

EVALUATION REPORT OF THE UNIT
PCC - Physico-Chimie Curie

UNDER THE SUPERVISION OF THE
FOLLOWING ESTABLISHMENTS AND
ORGANISMS:

Institut Curie

Centre national de la recherche scientifique -
CNRS

Sorbonne Université

Université Paris Sciences et Lettres

EVALUATION CAMPAIGN 2023-2024
GROUP D

Report published on February, 13 2024



In the name of the expert committee¹ :

Christine Grauby-Heywang, Chairwoman of the committee

For the Hcéres² :

Stéphane Le Boulter, acting president

In accordance with articles R. 114-15 and R. 114-10 of the Research Code, the evaluation reports drawn up by the expert committees are signed by the chairmen of these committees and countersigned by the president of Hcéres.

To make the document easier to read, the names used in this report to designate functions, professions or responsibilities (expert, researcher, teacher-researcher, professor, lecturer, engineer, technician, director, doctoral student, etc.) are used in a generic sense and have a neutral value.

This report is the result of the unit's evaluation by the expert committee, the composition of which is specified below. The appreciations it contains are the expression of the independent and collegial deliberation of this committee. The numbers in this report are the certified exact data extracted from the deposited files by the supervising body on behalf of the unit.

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CHARACTERISATION OF THE UNIT

- Name: Unité Physico-Chimie Curie
- Acronym: PCC
- Label and number: UMR168
- Composition of the executive team: Mr Pascal Hersen (unit director), Mr Mathieu Coppey (unit deputy director) and Mr Fabrice Demarthon (unit administrator)

SCIENTIFIC PANELS OF THE UNIT

ST2: Physics

SVE3: Living molecules, integrative biology (from genes and genomes to systems), cell and development biology for animal science

THEMES OF THE UNIT

Unit PCC develops a large diversity of research subjects, at the physics-biology interface, from molecules to tissues and at different temporal scales, both at the experimental and theoretical levels. Using notably imaging tools, tools from soft-matter and statistical physics, the topics under study are biomimetic and reconstituted systems, nucleus, cell, mechanobiology, developmental and quantitative biology, immunology and translational research/clinical applications.

HISTORIC AND GEOGRAPHICAL LOCATION OF THE UNIT

PCC, created in 1996, is located in Paris, on the campus of Institut Curie in one of the historical buildings of Institut du Radium. Two research teams are located in the Institut Pierre-Gilles de Gennes close to.

At the beginning of the evaluated period, Mr Maxime Dahan was the unit director, with Mr Axel Buguin as deputy director. Following the death of Mr. Maxime Dahan in 2018, Mr Axel Buguin accepted to be director for a limited period. An international call was launched to recruit the present director. Mr Pascal Hersen is director since September 2019, assisted by Mr Mathieu Coppey as deputy director.

During the evaluation Mr Pascal Hersen indicated the future new name of the lab, Physico-Chimie Curie being replaced by Physics of Cells and Cancer, which is coherent with the topics developed in PCC.

RESEARCH ENVIRONMENT OF THE UNIT

PCC is hosted by Institut Curie, and also depends on the Centre National de la Recherche Scientifique (CNRS), Sorbonne Université (SU, Physics Department) and Paris Sciences & Lettres (PSL) University.

The proximity of Curie Hospital is favorable for direct collaborations with medical doctors. Institut Curie provides 19 technological platforms. PCC hosts itself four in-house facilities and the labelled national IBISA cryo-EM facility.

PCC is a founding member of the "Domaine d'Intérêt Majeur" of Région Ile-de-France named Bioconvergences pour la Santé and of a major SU project, the Parisian Biofoundry. Its main doctoral school is accredited by SU and PSL. This last one is not an official PCC's supervisory authority, but PCC is concerned by its research ecosystem (PSL is a collegiate University of which Institut Curie is an associate member). It benefits from PSL programs and many PCC's members are involved in PSL academic organization (academic senate, physics graduate program board, QLife institute...). At last, PCC is involved in two labex of PSL University, Cell(n)Scale and IPGG ones.

UNIT WORKFORCE: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	2
Maîtres de conférences et assimilés	4
Directeurs de recherche et assimilés	11
Chargés de recherche et assimilés	15
Personnels d'appui à la recherche	15
Sous-total personnels permanents en activité	47
Enseignants-chercheurs et chercheurs non permanents et assimilés	4

Personnels d'appui non permanents	21
Post-doctorants	27
Doctorants	42
Sous-total personnels non permanents en activité	94
Total personnels	141

DISTRIBUTION OF THE UNIT'S PERMANENTS BY EMPLOYER: in physical persons at 31/12/2022. Non-tutorship employers are grouped under the heading "others".

Nom de l'employeur	EC	C	PAR
CNRS	0	24	7
Institut Curie	0	0	8
Sorbonne Université	5	0	0
Autres	1	2	0
Total personnels	6	26	15

GLOBAL ASSESSMENT

PCC is an attractive and dynamic unit, developing original and innovative research activities at the interface of physics and biology, and mixing pioneering experimental and theoretical approaches applied to a wide range of systems, from biomimetic ones to cells and tissues. Its research themes, in perfect adequacy with the strategic plan of Institut Curie, are relevant, tackling central questions in self-organization, cytoskeleton, collective behaviours, cell differentiation, mechanobiology... PCC is highly involved in the major public health challenge of fight against cancers.

PCC aims logically at enlarging its expertise; some recruited researchers over the period brought complementary skills in microfluidics, super resolution and synthetic biology. PCC takes also benefits on various topics from close collaborations with biologists in neighbour's laboratories and medical doctors from the Curie Hospital, but also from a solid national and international network of collaborations. PCC can also rely on several facilities, which are essential for the development of its research projects.

PCC's teams are remarkably successful in competitive calls, obtaining funds from the local to the European level. It is also proactive, being a founding member of two labex. This maintains it to the highest level, in a strongly competitive international context, as shown by its high-ranking production (mixing publications, conferences or protocols) and several prizes. Among PCC's productions, the committee wishes to mention the efforts made by PCC's direction and teams to provide a clear and detailed report, which gives a complete overview of not only the research activities, but also the organization and life in PCC.

PCC is also strongly involved in translational research projects and longstanding interaction with start-ups, and met several successes in patents. At last PCC has the will to share its research with the public through different actions of science popularization.

All these indicators and its future projects in the logical continuity of current activities show that PCC overcame collectively the brutal decease of the director.

Despite its very positive results and activities, PCC also has several challenges to confront. Among them, facilities are critical for the development of PCC research projects and need to be reinforced in the future, and the building limitations (some radioactive contamination slowing down renovations) are not completely solved. Another challenge will consist to reduce the risks of expertise loss due to a high turn-over, in particular in non-permanent members.

DETAILED EVALUATION OF THE UNIT

A - CONSIDERATION OF THE RECOMMENDATIONS IN THE PREVIOUS REPORT

Previous recommendations concerning scientific production and activities were taken into consideration by PCC with fostered combination of experimental and theoretical works, the recruitment of established teams with a new expertise and the development of projects with a socio-economic target.

PCC also took into consideration recommendations on its organization and life. It brought pertinent and well-adapted answers, among them the rebuilding of its internal communication, the use of English and French in official messages, the building renovation and actions concerning facilities. The co-leadership in one team was clarified.

Last recommendations concerned PCC scientific strategy and projects. Here also, PCC took them into consideration with the arrival of two junior teams and risky projects in the interaction with existing teams.

B - EVALUATION AREAS

EVALUATION AREA 1: PROFILE, RESOURCES AND ORGANISATION OF THE UNIT

Assessment on the scientific objectives of the unit

PCC is a internationally recognized, leading, attractive and dynamic unit developing original and innovative research activities at the interface between physics and biology, by mixing quantitative experimental and theoretical approaches in a wide range of systems. High-level and various productions (publications, protocols, conferences) are evidences of the quality of these activities in a competitive context.

Assessment on the unit's resources

PCC teams are very efficient in competitive calls, obtaining funds from the local and national (ANR) to the European (ERC) level. PCC is also proactive, being a founding member of two Labex. Its budget distribution is well adapted to its internal organization and teams are widely financially independent thanks to their successes in fund calls.

Assessment on the functioning of the unit

PCC succeeded to stabilize its administrative staff after a turbulent period and developed pertinent and efficient digital tools and workspaces for its functioning. It also has a voluntary and efficient politics for the traceability and storage of data. PCC encourages trainings for all its members. It is also attentive to safety and quality of life at work, and parity and gender issues. Its "Green Physics Lab" team aims at making PCC greener in its daily practices. Institut Curie and PCC did also a clear effort in the (still incomplete) depollution and renovation of the historical building of Institut Curie.

1/ The unit has set itself relevant scientific objectives.

Strengths and possibilities linked to the context

PCC's objectives are to promote a high-level collaborative and interdisciplinary research at the physics-biology interface, mixing experiments and theory, in perfect adequacy with the strategic plan of Institut Curie. It also aims to develop its activities in close collaboration with biologists from the neighboring laboratories and

institutions. PCC is also highly involved in the major public health challenge of fight against cancers, thanks to the closeness to the Curie Hospital and a direct contact with medical doctors. PCC aims logically at enlarging its internal expertise and some recruited researchers over the period brought, in particular, complementary skills in microfluidics, super resolution and synthetic biology, which are very relevant for future promising topics. PCC also considers as a priority the recruitment of 2 new junior teams in the following years.

Another objective of PCC is to promote internal multi-team initiatives and joint brainstorming sessions. The ElectroBiology project is a successful example of these interactions, paving the way to the development of other topics fitting with the PCC and Institut Curie scientific strategies.

Weaknesses and risks linked to the context

In a context of pluridisciplinary research, biology facilities are critical for the development of PCC research projects and must be maintained at their higher level. The arrival of junior teams working on different systems also implies to diversify, as much as possible, facilities' skills. The sustainability of the cryoEM facility is also a challenge. At last, a technical support would be useful in imaging, a large part of the teams developing setups and using image analysis.

The building limitations (with the specific context of radioactive contamination slowing down renovations, without any clear timetable for renovation work) prevented PCC to recruit more junior teams, whereas there is a need to renew the pool of young researchers and group leaders.

2/ The unit has resources that are suited to its activity profile and research environment and mobilises them.

Strengths and possibilities linked to the context

PCC encourages researchers to apply to grants. In this context teams are highly efficient in obtaining funds from the local to the European level, in particular, seven ERC and several FET OPEN (Pathfinder) funded projects. Under these conditions, PCC received 230 grants over the period, corresponding to an average of 40 grants per year equivalent to 5 M€ annually.

PCC is also proactive, being a founding member of the two labex Cell(n)Scale and IPGG, as well as a partner of the QLife program.

Annual budget is shared out transparently between different logical items. Half (around 250 k€) is used for the maintenance and functioning of shared resources, main equipment's and building. A significant part is also devoted to scientific animation, HSE and "Green Physics Team". The other half directly supports research teams, taking into account their size. Endowments not spent by the teams are re-oriented towards shared resources.

PCC activities are supported by complementary and efficient facilities, both at the laboratory and the Institut Curie levels. Efforts made to acquire new setups are also noteworthy. PCC's projects centered on the Parisian Biofoundry or the creation of a FabLab, are also highly pertinent, offering new perspectives.

The functioning of these shared facilities is simple and logical, their annual budget financing equipment and research team's preliminary data acquisition. For larger projects, teams must logically provide a financial support.

PCC takes benefits from PSL University ecosystem with a large offer of trainings and access to different fund sources.

At last, the depollution of the remaining untreated areas of the building has been already budgeted by the Institut Curie.

Weaknesses and risks linked to the context

Both labex will end in 2025, whereas they are used to co-fund large equipment for facilities, critical for some PCC's teams. Logically PCC is participating to the call for the PSL "Grand Programme" taking over Labex, proposing two projects "Engineering Life" and "Innovation with Microfluidics". PCC passed successfully the first round (the second one is planned in December 2023). However, "Grands Programmes" are more opened than Labex (which finance among others non-permanent positions in PCC) with a risk of reduction in fundings.

PCC was previously in the perimeter of INC for CNRS. In January 2024 it will depend on INP and INSB, which practice different policies and rules.

A major issue for PCC is the maintenance costs associated to large instruments such as cryoEM. A reflection has to be engaged concerning their economic model and sustainability.

Depollution of the building requires certified companies; the associated cost is very high. As a consequence, several rooms are still closed, slowing down promising scientific projects. For the renovation following depollution, the context is that Institut Curie is alone to support the charge.

3/ The unit's practices comply with the rules and directives laid down by its supervisory bodies in terms of human resources management, safety, environment, ethical protocols and protection of data and scientific heritage.

Strengths and possibilities linked to the context

The overall management of PCC is standard, relying on a direction team, a monthly meeting where all the teams are represented and a lab council (3 per year in average), completed with a "strategy day" opened to all PCC members.

Parity is globally respected with 47% of women, but the situation becomes increasingly more biased along the hierarchy: permanent researcher positions, group leaders and direction are 64%, 77% and 75% male, respectively. Gender issues are discussed and one person is identified as contact for harassment situations and human resources issues.

