Research evaluation

REPORT ON THE RESEARCH UNIT:
Center for Theoretical Physics (CPHT)

UNDER THE SUPERVISION OF THE FOLLOWING INSTITUTIONS AND RESEARCH BODIES:
École Polytechnique
Centre National de la Recherche Scientifique - CNRS

EVALUATION CAMPAIGN 2018-2019
GROUP E

In the name of Hcéres[1]:

Michel Cosnard, President

In the name of the experts committee[2]:

David Langlois, Chairman of the committee

Under the decree No.2014-1365 dated 14 November 2014,

[1] The president of Hcéres "countersigns the evaluation reports set up by the experts committees and signed by their chairman." (Article 8, paragraph 5);

[2] The evaluation reports "are signed by the chairman of the experts committee". (Article 11, paragraph 2).

This report is the sole result of the unit's evaluation by the expert committee, the composition of which is specified below. The assessments contained herein are the expression of an independent and collegial reviewing by the committee.
Tables in this report were filled with data provided by laboratories and supervising bodies in the unit's application and in the Excel files "Données du contrat en cours" and "Données du prochain contrat".

UNIT PRESENTATION

Unit name:	Center for Theoretical Physics
Unit acronym:	CPHT
Requested label:	UMR
Application type:	Renewal
Current number:	7644
Head of the unit (2018-2019):	Mr Jean-René CHAZOTTES
Project leader (2020-2024):	Mr Jean-René CHAZOTTES
Number of teams and/or themes:	6

EXPERTS COMMITTEE MEMBERS

Chair: Mr David LANGLOIS, CNRS, Université Paris Diderot

Experts:

Mr Nestor ARMESTO, Universidade de Santiago de Compostela, Spain

Mr Benjamin BASSO, École Normale Supérieure, Paris

Ms Marie-Thérèse BECHIER-DONEL, CNRS, Marseille (supporting personnel)

Mr Denis BERNARD, CNRS, École Normale Supérieure, Paris

Mr Thierry GIAMARCHI, Université de Genève, Switzerland

Ms Laura MESSIO, Sorbonne Université, Paris (representative of CNU)

Mr Karim NOUI, Université Francois-Rabelais de Tours (representative of CoNRS)

Mr Luis SILVA, Instituto Superior Técnico, Portugal

HCÉRES REPRESENTATIVE

Mr Yannis KARYOTAKIS

REPRESENTATIVES OF SUPERVISING INSTITUTIONS AND BODIES

Mr Benoit DEVEAUD, École Polytechnique

Mr Philippe LECHEMINANT, CNRS

INTRODUCTION

HISTORY AND GEOGRAPHICAL LOCATION OF THE UNIT

The Centre de Physique théorique (CPHT), located on the campus of École Polytechnique, is a mixed research unit (Unité Mixte de Recherche: UMR), which depends on both CNRS and École Polytechnique.

MANAGEMENT TEAM

Director: Mr Jean-René CHAZOTTES.

HCÉRES NOMENCLATURE

ST2 – Physique.

SCIENTIFIC DOMAIN

The unit's research covers a broad range of topics in various fields of theoretical physics. These include Quantum Chromo-Dynamics (QCD); string theory and its applications to particle physics, cosmology, black holes or condensed matter; various themes in mathematical physics concerning Quantum Field Theory, dynamical systems, stochastic processes, statistical physics; condensed matter; and finally plasma physics with the study of laser plasma interactions and of magnetised plasmas.

UNIT WORKFORCE

	Unit workforce	
	Center for Theoretical Physics	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	5	5
Assistant professors and similar positions		1
Full time research directors ("Directeur de recherche") and similar positions	10	9
Full time research associates ("Chargé de recherche") and similar positions	13	11
Other scientists		
High school teachers		
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	8	8
Permanent staff	**36**	**34**
Non-permanent professors and associate professors, including emeritus		

Non-permanent full time scientists, including emeritus, post-docs	42	
PhD Students	19	
Non-permanent supporting personnel	1	
Non-permanent staff	**43**	
Total	**79**	**34**

GLOBAL ASSESSMENT OF THE UNIT

During the evaluation period (2013-2018), the CPHT has contributed very significantly to all its research themes. Its scientific productivity is excellent with more than 500 papers published during these five years and the release of several software codes. Its worldwide reputation is excellent, as shown by the high number of invited presentations in international conferences and the large impact of several of its results. Several of its researchers have been granted prestigious grants, in particular three ERC grants (a fourth one has been awarded just before the committee's visit). The unit has also trained successfully a significant number of PhD students, who in general find easily a postdoctoral position or a job after their PhD defence. The CPHT is characterized by a very broad diversity of topics. The latest recruitments of permanent researchers and the future scientific strategy outlined by the management team are consistent with a healthy combination of diversity and excellence. Overall, the committee considers the CPHT to be an excellent research unit.

DETAILED ASSESSMENT OF THE UNIT

UNIT'S RESPONSE TO PREVIOUS RECOMMENDATIONS

One recommendation of the previous report was to intensify the recruitments. During the last few years, CPHT has managed to secure key permanent positions, improving its researcher net inflow with respect to the previous period. The committee has noticed in particular that the strong involvement of CPHT members in the physics department of École Polytechnique has been very helpful to hire new permanent researchers.

Another recommendation of the previous report was to officialise the partnership with College de France, where one of the unit's members is professor. This has not been completed yet but the committee was told during the visit that the administrative procedure had been recently revitalized and, hopefully, should be concluded in the near future.

CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

A – Scientific outputs and activities, academic collaborations, reputation and appeal

Scientific outputs and activities, academic collaborations, reputation and appeal From 01/01/2013 to 30/06/2018	Center for Theoretical Physics
Articles	
Scientific articles	535
Review articles	2
Other articles (professional journals, etc.)	
Books	
Scientific book edition	4
Book chapters	4
Meetings	
Meeting abstracts	82
Meetings and congress organisation	61
Electronic tools and products	
Software	11
Databases	1
Tools for decision making	
Solver competition tools	
Instruments and methodology	
Prototypes	
Platforms and observatories	
Other products	
Artistic creations	

Movie or theatre play creation	
Movies	
Editorial activities	
Participation to journal editorial boards (books, collections)	14
Peer reviewing activities	
Reviewing of journal articles	yes
Grant evaluation (public or charities)	yes
Participation to lab site visit committees (Hcéres, etc.)	yes
Participation to institutional committees and juries (CNRS, Inserm, etc.)	yes
Academic research grants	
European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	17
National public grants (ANR, PHRC, FUI, INCA, etc.)	19
Local grants (collectivités territoriales)	1
PIA (Labex, Equipex, etc.) grants	1
Grants from foundations and charities (ARC, FMR, FRM, etc.)	
Visiting senior scientists and post-docs	
Post-docs	51
Visiting senior scientists	71
Scientific recognition	
Prizes	10
Distinctions	6
IUF members	no
Chair of learned and scientific societies	yes
Invitations to meetings and symposia (out of France)	281
Members' long-term visits abroad	7

Strengths

The research of the unit is excellent, even outstanding in some specific areas. The unit had a remarkable scientific output during the evaluation period, with more than 500 papers published and the release of several software codes. The unit has a very strong international reputation and visibility as illustrated by the high number of invited presentations abroad (281). Several of its results have had a large impact internationally. The excellence of the unit is also illustrated by three prestigious ERC grants (one starting, one consolidator, one synergy), not including a new consolidator grant awarded very recently. The large number of postdoctoral researchers and international visitors demonstrates the appeal of the unit.

Weaknesses

While excellent from a global point of view, the funding could be improved and diversified within some of the teams by trying to apply more systematically to international sources, in particular to ERC grants which are potentially accessible for several young researchers.

Assessment of scientific outputs, reputation and appeal

The unit has an excellent scientific output and a strong international visibility, with a leading worldwide reputation in various research topics.

B – Interactions with the non-academic world, impacts on economy, society, culture or health

Interactions with the non-academic world, impacts on economy, society, culture or health From 01/01/2013 to 30/06/2018	
Socio-economic interactions / Patents	
Invention disclosures	
Filed patents	
Accepted patents	2
Licenced patents	
Socio-economic interactions	
Industrial and R&D contracts	4
Cifre fellowships	no
Creation of labs with private-public partnerships	no
Networks and mixed units	no
Start-ups	no
Expertise	
Consulting	no
Participation in expert committees (ANSES, etc.)	no
Legal expertise	no
Expert and standardization reports	no
Public outreach	
Radio broadcasts, TV shows, magazines	8
Journal articles, interviews, book edition, videos, etc.	9
Other popularisation outputs	3
Debates on science and society	

Strengths

Due to the nature of their research activities, some teams (condensed matter, laser-plasma interactions and magnetized plasmas) have links with the industrial world, which translate into a few industrial R&D contracts.

Weaknesses

The interactions with the non-academic world in terms of public outreach are very limited. Only a few individual commitments, mostly on a case-to-case basis, have contributed to the unit activities. This situation can be partially explained by the very formal and theoretical nature of many of the research interests in the unit. However, some specific research topics are directly related to subjects that could interest the general public.

Assessment of the interactions with the non-academic world

Three of the teams in the unit have interactions with the non-academic world through some industrial contracts. The public outreach activities of the unit as a whole are very limited and come from individual and mostly occasional commitments.

