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

Section des Unités de recherche

AERES report on the research unit

Physico-chimie Curie

sous tutelle des établissements et organismes :

CNRS-UPMC- Institut Curie

March 2011

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

Section des Unités de recherche

AERES report on the research unit

Physico-chimie Curie

From the

CNRS-UPMC- Institut Curie

Le Président de l'AERES

Didier Houssin

Section des unités de recherche

Le Directeur

Pierre Glorieux

March 2011

Research Unit

Name of the research unit : Physico-chimie Curie

Requested label : UMR CNRS

N° in the case of renewal : 168

Name of the director : Mr. Jean–François JOANNY

Members of the review committee

Committee chairman :

Mr. Eric KARSENTI, EMBL, Heidelberg, Germany

Other committee members :

Mr. P.F. LENNE, CNRS, IBDML, Marseille

Mr. P. BASTIAENS, MPI of molecular Physiology, Dortmund, Germany

Mr. D. WEITZ, School of Engineering and Applied Sciences, Harvard, USA

Mr. S. LECOMMANDOUX, LCPO, ENSCPB , Bordeaux

Mr. M. VERGASSOLA, CNRS, Institut Pasteur, Paris

Mr. P. RICHETTI, CNRS, CRPP, Bordeaux (CoNRS)

Observers

AERES scientific advisor :

Mrs Anne RENAULT

University, School and Research Organization representatives :

Mr. Daniel LOUVARD, Institut Curie

Mr. Philippe BARROIS, INC, CNRS

Mr. Giancarlo FAINI, INP, CNRS

Mr. Paul INDELICATO, UPMC, Paris 6

Mr. Brice KERBER, Délégué Régional CNRS, Délégation 03

Report

1 • Introduction

The evaluation was carried out on the 3rd and 4th of March 2011 at the Institut Curie in the Physico Chemistry Unit in Paris.

The Physicochemistry unit of the Curie Institute in Paris, has progressively evolved over the past 15 years towards a laboratory mainly centered on the physico-chemistry of living matter. From the initial theory work directed by Mr. Jacques PROST combined with the input of Mr. D. LOUVARD and Mr. M. BORNENS, interactions with biologists from the Cell Biology unit of the Curie Institute, have led to an interesting and still rare interaction between highly talented theoretical physicists and biologists. The unit has now incorporated high level experimentalists in physics of life in addition to theoretical physicists, and is certainly one of the best labs in the world in this field together with a few in Europe and the USA. This new way of studying living matter is still not very much developed although it is essential to better understand the very nature of living matter after decades of domination by molecular genetics. An other important aspect of this laboratory in the Curie institute concerns technological developments for basic and medical research. This is also very originally done and could lead to important new discoveries in the field of cancer prevention and therapy.

- Management team :

Mr. Jean Francois JOANNY has been directing the unit with the help of Mr. Patrick KELLER. The first one is a theoretical physicist while the second one is an organic chemist. They should be commended for the excellent job they did over the past term to build upon the advance of the unit in this field. It is now necessary not only to stabilize what has been accomplished, but also to drive this unit forward strongly to keep up with the high pace at which this emerging discipline is moving in some areas of the world. There is competition now and it would be wise to remain among the top leaders.

- Staff members : (on the basis of the application file submitted to the AERES):

	In the past	In the future
N1: Number of researchers with teaching duties (Form 2.1 of the application file)	8	7
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	23	25
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)	99	38
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)	11	11
N5: Number of engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)	0	
N6: Number of Ph.D. students (Form 2.8 of the application file)	41	
N7: Number of staff members with a HDR or a similar grade	15	16

2 • Overall appreciation on the research unit

- Summary :

This unit is combining theoretical and experimental approaches of living matter at the cellular level. They have also started to explore multicellular and early development systems. In addition, there is a strong technology component based on microfluidics and on interesting imaging developments as well as on medically oriented applications. Overall most groups are performing very well with some doing an outstanding job.

- Strengths and opportunities :

The strength of this unit relies largely on the fact that physicists and chemists are attacking biological problems at a scale and with a quantitative and dynamic approach usually completely absent from classical molecular biology laboratories. The theories developed on active gels for example are outstanding. Sophisticated technical developments providing important phenomenological information to theoreticians are also key. Another strength of the unit is the multicultural atmosphere that came through during discussions with the students and postdocs. The students and post docs learn from each other and this is extremely important to generate new ideas and promote new experimental approaches.

The whole unit IS an important opportunity for the development of this new approach of living matter from a physico-chemical point of view at the mesoscale level. In the past, physics and chemistry have played an important role in biology at the molecular level with imaging, sequencing and structural biology methods. Now the challenge is to understand how complex dynamic patterns emerge, leading to new complex functions at the cellular and supra celular level. To address such issues one needs to use physical modeling and quantitative phenomenological parameters to feed the models. This approach draws therefore a lot on statistical mechanics but needs to be strongly rooted in biological knowledge. This unit has the expertise to do this, but not necessarily a strong vision of HOW to do it yet as a group even if the initial leaders do see that.

Another important strength of the unit concerns technology development in the field of medical applications. Here again the unit is clearly leading on some important issues.

- Weaknesses and threats :

The link between theory and experiments still needs to be improved although this works already pretty well. There is also a risk that the unit does not make the necessary jump to the level required to remain competitive in this rapidly evolving field. Several groups are doing really original and sophisticated research, but this does not always show at the publication level. A better publication policy that balances the number of papers published in specialized journals with those published in more generalist, high profile, journals needs to be implemented at the level of the groups.

- Recommendations :

The unit is already functioning very well but needs to increase the turnover of the groups to bring in some new blood. Ideally it would be important to hire at least one strong group having a mixed activity in experimentation and theory in the field of cell or develomental biology. There is also a desire to go more into evolution. This can be done as long as the main strength of the lab is not diluted. Also evolution is a complex problem that requires a critical mass of people working on various aspects of it to really make an impact. The new director should seriously think through the overall strategy of the lab before embarking on such diversified issues at the level of the unit. Overall, most groups in the unit do have important synergistic interactions but this could and should be improved to keep the unit in the top leading laboratories of this field ; the addition of a few key new groups would help this tremendously.

During the review it became clear that the proposed new director was not well prepared to provide a clear vision of how to move the laboratory to the next stage. The committee therefore urges the Curie Institute to work to address this issue. This is an excellent unit that contains outstanding scientists and could bring a lot to the understanding of living systems in the coming years. This unit needs a strong lead with the clear mandate of promoting the appropriate level of turn over and interactions between the groups to achieve this goal.