After some difficulties (2017-19), the administrative staff is stabilized. It developed internally pertinent and efficient digital tools. A simple process is set up for newcomers and the hosting quality is good.

PCC encourages trainings for all members, including PhDs and Postdocs. Technical staff has different opportunities to diversify its skills through training programs or visits in other labs. This staff involves itself also in the training of students.

A HSE team deals with safety and quality of life. One person is in charge of laser risks. PCC acts transparently concerning some parts of the building still radioactive with a complete map of contaminations available and radioactive spots clearly tagged. A decontamination plan was validated in 2020. An entire floor and a part of the basement were decontaminated and renovated.

PCC has a voluntary politics for the traceability and storage of data: consolidating and facilitating repositories and tools, computers progressively encrypted...

A "Green Physics Lab" team (2019-...), with a budget and a roadmap, proposes solutions to make PCC greener in its practices. PCC also develops digital tools to replace previously paperwork-based processes.

Weaknesses and risks linked to the context

Even if parity is globally respected, there is a strong imbalance at the level of permanent researcher positions (23M/13W) and group leaders (10M/3W). Only one woman was recruited on the period.

An important weakness concerns the researcher training in good management practices, which has to be improved. The PCC's direction has started to deal with this issue.

People working in PCC for several years lack of safety training renewal and globally culture of safety at work has to be improved. Here also PCC's direction has a voluntary policy. A better control of lab access outside office hours is also needed.

A risk for data protection and storage, and more widely informatics, is evoked due to a lake of dedicated human resource.

EVALUATION AREA 2: ATTRACTIVENESS

Assessment on the attractiveness of the unit

PCC is highly attractive in terms of scientific and technological skills, maintaining its multi-disciplinary activities at the highest level. Its scientific reputation is excellent as shown by its successes in competitive calls and its international positioning in topics in the demanding fields of physics applied to biological systems, which are in permanent evolution.

1/ The unit has an attractive scientific reputation and is part of the European research area.

2/ The unit is attractive because for the quality of its staff support policy.

3/ The unit is attractive through its success in competitive calls for projects.

4/ The unit is attractive for the quality of its major equipment and technical skills.

Strengths and possibilities linked to the context for the four references above

Concerning attractiveness, the committee points out the recruitment of two juniors and one senior, about seven PhD defenses per year, about twenty interns per year, visiting researchers, and around fourteen invitations of international speakers in seminars in 2022. Other strengths concern the responsibilities of PCC's members taken in the organization of conferences, in editorial boards, and also a recognition by prizes (five during the period, including one CNRS silver and two bronze medals). At last, eight applications were received in the context of the international call organized to recruit a new director in 2019. The present director was recruited by a committee including external members from France and Europe.

Despite the absence of a welcome desk in PCC or in Institut Curie, the staff hosting quality is good, in particular thanks to the involvement of the administrative team helping newcomers to solve different problems. PCC developed a simple and clear process, based on a first webform. Practical aspects are treated before the arrival and a communication is made to the whole unit.

PCC organizes an integration week for all newcomers, including various presentations necessary to be efficiently and rapidly operational. Each newly recruited researcher receives a CNRS or SU installation grant (10 k€ and 17.5 k€, respectively), completed by a grant of PCC of 5 k€. Supervisory institutions also develop other actions towards young researchers (calls for financial supports, mentoring, help to answering to fund calls, decrease of the teaching time during two years for assistant-professors with a supplementary time for an ERC application).

PCC is highly efficient in applying to various competitive calls for projects and obtaining funds from the local to the international level (calls from Institut Curie, PSL and SU, Labex, PIA, ANR...). It is highly competitive in the European context with, in particular, seven ERC and several FET OPEN (Pathfinder) projects.

PCC is an attractive place in terms of leading-edge technologies. Some setups are included in research team's equipment, whereas other ones are available as shared facilities funded by PCC (around 70 k€/y) or from the Institut Curie. Well-equipped shared facilities in PCC are a real strength, covering different domains, all essential and complementary.

Mechanical workshop will evolve in the future by expanding with a FabLab space open to the whole Institut Curie, which will generate incomes for PCC lab. PCC also hosts the labelled national IBISA cryo-EM facility open to Institut Curie and beyond.

Such an organization based on common platforms enables to reach a critical mass of ITA in a context of restricted hiring and difficulties to attract and stabilize technical staff. This contributes to give a fair access to all teams and to favor an open and collaborative work atmosphere.

PCC is also attentive to career developments, encouraging trainings for all lab members including ITAs. Engineers are not attached to the teams but to shared facilities, giving them opportunities to diversify their skills.

PCC contributed to trainings with the organization of four international courses for young physicists on quantitative biology and physical-biology approaches, and the co-organization each year of the "Circle Meeting" in a European collaboration with EMBL, Crick Institute, Amolf University and MPI-Dresden. It is particularly attentive to PhD students and Postdocs for grant applications. The Cell(n)Scale Labex can support Postdocs for starting projects through funding or transition grants between two contracts.

Weaknesses and risks linked to the context for the four references above

PCC seems to have difficulties to gather European participants in the case of FET OPEN (Pathfinder) projects.

Even if PCC is widely open to visiting researchers, long-term visits have been restricted to only four teams over the period.

The two Cell(n)Scale and IPGG Labex will end in 2025. PCC has built two projects in the context of "Grands Programmes", which will be evaluated soon however they are more opened than Labex with a risk of lower fundings for PCC in fine.

Some PCC teams mention the more favorable context of researchers abroad, leading to more ambitious and expensive projects developed in easier conditions.

Collaborative projects inside a same unit are in general not accepted by grant agencies. This limits collaborative projects inside PCC.

Funding for large equipment is rare and some equipment are costly in maintenance (about 120k€/y for IBISA).

PCC has also difficulties to attract, recruit and promote engineers and technicians. The low level of salaries and the housing cost in Paris seem to be the main reason.

Two engineers are paid by one of the Labex ending in 2025. The risk is high to lose the technical expertise and to negatively impact the unit organization, since some tasks would be redistributed.

The interdisciplinary subjects of PhDs lead to durations higher than three years. High turnover of students also limits the ambition of PCC in its research projects.

EVALUATION AREA 3: SCIENTIFIC PRODUCTION

Assessment on the scientific production of the unit

PCC scientific production in terms of publications is rich and of high quality in journals with a strong impact, both in experimental and theoretical domains. This production is also wide with datasets, protocols, software/web applications and patents forming a solid heritage.

- 1/ The scientific production of the unit meets quality criteria.*
- 2/ The unit's scientific production is proportionate to its research potential and properly shared out between its personnel.*
- 3/ The scientific production of the unit complies with the principles of research integrity, ethics and open science. It complies with the directives applicable in this field.*

Strengths and possibilities linked to the context for the three references above

PCC shows an important level of publications, in increase as compared to the previous period, matching well the increase of PCC members.

The nature of journals where PCC researchers publish their results reflects well the high diversity of PCC activities and its interdisciplinary topics. Journals are of high quality, in clear progress as compared to the previous period. The production has an excellent international visibility with more than 10 400 citations for the papers published with PCC affiliation during the reported period.

PCC laboratory has an excellent scientific production beyond publications, with datasets, protocols, software/web applications and patents.

Different tools are well established to share the production between PCC members and to break down possible barriers between teams.

Several PCC members are involved in editorial committees in journals at the forefront of Open Science, and a fair number are reviewers. PCC also pays attention to the predatory publishers and conferences, with group leaders involved to guide younger researchers in such situations.

Three teams are mainly involved in experiments involving animals, human samples and medical records. All experiments are approved by the Institut Curie's ethics committee and comply with European and French legislation. Doctoral and post-doctoral students receive training in animal experimentation. Finally, a project developed at the PCC aims to reduce animal sacrifice in cancer research by developing tumor-on-vessel devices, also potentially used as patient avatars.

At last PCC favors the quality of the production rather than the number of published articles. It encourages its members to take risks with topics, which are not expected to lead rapidly to publications, but will contribute to its future activities through novel research areas.

Weaknesses and risks linked to the context for the three references above

For some PhD students or Postdocs, results are published late, which is penalizing them.

Article Processing Charges (APCs) are a major issue for PCC. Even if all publications are not concerned by Gold open access, APCs constitute a huge obstacle to publications in famous journals and more widely to open science, a huge impact on the laboratory resources and an undeniable brake for science diffusion.

EVALUATION AREA 4: CONTRIBUTION OF RESEARCH ACTIVITIES TO SOCIETY

Assessment on the inclusion of the unit's research in society

PCC is involved in translational research projects and longstanding interaction with startups, supported by the Tech Transfer Office of the Institut Curie. It met different successes in patents and licenses. It also benefits from the favorable closeness of medical doctors from the Curie Hospital for direct and constructive interactions in projects concerning a major public health issue, the fight against cancer. At last PCC has the will to share its research with the public through different actions of science popularization.

- 1/ The unit stands out for the quality and the amount of its interactions with the non-academic world.*
- 2/ The unit develops products for the cultural, economic and social world.*
- 3/ The unit shares its knowledge with the general public and takes part in debates in society.*

Strengths and possibilities linked to the context for the three references above

During the period, PCC generated height patents and licensed three methods. One startup was created and another one was developed. PCC also works efficiently with the Tech Transfer Office to better identify projects with a clear economic potential.

The labex Cell(n)Scale enabled to hire a person in charge of these economic developments.

PCC seizes the opportunity of its location to participate to the effort of Institut Curie aiming at finding solutions to treat cancer. The closeness of the Curie Hospital is a real opportunity for PCC members to collaborate directly with medical doctors.

Several PCC members were strongly involved during the pandemic in gathering labware or making DIY material for the hospital.

PCC is widely involved in different non-academic actions of science popularization such as Fêtes de la Science, large public conferences or DECLIC programs. It hosts regularly high-school students in immersion or for discussions. It also communicates to the public through global actions from the Institut Curie, CNRS and PSL University or different tools, some of them being rather innovative (comics and videos).

Weaknesses and risks linked to the context for the three references above

The collaborations with industrial partners funding outside Institut Curie are limited.

The Labex Cell(n)Scale will end in 2025 leading to the question of the way that PCC will manage further economic development and links with the Tech Transfer Office if the dedicated position disappears.

The involvement of PCC in societal issues (such as climate change) is not enough developed even if its projects on the fight against cancer clearly belong to societal emergencies.

ANALYSIS OF THE UNIT'S TRAJECTORY

PCC has clearly again consolidated its leader position in the application of physics to biological systems. It develops very original and innovative experiments and high-level theoretical descriptions applied to a wide range of systems, from the molecule to the embryo. Fundamental and applied research activities are present, biomedical applications benefiting in particular from a favorable continuum between research and clinics due to PCC specific environment.

Concerning its future scientific orientation, PCC makes a pertinent double choice: digging further into mature questions for a deeper understanding of physics acting in biological systems, and developing novel and emergent topics. PCC identifies collectively five research programs in the logical continuity of its previous activities aiming at "modeling or understanding or engineering life", with a clear organization where each team contributes to several programs. The theory-experiment association, historical strength of PCC, will be maintained and even reinforced. The various competences present in PCC will act as an undeniable support for both mature and more risky emerging topics.

Thus, activities focused on reconstituted systems will be extended to synthetic biology in combination with optogenetics, which is a novel subject for PCC. Biological active matter will remain a pillar of the PCC's research activities, going towards new topics around the implication of electrical fields (bioelectricity) in some unexpected biological processes such as patterning and morphogenesis. Activities within mechanobiology will be pursued, future works exploring the links between mechanics and shapes, sensory systems and pathologies. In this context, studies exploring cell differentiation will be accentuated. A part of PCC's activities will be devoted to the control, information, networks and fate, getting into metabolism, dynamics of gene regulation, response to external perturbations and differentiation. Such aspects will include data analysis via machine learning, already an active field of PCC but developed and extended in the future. At last, an important part of PCC's activities is turned towards the development of new technologies. Efforts will be maintained in this direction with different projects dealing with organ and tumor-on-chips, breast-cancer drug resistance through a single molecule approach or extracellular vesicles biophysics. Some of these topics will be studied in tight interaction with clinicians from Curie, Pasteur and Necker hospitals, in a therapeutic purpose.

Different calls have been successful, DIM's one paving the way towards innovations with a socio-economic impact in Paris region (development of the first France biofoundry, a "DNA factory" for the production of plasmids, cell transfection..., including an offshoot in PCC planned in 2026). Others projects are under review, whereas some of them were not selected but enabled to initiate discussions at the regional and national levels, useful for the future. Future activities devoted to the development of new technologies and therapeutic applications will surely open the door towards new relationships with industrial partners.

The two Cell(n)Scale and IPGG Labex will end in 2025, but PCC has already built two ambitious projects (evaluated at the end of 2023). These projects are in the logical continuity of previous ones and concern ambitious questions pertinent for fundamental and applied research. The Bioconvergence DIM funding and the Biofoundry, where PCC has a leading role, make also a favorable environment for future projects (including the development of the molecular and cellular biology facilities required by some projects).

