPTMC, in the structure it proposes to adopt over the next four years, is comprised of three poles:

Pole 1: Physique statistique et modélisation pour la chimie, la géochimie et la biologie

This pole uses the methods of statistical physics (and some other aspects of theoretical physics) and applies them to a range of different problems. It could be described as an applied and interdisciplinary statistical physics group.

Pole 2: Physique statistique

This pole carries out research in fundamental statistical physics including disordered and glassy systems, statistical field theory and non-equilibrium statistical mechanics.



Pole 3: Corrélations quantiques

This pole has an activity in strongly correlated fermionic systems, cold atoms, quantum information and mathematical aspects of quantum mechanics.

The laboratory has a scientific output of about 1.7 paper per researcher per year (this figure corresponds to 2.35 papers per full time researcher if the ECs are counted as half time researchers).

During this period the laboratory published over 30 publications in the top rated physics journals (Nature, PRL, Science, PNAS...). This is a particularly competitive figure even at the international level. On average, members of the laboratory are invited to give a conference once per year. These statistics testify to a high degree of scientific productivity and level of international recognition. There are a few senior members of the laboratory who have international scientific reputation and are regarded as leaders in their field. The laboratory also has a number of junior researchers with prolific scientific output who are starting to make a strong impression in their fields. At a national level, the majority of the laboratory has a high profile and is regarded as significant actors in their fields. The success in obtaining research contracts (ANR, IUF, and EU) is another indication of a strong reputation at the national and European level.

CNRS and ECs make more or less equal contributions to the scientific output in terms of quantity, quality and reputation. The laboratory is extremely well balanced from this point of view, it has a very low fraction of ECs who are not contributing significantly to the research effort.

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

Pole 1: This group brings together research themes which one may loosely refer to as "Statistical Mechanics applied to complex systems and phenomena in Physical Chemistry, Geophysics, Non-equilibrium Kinetics and Dynamics and Molecular Biology", although there is significant and constructive overlap with some of the themes of Pole 2. Particularly noteworthy are the recent break-through on ultra-fast probes of molecular motions in liquids, the computer simulation of magmatic melts (liquids under extreme conditions) which are of genuine interest in geophysics, the kinetic theory of stochastic motion in bounded domains and of the optimal search of hidden targets, the microscopic modelling of exothermal chemical wave-fronts and the highly interdisciplinary work on the structural organization (winding) of chromatin fibres. Some of the above work is genuinely world-class; most researchers of Pole 1 have developed strong ties with other excellent groups in France and abroad.

An important activity of Pole 1 consists in the application of statistical physics concepts and methods in the field of biology (living systems). In particular, problems of reaction-diffusion or random-walk processes, which have been studied for a long time in statistical physics, can be applied to issues such as the research of food by animals, of a target prey by a predator or, at a very different scale, as the diffusion of biomolecules in a cell. These applications lead to new interesting questions in these "old" fields; for example, intermittent random walks have been considered; the issue of confinement leads also to the development of new methods. Various very interesting results have been obtained and have led to numerous publications, some of them in top-level journals. Rich developments and extensions can be expected and will be supported by an ANR grant, all these points testifying the high level of this research group.

Another topic of interest of Pole 1 is the problem of the expression and regulation of genes in eukaryotes. The team has focused on the physics of the chromatin fiber, developing physical models of relevance in the biological context. The success of these approaches is shown by the articles published in high-level journals of biology or general interest. In the biophysics context, the research is developed in contact with experiments performed on single chromatin fibers. This synergy with experiments will be pursued, with a particular attention to the issue of 3D visualization. Overall, important contributions to the field of biophysics have been made and can be expected in the future, as the interdisciplinary research performed is highly competitive at the international level.



Pole 2: Physique statistique: This pole is specialised in the more fundamental aspects of statistical physics, collective phenomena and out of equilibrium phase transitions, disordered and glassy systems and algebraic statistical mechanics. Members of this team have been applying the functional renormalization group to a variety of equilibrium and non-equilibrium systems and recently to disordered systems. Many interesting results have been found and the approach they have developed seems extremely promising and has attracted a fair amount of attention. Work has also been carried out on the adsorption of fluids by porous materials using an approach related to disordered systems with an extensive entropy of metastable states like the random field Ising model. In the field of the glass transition, an interesting model of Lennard-Jones particles in the hyperbolic plane has been put forward, in order to obtain a tunable frustration and fragility. This model allows to explore the link between frustration and dynamical slowing down, and to explore the dynamical heterogeneities. The pole also has produced interesting results in the field of granular media and statistical physics of lattice based systems. The best of the research in this group is world class and the rest is highly competitive at the national level.

Pole 3: Members of this pole have applied ultimate numerical techniques to study the low temperature physics of strongly correlated electronic systems. Strong efforts have been made in the study of quantum phase transitions, supersolid Helium and some antiferromagnetic models. These systems are expected to be the best candidates to show a spin-liquid phase, and are relevant to recently synthesised compounds. It is worth mentioning that the group has acquired a reputation, not only because of the importance of the results obtained in the problems they investigate but also because of the intensive computation capabilities they have developed, which can be considered as a world benchmark for numerical methods. Many members of this pole are also very active in the field of cold atoms where exotic phenomena such as anionic excitations or quantum phase transitions, corresponding to conformal field theories with a non-integer central charge, are expected to be observed, at least indirectly, in experiments.