- Production results :

(cf. http://www.aeres-evaluation.fr/IMG/pdf/Criteres_Identification_Ensgts-Chercheurs.pdf)

A1: Number of permanent researchers with teaching duties (recorded in N1) who are active in research	32
A2: Number of permanent researchers without teaching duties (recorded in N2) who are active in research	0
A3: Ratio of members who are active in research among staff members [(A1 + A2)/(N1 + N2)]	100%
A4: Number of HDR granted during the past 4 years (Form 2.10 of the application file)	5
A5: Number of PhD granted during the past 4 years (Form 2.9 of the application file)	41

3 • Specific comments :

- Appreciation on the results :

  - Most groups are doing well-targeted original and sophisticated work of very high quality. Just to cite a few examples, the work on the physics of tissues and actin gels, the construction of actin cortices inside vesicles that may lead to the construction of artificial cells, the analysis of hair cells functioning, the understanding of bleb based motility, the development of imaging diagnostic tools using thermal radiation or sophisticated micro fluidic and self assembled devices.

  - Overall, the publication rate is satisfactory with fluctuations from group to group as expected in a large unit like this. However, given the originality and quality of the work carried out in the unit, there should be more high profile publications in generalist journals. This is important for the image of the lab for funding and for visibility worldwide.

  - The unit is particularly successful at getting ANR funding since it has about 40 funded projects as well as a few other grants from other agencies. This means that most groups are getting more than one big grant. The overall funding on grants is approximately 6 million Euros between 2008 and 2009, of which, about 1 million has been obtained for international projects. There is a clear recurrent commitment to obtain external funds, which is anyways essential given the very poor recurrent funding in France.

- Appreciation on the impact, the attractiveness of the research unit and of the quality of its links with international, national and local partner :

  - Several members of the Unit have obtained together the Grand Prix Cino del Duca of the French Academy of Sciences for collaborative work at the interface between physics and Biology, Jacques Prost became elected Member of the French Academy of Sciences and Mr. J-F JOANNY received the silver Medal of the CNRS. In addition, most groups have impressive lists of National and international collaborations as well as invitations to international conferences. The whole unit is quite active too in terms of organizing high-level courses and international conferences.

  - The committee has been very impressed by the quality and international flavor of the students and post docs we met in the unit. They all seemed extremely happy about the atmosphere and collaborative attitude of the group leaders in the unit. Numbers also show that the unit is very active in recruiting and training PhD students. There are currently 38 students in the unit and 40 received a PhD over the review period.

  - The unit has no problem whatsoever in obtaining funding and in responding to calls for proposals. They have a very large list of grants, actually mostly French and from the ANR with some HFSP collaborative grants. Some members do participate in the AERES and funding policy in France.

  - There is an impressive list of national and international collaborations for almost all groups in the unit. There are very structured collaborations with prestigious laboratories in the United States including Princeton University, the Rockefeller University and in Germany with the Max Planck Institute in Dresden.

  - Socio-economic impact is also a strong point of the unit through a large number of patents filed mostly by 2-3 groups, which have a strong bearing on cancer research on the basis of new physico-chemical developments made in the unit.

- Appreciation on the management and life of the research unit :

  - This unit has an interesting structure because of its interdisciplinary nature, clearly the present director has done an excellent job in generating a lively communicative scientific atmosphere in the unit that can be felt when talking to the students post docs and group leaders. There are a very significant number of papers published in collaboration between various groups of the unit and this was actually embodied by the joint Cino del Duca prize awarded to 4 members of the unit. This means that there is a good internal communication at the scientific level. The committee noticed however a communication issue between the laboratory council, the members of technical staff involved in support activity of the laboratory and external maintenance services in the Curie Institute. This is something that needs to be addressed, especially since technical staff members worried about feedback on security issues. This seemed to be more of a problem of communication than a real issue but this is nevertheless important.

  - There are regular, frequent internal seminars where members of the laboratory can present their work to the whole unit and exchange ideas. The whole lab has one retreat every second year. We would recommend that in addition to this, the group leaders organize one retreat per year among only them to discuss the work of their labs from a strategic point of view. Some strategic retreats between group leaders to discuss very general orientations should also be organized from time to time to evaluate the position of the unit relative to the worldwide trend in this field. This is still an emerging field and creativity needs to be stimulated through brainstorming sessions.

  - Out of the 25 EPST staff members of the unit 17 have an HDR. They all contribute to teaching activities.

  - There are 7 professors or assistant professors, 4 of which have a HDR. The presence of this teaching staff in the unit ensures a link with the university.

- Appreciation on the scientific strategy and the project :

Each group has written a specific project, which is, in most cases, an interesting follow up of the present research. This is fine because most projects have been maturing over the past review period and now need to be expanded. There is also a collective description of the future activities of the lab that has been worked out during meetings of the group leaders summarized by some of them.

This project is based on the motivation of the different teams of the lab by an integrative view of biology, based on physico-chemical and biophysical approaches, coupling molecular to cellular, cellular to multi-cellular and organic levels of life. It is also recognized that technological development is key to important breakthroughs both in basic and applied research. The summary project is therefore divided into 4 parts.

  - The molecular to cellular scale develops a collective approach towards the reconstitution of artificial cells by increasing the complexity of the experimental models already worked out in the unit. This is an attempt to go all the way towards the expression of genes in such artificial cells. It is clear that this unit is in a good position to achieve such a goal if at all feasible. A better description of how the various groups of the unit, and which ones, will actually work together on it would have been appreciated.

  - The second level concerns multi-scale coupling in tissues. This concerns the physical basis of collective cell behavior and communication. Here, the unit has a clear strong potential given the work carried out in the various groups. But again, how they are going to integrate the work of each group so that they really take advantage of their unique combined expertise is not well formalized although one could guess this from the summary and individual reports. That being said there is a real strong potential here and a strong interaction with some of the groups of the Cell Biology and Biophysics unit at EMBL would be mutually beneficial.

- The part about cancer and evolution is somewhat unclear. There is a discussion about the application of ecological principles to selection processes that may happen during chemotherapy and to develop this approach on eukaryotic and bacterial cell populations. This whole part is very vague and not really precise. It is impossible to actually evaluate what they really want to do.