The principal goal of PCC is to facilitate the development of its research programs. This will be possible through different complementary actions in terms of internal organization, recruitments and consolidation of expertise's, grants calls and international collaborations. PCC will consolidate its organization, already widely improved over the last period. In this context, it actively participates to the Curie 2030 program, being particularly pertinent in the field of digital transformation that is setup previously, freeing up time for administrative and research staffs.

Other aspects concern the finalization of the building's renovation, making rooms for novel projects and the development of PCC's technological expertise. On this last point, considerations are also in progress concerning the future organization of the shared Mechanical Workshop and the older clean room. A budget of 200 k€ (Labex Cell(n)Scale) has been already secured to expand the workshop with a FabLab space, open to the whole Institut Curie, and a prototyping pole project is being studied for the design and fabrication of microfluidics and microfabricated systems.

PCC plans also to continue a work already started around the consolidation and valorization of protocols and biological materials produced by its facilities. It also considers the possibility to regroup different NAS systems for data storage and to find resources to manage them collectively.

Taking into account an expected turnover in two already identified research teams at the end of the next period (for retirement reasons), PCC will give also a particular attention to the recruitment of new junior teams before these leavings and of engineers or technicians. It will also encourage the submission of projects in grant calls and to associate to large initiatives of its supervisory institutions. It will test in the next period the possibility to ease discussions and feedbacks within the unit, for the internal reviewing of publications and projects.

At last important task will concern the development of international collaborations through research programs with already identified institutions over the world.

RECOMMENDATIONS TO THE UNIT

Recommendations regarding the Evaluation Area 1: Profile, Resources and Organisation of the Unit

The committee invites PCC to continue to develop its relevant activities at the physics-biology interface and to maintain them at the current high level. The wealth provided by high-level experiments and theoretical approaches is a key point to be maintained, as far as a combination of fundamental and applied researches.

The committee encourages also PCC to continue its pertinent discussions centred on biomathematics with Institut Henri Poincaré.

Building on past success, the committee urges PCC to sustain its efforts in securing national and international funding. PCC adeptly anticipated the conclusion of the two Labex programs by proposing two "Grand Programmes". Vigilance is advised regarding compliance with different INP and INSB practices.

PCC is encouraged to prioritize its facilities, critical for future projects. It should devise an economic model for facility sustainability, emphasizing support for permanent staff to maintain cutting-edge skills. Consideration is needed for the impact of new teams and increased demands for imagery analysis.

Special attention is required for the cryoEM facility due to the impending retirement of its leader. Leveraging positive initiatives from the previous period, PCC should continue enhancing organization, communication, and collaboration both within and beyond the laboratory, considering the socio-economic environment.

Concerning the recruitment of new junior teams, PCC should be careful to their harmonious integration in the unit. Taking into account that senior leaders will leave PCC in a more or less near future.

The committee encourages PCC to maintain its efforts for recruitments and promotions of all the personal categories, and to work to increase the visibility of its assistant professors in Physics Department of SU.

The committee encourages PCC to continue to develop social life events, important for its cohesion.

Recommendations regarding the Evaluation Area 2: Attractiveness

The overall renovation of the building is necessary to guaranty health, surfaces dedicated to experiments and welcome of new members or visitors.

Long term visits should also be generalized to more teams.

The committee advises PCC to be more involved in the development of trainings upstream PhD, in order to increase its attractiveness but also to improve the integration of students.

Recommendations regarding Evaluation Area 3: Scientific Production

The committee encourages PCC to maintain its efforts in terms of publications of high level and diversity and to keep the direction of favouring their quality rather than their number. At the same time, PCC should continue to take some risks with topics which are not expected to lead rapidly to publications, but will contribute undeniably to its future activities and influence in a competitive context. The committee also encourages PCC to pursue its positive policy in terms of Open Science, Open Data and FAIR principles. To this respect, a collective reflection could be carried out on the relevance of continuing to contribute to a deleterious, always-more-expensive Article Processing Charges (APC) system.

At last, the committee invites PCC to maintain its excellent scientific production beyond publications, with datasets, protocols, software/web applications and patents, which make also its wealth.

Recommendations regarding Evaluation Area 4: Contribution of Research Activities to Society

In the favorable context of the close Curie Hospital and tight interaction with clinicians from other hospitals, PCC is encouraged to maintain and amplify such collaborations in the fight against cancer.

Efforts should be also maintained in the development of new technologies, including organ and tumor-on-chips. Such activities will surely open the door towards new relationships with industrial partners, translational research projects and interaction with startups. In this context the committee recommends to PCC to be careful concerning the protection of its activities in applied research by appropriate patents and licenses, as already done during the previous period.

The efforts of PCC aiming at making it greener in its practices are noteworthy and the committee encourages PCC to share its practices with other labs.

TEAM-BY-TEAM OR THEME ASSESSMENT

Team 1: Membranes and cellular functions

Name of the supervisor: Ms. Patricia Bassereau

THEMES OF THE TEAM

The purposes of the team are devoted to improve the knowledge in the field of the biological membranes and their role in living systems. To achieve their objectives, researchers are developing an approach based on synthetic biology and biomimetic systems to reproduce the complexity of cellular membranes. They rely on innovative experimental and technological developments such as the micromanipulation of giant uni-lamellar vesicles combining micropipette aspiration, optical tweezers, and confocal microscopy or the use of single molecule imaging techniques. This strategy allows the group to achieve a quantitative physical description of the role of lipid membranes and the associated proteins to better describe the cellular functions.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

No strong weaknesses were identified during the last evaluation. The main recommendation was to improve the biological expertise of the group. The team followed this recommendation, by hiring a researcher having a complementary profile with the other permanent staff.

WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	
Maîtres de conférences et assimilés	
Directeurs de recherche et assimilés	1
Chargés de recherche et assimilés	1
Personnels d'appui à la recherche	
Sous-total personnels permanents en activité	2
Enseignants-chercheurs et chercheurs non permanents et assimilés	
Personnels d'appui non permanents	
Post-doctorants	6
Doctorants	4
Sous-total personnels non permanents en activité	10
Total personnels	14

EVALUATION

Overall assessment of the team

The team is based on the strong recognition of the team leader helped by a CR CNRS recently arrived. They are developing a ground-breaking work in the fields of transmembrane transport, protein diffusion in membranes, adhesion, cell infection or endo-exocytosis. The many funded projects are balanced between innovative technical developments and fundamental activities. Their know-how and expertise are of high originality, leading to highly visible collaborations, a high publication track record, a high success rate in fund raising and a strong attraction for visiting scientists.

Strengths and possibilities linked to the context

The team has available state-of-the-art original equipment's including micropipette setups coupled with optical traps and also a super-resolution imaging platform. They are complemented to platforms of the Institut Curie.

The team is internationally recognized with a strong academic reputation. Their original and ground breaking scientific activities have a noticeable impact on the communities proven by different indicators. The team has an excellent publication track record with 50 peer-reviewed publications in high-level journals, such as Cell, PNAS, Nature, Science Advances. The team is corresponding author for around half of the papers and has many invited talks (>80) and participated in conferences organization (EMBO, BPS,...).

The team also developed a strong collaboration network with biologists and theoreticians at the local and international levels. Some of the publications are co-authored with a PCC team (mainly Levy's and Sens' teams) and others are coming from international collaborations. The international visibility of the team also leads to the hosting of 3 invited professors and 7 PhD students.

The team had an impressive success rate to research calls, with around 3 M€ raised over the period. This includes an ERC advanced grant as partner, 11 ANR projects, 1 Human Frontiers grant, a FRM labelled team fund, and Labex and local calls. A very promising point for the future is the ability of the CR to secure her own funding.

Successful recruitments of several postdocs allowed to complete the team thanks to very competitive fellowships. Two of them have secured a CNRS CR permanent position within the team. If the departure of a "maîtresse de conférences" for a promotion decreased the human potential, this is also a positive indicator of the excellent team's level. The strong visibility of the PI is also proven by the national and international awards received during the period, her various editorial activities, her participation to ERC, HFSP and ANR evaluation panels and institute councils in Germany, and her activities as chair in international scientific society.

Weaknesses and risks linked to the context

The committee points out only minor points. It concerns the involvement in teaching and in outreach activities. With the departure from the team of the only "maîtresse de conférences", none of the team members have a strong involvement neither in teaching duties nor in outreaching activities.

A mid-term risk is directly due to the strategy of the Institut Curie regarding the possibility for the PI of retiring before the end of the coming period. As for a senior PI retirement, this could lead to the disappearance of this team, which should be anticipated.

Analysis of the team's trajectory

From a scientific point-of-view, the team aims at understanding different important fundamental processes in membranes such as the behavior of transmembrane proteins, membrane shaping or its coupling with cytoskeleton. The project of the team is clear and in the continuity of previous activities. The axis on transmembrane proteins will be extended to the study of receptors in immune cells, whereas the axis on membrane shaping and scission will be pursued in direction of cavin associated with caveolin. Different studies on the generation of forces by cells or the formation of podosomes for instance will be developed in the frame of the third axis.

The team has successfully recruited a former postdoc as CR CNRS in 2019 and she is now developing her activities thanks to many funded projects such as a ANR JCJC. In 2020, Mrs S. Mangenot has left the team after being promoted professor at University Paris City, and her subject related to septins has been transferred to her new lab and to A. Bertin's team in PCC. The team is still growing with the arrival of new permanent as CR CNRS in 2023 after his postdoctoral fellow in the lab.

With now three permanent CNRS researchers, the team is extending and pursuing the on-going studies but will also develop new innovative projects within the next five years. In particular, through an ERC synergy grant recently obtained by the PI, the team will study how immune cells probe, sense and deform their environs by pushing into them. With existing funding for the years to come and the development of original activities by the two young researchers of the team, the team's future is still bright and the scientific projects are coherent with the current international state-of-the-art and are part of four PCC axis.

RECOMMENDATIONS TO THE TEAM

With the arrival of a "chargé de recherche" of CNRS care has to be taken to maintain the team cohesion and at the same time to allow the career development of the two other young researchers of the team.

A major point concerns the retirement of the team leader in a near future. The committee encourages the team to anticipate this departure and to elaborate a strategy with the two recently arrived CNRS permanent staff.

Concerning difficulties to attract PhD students and postdoctoral fellows from France, the committee suggests to the team to increase its participation to master's programs and to welcome students for M1 internships.

With the same idea, a better involvement in outreach activities (Fête de la Sciences...) could increase the attraction of the lab towards students.

Team 2: Light-based observation and control of cellular organization

Name of the supervisor: Mr Mathieu Coppey

THEMES OF THE TEAM

Through the development of innovative and cutting edge advanced light microscopies (super-resolution, single molecule imaging), the team aims to identify physico-chemical processes involved in cell migration and polarity, nuclear organization, signaling, and gene expression, from the molecular to cellular scales.

Original results were thus obtained in the control of the cellular signaling in the context of cell migration, using magneto- and optogenetics. Noticeable improvements of single molecule localization and tracking allowed to study the motion of individual transcription factors within the nucleus and the diffusion of objects in the cytosol. These complex data have been analysed thanks to the development of original visualization tools, shared with the scientific community on github.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The previous committee recommended that the equilibrium between developments of new methods and biological applications should be maintained as much as possible in the future. The present committee considers that this equilibrium was maintained, even if the magneto-genetics topics was considered as too heavy as compared to the team's human resources and then (reasonably) transferred to another lab of Institut Curie.

Another recommendation was to combine the expertise of the team members through projects. The team has been attentive to focus on given and well-defined biological questions. It decided to develop joint projects and to introduce overlap between team members in order to reinforce the team's cohesion.

At last, one recommendation of the previous committee was related to a weak number of public outreach activities for the different permanent and non-permanent team members. The present committee notes that team's members participated to different outreach actions such as "fêtes de la science" and a presentation of the research jobs in a high school.

WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	
Maîtres de conférences et assimilés	
Directeurs de recherche et assimilés	1
Chargés de recherche et assimilés	1
Personnels d'appui à la recherche	
Sous-total personnels permanents en activité	2
Enseignants-chercheurs et chercheurs non permanents et assimilés	1
Personnels d'appui non permanents	3
Post-doctorants	2
Doctorants	3
Sous-total personnels non permanents en activité	9
Total personnels	11

EVALUATION

Overall assessment of the team

With the loss of Mr Dahan, in 2018, the team was forced to re-organize. Despite this difficult situation, the team remains highly visible on the field of the study of the physical principles underlying cell migration, signaling and gene expression using highly innovative state-of-the-art optical equipment such as optogenetics and single molecule imaging. The team is internationally recognized for its expertise and its visibility is proven by national and international collaborations, an excellent publication track record in high-ranking journals and a high success rate in fund raising.

Strengths and possibilities linked to the context

The team had a high success rate in fund raising (total of 2.8 M€) and the two-team permanent members demonstrated clearly their ability to raise their own funding, mainly at a national level. They are particularly visible at the European level allowing them to fund PhD students and postdoctoral fellows. National and international collaborations are another evidence of their visibility.

