Research evaluation

REPORT ON THE RESEARCH UNIT:

Astroparticule and Cosmology

APC

UNDER THE SUPERVISION OF THE FOLLOWING INSTITUTIONS AND RESEARCH BODIES:

Université Paris Diderot

Observatoire de Paris

Centre National de la Recherche Scientifique - CNRS

Commissariat à l'énergie atomique et aux énergies alternatives - CEA

EVALUATION CAMPAIGN 2017-2018
GROUP D

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.

UNIT PRESENTATION

Unit name:	Astroparticule and Cosmology
Unit acronym:	APC
Requested label:	UMR
Application type:	Renewal
Current number:	UMR 7164
Head of the unit (2017-2018):	Mr Stavros KATSANEVAS
Project leader (2019-2023):	TBC
Number of teams or themes:	5 + one hosted team

COMMITTEE MEMBERS

Chair: Mr Steven RITZ, *University of California Santa Cruz,* USA

Experts:

Mr Reza ANSARI, *University of Paris Sud& CNRS IN2P3 LAL (*Orsay)

Mr Eric DELAGNES, *CEA*

Mr Dominique DUCHESNEAU, *CNRS In2p3* LAPP

Ms Piera GHIA, *CNRS In2p3* (representative of CoNRS)

Ms Mariana GRAÑA, *CEA*

Mr François MONTANET, *CNRS In2p3* (representative of CNU)

Mr Stefano VITALE, *University of Trente,* Italy

HCERES scientific officer:

Mr Yannis KARYOTAKIS

Representatives of supervising institutions and bodies:

Ms Ursula BASSLER, CNRS

Mr Claude CATALA, Observatoire de Paris

Ms Sonia COLETTE-MAATOUK, CEA

Ms Sylvie ROUSSET, université Paris Diderot

Mr Laurent VIGROUX, CEA

INTRODUCTION

HISTORY AND GEOGRAPHICAL LOCATION OF THE UNIT

The AstroParticle and Cosmology (APC) laboratory was founded in 2005 by the CNRS, in particular IN2P3 (Institut National de Physique Nucléaire et Physique des Particules), the University of Paris Denis Diderot, the CEA (Commissariat à l'Energie Atomique et aux Energies Alternatives) and the Observatory of Paris, to foster in France the activities in astroparticle physics and cosmology theory and experiment that were emerging. Since the founding of APC, each of its areas of interest has thrived, with frequent and exciting new results and opportunities. As these areas evolved quickly, the APC organization adapted accordingly. There was an auto-evaluation report covering only the first two years 2005-2006, then a report describing the activities during the period 2007-2012. The current report covers the period from January 2012 to June 2017. APC is located in the Building Condorcet, 10 Rue Alice Domon et Léonie Duquet, with an annex (Computing centre FACe) currently at 13 Rue Watt, both at 75013.

MANAGEMENT TEAM

Mr Stavros KATSANEVAS	Director
Mr Sotiris LOUCATOS	Deputy director research
Mr Antoine KOUCHNER	Deputy director education
Ms Emmanuelle FOISSAC	Deputy director administration
Mr Thomas ZERGUERRAS	Deputy Technical director

HCERES NOMENCLATURE

ST2 Physique
ST2_1 Physique nucléaire et particules
ST3_3 Astronomie, univers

SCIENTIFIC DOMAIN

The work is currently organized into the following main themes of overlapping interest: Cosmology, ranging from the study of the Cosmic Microwave Background (CMB) to the determination of the nature of dark energy using observatories on ground and in space; Gravitation, namely gravitational-wave astrophysics using ground-based and spaced-based detectors, and associated fields; High Energy Astrophysics, studying some of the most powerful phenomena in the Universe in a multimessenger context, from X-rays and Gamma rays to neutrinos and charged-particle cosmic rays; and Neutrinos and dark matter, in particular the determination of the nature and mass of neutrinos and dark matter and their impact on cosmological structure formation. APC has a strong Theory group in all the above themes, working in connection with the experimentalists.

A key aspect of APC is the presence of six technical departments, which provide the technical expertise required by the projects. They are organized according to their different skills: Mechanics, Electronics, Microelectronics, Instrumentation, Informatics, and Project Quality Procedures. Their work develops within and around a data science plateform created in 2010 the François Argo Centre FACe, four laboratories (Millimetric, Photodetection, Optics, Integration and Test (AIT/AIV)) and two workshops (Mechanics, Assembly Hall). Furthermore, the APC currently hosts the Energy Physics Group, whose interdisciplinary research includes understanding and modeling basic mechanisms and their potential application to novel energy systems.