Another area of expertise of the third pole is mathematical physics which can be further subdivided into mathematical foundations of quantum information theory and applications of combinatorial analysis to quantum mechanics and field theory. In both areas the investigations are very interesting and original. In quantum information theory the members of the group belong to initiators, on the worldwide level, of applications of differential-geometric methods to the problems of quantum-mechanical entanglement which has been giving a new and promising way of analyzing quantum correlations in composite systems as a supplement to more traditional algebraic and functional methods. The developed combinatorial methods of originating in ordering problems of quantum field theory provide effective tools applicable to many specific questions of quantum collective phenomena in quantum optics and quantum mechanics in general being, in addition, interesting from the purely mathematical point of view. The variety of methods and tools developed in the course of investigations secures the group a high ranking position in the world in the area of their activity.

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

- en termes de management :

The overall management of the laboratory at a scientific and administrative level is highly satisfactory, the director of the laboratory is to be congratulated. At the level of the relations with the university there are a number of problems. There is a great concern that a number of the MCFs, who have excellent scientific dossiers and are relatively old, see little prospect of promotion. This situation has been aggravated by the large number of recruitment of MCFs over the last few years and as these new recruits advance in the career the overall pressure to find positions for promotion will become greater. At the level of the CNRS and Ministry of Education Nationale et de la Recherche, during the last four years, the number of active researchers was under estimated; as a result the laboratory was significantly under funded leading to a shortfall which was only partially made up for by Paris 6. The laboratory is currently associated with the sections 02 and 13 of the CNRS, it would also like to be associated with the 05 and 06, which given the scientific themes of the laboratory seems an eminently reasonable demand. In terms of future recruitment projects at the CNRS level, the committee felt that a recruitment in commission 13, to make up for some departures in chemical physics, should be a priority.



- en termes de ressources humaines :

The laboratory has a good balance between ECs and CNRS; the ECs are extremely active scientifically despite a high degree of investment in teaching and administrative activities, the overall contribution of the ECs to the research output international reputation of the laboratory is in fact comparable to that of the full time CNRS researchers.

The laboratory benefits from a good level of technical and administrative support. There are concerns about the career prospects of the IR2 engineer responsible for computing resources and also the eventual replacement of secretarial staff who will soon retire. Finally the overall environment is of low quality for the laboratory members, the building work in Paris 6 is unavoidable but clearly has had a major effect on the quality of life of the laboratory. The cleaning services provided by the university were also criticised - members of the laboratory have had at times to undertake routine cleaning duties themselves - this is a situation which is unacceptable and clearly crazy from a human resources point of view.

- en termes de communication :

Communication appears good between the members of the laboratory. There are a number of members of the laboratory who play important roles in the popularisation of science for the general public. The number of invited conferences made by laboratory members was good, reflecting the impact of the laboratory's scientific research.

6 • Recommendations and advice

– Strong points :

The laboratory has a wide range of scientific activities but there are many areas of overlap and opportunities for collaborations between different poles. The level of scientific production and its quality is very good. There is an excellent track record of publication in prestigious scientific journals - thus helping Paris VI's position in the famous Shanghai ratings. It should be noted that it is extremely difficult to publish theoretical physics papers in journals such as Science and Nature (and increasingly PRL !). The contribution made to output is homogeneous across the laboratory and there are very few researchers who are not active. The three poles are in subjects that are very well represented in France and they have good records of collaboration at a national and international level. Recent recruitments have been of a high quality and the laboratory attracts visiting researchers of high calibre.

– What needs to be improved :

The recruitment at the university level has been largely at the MCF level, this has led to a great deal of pressure for promotions internally, the nature of the positions is however decided by Paris VI who must thus bear the bulk of responsibility for this problem. Having said this, MCFs should be strongly encouraged to apply to other universities for professor positions, as mobility is good for a scientific career and the national research infrastructure. The problem of the careers of MCFs in general poses problems at both the university and a national level. Members of the laboratory complained that MCFs are disadvantaged in the standard competition for a professor's position. For example when competing against CNRS candidates for a professor's position, at comparable ages MCFs may have weaker research dossiers as they have been investing in teaching - an activity they feel is not sufficiently taken into account by selection committees (CS's). This issue seems to be one of the major sources of frustration in the laboratory. The solution of professor competitions reserved exclusively for MCFs was raised (46.3), but the laboratory was concerned that such positions are regarded as second rate.

– Recommendations :

Given recent departures in the area of physical chemistry the laboratory should prioritise recruitment in this area possible via the section 13 of the CNRS. The University should seriously consider the problem of the large number of MCFs with good scientific dossiers, and who are relatively senior, who feel that their careers are effectively blocked. The committee supports the idea of an association with sections 05 and 06 on scientific grounds, Perhaps it would be prudent to restrict this association to the 06 as it is the pole 3 which is, perhaps, least well represented at the CNRS (poles 1 and 2 being compatible with attachment to the 02/13 and 02 respectively).