The team has state-of-the-art optical equipment. It is internationally recognized for its expertise in the development of cutting-edge optical methods and in their application to study the physical principles underlying relevant biological questions from molecular to cellular scales, in cell migration, signaling and gene expression. The team also develops innovative visualization tools to improve the treatment of large dataset and has also an access to the facilities and technological platforms of the Institut Curie.

The team had an excellent publication track record during the period with 46 peer-reviewed publications in high-ranking journals. Most of the high-ranked papers have been published with one team member as corresponding author and collaborations have led to 30 publications. Only 9 papers involved Mr Dahan as only permanent member of the team, which shows that the team was able to limit the impact of this tragic loss.

The team was involved in about 25 international invited seminars or conferences and in as many national or local invited seminars or workshops. Team's PI and non-permanent members also participate to several courses and summer schools. Team's permanent members have a significant implication in bachelor and master's classes. The team's members have also been very active in the organization of scientific days, workshops, international schools and courses.

In terms of collective duties, the PI is the deputy director of PCC since 2019 in addition to his participation to the steering committee of two GDR and the second permanent team member is part of the advisory board of the PICT imaging platform of the Institut Curie and member of the Labex Cell(n)Scale steering committee.

Weaknesses and risks linked to the context

There is no major weakness for this team, which has been quite resilient following Mr Dahan's death. With one of team's PI being the deputy director of PCC, they have to be attentive in maintaining their scientific activities at the same level.

Even if the team is very active in teaching and in the organization of workshops and international schools, they are weakly involved in interaction with the non-academic world and outreach activities.

Analysis of the team's trajectory

After 2018, the team has re-organized its activities and found another way of working. The projects led by Mr Dahan were split between the PI of the team and the CR-CNRS arrived in 2016. The team is complemented by a emeritus researcher since 2020, having his own activity and non-permanent PhD students (7 defenses, 3 ongoing), postdoctoral fellowships and engineers.

The past five years were a transitioning period, the members finishing Dahan's projects with success as well developing their own projects. Due to limited permanent staff members, the team decided to stop some of the projects, such as the one dedicated to magneto-genetics, which was successfully transferred to another Institut Curie's team, and to develop new joint projects between the two team permanent members, taking advantage of their complementary skills. In particular, they are developing a new topic aiming at using advanced super-resolution microscopy and biological methods to quantitatively probe nano-condensates in cells. This ambitious and innovative project has just been selected by the ANR within the call "Projet de Recherche Mono-Equipe (PRME)", thus validating the strategy of the team. In parallel, the team will continue its current projects on single molecule imaging and visualization tools, a field in which it has a strong recognition. The team will also be involved in a common PCC project about the role of Bioelectricity in the cell behavior. All these projects are coherent with the current international state-of-the-art and are part of the four PCC axes.

RECOMMENDATIONS TO THE TEAM

Following on their very good publication and funded grant record in the past period, the chance of success for the team is very good especially as its two permanent members manage to work together and to combine their expertise.

Nevertheless, the committee would have some advices for the next years:

With a limited permanent staff, care has to be taken to keep the particular focus and strength of the team regarding specific biological questions while maintaining the equilibrium between developments of new methods and biological applications. In this direction, and regarding scientific activities of the other PCC teams, it could be interesting for the unit management's team to consider to hire an engineer dedicated to image processing and data treatment which could be very helpful to support the LOCCO team's methodological development activities.

Team 3: Genome functions in Space and Time

Name of the supervisor: Mr Antoine Coulon

THEMES OF THE TEAM

The team develops experiments of micromanipulation of chromosomes in living cells and non-equilibrium models to investigate at the molecular level how active biological processes maintain chromosomes away from relaxed and equilibrated conformations. In particular the team showed the importance of non-equilibrium dynamics in the case of topologically associated domains, which are key conformational structures in genome folding and gene regulation.

The team is hosted by the UMR3664 of CNRS (Genome Biology), and his team leader is formally affiliated to this UMR. As such, this team will be evaluated with the UMR3664.

WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	
Maîtres de conférences et assimilés	
Directeurs de recherche et assimilés	
Chargés de recherche et assimilés	2
Personnels d'appui à la recherche	3
Sous-total personnels permanents en activité	5
Enseignants-chercheurs et chercheurs non permanents et assimilés	
Personnels d'appui non permanents	
Post-doctorants	2
Doctorants	
Sous-total personnels non permanents en activité	2
Total personnels	7

Team 4: Macromolecules and microsystems in biology and medicine

Name of the supervisor: Ms Stéphanie Descroix

THEMES OF THE TEAM

The research of the team is at the interface between physics, biology, and medicine. The team uses microfluidics to tackle biological questions, to design organ on chip models, and to propose new routes in nanomedicine and therapeutics. Thanks to technological innovations, the team is developing a new generation of bioengineered models, mimicking *in vivo* complexity, and strongly relevant for testing new therapies.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

A first recommendation was regarding the high level of production and activities, to be maintained despite the retirement of the team leader. Clearly, over the last years, though the team composition has evolved, as well as the research topics, the level of publications is still very high.

The team leader has retired at the end of the last evaluation period. It was recommended to manage carefully the human resources following this retirement. In fact, there has been no issues about leadership, and in parallel two new members have joined the group at the beginning of 2021 (1 DR and 1 CR from CNRS). The team has thus efficiently evolved.

Other concerns were about strategic choices to both maintain funding, and to focus more on biological questions. Here also, the team has been very efficient for collecting grants and has well defined its objectives in terms of biological questions to be tackled.

WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	
Maîtres de conférences et assimilés	
Directeurs de recherche et assimilés	2
Chargés de recherche et assimilés	1
Personnels d'appui à la recherche	
Sous-total personnels permanents en activité	3
Enseignants-chercheurs et chercheurs non permanents et assimilés	1
Personnels d'appui non permanents	1
Post-doctorants	4
Doctorants	8
Sous-total personnels non permanents en activité	5
Total personnels	17

EVALUATION

Overall assessment of the team

During this period, the team managed successfully the arrival of two CNRS researchers. Its scientific activities and production were excellent, increasing the team to a well-established international position in microfluidics and magnetic based-approaches applied to biological questions, bioengineering and nanomedicine. The team was also successful in competitive fund raisings, received numerous invitations in conferences and is attractive towards PhD students and postdoctoral fellows. At last, the team also has interest in tech transfer, being involved in interactions with companies.

Strengths and possibilities linked to the context

The team composition has evolved since the last evaluation period: the previous team leader has retired and two CNRS researchers (1 CR and 1 DR) joined the team, showing its attractiveness. The new senior (DR) researcher has an international visibility, with a very good publication track record, and obtained the CNRS silver medal in 2022. Both have brought complementary expertise in bioengineering and nanomedicine and new routes of research.

Regarding its positioning, this PCC team also remains a member of IPGG, providing its members access to all the state-of-the-art facilities for micro-fabrication and microfluidics.

Over the last years, the team had an impressive success rate in fund raising, with a total of 7,2 M€ through 34 grants including ERC, FETOPEN, ANR, CNRS, Cifre and Marie Curie grants. Both the funding, the original scientific topics, and the local context (IPGG, Curie, other labs in the vicinity) create a great attractiveness towards the team, which continuously recruit excellent international PhD students and postdocs. These students disseminate the team results, with typically five presentations in conference per year for each of them. In parallel, the team members have an excellent visibility, with more than 50 invited lectures and seminars. As well, the production is of very high quality, with more than 80 articles published, spanning over a wide range of interdisciplinarity domains (sensors, chip technology, physical chemistry, biology or pharmaceuticals).

The team is also involved in the construction of local and national structuring projects, like PEPR and Curie-IHU. As well, the team members have significant academic duties, such as deputy-director of IPGG for the team leader. At last, the team is strongly involved in outreach activities, especially with a chapter on microfluidics in the book entitled 'étonnante chimie', but also with radio and TV programs, and public conferences.

Weaknesses and risks linked to the context

The team is attractive, but with a strong turnover of students and CDD positions. As a consequence, and having no permanent 'PAR' (personnel d'appui à la recherche) associated to the team, this might induce some obstacles for maintaining the technological expertise. At this stage, the know-how on the experimental tools actually relies only on the three permanent CNRS researchers. As well, their availability for numerous interns, PhD students, postdocs - due to academic duties, conferences, etc. - might not be optimal.

The collaborations within other PCC teams remain low, though there are promising emerging connections with other groups in Curie. The team also points out that having a dual positioning (PCC/IPGG) actually gives strong possibilities, but can also include some risks that need to be handled.

The team has been much less involved in Tech transfer in the last years, despite they are developing new and high-potential technologies. Nine patents and two start up projects were reported in the previous evaluation period, while only two patents are evoked in the recent years. As well, some collaborations with industry are also reported (two Cifre grants), but the team also recognizes that this remains limited.

Analysis of the team's trajectory

The current team activities are devoted to two main axes. The first one, 'bioproduction/bioanalysis', focuses on the production of magnetic cells and extracellular vesicles, as major building blocks for further bioengineering developments. The second one, 'organ on chip', aims to develop *in vitro* models of organs in physiological and physio-pathological states. The scientific projects of the team are in this continuity and ambitious, with highly motivating goals, but realistic regarding the team expertise.

This trajectory relies on the specificity of the team, which is based on technological developments dedicated to originally address relevant well-identified biophysical questions. In that respect the microfabrication of original devices and chips remains a key element of the team, and science-to-technology breakthrough are expected. Fundings (ERC, ANR and others) are secured for the coming years.

RECOMMENDATIONS TO THE TEAM

The committee first encourages the team to continue to build an internationally renowned research activity, thanks to its well-defined and rather unique identity.

A major issue concerns the absence of a permanent engineer in the team, with a strong risk of loss of expertise and skills induced by successive temporary positions. The committee recommends that the team makes every possible effort to stabilize a position of engineer or to increase the duration of temporary positions.

There is a high turnover of PhD students and post-doctoral positions, with the same risk as previously mentioned and incompressible time constraints for their training, in particular at the beginning. However, the committee notes some very short post-doctoral positions, and suggests to increase, as much as possible, their duration.

To stabilize its position within PCC, the committee also encourages the team to increase connections with other PCC teams. One might expect that other groups may require the expertise of the team in microfabrication and microfluidics.

With regards to the dual positioning of the team and to its different expertise's, the members could also initiate a prospective work to anticipate possible strategic choices and to find the right balance between different routes (focusing on technological innovation, or on transfer and links with industry, or on more fundamental medical issues, etc....).

Team 5: Genetics and mechanics of tumoral and embryonic development

Name of the supervisor: Mr Emmanuel Farge

THEMES OF THE TEAM

This team investigates processes by which mechanical stress regulates gene expression during embryonic and tumor development, in drosophila, zebrafish and mouse with an extension to earliest metazoans (sea anemona *Nematostella vectensis*) and *Choanoeca flexa*.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The recommendations were: (1) Since the team's emphasis on mechano-transduction is shared by other teams in PCC, the committee would expect more interactions within it. (2) The innovation and new methods could benefit further to the scientific community by publications into method journals or more specialized journals. (3) While it is important to develop well-focused and targeted projects, there is always a risk in projects which are driven by a single hypothesis.

The team has responded positively to the first point by initiating collaboration within PCC with the BMBC facility and strengthening mechanobiology collaborations within Institut Curie (four collaborations).

For the second point, the team developed a new magnetic device to mimic pulsatile mechanical strains in mice colon loaded with ultramagnetic liposomes based on an oscillating 2D network of centimetric 0.5T cubes localized below mice cages, but the committee was not able to find a corresponding methodological paper.

For the third point, the team's hypothesis was to follow the mechano-sensitivity of the beta-catenin pathway during development and tumorigenesis. This question has been extended to new models such as *Nematostella vectensis* embryos. The team extended its original hypothesis to the role played by Myo II. They found that Myo-II-dependent trigger of active morphogenetic movement of gastrulation is mechanosensitive and responses to indents in *Drosophila* embryos.

WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	
Maîtres de conférences et assimilés	
Directeurs de recherche et assimilés	1
Chargés de recherche et assimilés	1
Personnels d'appui à la recherche	1
Sous-total personnels permanents en activité	3
Enseignants-chercheurs et chercheurs non permanents et assimilés	
Personnels d'appui non permanents	1
Post-doctorants	1
Doctorants	
Sous-total personnels non permanents en activité	2
Total personnels	5

EVALUATION

Overall assessment of the team

The team developed innovative experiments and strong expertise in molecular mechanisms mechanically induced in various models (embryos, metazoans, tumors). It progressed on fundamental and applied aspects, with an international patent in progress and pre-clinical experiments. The team was also successful in different fund raisings and developed a dense network of national collaborations. In terms of production, 4 original papers and 2 reviews were published, works being also presented in different international conferences.

Strengths and possibilities linked to the context

The team produces research at the edge of international knowledge in mechanobiology of multicellular systems, cell differentiation and tumor pathologies, focusing for instance on the reciprocal interplay between the biomechanical patterning in embryogenesis and tumorigenesis. In collaboration with the Curie hospital, the team also revealed the underlying molecular mechanosensitive pathway involved as anomalously activated in 8 of the 10 primary human solid tumor types, including the colon, and the worth prognosis lung, pancreas, and ovary tumors.