C – Involvement in training through research

Involvement in training through research From 01/01/2013 to 30/06/2018	
Educational outputs	
Books	
E-learning, MOOCs, multimedia lessons, etc.	1
Mean number of publications per student	
Training	
Habilitated (HDR) scientists	19
HDR obtained during the period	2
PhD students	42
Defended PhDs	22
Mean PhD duration	36
Internships (BTS, M1, M2)	53
Education	
Courses with international label (ERASMUS, etc.)	

Strengths

Overall, the unit has trained a reasonable number of PhD students, with respect to French standards: 21 PhD theses were defended during the evaluation period and 19 PhD theses are in progress. This represents a significant increase with respect to the previous evaluation period 2008-2013. According to the statistics provided by the unit when available, most of the PhD students who have completed their PhD thesis have managed relatively easily to find a post-doctoral position in academics or another job (in private companies, teaching, R&D etc.).

The committee has also favourably noted that several members of the unit are involved in research training within international networks, through international co-supervisions of PhDs.

Weaknesses

A potential threat is that a large majority of the permanent members are CNRS researchers and are thus not required to teach, which is however the best way to interact with students and to attract them for PhDs. At

present, this risk is avoided by a strong involvement of several members in the Department of physics and/or in teaching at the master level.

The number of PhD fellowships available is constrained and it can sometimes be difficult to obtain a PhD funding independently of a project-oriented research grant.

Assessment of the involvement in training through research

The unit has trained a reasonable number of PhD students during the evaluation period and the students who have completed their thesis have usually managed to find easily a job in academics or outside.

CRITERION 2: UNIT ORGANISATION AND LIFE

Unit organisation and life From 01/01/2013 to 30/06/2018	
Women/men ratio in the unit	14/120
Women/men ratio among unit scientists	4/34
Women/men ratio among unit PhD students	6/36
Women/men ratio among team leaders, unit head and deputy heads	1/7

Strengths

The unit is clearly structured into six research teams, supported by an administrative team and an IT team. The main decisions are discussed and validated by the "Conseil de Laboratoire", often after informal discussions between the director and the team leaders.

The involvement of the administrative team has been unanimously praised during the visit of the committee. The competence and dedication of the computer team has also been commended. The quality of these support teams plays a very important role in the life of the unit.

Recent initiatives to strengthen the cohesion of the lab, such as the PhD day, are very positive and should be encouraged.

Weaknesses

The broad diversity of the topics, while valuable, tends to reduce scientific communications between colleagues working in different fields. The committee has noted that only two teams (particle physics, string theory) organize a regular internal research seminar, whereas some other teams prefer to regroup with teams from other labs for regular meetings. At the level of the unit, the organization of a colloquium has been intermittent. The tradition of a PhD student day is still in its infancy and therefore fragile.

Gender balance is very skewed, but this is unfortunately not specific to this unit, especially in the field of theoretical physics. One can hope that the relatively higher women-to-men ratio among PhD students is an encouraging sign for the future.

The number of offices is too limited, forcing many students or postdocs to share the same office.

The upcoming retirement of the remarkable manager of the IT staff requires identifying and attracting a very qualified IT engineer, which might be difficult. The efficiency of the administrative team could be threatened by an overload of administrative tasks, compounded by difficult interactions with the central CNRS administration.

Assessment of the unit's life and organisation

The organization and life of the unit are very good. The synergy between the research teams and the administrative and IT teams appears excellent and should be preserved. The scientific interactions at the unit level could be reinforced *via* more frequent common events, such as a regular colloquium.

CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

Strengths

The scientific strategy of the unit, mostly defined at the level of the research teams, is well articulated, based on the scientific strengths of the team members while including some new research developments. The project is of very high quality with respect to international standards. The opening of new research directions on topics at the interface between a few teams will increase the synergy between these teams and reinforce internal interactions that will benefit the whole unit.

Weaknesses

A few research activities are threatened by the upcoming retirement of key researchers. If no new hiring in these areas is secured in the next few years, this will imply the extinction of these research topics within the unit.

The decision of École Polytechnique to leave the University of Paris-Saclay has had some negative side effects, for example producing some tensions among the members of labex projects common to École Polytechnique and Paris-Saclay. There is also a lot of uncertainty about the new institution that will be created. The unit will thus have to navigate wisely in uncharted waters, with potentially strong impacts on the recruitment policy and on the funding of PhD students.

Assessment of the scientific strategy and projects

The scientific strategy and projects are of very high quality with respect to international standards, combining the continuation in areas where the unit is already well positioned with the developments of new research avenues. Some research topics of the unit could disappear if no recruitment is secured in the near future.

RECOMMENDATIONS TO THE UNIT

A – Recommendations on scientific production and activities (criterion 1)

The committee recommends to maintain the high level of excellence reached by the unit and to continue to cultivate the diversity of its research activities. It is also important to maintain the involvement of the unit researchers in teaching activities, in particular within the Physics department of École Polytechnique, as a way to attract students for internship and PhD projects.

B – Recommendations on the unit's organisation and life (criterion 2)

The committee recommends the merging of the two plasma teams. Although the two teams have distinct research activities, their respective size will soon become subcritical and the proximity of their scientific interests makes their merging reasonable. From an external perspective, this would reinforce the visibility of the unit as a key actor in the physics of plasmas.

In order to strengthen the cohesion of the unit, it would be worth organizing a regular colloquium so that the whole staff could be exposed to basic knowledge about all the research topics of the unit. It could also be

useful to organize more regularly, for the benefit of new postdocs and PhD students, presentations on the research going on in other groups, in order to reduce the separation between the teams. The PhD day should be perpetuated and involve the postdocs as well.

Special care should be devoted to the recruitment of a new IT manager and to the well-being of the administrative staff.

C – Recommendations on scientific strategy and projects (criterion 3)

The overall strategy of the unit seems very sound, as it combines a continuation of the present research activities and the exploration of new avenues, in particular at the interface between several of the teams.

Given the uncertain and fast-evolving environment that will coincide with the creation of the new institution around École Polytechnique, the committee recommends a flexible and reactive policy combined with well-defined priorities, in particular concerning future recruitments.

TEAM-BY-TEAM ANALYSIS

Team 1: Particle Physics

Team leader: Mr Stéphane MUNIER

TEAM SCIENTIFIC DOMAIN

The team's research is focused on the study of Quantum Chromodynamics (QCD) from medium to high energies, dealing with both the structure of strongly interacting matter and the mechanisms of particle production through perturbative and non-perturbative techniques.

TEAM WORKFORCE

	T1	
	Particle Physics	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	1	1
Assistant professors and similar positions		
Full time research directors (Directeurs de recherche) and similar positions		
Full time research associates (Chargés de recherche) and similar positions	4	3
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")		
High school teachers		
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)		
Permanent staff	**5**	**4**
Non-permanent professors and associate professors, including emeritus		
Non-permanent full time scientists, including emeritus, post-docs	5	
PhD Students	2	
Non-permanent supporting personnel		
Non-permanent staff	**5**	
Total	**10**	**4**

CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

A – Scientific outputs and activities, academic collaborations, reputation and appeal

Scientific outputs and activities, academic collaborations, reputation and appeal From 01/01/2013 to 30/06/2018	Particle Physics
Articles	
Scientific articles	74
Review articles	2
Other articles (professional journals, etc.)	
Books	
Scientific book edition	
Book chapters	
Meetings	
Meeting abstracts	47
Meetings and congress organisation	13
Electronic tools and products	
Software	
Databases	
Tools for decision making	
Solver competition tools	
Instruments and methodology	
Prototypes	
Platforms and observatories	
Other products	
Artistic creations	
Movie or theatre play creation	
Movies	
Editorial activities	
Participation to journal editorial boards (books, collections)	1
Peer reviewing activities	
Reviewing of journal articles	yes
Grant evaluation (public or charities)	yes
Participation to lab site visit committees (Hcéres, etc.)	

Participation to institutional committees and juries (CNRS, Inserm, etc.)	yes
Academic research grants	
European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	
National public grants (ANR, PHRC, FUI, INCA, etc.)	5
Local grants (collectivités territoriales)	
PIA (Labex, Equipex, etc.) grants	1
Grants from foundations and charities (ARC, FMR, FRM, etc.)	
Visiting senior scientists and post-docs	
Post-docs	6
Visiting senior scientists	17
Scientific recognition	
Prizes	
Distinctions	
IUF members	
Chair of learned and scientific societies	no
Invitations to meetings and symposia (out of France)	44
Members' long-term visits abroad	

Strengths

The team has a strong record of publications in the top peer-reviewed international journals in the field. Some of the published articles have had a large impact e.g. perturbative corrections to diffractive processes, the use of neutrino beams for hadron spin structure, the relation between factorisation at small x in the dilute and dense regimes, the perturbative studies of deconfinement or the exploration of the role of the orbital angular momentum in proton spin and structure. The group has produced a reference review on initial conditions for heavy-ion collisions. It has been recognised with invitations to working group organisation in top conferences in the field, a contribution to reports of the International Union of Pure and Applied Physics and an important role in the forward physics working group at the Large Hadron Collider at CERN. The replacement of people that went into retirement has been well handled with the new hiring. Considering its size, the group covers a very wide range of activities in QCD, being a reference group worldwide. Their members act as organisers of programs at reference sites like the Institute for Nuclear Theory in Seattle or ECT* in Trento. The group has a large number of ongoing ANR and PICS grants and one of its members is actively applying to ERC grants (having been graded A twice).