- Technology developments in the fields of Microsystems technologies, nonconventional optics and chemistry in the fields of surface chemistry and self-assembling material. This part is extremely important and of very high caliber. It will have a strong impact on the development of the new P-G de Gennes institute for Microfluidics and at the same time benefit from it strongly.

In summary, from part of this report and from the individual projects, it seems like there is fantastic potential in this laboratory but that there has not been enough thought put into the overall coordination of the activity of the unit to take full advantage of this collective potential. The part of the project that deals with evolution and the higher scale level of life organization is not well structured. It does not seem that the unit is really ready to move efficiently at least in a strong concerted manner into the field of evolution. If they want to do so, it may be a good idea for one group to start developing a project that could progressively gain momentum when the ideas become more structured.

One big problem identified by the committee is that the proposed director did not show, during his presentation, a clear vision of the strategy that should be developed by the unit. This also emerged from the discussion that followed with the committee and this is also evident from the summary text attached to the project report.

The committee therefore recommends continuing the search to fill the directorship position of this very important and original unit.

- Innovation and risk-taking

The topic of the whole unit is original as well as the combination of expertise at the interface between biology, physics and chemistry. There is also a strong potential for application of discoveries made in fundamental research to cancer therapy or prevention. It is rare to see such a strong natural connection and this should definitely be strongly supported in the coming review period. Almost all aspects of the basic research carried out in this unit may at some point bear on applications in the cancer field. We therefore have here a potential jewel as a unit, that develops a very original basic research program bridging physics, theory and biology at the very scale at which this should be done and with very strong potential applications in the medical field. This opportunity should not be missed.

4 • Appreciation team by team and/or project by project

- Name of the team and team leader : M. F. AMBLARD

Staff members :

	In the past	In the future
N1: Number of researchers with teaching duties (Form 2.1 of the application file)		
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	3	3
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)	8	3+X
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)		
N5: Number of engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)		
N6: Number of Ph.D. students (Form 2.8 of the application file)	4	
N7: Number of staff members with a HDR or a similar grade	1	1

This group develops and applies innovative physical approaches, which are key to understanding the dynamics of the cytoskeleton and membrane functions in different contexts. Three main lines of research have been developed in the past years:

1- Cell and tissue dynamics : a) dynamics of E-cadherin in epithelia; b) bleb-based mobility

2- Multiphoton microscopy and its applications to immune response and cancer diagnosis

3- The induction of black body radiation in materials with extremely local temperature increase as a new imaging modality.

- Scientific productivity :

The research projects are innovative and the concepts (which drive them) are original. The quality of the production is excellent, but could have a better visibility by publications in high ranked journals.

- Scientific Impact :

The group interacts with a few experimental groups in the Curie institute and with theoreticians outside the institute (attested by publications). The list of international collaborations is broad but it is unclear which ones are active. The group has a good status nationally and internationally.

- Proposal :

The project is a continuation of the ongoing projects, with a special emphasis on cancer (detection of melanoma, study of tumor growth). The projects are risky and highly original, yet supported by preliminary data.

- Conclusion :

The group pursues original scientific questions with highly innovative approaches.

Its strengths rely on instrumentation (non-linear microscopy) and originality of scientific ideas.

The group should focus on the full accomplishment of scientific objectives ie to go beyond the proof of principle and to transform original ideas into scientific accomplishment. The group should try also to publish in journals with higher impact.

- Name of the team and team leader : M. P. BASSEREAU

- Staff members :

	In the past	In the future
N1: Number of researchers with teaching duties (Form 2.1 of the application file)	0	1
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	3	2
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)	13	8 + X
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)		
N5: Number of engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)		
N6: Number of Ph.D. students (Form 2.8 of the application file)	10	
N7: Number of staff members with a HDR or a similar grade	2	2

This group consists of three permanent scientists, two from CNRS and a new member from UPMC, as well as a relatively large number of graduate students and postdoctoral fellows. The focus of the group is on membranes, both the biophysical properties, and their biophysical functioning within cells. This has been a historic interest of the group, and their efforts are well recognized in this field. They investigate properties of bilayer vesicles, with a focus on extruding nanometer scale filaments allowing transport of materials through very narrow pores, and on the effects of proteins both to induce membrane curvature and to respond to the effects of curvature. They also investigate the role of local membrane indentations in cells.

- Scientific productivity :

The group has an excellent publication record over the past five years, publishing a good number of papers, with several in high-impact journals. For example, they routinely publish in PNAS, and have recently had one paper appear in Cell. They are very well represented by invited talks at meetings on soft matter physics, membranes and the functions of membranes in cells.

- Scientific Impact :

The group has a strong status internationally, and is recognized within the field. They have made important contributions to the science of cell membranes, both *in vitro* and *in vivo*. Some of their more recent publications have the potential of having much more impact in the future, particularly those dealing with the effects of local curvature on the shape and volume of cells subjected to osmotic stress, and on the role of curvature on the uptake of molecules within cells. If these papers have the impact they could have, and if this work becomes more widely recognized, the impact of the group could potentially increase significantly.

- Proposal :

The group has proposed a very interesting set of experiments that represent a solid continuation of their current efforts. The proposed work includes more studies of the properties of the pulled membrane filaments, and their role in transport of segregation of proteins. This is a natural extension of the historic expertise of the group. In addition, they will develop methods to study the rheology of membranes of cells and the role of caveolae. They are also involved in collaborative work with other groups in the lab on using their ability to manipulate membranes to investigate the behavior of stimuli-responsive membranes, and to study adhesion and polymerization of reconstituted membranes. These projects are all natural extensions of their current work, building on the success of their efforts.

- Conclusion :

The group does an excellent job of exploiting its expertise in membrane biophysics to investigate properties of membranes and properties of cells. The work on the properties that can be specifically applied to cells probably provides the greatest opportunities for future impact.

- Name of the team and team leader : M. BROCHARD-WYART
- Staff members :

	In the past	In the future
N1: Number of researchers with teaching duties (Form 2.1 of the application file)	2	2
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)		
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)	3	1+X
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)		
N5: Number of engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)		
N6: Number of Ph.D. students (Form 2.8 of the application file)	7	
N7: Number of staff members with a HDR or a similar grade	1	1

This group consists of two permanent members, both of whom are professors at UPMC, as well as a postdoctoral fellow and a graduate student. Despite the smaller size of the group, they have had a large number of internationally distinguished visitors. The group will not exist in its present form in about two years because of upcoming retirements. The group focuses on the application of concepts from soft condensed matter physics to biological systems, and contributes not only the projects from the group itself, but also to several projects done in collaboration with other groups in the lab.