Thanks to the quality of its high-level publications (for example Mitrossilis, D. et al. Nature 2017 and Roper, J. C. et al. eLife 2018), the team is internationally recognized in these highly competitive fields.

The team advances in both fundamental and applied aspects, with an international patent in progress and pre-clinical experiments. It would be interesting to know how this valorization will translate in the future in terms of registration and possible financing by the pharmaceutical industry. Despite the large number of projects for a team of its size, collaborations in its close proximity and access to Institut Curie's state-of-the-art platforms contribute to achieving its objectives.

The team's scientific output is satisfactory, with 6 articles. This production should increase in the future after the evaluated period devoted in particular to important experimental developments around a new magnetic device mimicking pulsatile mechanical strains.

Finally, the team's research strategy fits with the strategy of PCC and Institut Curie, which includes the study of the underlying processes of cancer progression and innovative therapeutics. The role of mechanics in cancer progression is well established, the team has a clear advance in this international context and its next challenge is to evaluate how to make use of its findings in a therapeutic perspective.

Weaknesses and risks linked to the context

Although relevant collaborations to meet the challenge around mechanobiology and tumors (collaboration with Phenix lab, SU, Institut-Curie Hospital and Research Center...) there is no collaboration with a pharmaceutical group for larger-scale testing in a context of possible fight against cancer.

In the field of mechanobiology and embryology, the team has investigative resources and a network of collaborators to carry out this new research. However, such projects are time-consuming and longer than a standard PhD or postdoctoral position, leading to potential problems in terms of organization and sustainability or publications for young researchers.

Analysis of the team's trajectory

During the evaluation period, the team's progression had a logical and well-constructed trajectory with fundamental projects starting from drosophila embryo. It characterized the molecular mechanisms of mechanotransduction activation of β -cat. This work was extended to stem cell in response to tumor growth pressure, resulting in the development of chemotherapeutic treatment with Vandetanib and Danusertil Ret inhibitors. Previous results enabled the team to focus on mechanotransduction origin of mesoderm in cnidarium *Nematostelle vectenis*.

The project of the team is pertinent, in the logical continuity of previous works, and it is an exciting process to pursue these fundamental subjects. At the same time, the team is taking a new complementary direction developing pharmacological treatment in colon cancer. The team takes here a risk and this is a remarkable choice, given that few mechanobiology teams are involved in this field, which could have yet a major impact on cancer treatment.

RECOMMENDATIONS TO THE TEAM

The committee suggests the team to align its projects with shorter periods, better suited to the PhD duration. This could help to “fluidify” the dynamics and to favor publications at the end of each step, in particular for young researchers, and potentially help to solve the difficulty to progress in parallel on the two axes of the team.

Team 6: Dynamic Control of signaling and gene expression

Name of the supervisor: Mr Pascal Hersen

THEMES OF THE TEAM

The team uses high-level technological tools such as microfabrication, optogenetics, AI, etc. to explore and manipulate the collective behavior of cells. It concerns specifically the signaling pathways and gene regulation networks (how cells process information) as well as minimal exogen and endogen ingredients (such as mechanics, chemistry, internal cell activity, etc.) at stake during synthetic or real morphogenesis. Since the team has moved 'recently' to PCC, some older projects have been finished, and new ones defined in order to match the PCC strategy and also to build up on the Curie ecosystem.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

Not applicable as the team moved to PCC in 2019-2021.

WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	
Maîtres de conférences et assimilés	
Directeurs de recherche et assimilés	1
Chargés de recherche et assimilés	2
Personnels d'appui à la recherche	1
Sous-total personnels permanents en activité	4
Enseignants-chercheurs et chercheurs non permanents et assimilés	
Personnels d'appui non permanents	1
Post-doctorants	3
Doctorants	6
Sous-total personnels non permanents en activité	10
Total personnels	14

EVALUATION

Overall assessment of the team

The production of the team is of very high-level and impressive considering that it has moved recently (with an associated slow-down in research) and its leader is at the head of PCC. The team benefited from the arrival of a new researcher and altogether, it produced state-of-the-art science, often original and even sometimes pioneering, centered on the dynamic control of biological systems in space and time. The level of financing is high and structuring. The collaborations within PCC and Institut Curie are ever increasing and there is a clear desire to match more closely to PCC strategy.

Strengths and possibilities linked to the context

The team possesses strong assets, especially concerning cybergenetics, optogenetics, microfabrication, and microfluidic expertise, which are applied to ongoing projects of prime importance: the pioneer field of cybergenetics (Lugagne et al., Nature Com. 2017) is extremely promising and remains quite timely as autonomous microfluidic labs are blossoming everywhere, even though rarely in synthetic biology. In this context, the team has made a significant contribution and remains a leader in the field, to the point of being able to disseminate in the community a Python-based program to move optical microscopy towards smart microscopy. This opens a fascinating avenue for more complex and cleverer automated feedbacks coupled to optogenetics in the field of synthetic biology. The arrival of a researcher from another PCC's team enabled also to bring a complementary expertise to the team towards physics of morphogenesis. During the period, she focused on cellular parameters generating forces involved in the patterning of chicken embryos and also participated to a project aiming at evaluate the mechanical impact of actin polymerization on membrane nanotubes depending on the properties of the actin network.

The team also makes a very clever use of microfabrication and microfluidic technologies for patterning substrates and / or confining and feeding selectively different species in order to address questions of synthetic embryology. In particular, the combined use of micropatterning and microfluidics (Etoc et al., Developmental Cell, 2016) has been essential in understanding some important events in the dynamic patterning of human cells.

During the evaluated period, the team was successful in fund raisings and was also able to attract PhD students and postdocs despite disabling constraints due to the building's depollution and renovation. The team was also successful to build an efficient network of collaborations, benefiting in particular of the Institut Curie environment.

At last, it is noteworthy that the team leader maintains a significant research activity, managing at the same time a lab so important than PCC with all the time-consuming tasks it implies.

Weaknesses and risks linked to the context

Despite the slow transition from MSC to PCC, the team has managed to adapt and evolve. However, as most current projects take a long time to mature, it is important to ensure continuity of know-how, which is probably not possible with PhD students and postdocs only, in a context where the team leader is also less available, being the PCC manager.

Analysis of the team's trajectory

After a long period of "migration" due to different constraints related to the renovation of the building, the team integrated PCC successfully and its research activities reach an impressive cadence. The team's trajectory is convincing. It builds on the core projects at the time of the MSC, leading to new, updated and ambitious ones that are both original and in line with the PCC strategy. The first interesting direction concerns the evolution of cybernetics, as a pioneering proof-of-concept, towards a fully automated, time- and space-dependent system based on synthetic biology for optimized information management at cellular and multi-cellular scales. The team also continues to gain expertise in the fields of optogenetics or AI-based image analysis. In addition, there is a massive effort on synthetic and developmental embryology which is to be encouraged as it perfectly demonstrates the well-founded approach combining cutting-edge technology and biology. Finally, a new project is emerging on therapeutic bacteria and tumor microbiota, which is already well-funded and will benefit from the expertise of other PCC teams. It is a formidable playground for physicists working on living matter, and this subject is indeed probably a disruptive project in France, as mentioned by the team.

RECOMMENDATIONS TO THE TEAM

In the evaluation period, the team has been remarkably successful in terms of applications to calls for funding, including an ERC consolidator FET open and a large number of ANR grants. However, most of these grants are over, and the list of grants valid beyond 2023 is more limited. The team leader assuming a heavy task as PCC manager, the committee encourages the team's members to take into account this situation and to support each other's in fund calls and student's managements. The recruitment of a CR would be greatly helpful.

The turn-over of PhD students and postdocs is a brake to ensure continuity of know-how and skills. The committee recommends that the team starts thinking to the recruitment of a young researcher who could ensure this continuity and reduce the team leader's workload.

Team 7: Computational Biology

Name of the supervisor: Mr Hervé Isambert

THEMES OF THE TEAM

The team developed during the evaluation period causal graphical models based on information-theoretic methods for the inference of causal networks for three major fields of applications: (multi-)omic data, live cell imaging data and medical /electronic health records. The team also studied the impact of whole genome duplications on the evolution of species and in relation with cancers, as well as the biomechanical mechanisms at play during the interaction of septin with biological membranes.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The two major recommendations to the team were: (1) Interactions of the team outside of the academic environment are extremely scarce. The collaboration network of the team, in particular with experimental groups and outside the Curie environment, would benefit to be more extensive; (2) To improve its visibility, the team should publish more into general-interest scientific journals and participate more in international funding schemes, like EU ones.

The team strongly improved its positioning regarding the first point, with a recent broadening of its projects carried out in interaction with groups beyond Curie. Although these new collaborators are still mainly theoreticians, applied mathematicians or computer scientists, some of them are indeed experimentalists or clinicians. Progress with respect to the last point has been more limited, although recent events are to be positively considered, like the success at the 2022 UE Horizon-Health call for funding with INEM. Also, the team has recently initiated a batch of several new international collaborations (Oxford, Stanford, UCSF, ICL...).

WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	
Maîtres de conférences et assimilés	
Directeurs de recherche et assimilés	1
Chargés de recherche et assimilés	
Personnels d'appui à la recherche	
Sous-total personnels permanents en activité	1
Enseignants-chercheurs et chercheurs non permanents et assimilés	
Personnels d'appui non permanents	1
Post-doctorants	1
Doctorants	4
Sous-total personnels non permanents en activité	6
Total personnels	7

EVALUATION

Overall assessment of the team

The major achievement of the team has been the development and deployment of a tool for the inference of causal networks, called MIIC. This is a remarkable achievement, especially for a team with a single PI. The publication record of the team has been very good, although somewhat non-stationary over the period. The main risks are related to the very small size of the team in terms of permanent staff (increasing also the pressure in terms of student management) and its corresponding lack of activity outside pure academic research.

Strengths and possibilities linked to the context

Causal inference is a worldwide major topic of interest in computational biology and medicine, MIIC is both a promising and timely effort. This methodology has been published in the best specialised journals. In addition to publications, MIIC is accessible as an open-source package and a free online webservice, showcasing a remarkable dissemination effort for a single-PI group. Besides MIIC, the team carried out interesting research on the impact of Whole Genome Duplications on species evolution, offering insights into oncological processes that may turn out to be significant.

The team publication record has definitely been excellent for the most part of the evaluation period. The 2017-2020 period has been especially prolific, the last two years (2021-2022), however, have been less successful. That being said, the team has a list of several preprints in the pipeline, either submitted or in revision, including in outstanding journals. This is likely to balance quite favorably the previous remark.

With solid methodological bases, the team now seeks to apply its expertise on a number of exciting questions: extension of MIIC for time series data, application to cell differentiation trajectories from omics data, exploitation of causal clinical networks for diagnosis and a number of biological or biomedical applications... These perspectives are definitely exciting, and the team has secured grants to fund them.

Weaknesses and risks linked to the context

Besides MIIC-based applications or WGD-related work, the team has also worked on the biomechanical modelling of septin-membrane interactions. But it is difficult to see where this line of research fits within the team roadmap. The issue is even more critical when considering the size of the team, especially its senior part (1 PI, 1 postdoc). In the perspectives section, the team lists its future projects/research axes: the associated work is expected to be carried out by a total of more than ten PhD students and four engineers. With a total of only two senior members in the team, the supervision of such a group of junior researchers is a significant risk, even with many co-supervisions with collaborators. This questions even more the pertinence of the research on septin-membrane interactions in a strategy perspective whereas planned projects are already very extended.

All the development effort around MIIC is a remarkable endeavor. However, this does not guarantee that it will indeed be used by the community. The team should think about a strategy to promote its dissemination. It will be also important to monitor how it is used in the community and the number of teams / articles, that do use it.

The small size of the team is also a risk for its visibility. In its field, some of the competitors are huge research institutes and the size of the team might be subcritical. In addition, non-academic activities (innovation, transfer, public outreach) are mostly ruled out by this limited size, which may also contribute to limit its visibility.

Analysis of the team's trajectory

The evaluation period has seen a drastic change for the team, leading to a change of its name: it moved from its previously recognized expertise in RNA folding simulations to new adventures in biological network causal inference, which is a bold move. Academic researchers are not always prone to take this kind of risks, even in a high-risk high-gain situation, so the team (and PI) must be praised. Now that the methodological bases of both fields have been firmly set by the team, time is ripe for the team to apply its methodologies to a range of exciting biological problems. It is very difficult to predict whether MIIC will become a standard in causal graph modeling or if the team's work on WGD will provide new perspectives with which to approach tumorigenesis. But it is certainly worth giving it a try, and the team's trajectory in this direction is obviously commendable.

RECOMMENDATIONS TO THE TEAM

Given the team's limited supervisory capacity, there is a risk of being overwhelmed by the numerous projects. The committee recommends that the team makes its best to reinforce its PhD supervision capacity in the coming years. This is crucial to effectively execute ongoing and planned projects, enhance visibility, and mitigate expertise loss due to high student turn-over.