Weaknesses

While the number of ongoing ANR and PICS grants is large, the involvement of the team in EU funding remains modest, given the potential in the group for ERC applications and for leadership roles in H2020 grants. The participation in conferences is not as large as it could be considering the scientific quality of the members of the team. Lattice activities are weak and there seems to be no continuation of this line. The interactions of the team with experimentalists from the LLR at the École Polytechnique, or other experimental groups nearby, could be further strengthened. The collaboration inside the team seems, at this moment, reduced to some lattice calculation applied to small-x evolution of parton densities and on observables in proton-nucleus collisions, while possibilities for other ones look evident on transverse momentum distributions at small x, and on lattice and perturbative confinement, and possible with the Mathematical Physics group on stochastic models.

Assessment of scientific outputs, reputation and appeal

The team quality is very high with respect to international standards, and the continuation of the present scientific activities (except those related to lattice QCD) is guaranteed by the team's age structure. Its international presence and financial support could however be larger. The team can be qualified as excellent, with large possibilities for quickly becoming outstanding.

B – Interactions with the non-academic world, impacts on economy, society, culture or health

Interactions with the non-academic world, impacts on economy, society, culture or health From 01/01/2013 to 30/06/2018	
Socio-economic interactions / Patents	
Invention disclosures	
Filed patents	
Accepted patents	
Licenced patents	
Socio-economic interactions	
Industrial and R&D contracts	
Cifre fellowships	
Creation of labs with private-public partnerships	
Networks and mixed units	
Start-ups	
Expertise	
Consulting	
Participation in expert committees (ANSES, etc.)	1
Legal expertise	
Expert and standardization reports	
Public outreach	
Radio broadcasts, TV shows, magazines	
Journal articles, interviews, book edition, videos, etc.	6
Other popularization outputs	1
Debates on science and society	

Strengths

See global unit's assessment.

Weaknesses

See global unit's assessment.

Assessment of the interactions with the non-academic world

See global unit's assessment.

C – Involvement in training through research

Involvement in training through research From 01/01/2013 to 30/06/2018	
Educational outputs	
Books	
E-learning, MOOCs, multimedia lessons, etc.	
Mean number of publications per student	
Training	
Habilitated (HDR) scientists	3
HDR obtained during the period	
PhD students	2
Defended PhDs	
Mean PhD duration	36
Internships (BTS, M1, M2)	11
Education	
Courses with international label (ERASMUS, etc.)	

Strengths

Members of the group are involved in the board of the Doctoral School PHENIICS and in the joint Master of High Energy Physics with ETH Zürich. They also participate in co-supervision of PhDs with researchers from other institutions in France and Spain.

Weaknesses

The number of habilitated members is too small and should be increased – PhD. co-supervision with non-CPhT members should not be the standard procedure. Given the possibilities of the group, the number of supervised PhD. students is small and the involvement in teaching is low.

Assessment of the involvement in training through research

The present involvement of the team's members in training could be improved. The numbers of habilitated members and of supervised PhD students are too small considering the large activity of the team.

CRITERION 2: TEAM ORGANISATION AND LIFE

Team organisation and life From 01/01/2013 to 30/06/2018	
Women/men ratio in the team	1/20
Women/men ratio among team scientists	0/6
Women/men ratio among team PhD students	0/2
Women/men ratio among team leaders, team head and deputy heads	0/1

Strengths

The team has a clear organisational structure and a good internal coordination, with the organisation of group seminars on a regular basis. The team has a significant involvement (3/15 members) in the Laboratory Council. Interactions between the staff and postdocs and students seem excellent.

Weaknesses

Gender balance is very negative, both at the level of members of the team and of PhD students. Nevertheless, this is, most unfortunately, a feature of Physics in general and of Theoretical Physics in particular. Office space is lacking, with some staff members of the team sharing office, and postdocs and students rather packed.

Assessment of the team's life and organisation

The organisation of the team is excellent and clear with respect to international standards. The gender balance is very negative but similar to the situation at international level.

CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

Strengths

The projects contained in the scientific strategy are very relevant in the field: studies of hadron structure (energy-momentum tensor, twist-3 distributions, tomography), of the high-energy domain (TMDs and their relation to CGC calculations, energy-momentum tensor of the matter in a hadronic collision, diffraction) and of the non-perturbative structure of QCD (perturbative expansion in the Curci-Ferrari model and its extension to include chiral symmetry breaking). The team is fully capable of developing them successfully, provided enough funding is obtained. They involve all the personnel in the team, the only missing item being lattice QCD. Some of them are suitably related to the corresponding experimental programmes. Of particular novelty are those related to the QCD energy-momentum tensor, both in a hadron and of the matter produced in high-energy hadronic collisions, with strong relation with experimental programmes in the US and Europe.

Weaknesses

We regret that there is no project related to lattice QCD, one line that could be of great importance but is apparently abandoned – although the same seems to happen all around France. There is little effort to relate the different projects, which look disjoint even though there is complementary expertise among the different members of the team (although plans for improving this aspect were shown during the visit). As an example, the studies of QCD tomography/TMDs in the intermediate and large energy regimes, as presented in the scientific strategy, are decoupled. Some of the projects miss novel aspects, looking like a continuation of an otherwise very relevant research.

Assessment of the scientific strategy and projects

The quality of the scientific strategy and projects is excellent and fully relevant at international level, with relation to experimental programmes and some novel ideas, but links between complementary aspects are missing.

RECOMMENDATIONS TO THE TEAM

A – Recommendations on scientific production and activities (criterion 1)

Apply (as PIs) to ERC and H2020 EU grants, considering that the quality of the team and the interest of its research are high enough for these aims. Increment the participation in conferences to enhance the visibility of the obtained results, and the number of postdocs. Explore/strengthen the interaction with experimental groups, particularly those nearby through e.g. joint seminars or workshop organisation. Explore or strengthen the collaboration between members of the team with complementary expertise and with other teams in CPHT. Explore the possibilities for keeping lattice activities if the national context allows.

Increase the number of habilitated members to supervise more PhD students. Participate to doctoral programmes at national and international levels as soon as the situation with the new doctoral school is clarified.

B – Recommendations on the team's organisation and life (criterion 2)

Encourage the recruiting of women to the largest possible extent.

C – Recommendations on scientific strategy and projects (criterion 3)

Increase the collaboration between members of the team with complementary expertise along the lines shown in the presentation by the group during the visit. Explore the possibilities for keeping a lattice line that could strongly complement the existing ones, considering the national context. Undertake formal roles in committees for present and future theoretical and experimental activities/programmes.

Team 2: String Theory

Team leader: Mr Marios PETROPOULOS

TEAM SCIENTIFIC DOMAIN

The team's research activities cover a wide range of topics in high-energy physics and cosmology, including formal aspects of string theory and supergravity, string inspired particle phenomenology and cosmology, supersymmetry, black hole physics, holography and its applications to condensed matter physics.

TEAM WORKFORCE

	T2	
	String Theory	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	1	1
Assistant professors and similar positions		
Full time research directors (Directeurs de recherche) and similar positions	2	2
Full time research associates (Chargés de recherche) and similar positions	3	3
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")		
High school teachers		
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)		
Permanent staff	**6**	**6**
Non-permanent professors and associate professors, including emeritus		
Non-permanent full time scientists, including emeritus, post-docs	7	
PhD Students	5	
Non-permanent supporting personnel		
Non-permanent staff	**7**	
Total	**13**	**6**

CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

A – Scientific outputs and activities, academic collaborations, reputation and appeal

Scientific outputs and activities, academic collaborations, reputation and appeal From 01/01/2013 to 30/06/2018	String Theory
Articles	
Scientific articles	96
Review articles	
Other articles (professional journals, etc.)	
Books	
Scientific book edition	
Book chapters	
Meetings	
Meeting abstracts	12
Meetings and congress organisation	28
Electronic tools and products	
Software	
Databases	
Tools for decision making	
Solver competition tools	
Instruments and methodology	
Prototypes	
Platforms and observatories	
Other products	
Artistic creations	
Movie or theatre play creation	
Movies	
Editorial activities	
Participation to journal editorial boards (books, collections)	4
Peer reviewing activities	
Reviewing of journal articles	yes
Grant evaluation (public or charities)	yes
Participation to lab site visit committees (Hcéres, etc.)	

Participation to institutional committees and juries (CNRS, Inserm, etc.)	yes
Academic research grants	
European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	7
National public grants (ANR, PHRC, FUI, INCA, etc.)	2
Local grants (collectivités territoriales)	0
PIA (Labex, Equipex, etc.) grants	
Grants from foundations and charities (ARC, FMR, FRM, etc.)	
Visiting senior scientists and post-docs	
Post-docs	11
Visiting senior scientists	16
Scientific recognition	
Prizes	3
Distinctions	1
IUF members	
Chair of learned and scientific societies	yes
Invitations to meetings and symposia (out of France)	67
Members' long-term visits abroad	5

Strengths

The scientific production of the String Theory group is very diverse and of the highest quality. During the evaluation period, its members obtained numerous important results in their research domains and published around 100 articles, mostly in the field's highest impact peer-reviewed journals (*Physical Review Letters, Journal of High Energy Physics, Journal of Cosmology and Astroparticle Physics, European Physical Journal C*, etc). The team members are internationally recognised researchers: they lecture in international conferences, workshops and schools; they were awarded prestigious and competitive grants (ERC, ANR), prizes and distinctions; they are members of international committees, evaluating councils, journal editorial boards. The team also developed a network of collaborations and partnerships with institutions across the world, along with several PICS projects, and is maintaining a constant flow of students, postdocs and visitors. Besides, the group members are actively engaged in the organization of the scientific life in the Paris area, through common workshops, seminars, lectures series, and journal clubs.