- Scientific productivity :

The group has a very strong record of publication with many ground-breaking papers that lead the field. The group interacts strongly with other groups within PCC, as well as with internationally-recognized external groups, to publish papers that set the trend in extending concepts of soft matter physics to new directions. Most of these reflect the interest and expertise in interactions at interfaces, both adhesion on interfaces and the properties of thin interfaces, such as those of polymersomes. The papers often set the standard for new fields of research.

- Scientific Impact :

The activity of the group has a very strong international status, and is very well recognized within the soft-matter community. The work is highly innovative in applying concepts of soft matter physics, particularly interfacial phenomena, to biological matter. A good example of this is the application of the experimental tools and techniques, as well as the conceptual framework of membranes to the study of spheroids, collections of cells that are models for tumors. The application of pipette aspiration and spreading on surfaces offers a completely new way of investigating the properties of spheroids, based on the application of concepts of soft-matter science. This is certainly a beautiful new problem in soft-matter physics. Its ultimate relevance to the study of spheroids themselves has yet to be determined. The group does several things with a similar spirit, all of which gives them a very strong impact internationally.

- Proposal :

The list of interesting problems in biology to which the group has proposed to apply soft-matter physics concept continues to grow, with several new and interesting problems proposed. This represents an exciting opportunity, and success in any of these will provide leadership to the international community, identifying new problems to work on.

- Conclusion :

This group continues to set the standard in identifying new problems in soft-matter physics that are inspired by systems of interest to biology. The application of both experimental and theoretical methods of soft-matter physics provides new insight into the systems. This sets a standard in this field both in France and internationally.

- Name of the team and team leader : M. E. FARGE
- Staff members :

	In the past	In the future
N1: Number of researchers with teaching duties (Form 2.1 of the application file)		
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	1	1
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)	6	3 + X
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)		
N5: Number of engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)		
N6: Number of Ph.D. students (Form 2.8 of the application file)	2	
N7: Number of staff members with a HDR or a similar grade	1	1

This group investigates the role of mechanical effects in gene expression during animal development and cancers, using different animal systems (*Drosophila* embryos and mice).

- Scientific productivity :

The objectives that the group is pursing are original and they are biologically relevant. The scientific production is good yet limited in number. The group is well funded, with a good visibility at the international level, as reflected by invited conferences.

- Scientific Impact :

The group has attracted good students and postdocs. Collaborations are national and international, especially through a HFSP grant. Note that this grant has not led to intensive collaborations between the involved groups.

- Proposal :

The first project is the continuation of existing projects on *Drosophila* gastrulation with refinements of the experimental and modelling approaches. The second project is more challenging: it aims at finding a mechanotransduction pathway (upstream to beta-catenin) and at mimicking tumour growth *in vivo*. It will rely on an ongoing collaboration with the biology department of Curie Institute. The project is risky and ambitious but the commitment of the group is high.

- Conclusion :

The group is pursuing an important scientific objective with good success.

Its strengths rely on the originality of the approaches and on the scientific enthusiasm. Note that the lab would greatly benefit from stronger collaborations with biology labs involved in the study of gene regulation and gene expression.

- Name of the team and team leader : M. H. ISAMBERT
- Staff members :

	In the past	In the future
N1: Number of researchers with teaching duties (Form 2.1 of the application file)		
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	1	1
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)	1	X
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)		
N5: Number of engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)		
N6: Number of Ph.D. students (Form 2.8 of the application file)	4	
N7: Number of staff members with a HDR or a similar grade	1	1

The team's research program is oriented towards the structure and function of RNAs. The originality of the approach concerns the combination of synthetic biology methodologies with advanced RNA simulations to design and understand the interactions, dynamics and regulation mechanisms. In particular the formation of DsrA filaments has been evidenced recently and the underlying self-assembly mechanism understood. Such coded interactions are proposed to be found in natural, physiological conditions and to have impact on RNA function in cells.

- Scientific productivity :

The level of the research conducted is good with a few publications in high impact journals in the field such as PNAS (2007, 2008) and JACS (2009) allowing reaching a good international position. Researchers have been invited to a large number on conferences attesting the impact of the conducted work. However, the impact and productivity could be improved.

- Scientific Impact :

Even if RNAs can be building blocks for self-assembly and they certainly constitute crucial regulatory mechanisms, the interaction of the team with other groups in the laboratory or in the Curie Institute is quite limited and may be reinforced. However, international and national collaborations are ongoing in a nice way with HSFP program especially. The number of students supervised is in good relation with the level of funding and the constraints imposed by doctoral schools.

- Proposal :

The project aims at developing the most promising research and can have an interesting impact. A specific part concerns the prediction and functional studies of natural RNA nanostructures that can impact synthetic biology and nanomedicine. Another project is about the modification and prediction of the evolution of signaling pathways implicated in cancer, by using comparative genomics and evolutionary models to analyze sequences of oncogenic mutations. This original approach can give rise to a better understanding of the underlying mechanisms implied in mutation of normal to cancer cells.

- Conclusion :

This team has an interesting approach combining original synthetic tools together with modeling capabilities that should allow original developments and excellent competences in RNA production and simulations. This field is in great expansion and RNA building blocks are nowadays widely used in a large number of different fields, as components for self-assembly, in molecular biology, nanotechnologies and medicine. A better and clear implication with the surrounding scientific environment is however necessary. The two proposed orientations in the projects are the continuation of recent developments. The positioning in a highly competitive field should need clear and specific focus.

- Name of the team and team leader : M. J.F. JOANNY / M. J. PROST
- Staff members :

	In the past	In the future
N1: Number of researchers with teaching duties (Form 2.1 of the application file)	3	4
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	1	1
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)	7	
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)	0	0
N5: Number of engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)	0	
N6: Number of Ph.D. students (Form 2.8 of the application file)	9	
N7: Number of staff members with a HDR or a similar grade	2	3

- Scientific productivity :

This is a very strong theory group who has pioneered the introduction of soft matter physics theory in biology many years ago. Since then, they have progressively moved more and more into the study of biological systems using this approach, and have been very successful at it. During the review period, they worked on several topics ranging from the formation of membrane tubes, cytoskeletal properties, in particular a nice treatment of actin gels, to the physics of tissues. On all these topics they have been very productive and their theoretical demonstration that living tissues have fluid properties that may play an important role in the migration and invasive properties of tissues relative to each other and in particular in the metastatic power of cancer tissues is particularly innovative. This work is highly original and poorly addressed elsewhere in the world.