The committee also recommends that the team considers with care its implication into research avenues that are not directly in the critical path of its scientific roadmap (including the research line on septin biomechanics).

Team 8: Quantitative developmental biology

Name of the supervisor: Mr Wolfgang Keil

THEMES OF THE TEAM

The scientific objectives of the team are centered on fundamental principles of developmental biology: cell-fate acquisition, transcriptional regulation during development and developmental robustness. The team combines microfluidics with life cell imaging methods to perform quantitative measurements of protein levels in living organisms, and develops predictive mathematical models.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The team has been created during the evaluation period in November 2019 and there is no previous report.

WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	
Maîtres de conférences et assimilés	
Directeurs de recherche et assimilés	
Chargés de recherche et assimilés	1
Personnels d'appui à la recherche	
Sous-total personnels permanents en activité	1
Enseignants-chercheurs et chercheurs non permanents et assimilés	
Personnels d'appui non permanents	2
Post-doctorants	2
Doctorants	2
Sous-total personnels non permanents en activité	6
Total personnels	7

EVALUATION

Overall assessment of the team

This young team was successful in setting up and structuring its activities, in good agreement with the scientific themes of PCC, on cell fate acquisition, transcriptional regulation during development and developmental robustness. The team had a high success rate in fund raising, which allowed hiring of personnel and acquisition of high-end instruments. It also established pertinent local, national and international collaborations. The team starts publishing its results following heavy and time-consuming experimental developments, and the publication rate is likely to be amplified in the next years.

Strengths and possibilities linked to the context

The objectives are in good agreement with the general interdisciplinary scientific themes of the unit. The scientific questions are pertinent and the methods used, based on high-end imaging, image quantification, and mathematic modelling are relevant and of state-of-the-art.

This newly-created team was successful in setting up and structuring a competitive team, which comprises a permanent CNRS position for the team leader, two engineers, two post-docs and two PhD students.

The team had a high success rate in fund raising, with a total of 1.8 M€ through thirteen successful applications, which allowed hiring of personnel and acquisition of high-end instruments. The team identified and established scientific collaborations with key international labs in USA, Israel and the Netherlands that fuel new ideas and technology developments. The team has also established four national and two in-house collaborations around imaging technologies and mathematical modeling, which provide new opportunities and synergies.

The team has already been invited to six conferences (one of them was international), and contributed to 5 outreach events.

Following heavy and time-consuming experimental developments, the team mentions four papers : two publications in *Current Biology* in collaboration with groups in the US and involve only the PI, one published in *Developmental Cell* involving the PI and a PhD student as first co-author, one mentioned under preparation. This shows an encouraging trajectory for a newly created team and puts forward the excellent team networking.

The team highlights collaboration with the *École professionnelle supérieure d'arts graphiques (EPSAA)*, which led to a graphic art work for the lay public around the research projects of the team.

Weaknesses and risks linked to the context

As the team develops novel imaging and quantification tools, it appears as technology oriented and gives rise to collaborative research. It may be difficult to find the core biology questions embodied by the team. The ontology-related questions are very broad and cover a huge number of topics such as cell fate decisions, transcriptional regulation during development, role of LIN12 miRNA, hormonal gradients, temperature robustness, epigenetic perception-induced changes, development of "gene-free" geometric modeling, translational regulation. Although these projects are interrelated, it might be too ambitious for a single PI to handle all these topics considering the limited size of the group and the international competition.

The question of the long-term sustainability of the team, and thus the theme continuity, may be raised since all members except the PI are on short term contracts that need to be funded. The outstanding funding opportunities of the past period may be difficult to reproduce since the starting grants have been exploited.

The team mentions difficulties to attract personnel at all levels particularly from France, and examines the possibility to be involved in European doctoral training networks.

Analysis of the team's trajectory

The young team is building up on first results concerning the quantitative deciphering of the molecular mechanisms for tissue synchrony and temperature robustness by using an innovative microfluidic device for long-term imaging and precise temperature control. The team aims at analyzing the miRNA-based switches that control seam cell fate progression and plans to use a MS2/PP7 based system to follow cell fate decisions at the molecular level. This approach will result in quantitative measurements of molecular gradients that affect development and differentiation. This part of the research project is in line with the previous research directions of the team. The team also plans to investigate a new direction of perception-induced changes in organism physiology, which, despite its fundamental importance, seems distantly related to the current research directions.

RECOMMENDATIONS TO THE TEAM

The team uses and develops outstanding quantitative imaging tools, fostering collaborations on many biological questions. Despite its undeniable skills, concerns about long-term sustainability arise due to the team size in relation to the wide range of biological questions. The committee suggests to focus on a limited number of questions and to embody these projects.

The team may exploit the exceptional scientific environment at PCC to establish collaborations with mutual benefits to enrich the chosen biological quest. Given the team expertise in nematodes imaging and microfluidics, it is crucial for the visibility and attractiveness of both the team and the whole PCC unit to continue the technology and methodological developments. The committee recommends that PCC supports the facility aspects of the team.

The committee also encourages the team to go on publishing its results without delay, this point being essential for its own attractiveness and for PhD and postdocs careers. One of the goals may be to apply for an ERC grant and the team should reflect and work on what is missing for a successful application.

Team 9: Molecular Microscopy of Membranes

Name of the supervisor: Mr Daniel Levy

THEMES OF THE TEAM

This team studies the organization and physical properties of membranes, membrane proteins and their associated cytoskeleton partners at different spatial and temporal scales by cryo-electron microscopy and tomography of integrated systems assembled *in vitro*.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The previous report mentioned that the team's activities were at the edge of cryo-microscopy technical capabilities. During the evaluated period, the team made considerable efforts to obtain a multi-institute grant for the purchase of a latest generation cryo-microscope installed in February 2023.

The previous recommendations were also to attract more PhD students, to thrive from a network of collaborators and to benefit from the C-CINA platform at the Basel Biozentrum. Attracting PhD students is still a major problem for the team, which could be due at least partly to the few master courses dedicated to cryo-microscopy, but this is a general trend in most of the French laboratories. The commissioning of the new microscope and the team's network of collaborations might improve the situation. The team has an excellent network of collaborators both within the Curie Institute and outside; this improved significantly the scientific outcome as suggested by the previous Hcéres committee.

WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	
Maîtres de conférences et assimilés	1
Directeurs de recherche et assimilés	2
Chargés de recherche et assimilés	
Personnels d'appui à la recherche	1
Sous-total personnels permanents en activité	4
Enseignants-chercheurs et chercheurs non permanents et assimilés	
Personnels d'appui non permanents	1
Post-doctorants	1
Doctorants	2
Sous-total personnels non permanents en activité	4
Total personnels	8

EVALUATION

Overall assessment of the team

During the period, the team has explored to the highest level cryo-electron microscopy and tomography for the study of reconstituted membrane systems, giving it a leading position in the study of septins and providing a dense network of collaborations. The team was successful in fund raising allowing recruitments and acquisition of high-end instruments. Results have been published in high-ranking journals, a major part of the production reflecting the strong involvement of the team in collaborative works. Numerous invitations and selected talks in conferences are other evidences of its attractiveness.

Strengths and possibilities linked to the context

The team has a leading position in France and internationally for the study of reconstituted membrane systems including controlled lipid composition and purified membrane and cytoskeleton proteins. Its work on septins and ESCRT proteins is internationally recognized, constituting a major scientific focus of the team.

During the period, the team had a high success rate in fund raising from local to international level, with a total of 3.1 M€, which allowed hiring of personnel and acquisition of high-end instruments. The team composition has evolved positively with notably the recruitment of a new permanent assistant professor.

The team is heavily involved in the strategic steering of key platforms of major importance for PCC. It also plays a major role in the structuration of the imaging resources at the local and national level through its involvement in FranceBioImaging for example.

The team is involved in a dense network of local, national and international collaborations. In particular, it capitalizes on key collaborations with mathematicians to develop new image analysis tools dedicated to electron tomography of membrane systems.

The team has explored to the highest level cryo-tomography and electron microscopy. It has also developed innovative scientific approaches notably through the *in vitro* reconstitution of complex membrane systems and the implementation of image analysis workflows specific for the 3D reconstruction of electron cryo-tomography. The new microscope will improve the quality of the collected tomograms and will enforce the attractiveness of the team.

Numerous invitations in national and international conferences are other evidences of the team's attractiveness.

The team contributed to 33 peer-reviewed publications, in strong progress as compared to the previous period, with about 70 % of the scientific production corresponding to collaborative works, within PCC (10 publications), within or outside Institut Curie. Results have been published in many high-ranking journals (4 in Nature Communications, 2 in e-life, 1 in Dev. Cell) and in more oriented journals. All permanent researchers published actively during the evaluation period.

Weaknesses and risks linked to the context

The team has developed unique specimen preparation methods that allow recording large cryo-tomography datasets but failed, up to now, to reach near atomic resolution permitting mechanistic interpretation. It had also to invest time and energy to fund a high-end microscope and equip a suitable room. Other major weaknesses concern the absence of a permanent engineer on this setup, the costs of maintenance and the retirement of the team leader in a relatively near future with a risk of loss of expertise and uncertainties for the future projects.

About 70% of the team scientific production corresponds to collaborative works in which the team members do not appear as first or corresponding author. Collaborations reflect the strong need of the team's expertise. But they may affect the rate of publications fully embodied by the team.

The team mentions difficulties to attract students in the context of high competition for access to high-end instruments and to train them on a standard PhD duration. The situation will improve with the new instrument concerning the first point. The committee found that the level of publications per PhD is variable and rather weak for some students. Another difficulty encountered by the team is to stabilize personnel on a long-time.

Analysis of the team's trajectory

The team develops an innovative research direction on reconstituted membrane systems by using electron cryo-microscopy and tomography approaches. In the reported period, the team suffered from a limited access to high-end instrumentation and concentrated their efforts to setup a competitive cryo-EM environment at PCC. In parallel, the team developed studies centered on the structural organization of complex molecular systems in membranes. Its know-how, methodological developments and scientific involvement in several PCC platforms (imaging and Proteam) led also to a strong network of internal and national collaborators, while giving the team a strong visibility.

The team will continue to explore membrane-bound biological processes by using high-end electron cryo-microscopy and tomography of reconstituted systems in the logical continuity of its previous works. This relevant approach has the advantage of generating the large number of events needed for high resolution sub-tomogram averaging. To validate the reconstituted systems, the team plans to confront their results with *in situ* tomograms and high-resolution fluorescent microscopy data, which are reasonable validation steps. The project aims at going beyond structural data to reach the mesoscopic scale.

After the successful work on septins, the team further plans to study membrane contact sites that regulate the communications between cellular organelles. These projects are in line with the objectives of PCC. The team has setup a comprehensive workflow ranging from protein purification to assembly of functional systems and structural analysis by sub tomogram averaging. It furthermore benefits from internal and national collaborations, as well as strong interactions with the different PCC imaging facilities.

The team has the ambitious project to create a center dedicated to 3D electron and correlative microscopies, opened to the French and European community. The interest of such a center is undeniable but needs to be backed up by an engineer position.

RECOMMENDATIONS TO THE TEAM

The committee recommends that the team continues his efforts to characterize fundamental properties of protein-membrane systems and suggests to concentrate them on septins's interaction with membranes/cytoskeletal proteins and membrane contact points, to reach a molecular and mechanistic description of these systems and to assess their functional and physiological relevance.

The committee recognizes the team's efforts to disseminate cryo-electron microscopy methods and recommends the recruitment of a dedicated person to interface with new projects.

The committee encourages the team to maintain its efforts in recruiting PhD and postdocs. The team should make sure that each PhD student finishes his/her thesis with a first author publication.

The committee is concerned about the economic model needed to cover the maintenance costs of the microscope. It recommends a better separation of the service contributions from team's projects with a reasonable pricing system preserving the strong and essential involvement of the team in running the platform, teaching users and supporting developments.

The committee recommends to continue the reflection between the team and PCC direction about the future of the cryoEM facility, in the context of retirement of the current team leader in a relatively near future but also of possible relay thanks to the presence of a DR in the team. Corresponding skills in experiments and data analysis should be maintained in PCC.

Team 10: Active mechano-sensitivity of inner ear cells

Name of the supervisor: Mr Pascal Martin

THEMES OF THE TEAM

The team works on the mechanical properties of hearing, developing tools for micromanipulation and force measurement on single mechanosensory hair cells using flexible microfibers and fluid jets. The team also focuses on active mobility of flagellum through molecular self-assembly of actin filaments and myosin motors of the cytoskeleton.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The recommendations were (1) To increase in size (adding 1-2 postdocs/graduate students); (2) To move to mammalian rodent system for answering questions in a frequency regime relevant for human hearing; (3) Concerning the project on *in vitro* assemblies of actin and myosin, the difficult experiments may require more involvement for the team.