Weaknesses

None identified.

Assessment of scientific outputs, reputation and appeal

The group is composed of internationally recognised scientists and its scientific production is excellent. During the evaluation period, it has been able to attract two outstanding young researchers.

B – Interactions with the non-academic world, impacts on economy, society, culture or health

Interactions with the non-academic world, impacts on economy, society, culture or health From 01/01/2013 to 30/06/2018	
Socio-economic interactions / Patents	
Invention disclosures	
Filed patents	
Accepted patents	
Licenced patents	
Socio-economic interactions	
Industrial and R&D contracts	
Cifre fellowships	
Creation of labs with private-public partnerships	
Networks and mixed units	
Start-ups	
Expertise	
Consulting	
Participation in expert committees (ANSES, etc.)	
Legal expertise	
Expert and standardization reports	
Public outreach	
Radio broadcasts, TV shows, magazines	
Journal articles, interviews, book edition, videos, etc.	1
Other popularization outputs	1
Debates on science and society	

Strengths

See global unit's assessment.

Weaknesses

See global unit's assessment.

Assessment of the interactions with the non-academic world

See global unit's assessment.

C – Involvement in training through research

Involvement in training through research From 01/01/2013 to 30/06/2018	
Educational outputs	
Books	
E-learning, MOOCs, multimedia lessons, etc.	
Mean number of publications per student	
Training	
Habilitated (HDR) scientists	3
HDR obtained during the period	
PhD students	9
Defended PhDs	4
Mean PhD duration	36
Internships (BTS, M1, M2)	18
Education	
Courses with international label (ERASMUS, etc.)	

Strengths

The team members are actively engaged in teaching and training at various levels (master-PhD). During the evaluation period, they supervised 18 undergraduate internships and six (3 defended and 3 on-going) PhD students.

Weaknesses

None identified.

Assessment of the involvement in training through research

The group members are actively engaged in the training of the next generation of researchers.

CRITERION 2: TEAM ORGANISATION AND LIFE

Team organisation and life From 01/01/2013 to 30/06/2018	
Women/men ratio in the team	3/18
Women/men ratio among team scientists	1/5
Women/men ratio among team PhD students	1/8
Women/men ratio among team leaders, team head and deputy heads	0/1

Strengths

The team is maintaining a vibrant scientific atmosphere, through e.g. the seminars and journal clubs that the team members organise. The 3/18 women-to-men ratio of the team is regrettably low; it appears nonetheless good in comparison with similar research teams in the Paris area and attests of the team awareness of the gender imbalance issue in high energy physics groups.

Weaknesses

The lack of space (offices, discussion and seminar rooms) is a threat to the team's scientific life as well as its development.

Assessment of the team's life and organisation

The team is maintaining a vibrant scientific atmosphere, but the lack of space represents a serious threat to its development.

CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

Strengths

In the near future the group plans on maintaining the diversity of its research activities and developing its current (traditional and recent) lines of research, along with several on-going projects and recently submitted proposals (ERC, ANR) under evaluation. The group is also expressing the desire of exploring new research directions in connection with the Mathematical Physics group, on topics related to tensor models, dynamical systems and conformal field theory, and of increasing the scientific collaboration with the Condensed Matter group, through notably an ambitious systematic investigation of universal transport properties in strongly coupled systems.

Weaknesses

None identified.

Assessment of the scientific strategy and projects

The research agenda for the next few years is timely and exciting. It should allow the team to maintain its position at the forefront of the field. The combination of the team's complementary expertises in tensor models, dynamical systems, holography, conformal field theory and condensed matter physics might lead to important new developments in these lively research areas.

RECOMMENDATIONS TO THE TEAM

A – Recommendations on scientific production and activities (criterion 1)

No specific recommendation, apart that the committee encourages the younger members of the team to obtain the habilitation (HDR).

B – Recommendations on the team's organisation and life (criterion 2)

None.

C – Recommendations on scientific strategy and projects (criterion 3)

The committee endorses the team's desire of reinforcing the synergies with the Condensed Matter group and the Mathematical Physics group.

Team 3: Mathematical Physics

Team leader: Mr Christoph KOPPER

TEAM SCIENTIFIC DOMAIN

The research topics covered by the Mathematical Physics team are very diverse, from the more mathematical to the more applied, including quantum field theory, dynamical systems, stochastic processes, statistical physics, and their applications. The group has renewed some of its research topics since the last evaluation, and it is currently working on very topical subjects.

TEAM WORKFORCE

	T3	
	Mathematical Physics	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	1	1
Assistant professors and similar positions		
Full time research directors (Directeurs de recherche) and similar positions	1	1
Full time research associates (Chargés de recherche) and similar positions	2	2
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")		
High school teachers		
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)		
Permanent staff	**4**	**4**
Non-permanent professors and associate professors, including emeritus		
Non-permanent full time scientists, including emeritus, post-docs	5	
PhD Students	2	
Non-permanent supporting personnel	1	
Non-permanent staff	**6**	
Total	**10**	**4**

CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

A – Scientific outputs and activities, academic collaborations, reputation and appeal

Scientific outputs and activities, academic collaborations, reputation and appeal From 01/01/2013 to 30/06/2018	Mathematical Physics
Articles	
Scientific articles	72
Review articles	
Other articles (professional journals, etc.)	
Books	
Scientific book edition	4
Book chapters	2
Meetings	
Meeting abstracts	2
Meetings and congress organisation	4
Electronic tools and products	
Software	
Databases	
Tools for decision making	
Solver competition tools	
Instruments and methodology	
Prototypes	
Platforms and observatories	
Other products	
Artistic creations	
Movie or theatre play creation	
Movies	
Editorial activities	
Participation to journal editorial boards (books, collections)	3
Peer reviewing activities	
Reviewing of journal articles	yes
Grant evaluation (public or charities)	yes
Participation to lab site visit committees (Hcéres, etc.)	

Participation to institutional committees and juries (CNRS, Inserm, etc.)	yes
Academic research grants	
European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	
National public grants (ANR, PHRC, FUI, INCA, etc.)	
Local grants (collectivités territoriales)	
PIA (Labex, Equipex, etc.) grants	
Grants from foundations and charities (ARC, FMR, FRM, etc.)	
Visiting senior scientists and post-docs	
Post-docs	2
Visiting senior scientists	8
Scientific recognition	
Prizes	1
Distinctions	1
IUF members	
Chair of learned and scientific societies	yes
Invitations to meetings and symposia (out of France)	15
Members' long-term visits abroad	1

Strengths

The group activities cover a very large domain of interests, and the team members have produced a considerable amount of articles with a set of remarkable results during the evaluation period. The CPHT team is internationally recognized for its works on tensor field theory. Numerous results have been obtained in this topic with noticeable echoes, in part because of their connections with the so-called SYK models with applications to quantum critical points and/or black hole physics. Remarkable rigorous results on dynamical systems and stochastic processes have been proved, in particular for birth-and-death processes with applications to theoretical ecology. This research direction, in connection with the CMAP *via* the Chair `Modélisation Mathématique et Biodiversité', is very promising in view of the expansion of theoretical ecology. A long-term project is undertaken on rigorous non-perturbative renormalisation of quantum field theory, based on the renormalisation group flow, especially in connection with gauge theory and the standard model. Proofs of the convergence of the operator product expansion in certain quantum field theories have been given. All this clearly illustrates the group's vitality.

Weaknesses

The group would certainly benefit from developing interactions between its different members.

Assessment of scientific outputs, reputation and appeal

The research performed by the Mathematical Physics group is excellent, at a very high level, internationally competitive and internationally recognized. The scientific production is very diverse with a very high quality. Some of their results have had a strong impact in the community.

B – Interactions with the non-academic world, impacts on economy, society, culture or health

Interactions with the non-academic world, impacts on economy, society, culture or health From 01/01/2013 to 30/06/2018	
Socio-economic interactions / Patents	
Invention disclosures	
Filed patents	
Accepted patents	
Licenced patents	
Socio-economic interactions	
Industrial and R&D contracts	
Cifre fellowships	
Creation of labs with private-public partnerships	
Networks and mixed units	
Start-ups	
Expertise	
Consulting	
Participation in expert committees (ANSES, etc.)	
Legal expertise	
Expert and standardization reports	
Public outreach	
Radio broadcasts, TV shows, magazines	
Journal articles, interviews, book edition, videos, etc.	
Other popularization outputs	1
Debates on science and society	

Strengths

See global unit's assessment.

Weaknesses

See global unit's assessment.

Assessment of the interactions with the non-academic world

See global unit's assessment.

C – Involvement in training through research

Involvement in training through research From 01/01/2013 to 30/06/2018	
Educational outputs	
Books	
E-learning, MOOCs, multimedia lessons, etc.	1
Mean number of publications per student	
Training	
Habilitated (HDR) scientists	4
HDR obtained during the period	1
PhD students	5
Defended PhDs	3
Mean PhD duration	36
Internships (BTS, M1, M2)	4
Education	
Courses with international label (ERASMUS, etc.)	