They have also revisited the very fundamental fluctuation-dissipation theorem to non-equilibrium situations. Many of them are met in living systems, in particular with cellular behaviors involving active processes.

The production of the group is very good and of very high quality. During the review period, the group has published more than 50 publications in high ranked journals either of physics or biology.

- Scientific Impact :

The impact and the great visibility of the group leaders are reflected by numerous invitations to international meetings, as many collaborations established with national and international researchers. The group attracts French PhD students of very high training level (Ecole Normale and Polytechnique), but also foreign students and post-docs. As partners of collaborative networks, financial supports have been obtained from the French (ANR) and European agencies.

- Proposal :

The group offers pertinent research projects built on what has been started over the present review period in particular to expand the work on tissue mechanics and the application of theory to concrete biological questions mostly related to cortical actin, to membranes and membrane tubes and in addition to develop conceptual tools for the understanding of cell population behavior in tissues.

Mechanics and growth of tissues. They want to extend the theory that describes the fluid properties of tissues to asymmetric tissues like epithelia to better understand the origin of tissue patterns. This is original and or great interest.

Cell dynamics. They want to use the equations that describe active actin gels to examine the theoretical description of complex active cellular processes like lamellipodium behavior, stress fiber formation and cytokinesis. This will lead to very interesting predictions to be tested in collaboration with experimentalists in biology in Curie but also abroad.

Proteins in membranes and nanotubes. They will work in particular on the role of membrane nanotube curvature on the segregation of well chosen proteins and on under which conditions action potential can propagate and look for oscillatory instabilities. Although the detailed approach is not described in the project obviously, this seems also well feasible in the coming year and of great interest.

Fluctuation-dissipation theorem. The investigation of less general variants of the theorem to dynamical systems in order to readily access observables will be an important step to experimentally validate the extensions of the primary theorem.

Evolution. It is clear that sequencing methods are developing rapidly, allowing to go deeper into the analysis of the evolution of genomes. This is probably the most risky part of the project but also the most original one. It will certainly require a strong interaction with bioinformaticians if they want to avoid the pitfall of wandering away from real and concrete problems.

All of these projects are original and of great interest. Apart from the evolution part of the project, the approaches proposed are fairly well controlled by the group and in this sense not very risky.

- Conclusion :

This is a very strong group, one of the pillars of the unit and one that brings a lot to all the groups of the unit through the theoretical treatment of fundamental biology projects that give rise to experimental predictions and interpretations.

Very strong theory background and proximity to biologists. They have acquired a broad biology culture over the past decade. A still tighter connection to experimental systems would help to boost the efficiency and visibility of the group.

- Name of the team and team leader : M. P. KELLER
- Staff members :

	In the past	In the future
N1: Number of researchers with teaching duties (Form 2.1 of the application file)		
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	3	3
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)	7	4+X
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)		
N5: Number of engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)		
N6: Number of Ph.D. students (Form 2.8 of the application file)	4	
N7: Number of staff members with a HDR or a similar grade	2	2

This group is composed of three permanent scientists from CNRS, and an increasing number of graduate students and postdoctoral fellows. The development of synthetic tools and methodologies developed in the team has been used over the last years for the design of biomimetic surfaces and nanostructures. The team has strong interactions within the laboratory and the local environment. The use of responsive polymers to design smart surfaces based on nematic elastomer, which can modify surface wettability, is particularly interesting. The development of original polymersomes either with liquid crystal moieties, asymmetric or that incorporate sensitive and bioactive dyes are really promising and open new areas for the future.

- Scientific productivity :

The scientific activity over the recent years has significantly improved together with the number of students, and papers of good standard for chemistry have been published.

- Scientific Impact :

The team has been coordinator or participant in national and international granted projects and has developed a network of national and international collaborations. However, the impact of the research has not yet reached international standards. Some of the research activities have led to patents and strong interactions with clinicians.

- Proposal :

The scientific project of the team is a direct continuation of the ongoing ones. On the one hand, molecular and macromolecular approaches are used to design smart and biocompatible or bioactive surfaces. On the other hand, amphiphilic copolymer structures are designed for nanostructure formation, mainly polymersomes. A close relation to clinicians via a PIC "thérapie ciblée" is programmed and encouraged. Cross-fertilization between internal different projects is also recommended, for example towards the common use of gold nanorods with polymersomes.

- Conclusion :

The team has developed interesting synthetic tools and an original approach in stimuli-responsive materials using liquid crystal moieties. Their unique competences in the laboratory should be reinforced and implemented by stronger interactions. They however have to keep developing innovative chemistry. Their biomimetic synthetic approaches are actual and original. The group should reinforce their interactions with the other groups of the laboratory and in the institute, with biologists and even medical groups. The impact of the research still needs to be improved. There are opportunities and needs for synthetic developments within the laboratory that should also lead to the initiation of other projects.

- Name of the team and team leader : M. D. LEVY
- Staff members :

	In the past	In the future
N1: Number of researchers with teaching duties (Form 2.1 of the application file)		
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	1	1
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)	3	1+X
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)	1	1
N5: Number of engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)		
N6: Number of Ph.D. students (Form 2.8 of the application file)	2	
N7: Number of staff members with a HDR or a similar grade	1	1

The group of Daniel Levy centers on the structural analysis of membrane proteins using electron microscopy. The strength of the group lies in the reconstitution of membrane proteins in the proper orientation within membranes. At this stage in time the group's major focus seems to be on the structural analysis of ABC transporters and their mechanism of action.

- Scientific productivity :

The group's publication output does not reflect the quality of its scientific vision. The group has produced 20 publications reaching mostly low-to-mid-range impact journals. No clear evidence is present from invitations to conferences on international leadership in the field. However, a clear potential for excellence was demonstrated to the reviewers that could well manifest at a later stage should the group be able to demonstrate the usefulness of their reconstitution and EM analysis approaches by publication in more high ranked journals.

- Scientific Impact :

The group is relatively small and clearly thrives from collaborations with other groups in the unit. At this stage the visibility of the group for potential students and post-docs from outside seems low. The research on reconstituted membrane systems that is done in the group is highly relevant for the research on bio-mimetic systems in the unit.