The team answered positively to the first point, since it globally grew during the evaluated period: a CR (arrived in October 2022) and 4 PhD students joined the team. Concerning the second point, the team developed efforts to study hair-bundle mechanics in rat cochlea after working a long time on cells from frog's ear. At last, the team continued its project on assemblies of actin and myosin (transport of colloidal particles by myosin motors, organization of polymerizing actin filaments in the presence of myosin motors) in a context of internal, national and international collaborations.

WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	
Maîtres de conférences et assimilés	
Directeurs de recherche et assimilés	1
Chargés de recherche et assimilés	1
Personnels d'appui à la recherche	
Sous-total personnels permanents en activité	2
Enseignants-chercheurs et chercheurs non permanents et assimilés	
Personnels d'appui non permanents	
Post-doctorants	1
Doctorants	4
Sous-total personnels non permanents en activité	5
Total personnels	7

EVALUATION

Overall assessment of the team

The team develops original research on the mechanics of sensory hair cells and self-assembled filament bundles made by polymerizing actin filaments in the presence of myosin motors and exhibiting wave-like beating. It uses micromanipulation and force measurement tools, and built up a solid network of collaborators (especially on theoretical approaches). It was successful in raising funds, mainly at the national level, and its activity led to publications in high-profile interdisciplinary journals. During the period, four PhD students and one CR of CNRS joined the team, showing its attractiveness.

Strengths and possibilities linked to the context

The team shows a clear leadership in micromanipulation and force measurement on unique hair cells. After working a long time on cells from frog's ear, the team reoriented its activities to study hair-bundle mechanics in rat cochlea. It develops also activities on self-assembled filament bundles made by polymerizing actin filaments in the presence of myosin motors. This axis constituted at the beginning a significant thematic mobility, which was successful and opens new relevant fundamental questions, such as intracellular transport in complex cytoskeletal architectures and flagellar beating.

The team is attractive, having recruited a CR CNRS in 2022 and four PhD students. It has a solid network of collaborations from the local to the international level, in particular with theoreticians from MPIPKS (Germany), their expertise helping to identify the physical laws of active transport and positioning in filament networks or highlighting the importance of internal friction.

Over the period, the team was successful in fund raisings with two ANR and a research grant from the Fondation pour l'Audition. The team also obtained a PhD fellowship from the Horizon 2020 program.

The scientific production is of high quality (1 article in Nature Physics, 2 PNAS, 1 eLife, 1 New J of Physics, Biophys and 1 review paper). Team members have given seven invited oral presentations at international conferences.

Weaknesses and risks linked to the context

A consequence of the turn-over of PhD students is the difficult transfer of know-how between them, with a potential risk of loss of expertise.

Analysis of the team's trajectory

The team's initial focus concerns mechanosensitivity of inner ear tissue. It studied the mechanics of sensory hair cells along the tonotopic (frequency) axis of the rat cochlea, showing that the mechano-electrical transduction apparatus of a given hair cell is mechanically tuned to the cell's characteristic frequency, with a gradient of stiffness and mechanical tension within the organ. At the same time, the team is interested in the active and spontaneous oscillations observed in living hair cells in relation with assembly of actin filaments self-assembled into polar bundles in the presence of myosins, a form of self-organization resembling the beating of eukaryotic flagella. The team developed a theoretical description of these experimental observations to identify a physical principle of motor coordination based on actin bending control of myosin activity under high internal friction.

The team's project will logically focus on further characterization of hair cell's mechanics, going to electrical and calcium control of capillary bundle mechanosensitivity. The team will also continue its work on the role of cochlear traveling waves in shaping the frequency-dependent stimulus that drives the sensory epithelium at a given location in the cochlea. Another question concerns the self-organized beating of actin filament bundles driven by myosin density waves. The scientific project of the team is in line with the PCC's "mechanobiology in cell fate and behavior" axis and very promising. It retains all its originality, enabling the team to stay ahead of the current international state of the art in micromanipulation and force measurement, with a strong publication potential. The team is also continuing its technological innovation by planning to develop new microfluidic tools to control the ionic composition of the fluid around a hair bundle. In its second axis of research on actin filaments and myosin motors of the cytoskeleton, the team also opens new relevant fundamental questions, such as intracellular transport in complex cytoskeletal architectures and flagellar beating.

RECOMMENDATIONS TO THE TEAM

The committee encourages the CR of the team to participate to the two axes of research for a better overlap.

The team could benefit of having more overlap between students, or having more than one student working on a given project to better deal with the technical challenges of the experiments.

The team recruits mainly PhD students as non-permanent researchers. It could be interesting to focus on postdoctoral positions, certainly shorter than PhD ones but devoted to more autonomous researchers.

Team 11: Quantitative Immuno-Hematology

Name of the supervisor: Ms Leila Perié

THEMES OF THE TEAM

This team has been launched in 2016 based on the PI's competences in the field of lineage specification during hematopoiesis using innovative bar-coding approaches to follow the fate of single cells. Since her arrival in PCC, the PI is developing original and innovative methodologies and approaches to quantitatively understand the functioning of hematopoiesis during homeostasis, ageing and infection, and in response to different perturbations such as pathogens and inflammation. To achieve these scientific objectives, the team is using several experimental and computational tools at the single cell level both in mouse and human.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

As a newly created team in 2016, the previous report did not emphasize on scientific recommendations but rather on its integration within PCC. The team followed these recommendations by securing funding, recruiting students and inducing collaborations with other PCC's teams. However, the team met difficulties to secure an IE or technician position. This point is now solved with the recruitment of a technician on a permanent contract.

WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	
Maîtres de conférences et assimilés	
Directeurs de recherche et assimilés	
Chargés de recherche et assimilés	1
Personnels d'appui à la recherche	1
Sous-total personnels permanents en activité	2
Enseignants-chercheurs et chercheurs non permanents et assimilés	
Personnels d'appui non permanents	
Post-doctorants	4
Doctorants	2
Sous-total personnels non permanents en activité	6
Total personnels	8

EVALUATION

Overall assessment of the team

The team aims at adding a quantitative aspect to the understanding of hematopoiesis through new lineage tracing methods complemented by data processing and analysis. This led to 14 publications published in high-ranking journals and presentations in various international conferences. The team is attractive and visible locally and internationally through governing boards, many collaborations and students. The PI had a high success rate in competitive fund raisings. Finally, the team strategy is relevant and innovative.

Strengths and possibilities linked to the context

The team has been established in 2016 through the recruitment of a junior PI. After obtaining an ERC starting grant at the beginning of the period, the PI recruited many postdoctoral fellowships and PhD students. The team has since been joined by a permanent engineer from the Institut Curie and the PI became recently DR, which showed a successful integration of the team. She is now involved in the Single Cell Initiative (Institut Curie), the development of the Customized Single Cell Omics facility and the governing board of the Cell(n)Scale labex.

The team's objectives are to add a quantitative aspect to the understanding of hematopoiesis and to determine how the diversity of hematopoietic cells is produced upon external information. Working with human and mouse models, it developed new lineage tracing methods to follow the fate of single cells *in vitro* and *in vivo* and complemented them by data processing and analysis.

The team is internationally recognized and involved in many international collaborations thanks to its innovative approach leading to an important interest of the community, either from a fundamental point-of-view or for clinical and therapeutic perspectives. Its original tools could be useful for other health issues and the team is then also transferring its expertise to other subjects such as oncology.

The team had a high success rate in fund raisings, with a total of 2.8 M€ (including an ERC starting grant and ANR). A recent project funded a new FluidFM equipment that is part of the Single Cell Initiative. These fundings allowed to recruit postdoctoral fellows and PhDs students, mainly internationally through the network and scientific visibility of the PI. The CNRS bronze medal received by the PI is a proof of the relevance of the team's scientific strategy.

The team contributed to 14 peer-reviewed publications, including three reviews or opinions. Ten of them have been published in 2021-2022, the less prolific 2017-2019 period corresponding to the PI installation. The results have been published in famous journals. A majority of papers are published in the frame of international collaborations or more recently through collaboration in Institut Curie. Two PhD students defended their thesis in the period, with 2 papers each (one as first author).

The team's activities were presented in about 20 international invited seminars and conferences. The team also participated to courses and summer schools and was in the committee of two conferences. These activities are complemented by knowledge diffusion towards the non-scientific community.

Weaknesses and risks linked to the context

The arrival of a permanent engineer should allow the development of the technological and methodological activities. Nevertheless, the quick staff turnover could hinder the team development so as a loss in some technical competences when the current long-time non-permanent researchers will leave the team.

Regarding the interest of the methodological and instrumental activities of the team, there is a risk that it gets isolated within the lab.

Another risk could be to try to valorize the novel quantitative methods developed in the group by multiplying collaborations, but with a limited contribution as for the originality of the work. Because of the limited human resources in the team, this could be to the detriment of the pursuit of the quantitative tool developments.

Analysis of the team's trajectory

After a slow start between 2016 and 2019 in connection with the PI installation in PCC, the team has found its scientific identity and the research topics are now clearly defined based on a strong originality at the international level. The results are now published in high-ranked journals with a good balance between the own specific developments led by the PI and the collaborative works.

The scientific project includes three items. Two of them aim to quantify the number of divisions to produce immune cells and single cell dynamics in healthy or perturbed conditions. The third one is more methodological with the development of a new lineage tracing method. This project is coherent with the current international state-of-the-art aiming at developing a quantitative model of hematopoiesis and is fully within the scope of the axis "Control, Information, Networks, and Fate" of PCC.

RECOMMENDATIONS TO THE TEAM

Nevertheless, the committee would have some advices for the next years:

With a limited permanent staff, care has to be taken to keep the particular focus and strength of the team instead of increasing the number of collaborations for which the team is just used as a "service provider" for their barcoding competences. A clear strategy has to be implemented to hire permanent researchers to help the PI.

The most important warning is about the integration of the team within PCC. The current projects involving another PCC team are limited and should be more developed to avoid the PI isolation. As the number of collaborations with other labs of the Institut Curie is growing, an effort should be devoted to increase the internal collaboration.

Team 12: Physical approach to biological problems

Name of the supervisor: Mr Pierre Sens

THEMES OF THE TEAM

The team is at the forefront of international research in theoretical physical biology. It has explored a range of important issues related to the application of theoretical non-equilibrium statistical physics and soft matter physics to biology, including the self-organization of molecular motors for active transport and stress generation; the self-organization of membrane proteins with application to mechano-transduction or active membranes; the theoretical physics of hearing or the theoretical formalization of epithelial tissue / multicellular systems within an active-nematic framework.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The recommendations were (1) The team should invest more effort into the obtention of research grants, especially international ones. Given the international visibility of the team, the committee suggested that the team could easily obtain more of these grants; (2) The team had a lack of interactions with the non-academic world, especially the general public; (3) There was ample room for the team to improve the PhD students/PIs ratio.

The two first points were most successfully treated by the team. The team secured two prestigious international grants: an HFSP grant (2018-2022) and an ERC synergy one (2023-2029). One also notes an increase in investment regarding interactions with the general public, in particular with a documentary movie, a general audience book and archival work regarding Pierre-Gilles de Gennes's contribution to science.

The lack of PhD students, however, persists despite the renown of the team in its research field and its number of permanent researchers able to potentially supervise a thesis.

WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	1
Maîtres de conférences et assimilés	2
Directeurs de recherche et assimilés	1
Chargés de recherche et assimilés	2
Personnels d'appui à la recherche	
Sous-total personnels permanents en activité	6
Enseignants-chercheurs et chercheurs non permanents et assimilés	2
Personnels d'appui non permanents	
Post-doctorants	3
Doctorants	3
Sous-total personnels non permanents en activité	8
Total personnels	14

EVALUATION

Overall assessment of the team

The achievements of the team during the evaluation period are outstanding. The number and variety of international invited talks it gave, the volume of its scientific production and the level of the journals it published in, are impressive. The academic duties performed by most of its members are not less exceptional. Scientifically speaking, the team delivered an amazing number of new results at the interface between biology and physics with a focus on statistical physics and soft matter in biology, and applications ranging from intracellular self-organisation to (multi)-cellular mechanics.

Strengths and possibilities linked to the context

The team develops high-level activities on the non-equilibrium statistical physics description of soft biological matter. The wide range of subjects is impressive, ranging from self-organization in active matter to mechanobiology with the development of active-gel approaches to describe morphogenesis processes or the functioning of sensory systems.

The team is the biggest of PCC in terms of permanent researchers (6 researchers and 2 Emeritus). It is involved in a wide range of collaborations, one strength being its strong interaction with experimental biologists.

The international recognition of the team is at the highest level. This can be judged by the number of international invited conferences (more than 3 per PI per year) but also by the volume of prestigious classes it taught (EMBO lecture courses, Collège de France lessons, invited international courses). Likewise, the list of academic duties is spectacular: French and EU academies of sciences, evaluation committee of the ENS physics department, head of ESPCI, committee abroad (MPI Goettingen, Max Planck Medal).

But the most striking aspect of the team activity is its publication record, with 146 articles over the period representing 36 % of the publication of the whole PCC, for a team that represents 22% of the PIs and less than 10% of its PhD students. Beyond numbers, the quality of the journals (Cell, Nature Physics...) speaks highly of the quality of the work and in roughly two thirds of the articles, a team member is first, last or corresponding author.