Strengths

Three PhD theses were finished during the evaluation period, and three started recently, some of them with joint supervisions. These are good numbers in view of the size of the team. They should increase in the near future with the arrival of a recently recruited permanent researcher and the new ERC grant.

The PhD students have worked on a wide variety of topics across the range of research activities in the group. Most of the PhD students easily find a job in academia or in industry after their defence.

Members of the team have also written four books or e-books during this period.

Weaknesses

An important threat is the insufficient number of PhD fellowships with respect to the number of outstanding students who wish to do their PhD at CPHT. This is a very frustrating situation for the team members.

Assessment of the involvement in training through research

The members of the team have been supervising a good number of PhD students during the evaluation period.

CRITERION 2: TEAM ORGANISATION AND LIFE

Team organisation and life From 01/01/2013 to 30/06/2018	
Women/men ratio in the team	0/14
Women/men ratio among team scientists	0/7
Women/men ratio among team PhD students	0/5
Women/men ratio among team leaders, team head and deputy heads	0/2

Strengths

The atmosphere in the team is excellent, with a lot of daily discussions even if there are no concrete collaborations. Furthermore, the group is very well represented in the physics department. Two of the members of the team have important synergetic activities in the Laboratory or the Physics Department of École Polytechnique.

It is regrettable that there is no woman in the group but this situation is unfortunately customary in mathematical physics.

The scientific animation of the group (seminars, journal club, or else) and their interactions with the other teams can be improved.

Assessment of the team's life and organisation

The team members are working in an excellent atmosphere.

CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

Strengths

The research pursued by the Theoretical physics team is highly topical at present. The project is ambitious and the expected results could have a very strong impact. The projects of the team members are excellent.

Weaknesses

More interactions between the members of the team and with members of the other teams of the CPHT would most probably be welcome with potential important impacts.

Assessment of the scientific strategy and projects

The research performed by the mathematical physics group is topical. The research program along these lines is timely with a potential high impact.

RECOMMENDATIONS TO THE TEAM

A – Recommendations on scientific production and activities (criterion 1)

The group should preserve its research diversity and excellence.

B – Recommendations on the team's organisation and life (criterion 2)

Increasing scientific interactions with other teams of the CPHT could be beneficial.

C – Recommendations on scientific strategy and projects (criterion 3)

The group should preserve its diversity. Formulating more explicitly their long-term research goals (the possible opportunities and how those are embedded in the international research) could be gainful.

Team 4: Condensed Matter

Team leader: Ms Silke BIERMANN

TEAM SCIENTIFIC DOMAIN

The condensed matter team works both on the development of (analytic and numerical) techniques and on their application to real or model systems (crystalline materials, ultracold atomic gases, quantum dots…) with the aim to describe the effect of interactions, to identify potential new phases and characterize structural, spectral, magnetic and transport properties.

TEAM WORKFORCE

	T4	
	Condensed Matter	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions	2	2
Assistant professors and similar positions		1
Full time research directors (Directeurs de recherche) and similar positions	2	2
Full time research associates (Chargés de recherche) and similar positions	2	2
Other scientists (“Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.”)		
High school teachers		
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	1	1
Permanent staff	**7**	**8**
Non-permanent professors and associate professors, including emeritus		
Non-permanent full time scientists, including emeritus, post-docs	18	
PhD Students	8	
Non-permanent supporting personnel		
Non-permanent staff	**18**	
Total	**25**	**8**

CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

A – Scientific outputs and activities, academic collaborations, reputation and appeal

Scientific outputs and activities, academic collaborations, reputation and appeal From 01/01/2013 to 30/06/2018	Condensed Matter
Articles	
Scientific articles	171
Review articles	
Other articles (professional journals, etc.)	
Books	
Scientific book edition	
Book chapters	2
Meetings	
Meeting abstracts	4
Meetings and congress organisation	8
Electronic tools and products	
Software	3
Databases	
Tools for decision making	
Solver competition tools	
Instruments and methodology	
Prototypes	
Platforms and observatories	
Other products	
Artistic creations	
Movie or theatre play creation	
Movies	
Editorial activities	
Participation to journal editorial boards (books, collections)	3
Peer reviewing activities	
Reviewing of journal articles	yes
Grant evaluation (public or charities)	yes
Participation to lab site visit committees (Hcéres, etc.)	yes

Participation to institutional committees and juries (CNRS, Inserm, etc.)	yes
Academic research grants	
European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	6
National public grants (ANR, PHRC, FUI, INCA, etc.)	5
Local grants (collectivités territoriales)	1
PIA (Labex, Equipex, etc.) grants	
Grants from foundations and charities (ARC, FMR, FRM, etc.)	
Visiting senior scientists and post-docs	
Post-docs	24
Visiting senior scientists	22
Scientific recognition	
Prizes	4
Distinctions	3
IUF members	
Chair of learned and scientific societies	yes
Invitations to meetings and symposia (out of France)	133
Members' long-term visits abroad	1

Strengths

The team is at the highest international level in the field of condensed matter (ab-initio calculations for real materials, DMFT), quantum optics/electrodynamics and ultracold atoms. During the evaluation period, many high-profile papers have been published in the best journals of the field (among which 19 articles in PRL, 3 in Nature). The team realizations are distinguished by prizes and by the attribution of many international (including 2 ERC) and national (including 3 ANR) grants. Its members have received numerous invitations for international conferences. The team is well implanted in the community, both at the international and national levels with collaboration and exchanges with several laboratories (including a direct connection with the College de France).

Weaknesses

No weaknesses were identified

Assessment of scientific outputs, reputation and appeal

This outstanding team is highly recognized at the international level. It produces high quality outputs (articles, software, congresses) and is very attractive, with a large number of students and invited researchers. Many national and international grants have been obtained.

B – Interactions with the non-academic world, impacts on economy, society, culture or health

Interactions with the non-academic world, impacts on economy, society, culture or health From 01/01/2013 to 30/06/2018	
Socio-economic interactions / Patents	
Invention disclosures	
Filed patents	
Accepted patents	
Licenced patents	
Socio-economic interactions	
Industrial and R&D contracts	1
Cifre fellowships	
Creation of labs with private-public partnerships	
Networks and mixed units	
Start-ups	
Expertise	
Consulting	
Participation in expert committees (ANSES, etc.)	
Legal expertise	
Expert and standardization reports	
Public outreach	
Radio broadcasts, TV shows, magazines	
Journal articles, interviews, book edition, videos, etc.	
Other popularization outputs	
Debates on science and society	

Strengths

The team performs theoretical research in fundamental physics. This requires a great deal of developments in terms of new methods and technologies. Industrial R&D activity and patents are not typical for this kind of research. It is quite likely, however, that the research will spur applications in the future, e.g. in the area of quantum technologies or materials.

In addition, the team had an industrial contract with a *Chaire Saint Gobain* from 2007 to 2017. The team is also active in terms of public outreach. It is especially worth mentioning the lectures given at "Collège de France" by a member of the team that are intended not only for experts but also for a broad audience.

Weaknesses

No identified weaknesses considering the nature of the research performed by the team.

Assessment of the interactions with the non-academic world

In view of the research domain, which makes interactions with the non-academic world difficult, the team has a satisfying level of activity in that respect, even if one could wish for more effort in the direction of outreach.

C – Involvement in training through research

Involvement in training through research From 01/01/2013 to 30/06/2018	
Educational outputs	
Books	
E-learning, MOOCs, multimedia lessons, etc.	
Mean number of publications per student	
Training	
Habilitated (HDR) scientists	3
HDR obtained during the period	
PhD students	18
Defended PhDs	10
Mean PhD duration	36
Internships (BTS, M1, M2)	18
Education	
Courses with international label (ERASMUS, etc.)	

Strengths

The number of PhD theses (10 defended, 8 in progress) in the team is consequent. The PhD students produce high quality research, with many collaborations. They usually publish several articles during their PhD. All the PhD students of the last five years have found a post-doc or a position after their defence (in start-ups, teacher, R&D, finance...).

Most of the members of the team are at least part-time professors (6 out of 8). They are highly involved in teaching at all levels (one of the team members is vice-chair of the Physics Department of École Polytechnique).

Weaknesses

No identified weaknesses.

Assessment of the involvement in training through research

The training of the students in the team is carried out at the highest level with reference to international standards. The PhD students are well supervised and they easily find post-docs after their defence.

CRITERION 2: TEAM ORGANISATION AND LIFE

Team organisation and life From 01/01/2013 to 30/06/2018	
Women/men ratio in the team	10/40
Women/men ratio among team scientists	2/6
Women/men ratio among team PhD students	5/13
Women/men ratio among team leaders, team head and deputy heads	1/1

Strengths

This team has a relatively high ratio Women/Men in comparison with the other teams and with other theoretical physics labs.

Two researchers (CNRS) were hired in 2017 and another will arrive in 2018. This is a large renewal (and even expansion: +4 permanents since 2008), to relate to the large number of post-docs and visitors that have benefited from the stimulating environment of the CPHT. Consequently, the distribution of ages in the team is excellent.

Weaknesses

We have noted the distribution of the team in two sub-teams of quite unequal size. One is mostly focused on the ab-initio calculations for materials, and is part time delocalized in College de France. The other sub-team is more recent and is more oriented on quantum optics and cold atoms. Although this multifaceted activity is a strength, it is important to monitor that strong relations exist between the two parts of the team and that such relations lead to a positive synergy in the future (which is presently the case).