- Proposal :

The group has a clear scientific vision that is the reconstitution of membrane proteins in the proper orientation into reconstituted membrane systems. This allows the elucidation of the structure of proteins that are difficult to obtain by other means and the generation of bio-mimetic systems. Combining a protein purification approach with reconstituted membranes to obtain a system with the proper topology is highly original. The material that was shown to the reviewers demonstrated that the project has a good chance of succeeding.

- Conclusion :

The group has a good scientific potential that needs to be recognized at the international level by publication of their work in high-end journals. Care should be taken that the group does not become isolated in their activity around structure-function relationships of membrane transporters at the molecular level on the one hand, or becomes a simple service for EM activity for the other groups on the other hand. In that sense, the integration of the group in the unit via the biomimetic membrane systems is excellent and could be amplified.

- Name of the team and team leader : M. P. MARTIN
- Staff members :

	In the past	In the future
N1: Number of researchers with teaching duties (Form 2.1 of the application file)		
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	1	1
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)	1	X
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)		
N5: Number of engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)		
N6: Number of Ph.D. students (Form 2.8 of the application file)	4	
N7: Number of staff members with a HDR or a similar grade	1	1

The group is developing internationally state-of-the-art research on hair cells and the role of active mechanisms in hearing. The idea that active mechanisms drive the hair cells to the brink of Hopf criticality was introduced in the literature about ten years ago, yet it is still a subject of controversy and active research. The group is providing major and well-visible contributions in two directions: demonstrating the biological and experimental consequences of the hypothesis of critical oscillators; investigating fundamental and theoretical aspects of the model.

- Scientific productivity :

The group has an excellent publication record over the past five years, with a selected number of clear and well-written papers that constitute references in the field. The work is visible at the international level, leading to invitations to major workshops and conferences in the field.

- Scientific Impact :

The group has a strong status internationally, and is recognized within the field. They have made important contributions to the field. For example, recent work on the auditory illusion of *terzi suoni* provides a striking instance of the nonlinearities present in the hearing system, as postulated by theoretical models. The committee also remarked work highlighting the role of coupling among hair cells in noise reduction. The impact of the group is poised to further increase in the next years.

- Proposal :

The major problem that will be tackled by the group in the forthcoming future is the biological possibility of oscillations driven by calcium rather than ATP, which would allow explaining the high frequencies observed in the auditory systems, and constitutes a major open issue. Future projects are in the streamline of past work so that experience in the field is very solid. However, the questions posed and the approaches proposed are new and ambitious. The answers will definitely advance the field.

- Conclusion :

The group does an excellent job at combining modeling, simulations and experiments in a very effective blend that should be further pursued and exploited.

- Name of the team and team leader : M. P. SILBERZAN
- Staff members :

	In the past	In the future
N1: Number of researchers with teaching duties (Form 2.1 of the application file)	1	1
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	1	1
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)	3	1+X
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)		
N5: Number of engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)		
N6: Number of Ph.D. students (Form 2.8 of the application file)	7	
N7: Number of staff members with a HDR or a similar grade	2	2

This group consists of two permanent members, from CNRS and UPMC, as well as a postdoctoral fellow and six graduate students. The group explores living systems to identify interesting physics problems. They distinguish their efforts by the relevant size scale, which is that of the cell, rather than molecular. The group has constructed a small clean room, enabling them to fabricate their own devices locally. Most of these are made using soft lithography. They combine their devices with microscopy for most of their investigations.

- Scientific productivity :

The group has a steady publication record in journals typical to physics and the intersection of biology with physics. The publications reflect their efforts, and illustrate the commonly encountered problem of publication of such interdisciplinary topics, where there is a paucity of journals in which to publish.

- Scientific Impact :

The group seems to be mainly opportunistic in its choice of problems. They have chosen several interesting questions to investigate, but these seem to be motivated almost exclusively by the physics questions they pose rather than by some larger vision about what the interesting questions to investigate are, or by some overriding questions of either physics or biology.

- Proposal :

The group has proposed an interesting set of experiments that take advantage of their expertise and the facilities that they have assembled. These exploit traction force measurements of cells using deformable pillars, the study of collective motion of cells and the collective motion of bacteria. They all represent natural extensions of work that has already been started in the group.

- Conclusion :

This group has been very successful in doing interesting physics that is inspired by living systems. However, their impact would likely be increased if they were to espouse a more coherent vision, either about what the truly important physics questions are, or how the problems they choose address important questions in biology. As it is today, their work seems more opportunistic than visionary, and their impact would be increased considerably if a vision were expressed.

- Name of the team and team leader : M. C. SYKES
- Staff members :

	In the past	In the future
N1: Number of researchers with teaching duties (Form 2.1 of the application file)		
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	3	3
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)	9	5+X
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)		
N5: Number of engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)		
N6: Number of Ph.D. students (Form 2.8 of the application file)	5	
N7: Number of staff members with a HDR or a similar grade	2	2

The ultimate goal of this group's work is to develop tools to understand how cells move with implications for the treatment of metastatic cancers. They develop bio-mimetic systems that reproduce cell movements under controlled conditions in order to understand the physical and biochemical mechanisms governing cell movement.

- Scientific Productivity :

One of the strong points of this group is that they actually mix very well the biochemical reconstitution of complex organelle systems ranging from actin comet tail dynamics to membrane-actin cortices with theoretical analysis of the behavior of these reconstituted systems. On the way they have developed sophisticated physical tools to measure movement fluctuations and dynamics at high spatial and temporal resolutions. The main strengths of the whole group resides in the combined expertise in biochemistry, physical instrumentation and theoretical treatment of observations. Although other groups in the world are working along similar paths, this group is among the best in the world in terms of combined expertise. The results are very clean, clear-cut and impressive, and have important conceptual impacts concerning the understanding of cell movements and cell motility in general. Moreover, in vitro experiments such as the formation of cortices inside artificial membranes open the way to the reconstitution of whole cells. This endows this group with a huge potential in the coming years.

- Scientific Impact :

The group has a strong publication record and international impact with recognition through the Cino del Duca prize for example, but mostly through the impressive list of invited communications at the international level, important international collaborations and the excellence of the students and post docs attracted by the group.