This is an impressive achievement covering a vast range of scientific explorations. Notably, the team excels in developing physical theories for intracellular compartments, including the dynamics of organelles and active membranes. At a macroscopic scale, their modelling of multicellular ensembles using the physics of active fluids has significantly advanced our understanding of cell population dynamics.

Weaknesses and risks linked to the context

Given the visibility of the team, its access to international grants is still a bit lagging behind, even if it was clearly improved during the evaluation period compared to the former one, with HFSP and ERC grants. But the team could probably improve this aspect even more.

The ratio of PhD students to PIs is still very low. Although it does not hinder the productivity and visibility of the team, it may be a risk when considering the renewal of the team's themes and/or composition.

Analysis of the team's trajectory

The projects of the team are in the logical continuity of its past research activities, since it will continue to develop physical approaches of biological processes. A first axis will be devoted to the development of tools to study active systems of non-conserved interacting agents in the overall context of active matter and self-organization. In a second axis, the active-gel models will be pushed to better understand membrane-cytoskeleton interactions. This theme will be supported by an ERC synergy grant newly obtained (May 2023). The team aims also to explore other phenomena, such as bioelectricity by considering different time scales and tissue development/cell differentiation with the development of a coarse-grained theoretical model.

During the period, the team has maintained, if not improved, its position of international leader at the interface between theoretical physics and cell biology. Its main challenges are the renewal of the team composition (as several of its members will probably retire soon) and the improvement of its attractivity towards PhD students.

RECOMMENDATIONS TO THE TEAM

Given the outstanding work and the visibility of the team, it is difficult to see the reasons behind its low level of attractivity towards PhD students and the means to change it. The committee suggests that the team works out a strategy with the direction of PCC to specifically address this point.

Also, several of the most prominent researchers in the team will probably start to think about retirement in the coming years. The committee recommends that the team elaborates a strategy to maintain its international visibility despite this turnover in the team composition.

Team 13: Biology inspired physics at mesoscales

Name of the supervisors: Mr Pascal Silberzan & Mr Axel Buguin

THEMES OF THE TEAM

The team studies populations of interacting cells under a variety of conditions that are very well controlled thanks to dedicated 2D and 3D microenvironments. Activities are focused on the collective behavior of cells (behaving as an active nematic phase, mechanical competition, organs-on-a-chip), with a strong emphasis on technological developments. In these highly controlled systems, fine perturbations (via optogenetics, for example) and precise analytical or computational tools enable a physics-based, multi-scale approach to the complex biological collective behavior of cells. To make the most of its results, the team interacts with numerous experts in different fields.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The main recommendation was: "The strategy and projects are very interesting and stimulating, while remaining based on the team's solid expertise. Links with medical issues or applications could be further explored through internal collaborations within the institute". This point has been addressed with the "kidney-on-a-chip" project, which combines state-of-the-art constructions of living soft matter with a clear translational research objective, elucidating the mechanism of cyst formation in a renal disease, funded until 2025.

WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	1
Maîtres de conférences et assimilés	1
Directeurs de recherche et assimilés	1
Chargés de recherche et assimilés	1
Personnels d'appui à la recherche	
Sous-total personnels permanents en activité	4
Enseignants-chercheurs et chercheurs non permanents et assimilés	
Personnels d'appui non permanents	
Post-doctorants	2
Doctorants	6
Sous-total personnels non permanents en activité	8
Total personnels	12

EVALUATION

Overall assessment of the team

The team is pursuing a clear and consistent strategy concerning the physical study of collective behaviors of cells, delivering excellent results in the frame of efficient collaborations. There is a clear evolution from 2D to 3D with subsequent experimental and analytical challenges, which are well identified and addressed. The team being quite known and visible, in particular through teaching and conferences, it attracts talented young scientists, who are managed with care. The team is also very involved in science dissemination, but acknowledges a limited connection with the private sector.

Strengths and possibilities linked to the context

The team benefits from the on-site clean room and nearby IPGG facility, and also from strong and efficient collaborations with theoreticians and biologists.

The ongoing efforts in 2D have been rewarded, allowing the 3rd dimension to be explored either naturally or in an engineered manner. This way is a real challenge, both experimental and analytical, but the team has already begun to explore them with the current development of a next generation of kidney-on-chip using a high-resolution 3D printer based on 2-photons polymerization.

The team has a high expertise and visibility (many seminars and invited talks)

Thanks to its expertise and methods the team is well placed, probably a world-leading team in the field, to tackle a paradigm shift that is more than relevant for biology: from 2D to 3D, where the knowledge acquired about 2D systems may prove to be very important for the transition between the different dimensionalities.

All permanent members of the team are involved in PhD supervisions.

It is noteworthy that PhD students and postdocs find later permanent positions in academic research or in private companies.

At last, the team is involved in popular sciences events, participating to science diffusion.

Weaknesses and risks linked to the context

The switch from 2D to 3D for the team is timely but raises questions.

The main research axes scale from very fundamental to near-translational aspects, with some emphasis on mechanobiology. Their scientific soundness is assessed. However, because the development time of such projects is long (typically longer than a PhD), there is a risk of lack of continuity identified by the team. As there is a (natural) degree of thematic overlap with several PCC teams, the risk could be mitigated by pooling knowledge and know-how.

The kidney-on-a-chip theme, although very clear, exciting, and well connected to PCC does not raise the same questions of fundamental physics. The committee understands that it represents, in a way, the most applied variation of the collective behavior of cells, but there is a risk that the excellent team spirit might fade a little if this cross-disciplinary theme does not deliver very general questions of fundamental physics. Indeed, the theme is specific and offers a certain proximity to clinicians (an interesting advantage), but the committee wonders how this specificity may translate into generalities and how the theory of active soft matter can serve this project. Nevertheless, it is perfectly supported by the PCC theoreticians, who should bring out the physical part of renal tubules.

Analysis of the team's trajectory

The team has a long experience of cells as active nematic phase, cells in mechanical competition and organ-on-a-chip, with clear expertise and skills in microfabrication, microfluidics and quantitative data analysis. The transition from 2D to 3D systems is biologically relevant, timely and pushed by the development of a 2-photon polymerization system enabling to build now even more elaborated systems based on nanofabrication processes.

The team's trajectory is clear, well described and convincing. It demonstrates how pushing the historical themes to their limits feeds the new projects. The trajectory thus not only reflects an evolution from 2D to 3D but also how the team made the most of intermediate states (budding layers of cells, mechano-induced morphogenesis, mechanical competition between populations, etc).

RECOMMENDATIONS TO THE TEAM

The committee encourages the team to pursue its commitments, to develop the scientific perspectives in line with previous results, and to approach them with the same level of excellence, corresponding challenges involving new methods and tools (in particular digital ones), for which the team has demonstrated a certain agility.

The committee suggests that the team considers the possibility to interact more within PCC as there is a degree of overlap in the research axes. Some mutualization of research could relief pressure.

Finally, the kidney-on-chip axis could be promoted to the socio-economic world. This axis is based on high-level technological and methodological developments, which are very interesting for producing model or phantom organ samples (they do not necessarily have to be biologically active) that can withstand pressure, flow and mechanical response, and which look promising for modelling organic stress, for example.

The team should also continue its action toward science diffusion, such subjects centered on organ-on-chip being likely interesting for general public.

Team 14: Biomimetism of cellular movement

Name of the supervisor: Ms Cécile Sykes

THEMES OF THE TEAM

A part of the team left PCC in 2021 to join the LPENS. The team focused on physical and biochemical mechanisms governing cell shape change and movement, with implication for understanding cancer invasion and metastasis.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

Not considered because a part of the team left PCC during the evaluated period.

EVALUATION

Overall assessment of the team

The team was split in 2021, with one member joining a PCC team and the other members joining LPENS. Over 2017-2021, it developed an approach based on imaging, genetics and microfluidics to study biomimetic systems, worm and embryos models to study cell shape changes and movements with possible implications in cancer. These activities led to 15 publications with PCC affiliation in high-ranking journals and to numerous talks in seminars or conferences. The team also developed an important network of national and international collaborations and was successful in several fund raisings.

Strengths and possibilities linked to the context

Not evaluated due to the context.

Weaknesses and risks linked to the context

Not evaluated due to the context.

Analysis of the team's trajectory

The team examined the role of the acto-myosin cytoskeleton in cell movements, shape changes and collective cell reorganizations in cells, animals and embryos. It developed imaging and genetics tools to study cell movements during embryo and worm development in *Caenorhabditis elegans* and other nematode species. The team has also studied the role of actin and myosin networks in providing mechanical cues during somitogenesis in the chicken embryo. In the work on cellular mimicry, it mimicked in a controlled manner cell division, shape changes and endocytosis by modifying actin dynamics and network-membrane attachment using functionalized surfaces. Team's members have also collaborated with the Curie Hospital to characterize the link between the nucleus and the cytoskeleton in metastases.

The team was split up in 2021, with one member joining PCC's team 6 and the other members joining LPENS.

RECOMMENDATIONS TO THE TEAM

Not given due to the context.

CONDUCT OF THE INTERVIEWS

Dates

Start: 18 October 2023 at 08:30

End: 20 October 2023 at 12:00

Interview conducted: on-site

INTERVIEW SCHEDULE

Jour 1 - Mercredi 18/10

08h45 – 09h00	Présentation du comité et du programme	Amphi Curie
09h00 – 10h00	Présentation du directeur/directrice devant le comité, les tutelles et le personnel	
10h00 – 10h30	Questions du comité et échange	
10h30-11h00	<i>Huis-clos et pause</i>	
11h00 – 12h30	Présentations scientifiques et faits marquants par les équipes de recherche 11h00 - Equipe P. Sens 11h15 Equipe P. Hersen 11h30 - Equipe M. Coppey 11h45 - Equipe P. Silberzan 12h00 - Equipe P. Martin 12h15 - Equipe P. Bassereau	Salle M. Dahan
15'	<i>Huis-clos</i>	
13h00-14h00	plateaux-repas	
14h00 – 15h30	Présentations scientifiques et faits marquants par les équipes de recherche 14h00 - Equipe D. Lévy 14h15 - Equipe L. Perié 14h30 - Equipe H. Isambert 14h45 - Equipe E. Farge 15h00 - Equipe W. Keil 15h15 - Equipe S. Descroix	Salle M. Dahan
15h30-16h00	<i>huis-clos du comité ou pause</i>	
16h00 - 18h00	Visites de manips ou des services tech en petits groupes (~25 min par équipe)	
	Groupe 1 (R+3): Equipe P. Martin Equipe ProTeam Equipe BMBC Equipe E. Farge	Group 2 (R-1) Equipe P. Silberzan Plateau FluidFM Equipe M. Coppey Atelier de mécanique

Jour 2 - Jeudi 19/10

09h00 – 9h45	Échange comité-tutelles		Salle M. Dahan
09h45 – 10h30	Echange comité – PAR (ITA/BIATSS/CDD/CDI)		
30 mn	<i>huis-clos du comité et pause</i>		
11h00 – 11h45	Echange comité – Doctorants et Postdocs		
11h45-12h30	Échange comité – C/EC		
30'	<i>huis-clos du comité</i>		
Pause déjeuner	plateaux-repas		
14h30 – 16h00	Visite des équipes (~25 min par équipe)		Bâtiment Curie
	Groupe 1 [RdC] Equipe L. Perié Equipe P. Sens Equipe H. Isambert	Groupe 2 [R-1/R+2] Equipe D. Lévy Equipe P. Hersen Equipe P. Bassereau.	
30'	<i>huis-clos du comité ou pause</i>		Salle M. Dahan
15'	<i>Déplacement vers l'IPGG.</i>		
16h30 - 18h00	Visite des équipes Présentation générale de l'IPGG (S. Descroix) Le comité rencontre successivement Equipe W. Keil Equipe S. Descroix		IPGG, 4th floor

Jour 3 - Vendredi 20/10

09h-10h30	Échange comité – Direction (& future direction)	Salle M. Dahan
10h30-14h	Huis-clos et plateaux-repas	Salle M. Dahan

GENERAL OBSERVATIONS OF THE SUPERVISORS

CENTRE DE RECHERCHE

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Objet

Comments to HCERES Evaluation report of the Unit
PCC- Unité Physico-Chimie Curie
DER- PUR250024483 - EV 0753172R
Evaluation campaign 2023-2024 / Group D

HCERES

For the attention of HCERES President,
Mr Stéphane Le Bouler
and the HCERES Expert Committee

Paris, 31st January 2024

Dear All,

We would like to send our warmest thanks to the members of the HCERES Expert Committee for their very positive evaluation that captured the scientific quality as well as the human and organization dynamics of the UMR 168 / PCC.

We do not have any special comments except for some factual modifications in the report content (please see enclosed list).

Finally, we have also taken due note of your very relevant recommendations.

Yours sincerely,

Pr Alain PUISIEUX
Directeur du Centre de Recherche de l'Institut Curie



Dr Pascal HERSEN
Directeur de l'UMR168

Pascal HERSEN
Directeur UMR168

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