The team largely benefits from the MesoCenter as it uses many codes. It will suffer from the retirement of one of its main ITA in one or two years.

Moreover, the insufficient number of offices is damaging to this team that has the largest number of PhD students and post-doctorants. Collaborations with other institutions require video meeting, which are difficult for this same reason.

Assessment of the team's life and organisation

The team is very active and well organized, participates to and organizes many events. The repartition of ages and the parity is good. It is important to check that the synergy between the two subgroups of the team continues to develop.

CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

The project consists for a large part in the continuation of the many fruitful projects initiated during the last years, both in the ab-initio direction and in the quantum optics/quantum simulation one and in an original project of collaboration with string theorists (AdS-CFT).

Strengths

The team plans to refine and exploit several tools constructed over the last years: computational methods (diagrammatic Monte Carlo, DMFT, ab initio methods) with the aim to understand spectroscopy results, design new functional materials, study out-of-equilibrium dynamics. Projects in the field of out of equilibrium physics and topological phases are planned. The projects include already initiated subjects (as exploitation of refined electronic calculations) and still unexplored domains (as complex magnetic orders). In addition, a prospective part relates condensed matter and string theory. Many international and national collaborations are planned.

Weaknesses

No weaknesses were identified.

Assessment of the scientific strategy and projects

The project of the condensed matter team is well balanced, with both newly initiated researches and projects extending previous works. It preserves the wealth of topics of the last period. The localization of one of the central members of the team in another institute has to be factored in for the next period in the dynamics and organization.

RECOMMENDATIONS TO THE TEAM

A – Recommendations on scientific production and activities (criterion 1)

No specific recommendation. Continue the excellent work.

B – Recommendations on the team's organisation and life (criterion 2)

It is important to ensure a proper synergy between the two subgroups of the team and to participate to events that are common to all teams.

C – Recommendations on scientific strategy and projects (criterion 3)

No specific recommendation. The strategy and projects are sound.

Team 5: Laser Plasma Interactions

Team leader: Mr Stefan HÜLLER

TEAM SCIENTIFIC DOMAIN

The team develops theoretical and simulation work on the interaction of laser light with plasmas in the nonlinear regime, from moderate to high intensity regimes.

TEAM WORKFORCE

	T5	
	Laser Plasma Interactions	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions		
Assistant professors and similar positions		
Full time research directors (Directeurs de recherche) and similar positions	2	2
Full time research associates (Chargés de recherche) and similar positions	1	
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")		
High school teachers		
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)		
Permanent staff	**3**	**2**
Non-permanent professors and associate professors, including emeritus		
Non-permanent full time scientists, including emeritus, post-docs	6	
PhD Students	2	
Non-permanent supporting personnel		
Non-permanent staff	**6**	
Total	**9**	**2**

CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

A – Scientific outputs and activities, academic collaborations, reputation and appeal

Scientific outputs and activities, academic collaborations, reputation and appeal From 01/01/2013 to 30/06/2018	Laser Plasma Interactions
Articles	
Scientific articles	88
Review articles	
Other articles (professional journals, etc.)	
Books	
Scientific book edition	
Book chapters	
Meetings	
Meeting abstracts	13
Meetings and congress organisation	8
Electronic tools and products	
Software	4
Databases	
Tools for decision making	
Solver competition tools	
Instruments and methodology	
Prototypes	
Platforms and observatories	
Other products	
Artistic creations	
Movie or theatre play creation	
Movies	
Editorial activities	
Participation to journal editorial boards (books, collections)	3
Peer reviewing activities	
Reviewing of journal articles	yes
Grant evaluation (public or charities)	yes
Participation to lab site visit committees (Hcéres, etc.)	

Participation to institutional committees and juries (CNRS, Inserm, etc.)	yes
Academic research grants	
European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	2
National public grants (ANR, PHRC, FUI, INCA, etc.)	3
Local grants (collectivités territoriales)	
PIA (Labex, Equipex, etc.) grants	
Grants from foundations and charities (ARC, FMR, FRM, etc.)	
Visiting senior scientists and post-docs	
Post-docs	6
Visiting senior scientists	6
Scientific recognition	
Prizes	2
Distinctions	
IUF members	
Chair of learned and scientific societies	no
Invitations to meetings and symposia (out of France)	17
Members' long-term visits abroad	

Strengths

The research output is impressive for a team of this size and with this profile, with several high-profile publications in top journals, such as Physical Review Letters, and with research clearly led by a team of top quality. The team is well immersed in the national context, as demonstrated by the collaborative work with experimental teams, which explains the significant output in terms of papers. Its members enjoy a very high national and international reputation and visibility in line with a long-standing tradition in the research unit, as evidenced by the awarded prizes and the invitations to meetings and symposia.

Weaknesses

The team still relies significantly on the contribution, reputation and visibility of members who are already retired or will soon retire. The collaboration work with other research units in France is also of very high relevance but in many cases, the leading role is external to the team, which is however not unusual in experimental-theory collaborations. The contributions of the team are in relevant topics but in some cases might not be at the forefront of research in laser plasma interactions. The portfolio of funded research projects is limited in scope.

Assessment of scientific outputs, reputation and appeal

The team outputs, reputation, and appeal are excellent and of very high quality. The research team is widely considered as one of the world leading teams.

B – Interactions with the non-academic world, impacts on economy, society, culture or health

Interactions with the non-academic world, impacts on economy, society, culture or health From 01/01/2013 to 30/06/2018	
Socio-economic interactions / Patents	
Invention disclosures	
Filed patents	
Accepted patents	2
Licenced patents	
Socio-economic interactions	
Industrial and R&D contracts	1
Cifre fellowships	
Creation of labs with private-public partnerships	
Networks and mixed units	
Start-ups	
Expertise	
Consulting	
Participation in expert committees (ANSES, etc.)	
Legal expertise	
Expert and standardization reports	
Public outreach	
Radio broadcasts, TV shows, magazines	
Journal articles, interviews, book edition, videos, etc.	2
Other popularization outputs	
Debates on science and society	

Strengths

See global unit's assessment.

Weaknesses

See global unit's assessment.

Assessment of the interactions with the non-academic world

See global unit's assessment.

C – Involvement in training through research

Involvement in training through research From 01/01/2013 to 30/06/2018	
Educational outputs	
Books	
E-learning, MOOCs, multimedia lessons, etc.	
Mean number of publications per student	
Training	
Habilitated (HDR) scientists	4
HDR obtained during the period	
PhD students	4
Defended PhDs	2
Mean PhD duration	36
Internships (BTS, M1, M2)	1
Education	
Courses with international label (ERASMUS, etc.)	

Strengths

The quality of the PhD training is evident from the PhD theses produced during this period. The team interacts with PhD students from many other institutions.

Weaknesses

The number of PhDs involved in the team's activities is low for the dimension of the team during the evaluation period, and the number of internships is too small to guarantee the attraction of enough students and a steadier inflow of PhD students. The reduced number of PhD students and staff in the team also do not favour an interacting and vibrant research environment, usually associated with larger groups with more permanent and non-permanent members. With respect to the large number of scientific outputs, the number of papers per student is small. The team interactions with PhD students from other institutions should be given more visibility.

Assessment of the involvement in training through research

The involvement in training is modest for a research team with such high quality scientific outputs. The (lack of) attraction of internships presents a significant risk for the medium to long-term sustainability of the research team. The interactions between/with other PhD students in theoretical and computational plasma physics should also be reinforced.

CRITERION 2: TEAM ORGANISATION AND LIFE

Team organisation and life From 01/01/2013 to 30/06/2018	
Women/men ratio in the team	1/15
Women/men ratio among team scientists	1/5
Women/men ratio among team PhD students	0/4
Women/men ratio among team leaders, team head and deputy heads	0/1

Strengths

The team life is organised along clearly identified research lines with connections with the magnetised plasma group through team members in that area affiliated to both groups, providing a natural bridge between the activities of the two groups.

Weaknesses

There are no evidences that demonstrate a policy towards parity, a clear team integration, or existence of internal communication channels. The research team has presented itself as a combination of independent research lines with very modest interactions and synergies between the research lines/themes; this perspective is compatible with a purely theoretical team but the challenges posed to the medium- long-term evolution of the team would require a more integrated approach. The men/women parity is a further reason for concern, and the profile of the attracted students does not provide evidence of positive short/medium-term evolution.

Assessment of the team's life and organisation

The team is organized along independent research lines with limited interactions, and thus with low evidence for an interactive and lively work/team environment, which is further evident from the reduced number of members in the team. The men/women balance is very far from ideal, even for the typical standards of the field: the profile of the students does not mitigate this issue.

CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

Strengths

The team has clearly identified the most pressing and important topics of research in the field and has included them in their medium-term strategy, in connection with the implementation of large-scale experimental research facilities that will be central to the future developments of the field. The team is well positioned, within the regional and national context, to take advantage of its expertise and natural connection with some of these facilities, such as Apollon, and to contribute to potential breakthroughs in the field leveraging on the tradition and the know-how in theory and modelling. Synergies with other teams in the research unit are identified and there is further potential to accelerate these synergies.