- Proposal :

The project of this group is essentially to extend the ongoing work on in vitro cytoskeleton and whole cell reconstruction. This is a good and reasonable idea at this stage because all the tools have been developed and well characterized and the project is ripe for a strong step forward. When running a group, there is often a trade off between capitalizing on previous work and broadening the topics in order to make it richer and more interesting. This group is still in a phase where it needs to grow on the topics it has developed both at the technical and conceptual level. Therefore the choice of remaining focused is the correct one. In addition they are going to start to develop in vivo analyses on bleb mechanics, cell motility and cell shape changes in living cells using innovative optical methods, which will allow the group to initiate in vivo investigations that could be compared with what they find in their reconstituted systems. There is a very good balance between originality, ground work and risk.

- Conclusion :

This group is extremely well structured. People seem to have very clear and complementary projects and they are clearly on top of what they are doing. It belongs to the best groups in the world on this topic. The committee recommends to the group to continue on this trajectory while begin to think about diversification.

- Name of the team and team leader : M. J. L. VIOVY
- Staff members :

	In the past	In the future
N1: Number of researchers with teaching duties (Form 2.1 of the application file)		
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	4	4
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)	7	6+X
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)	1	1
N5: Number of engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)		
N6: Number of Ph.D. students (Form 2.8 of the application file)	15	
N7: Number of staff members with a HDR or a similar grade	3	3

The group has evolved in the past years thanks to active policies of recruitment that definitely strengthened the group and permitted to partially evolve and update the scientific toolbox of the team. Members of the group work on a large spectrum of problems, using condensed soft-matter tools for applications to biology and medicine.

- Scientific productivity :

The group has a very strong publication record over the past five years, publishing an impressive number of papers. Members of the group are very visible at the international level, leading to a very large number of invitations to workshops and conferences.

- Scientific Impact :

The group has a strong status and is well-recognized and invited within the field. It is also important to remark that the group actively collaborates with the rest of the laboratory and provides essential know-how on microfluidics and microfabrication. Permanent researchers attract a strong influx of students and postdocs and they are involved in a large number of national and international grants and networks.

- Proposal :

The group has proposed a wide and very interesting set of experiments that represent a solid continuation of their current efforts. The future will feature major opportunities for the group, thanks to the Institute for Microfluidics P.G. de Gennes. The nearby location will allow to benefit of expertise in both Institutes, and members of the group will be capable of developing both fundamental and applied themes, which are at the very core of the novel scientific endeavor.

- Conclusion :

The group has done an excellent job in the past years. The project on the Institute for Microfluidics constitutes an ambitious initiative, which will provide a unique structure in the center of Paris with a world-level potential, providing the team with excellent opportunities.

Intitulé UR / équipe	C1	C2	C3	C4	Note globale
Physique pour le vivant	**A+**	**A+**	**A**	**A**	**A**
Amblard	A	A	Non noté	A+	A
Bassereau	A+	A	Non noté	A	A
Brochard	A+	A+	Non noté	A	A+
Farge	A+	A	Non noté	A	A
Isambert	A	A	Non noté	A	A
Joanny	A+	A+	Non noté	A+	A+
Keller	A	B	Non noté	A	A
Levy	B	B	Non noté	A	B
Martin	A+	A	Non noté	A+	A+
Silberzan	A	A	Non noté	A	A
Sykes	A+	A+	Non noté	A+	A+
Viovy	A+	A+	Non noté	A+	A+
Scheuring	Non noté	Non noté	Non noté	Non noté	Non noté

C1 Qualité scientifique et production

C2 Rayonnement et attractivité, intégration dans l'environnement

C3 Gouvernance et vie du laboratoire

C4 Stratégie et projet scientifique

Statistiques de notes globales par domaines scientifiques

(État au 06/05/2011)

Sciences et Technologies

Note globale	ST1	ST2	ST3	ST4	ST5	ST6	Total
A+	6	9	12	8	12	11	58
A	11	17	7	19	11	20	85
B	5	5	4	10	17	8	49
C	2	1	2				5
Total	**24**	**32**	**25**	**37**	**40**	**39**	**197**
A+	25,0%	28,1%	48,0%	21,6%	30,0%	28,2%	29,4%
A	45,8%	53,1%	28,0%	51,4%	27,5%	51,3%	43,1%
B	20,8%	15,6%	16,0%	27,0%	42,5%	20,5%	24,9%
C	8,3%	3,1%	8,0%				2,5%
Total	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Intitulés des domaines scientifiques

Sciences et Technologies

ST1 Mathématiques

ST2 Physique

ST3 Sciences de la terre et de l'univers

ST4 Chimie

ST5 Sciences pour l'ingénieur

ST6 Sciences et technologies de l'information et de la communication

Ref : JFT/RR/ AERES 02 - D-2014-358

AERES
Section 2
Evaluation des unités de recherche

Paris, le 4 mai 2011

Institut de Chimie

www.cnrs.fr

Campus Gérard Mégie
3, rue Michel-Ange
75794 Paris cedex 16

01 44 96 40 00
01 44 96 53 90

Objet : pré-rapport de l'AERES concernant l'UMR168 intitulée : « Physico Chimie Curie »

L'Institut de Chimie tient à remercier le Comité d'évaluation de l'UMR168 "Physico Chimie Curie" qui confirme dans son rapport notre avis sur l'originalité et la pertinence du positionnement thématique de cette unité et souligne la stature internationale de plusieurs de ses membres.

La direction future de cette Unité est considérée avec la plus haute importance au sein de l'INC qui mettra en place le soutien nécessaire pour préserver un rôle essentiellement scientifique au prochain Directeur.

Des éléments contextuels et des précisions, apportés par la direction de l'UMR et certains responsables d'équipes, sont joints à ce courrier.

Le directeur scientifique
Régis REAU

PJ : Observations de l'UMR168

institutCurie
Together, let's beat cancer.

Answer of UMR 168 to the AERES evaluation report

The laboratory thanks the committee for his evaluation. We are grateful for the suggestions made by the committee such as the organization of a group leader meeting in order to coordinate the activities between the various groups and favor internal collaborations and the specific suggestions made to the individual groups. We will make sure to apply these suggestions in the near future.

We answer below on the choice of the new director of the unit.

Some of the comments made by the committee on the individual groups must also be given an answer. We feel that the committee did not fully appreciate the strategy and the scientific impact of the group "Physical Biology at mesoscales" of P. Silberzan. We also want to emphasize that the groups "RNA dynamics and biomolecular systems" of H. Isambert and "Structural analysis of membrane proteins and of biomimetic systems by electron microscopy" of D. Lévy have started a new activity during the last 4 years. These group leaders give below their detailed answers to the report.

Laboratory director

Following the comments of the committee on the day of the evaluation and after having discussed with the head of the committee, the Director of the Research Center at Institut Curie has decided not to pursue with the application of L. Peliti a the new Unit director. Correspondingly, some parts of the project on evolution which corresponded to the work of L. Peliti will be dropped. The following decisions have been taken ;

-JF Joanny will remain director of Physico Chimie Curie for one more year until December 31 2012 ;

-The unit will spend one year actively looking for a new director coming from outside ;

-If after one year an external director has not been found, a new director will be chosen inside the unit ;

-In order to improve the efficiency of the lab management during this period and make the search more efficient, a direction committee of 4 members has been created to assist the director.

-In order to diminish the administrative load associated to the direction, a position of Ingénieur de Recherche has been asked to the CNRS (and a position has been opened as a "NOEMI" by CNRS). The hired person will act as a laboratory (unit) administrative manager and will report directly to the director.

Physical Biology at mesoscales (P. Silberzan)

We thank the committee and the reviewers for their comments on our activity. We will take them into account in our future work. We wish however to add the following comments to this evaluation.

We have focused our research activity in the last years on a single main theme : the study of multicellular collective assemblies. Practically, we use two systems that, although biologically very different, can be effectively described by similar physics concepts : we study chemotactic bacteria that communicate via soluble factors and epithelial cells that collectively migrate on surfaces while maintaining strong cell-cell interactions. As already mentioned, working on these two systems has been extremely profitable since concepts and experimental techniques can often be shared between them.

We strongly believe that an integrated view of these living systems can only emerge from the correlation of biological and physical descriptors measured at different scales (population vs. individuals within the population). To be quantitative on these multi-scale analyses, we perform our experiments in well defined geometries. Therefore, we heavily rely on the microfabrication facility that we have set up and that many other groups now

use for their own research. With this strategy, we have reached several important conclusions and we continue to do so. In particular, we have quantitatively explained how the macroscopic wave propagation of bacteria in microchannels was related to the details of the microscopic trajectories and we have characterized the duality in behaviors in collective cell migration where very collective displacements coexist with more individual "leader cells". These results have been published in journals such as PNAS, PLoS Comp. Biol., Biophys. J. and others. They have been presented at international conferences at numerous occasions, mostly in the form of invited talks. Moreover, our experimental observations have given rise to original theoretical models designed in close collaboration between us and theory groups from outside institutions.

We do realize that the physics of these systems has to be ultimately integrated with their biology in a larger perspective. Therefore, we work in very close collaboration with several biology groups that share the same view. Using this strategy, we can make an efficient use of genetic tools and couple them to physics measurements. This dialog with biologists is also essential for defining the important biology questions. As a matter of fact, the problem of collective bacterial chemotaxis has been very useful in suggesting new routes for the formation of biofilms. As for collective cell migration, it is widely recognized as a key-process in many biological situations including the development of epithelial tumors.

We intend to develop even more these general principles in our future projects that, besides the natural developments of our present activity, encompass aspects of competition/cooperation between different populations.

RNA dynamics and biomolecular systems (H. Isambert)

We briefly address a few points either raised or omitted in the committee report.

Concerning the "implication with the surrounding scientific environment", we would like to point out that our group has had and continue to have a number of collaborations with other nearby groups : first, at Institut Curie itself with the Silberzan/Buguin group (one shared paper in 2009) and with the Camonis group (one PhD student in "cotutelle" + one grant, papers in preparation), but also with colleagues from close-by Institutes, such as V.Viasnoff from the Bockelmann group at ESPCI (one grant + one shared paper in 2010) and with the Roest Crollius group from ENS (one grant starting in 2011).

In the last 4 years, we have also made a particular effort to start a novel research topic but this is not mentioned in the committee review (except in terms of "projects" in the "proposal" section). This work on the evolution of biomolecular networks has already lead to 5 publications including 2 PNAS papers with several others under review or in preparation. Starting a completely novel line of research is particularly risky for a small team like ours but also a healthy stimulus for scientific creativity and future interactions.

While we agree with the committee, that our "productivity could be improved", this should also be put in perspective with the small size of the group (only one permanent faculty member). It is not so clear to what extent the group size and multiple co-authorship are taken into account in the productivity standards of AERES.

On a side note, we are grateful for the time and insights of the reviewing committee. Yet, we regret that they did not have the chance to hear all group leaders in a plenary session. Instead, each group was visited/interviewed for 30 minutes by only two of the seven experts of the committee.

Structural analysis of membrane proteins and of biomimetic systems by electron microscopy (D. Lévy)

Nous souhaitons remercier le comité pour le temps passé à l'analyse de l'équipe. Nous avons conscience que le développement de la cryo-microscopie électronique, qui nécessite encore des utilisateurs experts, peut apparaître comme un service. Nous avons depuis 2007 fortement contribué à la mise en place du nouveau microscope FEG à Orsay qui doit hisser l'imagerie EM du vivant à l'Institut Curie aux niveaux des standards internationaux. Nous avons aussi rendu la microscopie électronique moléculaire plus accessible à la communauté. Nous pensons que maintenant le temps dévolu à l'EM ouverte devra diminuer significativement.

Nous avons dès 2007 clos un sujet d'analyse de supercomplexes photosynthétiques sur lequel nous avions publié dans des journaux à fort impact. Nous avons pris le risque d'ouvrir un nouveau sujet d'étude des ABC transporteurs humains qui requiert des expertises de cryoEM, de biochimie et de physico-chimie. Nous avons un nombre croissant de publications, 2 projets ANR, une thèse en cours (le nombre de thésard étant limité à 1.5 étudiant par HDR par l'école doctorale Iviv).

L'analyse fonctionnelle des ABC est associée au développement, en collaboration avec des équipes de l'UMR et externes, de systèmes biomimétiques. Nous pensons que ces systèmes auront des applications dans les domaines de la physique et de la biologie cellulaire. Dans ce cadre, l'expertise de l'équipe est reconnue au travers

d'invitations aux congrès et ateliers internationaux en 2006/2008/2010, et des publications très régulièrement citées (H-index 21).

Jean-François Joanny
Professeur de Physique, Université Paris VI
Membre de Institut Universitaire de France
Physico-Chimie Curie Directeur