Weaknesses

Synergies with other teams in the local and national contexts should have been further emphasized. With the retirement of a significant part of the research team, there is lack of a clear leader/permanent member to move the team towards new areas at the forefront of research into which the team would aim to transition and focus its activity. The expertise in the new topics is not well consolidated within the team. These two points present a significant risk in the implementation of the proposed scientific strategy. Moreover, one of the key methodologies underpinning the activities in Laser Plasma Interactions, namely particle-in-cell technique, is critical for any theoretical and computational program in plasma physics and this expertise will disappear very soon from the CPHT.

Assessment of the scientific strategy and projects

The scientific strategy is at the forefront of the research field, pushing the research team into some of the most exciting avenues for research in the field. The evolution of the permanent staff, with a very significant fraction moving into retirement, bringing the team to a sub-critical dimension, presents an important risk for the implementation of the research strategy.

RECOMMENDATIONS TO THE TEAM

A – Recommendations on scientific production and activities (criterion 1)

The team should address in a strategic way the most critical point of its future: how will the evolution of its permanent staff (with a very large number of retired/emeritus) members, combined with the low number of students, affect its high-quality high-profile publication record, and its national and international standing and reputation, and what are the measures that the team intends to implement to mitigate the risks associated with this scenario? The team should adopt a more prominent role in the collaborations, teaming up with other local teams, to clearly lead the research in a broader range of projects/areas. The team should pursue other funding schemes to strengthen and diversify its projects portfolio.

B – Recommendations on the team's organisation and life (criterion 2)

The team should implement a strategy to increase the number of internships that in turn can evolve into PhD students. This strategy should be aligned with a communication strategy to attract more women for internships. The team should implement incentives to promote the interaction between the different team members.

C – Recommendations on scientific strategy and projects (criterion 3)

The team should try to hire a permanent faculty member, combined with the recruitment and/or attraction of post-docs closely aligned with its scientific strategy, in order to guarantee the person power required for these topics, while, at the same time, guaranteeing the training/interaction of this pool of post-docs/new generation of scientists within the outstanding tradition and reputation of the research team.

The team should pool its human and financial resources with the Magnetised Plasmas team into a single team in order to avoid sub-criticality, in order to take advantage of cross-fertilization in the methodologies employed (as already evident from some of the sub-activities in the two teams), to create a more vibrant and interacting environment for the PhD students and the post-docs, and to increase the internal visibility, and the national and international impact and visibility of the work developed at CPHT in theoretical and computational plasma physics.

Team 6: Magnetised Plasmas

Team leader: Mr Hinrich LÜTJENS

TEAM SCIENTIFIC DOMAIN

The research team is focused on the study of magnetized plasmas in laboratory and natural environments, resorting to theory and simulations.

TEAM WORKFORCE

	T6	
	Magnetised Plasmas	
Active staff	**Number 30/06/2018**	**Number 01/01/2020**
Full professors and similar positions		
Assistant professors and similar positions		
Full time research directors (Directeurs de recherche) and similar positions	3	2
Full time research associates (Chargés de recherche) and similar positions	1	1
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")		
High school teachers		
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	1	1
Permanent staff	**5**	**4**
Non-permanent professors and associate professors, including emeritus		
Non-permanent full time scientists, including emeritus, post-docs	1	
PhD Students		
Non-permanent supporting personnel		
Non-permanent staff	**1**	
Total	**6**	**4**

CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

A – Scientific outputs and activities, academic collaborations, reputation and appeal

Scientific outputs and activities, academic collaborations, reputation and appeal From 01/01/2013 to 30/06/2018	Magnetised Plasmas
Articles	
Scientific articles	32
Review articles	
Other articles (professional journals, etc.)	
Books	
Scientific book edition	
Book chapters	
Meetings	
Meeting abstracts	4
Meetings and congress organisation	
Electronic tools and products	
Software	4
Databases	1
Tools for decision making	
Solver competition tools	
Instruments and methodology	
Prototypes	
Platforms and observatories	
Other products	
Artistic creations	
Movie or theatre play creation	
Movies	
Editorial activities	
Participation to journal editorial boards (books, collections)	
Peer reviewing activities	
Reviewing of journal articles	yes
Grant evaluation (public or charities)	yes
Participation to lab site visit committees (Hcéres, etc.)	

Participation to institutional committees and juries (CNRS, Inserm, etc.)	yes
Academic research grants	
European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	2
National public grants (ANR, PHRC, FUI, INCA, etc.)	4
Local grants (collectivités territoriales)	
PIA (Labex, Equipex, etc.) grants	
Grants from foundations and charities (ARC, FMR, FRM, etc.)	
Visiting senior scientists and post-docs	
Post-docs	2
Visiting senior scientists	2
Scientific recognition	
Prizes	
Distinctions	1
IUF members	
Chair of learned and scientific societies	no
Invitations to meetings and symposia (out of France)	5
Members' long-term visits abroad	

Strengths

The scientific outputs of the team are of excellent quality, with publications in the most relevant specialized journals of the field, and with three publications in Nature, bridging laboratory and natural plasma environments, and well immersed in the European magnetic nuclear fusion effort. The numerical codes maintained and developed by the research team are impressive and this must be highlighted given that these activities, despite being person power intensive, do not always lead to recognition (e.g. *via* publications). The portfolio of funded research projects is diverse, resorting to several funding agencies, both national and international, which confirms the national and international reputation of the team.

Weaknesses

The quantity of publications and presentations in conferences is small, given the number of permanent members. This can be attributed to the strong effort devoted to the development/implementation of numerical models, but that should nevertheless be noted and addressed by the research team. We also note that the potential to apply to ERC grants seems untapped.

Assessment of scientific outputs, reputation and appeal

The scientific outputs are of very high quality and very high visibility; these outputs could be further expanded in quantity. The funding portfolio is diverse, providing a path for the medium-term sustainability of the research team.

B – Interactions with the non-academic world, impacts on economy, society, culture or health

Interactions with the non-academic world, impacts on economy, society, culture or health From 01/01/2013 to 30/06/2018	
Socio-economic interactions / Patents	
Invention disclosures	
Filed patents	
Accepted patents	
Licenced patents	
Socio-economic interactions	
Industrial and R&D contracts	2
Cifre fellowships	
Creation of labs with private-public partnerships	
Networks and mixed units	
Start-ups	
Expertise	
Consulting	
Participation in expert committees (ANSES, etc.)	
Legal expertise	
Expert and standardization reports	
Public outreach	
Radio broadcasts, TV shows, magazines	8
Journal articles, interviews, book edition, videos, etc.	
Other popularization outputs	
Debates on science and society	

Strengths

The industrial contracts provide a very relevant funding resource that further contributes to the diversification of the portfolio. The very high-profile publications in the team have led to significant national and international media exposure.

Weaknesses

The interactions with the non-academic world are very limited, without structured outreach and science communication activities. The connection with the fusion programme is not explored in terms of popularisation, nor the high impact publications that have given rise to enhanced visibility of the team, beyond the extensive coverage in the news previously noted; this is an indication of a lack of communication strategy.

Assessment of the interactions with the non-academic world

The interaction with the non-academic world is focused on research contracts, leveraging on the technical and scientific expertise of the team, which is reasonable given the expertise of the team. Nevertheless, the quality of the scientific outputs, their visibility in the media, and the European wide network in which the team is immersed is not reflected in terms of a coherent outreach or communication strategy.

C – Involvement in training through research

Involvement in training through research From 01/01/2013 to 30/06/2018	
Educational outputs	
Books	
E-learning, MOOCs, multimedia lessons, etc.	
Mean number of publications per student	
Training	
Habilitated (HDR) scientists	2
HDR obtained during the period	1
PhD students	4
Defended PhDs	3
Mean PhD duration	36
Internships (BTS, M1, M2)	1
Education	
Courses with international label (ERASMUS, etc.)	

Strengths

The team demonstrates a very good involvement with PhD students and the outcome of their training is excellent in terms of publications. There is a steady flow of PhD graduates and one HDR awarded during the evaluation period, which indicates a concerted strategy towards both junior members and more senior/leadership positions. This strategic awareness is evident in the report submitted by the research team.

Weaknesses

The number of internships is too small to guarantee the attraction of students and a more steady inflow of PhD students. The reduced numbers of PhD students and staff in the group also do not favour an interacting and vibrant research environment, usually associated with larger groups with more permanent and non-permanent members.

Assessment of the involvement in training through research

The training provided by the research team is excellent, as evidenced by the outputs achieved by each student, and there is a good flow of students, which must be further supported with internships at lower levels, and with the promotion of the interactions between/with other PhD students in theoretical and computational plasma physics.

CRITERION 2: TEAM ORGANISATION AND LIFE

Team organisation and life From 01/01/2013 to 30/06/2018	
Women/men ratio in the team	0/13
Women/men ratio among team scientists	0/5
Women/men ratio among team PhD students	0/4
Women/men ratio among team leaders, team head and deputy heads	0/1

Strengths

The report provides evidence for a scientific coherence and a global strategy for the team, encompassing computational infrastructures, support staff, and renovation/hiring/recruitment of researchers. The interplay and complementarity between the different research lines is clear and demonstrates a very good integration. The leadership of the team demonstrates a clear perspective towards the key challenges/weaknesses of the team.

Weaknesses

There are no evidences that demonstrate a policy towards parity. The men/women parity is a strong reason for concern: the profile of the attracted students does not provide evidence of positive short/medium-term evolution. The medium- to long-term evolution of the permanent members should also be of concern with the strong risk of loss of know-how/absence of knowledge transfer due to retirements. The tech/infrastructure requirements needed to maintain the software infrastructure (and the corresponding know-how) is not fully assessed. The synergies with the Laser Plasma Interactions team are only partially, but nevertheless meaningfully, explored, despite covering a critical expertise in computational plasma physics.

Assessment of the team's life and organisation

The team is well organized with an adequate integration between the research lines, despite the reduced number of team members precluding a more vibrant research environment (e.g. *via* internal seminars). The men/women parity is very far from ideal, even for the typical standards of the field: the profile of the students does not mitigate this issue.

CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

Strengths

The scientific strategy leverages on the technical and scientific expertise of the research team and on the suite of numerical codes that supports this expertise. It is aligned with the European programmes in the relevant fields of research, and, in particular, magnetic nuclear fusion. The more programmatic research is complemented by topics that can be more obviously identified as curiosity-driven. This provides a diverse mix that can more easily guarantee funding, in-flow of students, and contributes to the reputation and the international visibility of the team.

Weaknesses

The team is possibly abandoning a research line in which it has established a unique reputation (Hall thrusters). Despite the identification of the problems associated with the evolution of the team members, no mitigation strategies have been identified for these important challenges. The expertise underpinning this particular research line is critical for any theoretical and computational program in plasma physics. Moreover, the maintenance and development of a large suite of numerical codes should be supported by a clear plan, addressing both scientific, technical and infrastructure resources required to support the strategy of the team.

Assessment of the scientific strategy and projects

The team strategy is very good, leveraging on the scientific and technical know-how to ensure the involvement in the fusion programme while exploring, with outstanding outcomes, curiosity driven research lines that leverage on the existing scientific and technical competences.

RECOMMENDATIONS TO THE TEAM

A – Recommendations on scientific production and activities (criterion 1)

The team should devise strategies to increase its overall scientific output and visibility, in particular in magnetic nuclear fusion, while maintaining its high standards, as demonstrated by the high-profile publications. This can be achieved, for instance, with the dissemination of the unique suite of numerical tools. The team should address in a strategic way one of the critical points for its future: computational support, which should be combined with other research teams in the research unit, in particular the closely connected Laser Plasma Interactions team. The team should implement a communication strategy to disseminate its results to the general public, also as a mechanism to attract more candidates and more students. This strategy should be combined with other organizations with which the team interacts, e.g. European fusion programme or the national HPC organizations. This strategy should support the goal to increase the number of internships, which in turn can evolve into PhD projects, and the goal to attract more women for internships.

B – Recommendations on the team's organisation and life (criterion 2)

The team should implement a strategy to increase the number of internships that in turn can evolve into PhD students. This strategy should be aligned with a communication strategy to attract more women for internships. The team should implement incentives to promote the interaction between the different team members.

C – Recommendations on scientific strategy and projects (criterion 3)

The team should define a plan to guarantee that the development of the numerical codes, a critical component of the scientific strategy, is properly supported in the short- to medium-term, either by adopting broader collaboration models for the code development, by maintaining the person power or strengthening the team members involved in these activities. This should also be aligned with the national and European wide strategies for HPC.

The team should pool its human and financial resources with the Laser Plasma Interactions team into a single team in order to increase the critical mass, and take advantage of cross-fertilization in the methodologies employed (as already evident from some of the sub-activities in the two teams), to create a more vibrant and interacting environment for the PhD students and the post-docs, and to increase the internal visibility, and the national and international impact and visibility of the work developed at CPHT in theoretical and computational plasma physics.

CONDUCT OF THE VISIT

DATES

Start: 17 December 2018 at 9:00

End: 18 December 2018 at 17:30

VISIT SITE

Institution: École Polytechnique

Address: Route de Saclay, 91128 Palaiseau cedex

CONDUCT OR PROGRAM OF THE VISIT

17 December 2018

09:00 - 09:30	Committee closed meeting
09:30 - 10:30	General presentation of the laboratory by the director
10:30 - 11:00	Coffee break
11:00 - 11:45	Visit of the laboratory and of the PhyMath mesocenter
11:45 - 12:30	Presentation of the Condensed Matter Group
12:30 - 13:30	Lunch
13:30 - 14:15	Presentation of the Laser Plasma Interaction Group
14:20 - 15:05	Presentation of the Magnetized Plasma Group
15:10 - 15:55	Presentation of the Mathematical Physics Group
16:00 - 16:30	Coffee break
16:30 - 17:15	Presentation of the Particle Physics Group
11:45 - 12:30	Presentation of the String Theory Group

18 December 2018

08:45 - 09:30	Meeting with the supervising bodies (CNRS and École Polytechnique)
09:30 - 10:15	Meeting with the Laboratory Council
10:15 - 10:30	Coffee break
10:30 - 11:15	Meeting with the support staff (administration and IT)
11:15 - 12:00	Meeting with the PhD students and postdocs
12:00 - 13:00	Lunch
13:00 - 13:30	Meeting with the director of the lab
13:30 - 17:30	Committee working session

SUPERVISING BODIES' GENERAL COMMENTS

Benoît DEVEAUD
Directeur adjoint de l'Enseignement et de la Recherche

Palaiseau, March 4th 2019

Dear members of the evaluation HCERES committee of CPHT

We thank you very warmly for the work your committee has done for the evaluation of CPHT. We also thank you for your extremely positive opinion of this unit which, as you note, shows an excellent scientific output and a strong international visibility, with a leading worldwide reputation in various research topics. We agree with you that the CPHT's scientific strategy and projects are of very high quality with respect to international standards, combining the continuation in areas where the unit is already well positioned with the developments of new research avenues.

The other way round, we have to disagree with the statement :
The decision of École Polytechnique to leave the University of Paris-Saclay has had some negative consequences, for example concerning the effective participation of the unit members to labex projects common to Paris-Saclay. Moreover, there is a lot of uncertainty about the new institution that will be created. The unit will thus have to navigate wisely in uncharted waters, with potentially strong impacts on the recruitment policy and on the funding of PhD students.
As far as today, the participation of all teams of Ecole Polytechnique to the Labex is maintained, at least till 2022. It seems to us that this way of presenting the creation of Institut Polytechnique de France is rather biased and should not appear in a HCERES report.

We noted your statements concerning gender issues as well a public outreach, and will work with the unit in order to improve such issues, although we noted factual errors in the report on both issues.

We will continue to support the activities of CPHT by working to provide in optimal conditions the replacement of seniors on the departure and managing to provide additional surfaces within Institut Polytechnique de Paris.

Pour la Direction de l'École polytechnique

Prof. Benoit Deveaud
DAER École Polytechnique

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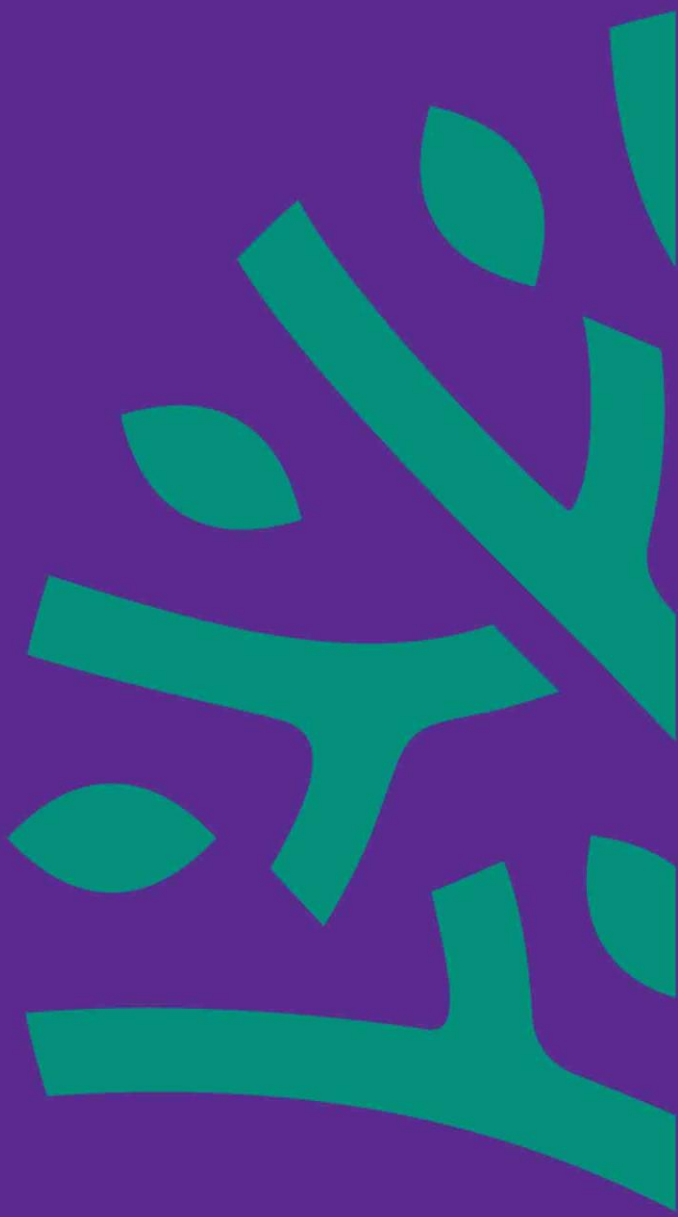

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