UNIT WORKFORCE

Unit workforce	Number 30/06/2017	Number 01/01/2019
Permanent staff		
Full professors and similar positions	10	11
Assistant professors and similar positions	12	10
Full time research directors (Directeurs de recherche) and similar positions	14	19
Full time research associates (Chargés de recherche) and similar positions	17	19
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	6	6
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	48	47
TOTAL permanent staff	**107**	**112**
Non-permanent staff		
Non-permanent professors and associate professors, including emeritus	2	
Non-permanent full time scientists, including emeritus, post-docs	26	
Non-permanent supporting personnel	15	
PhD Students	32	
TOTAL non-permanent staff	**75**	
TOTAL unit	**182**	

GLOBAL ASSESSMENT OF THE UNIT

During the evaluation period, APC made very significant contributions to all its fields of research. APC continued its reputation for excellent productivity, including (according to APC) 1105 publications in the review period. Of these, 12 are "renowned" (>500 citations) and 18 are "famous" (250-500 citations). There have also been numerous prestigious prizes and awards to APC researchers, including the Gruber Prize, the Breakthrough Prize in Fundamental physics, and Unesco-L'Oréal prizes for women in science. The laboratory structure has evolved appropriately and strategically, based on the needs of the dynamic fields of research and the needs of the member groups. Staff members continue to engage in important and effective roles in French public outreach activities. Overall, the Committee evaluates the APC as excellent.

DETAILED ASSESSMENT OF THE UNIT

Recommendations and actionable comments from the previous report were as follows:

"*The laboratory should be continued at its present level with modest growth to support its diverse and exciting scientific program.*" EVALUATION: this has been done, to the extent possible.
"*A potential new major project that emerged from the strategic planning process is SKA. The laboratory will need to take proactive steps to establish a credible program in this new field.*" EVALUATION: through a deliberate process, APC decided not to pursue SKA (along with several other opportunities) as a laboratory project, due to limited technical resources and the need to set priorities. The committee concurs with this choice.

"*APC has developed a very ambitious strategic plan, involving many new projects. If all of these projects come to fruition, the laboratory will be strapped to fulfill all of its desired roles, and some difficult choices will have to be made.*" EVALUATION: this is an ongoing issue requiring constant attention. This is a good problem to have: APC areas of research are vibrant and quickly evolving.

"*There is a modest threat associated with the fact that the Director will soon step down as Director. He has personally played an enormous role in the establishment of APC and in the guidance of its formative years. He will be very difficult to replace*". EVALUATION: the subsequent death of the previous director was a tragedy and a terrible loss. The appointment of the current director, who is well known internationally as a highly effective leader and strategist with broad interests, ensured continued management excellence. He is now stepping down.

Since its inception, the laboratory has organized its projects based on a matrix structure. Every project is managed by a pair of group leaders made of a scientist and an engineer, the scientist being in charge of scientific issues and the engineer of project management and technical issues. The allocation of human resources and the general oversight of projects are carried out during *Cellule de Suivi des Projets* (CSP) meetings involving the directorate, the group leaders and the heads of the technical and administrative services. Up to now, this organization has proved efficient, and APC is considered a reliable partner for its excellent technical contributions and, at the same time, its capacity to develop pioneering activities such as ultra-cryogenic microelectronics. The technical staff is also highly involved both in laboratory life and student training.

However, the number of projects with significant instrumental responsibilities, including space projects, has increased substantially over the years, thereby increasing the workload of the technical teams, and this is now reaching a level of risk that endangers the success of the projects and the sustainability of the teams. Furthermore, the general increase of time-consuming administrative tasks has caused additional strain. As a result, only a very limited amount of time can be devoted to upstream R&D or to the pursuit of new skills. In the past, instrumentation physicists played the role of intermediaries between engineering and science teams. Their numbers have gradually decreased, leaving gaps that have been only partially compensated by already overworked engineers. The ambition of the laboratory to bring major contributions to both instrumentation and scientific achievements would be well served by additional instrumentation physicists.

Note that the information in all the tables was provided by the Unit during the visit. The committee did not have the opportunity to verify all the numbers shown in these tables, though overall personnel levels and strategies were discussed in detail during the visit.

CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

A – Scientific outputs and activities, academic reputation and appeal

Scientific outputs and activities, academic reputation and appeal From 01/01/2012 to 30/06/2017	Number
Articles: scientific articles	1 105
Articles: review articles	
Scientific articles with a unit member as last author	
Books: monographs, critical editions, translations	13
Books: scientific book edition	4
Books: book chapters	7
Books : published/edited theses	2
Meetings: conference proceedings	318
Symposia, meetings: articles in meeting proceedings	
Meetings: other conference outputs	
Academic research grants: European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	10
Academic research grants: national public grants (ANR, PHRC, FUI, INCA, etc.)	10
Academic research grants: local grants (collectivités territoriales)	1
Academic research grants: PIA (Labex, Equipex etc.) grants	2
Academic research grants: grants from foundations and charities (ARC, FMR, FRM, etc.)	0
Visiting scientists (more than one month in the unit)	42
Post-docs (more than 12 months in the unit)	
Electronic tools and products: softwares	20
Electronic tools and products: libraries and cohorts	
Electronic tools and products: corpus	
Electronic tools and products: tools presented in solver competitions	

Electronic tools and products: decision tools	1
Editorial activities: participation to journal editorial boards (books, collections)	28
Peer reviewing activities: participation to institutional committees and juries (CNRS, INSERM, etc.)	yes
Peer reviewing activities: reviewing of journal articles	yes
Peer reviewing activities: participation to lab site visit committees (HCERES etc.)	yes
Peer reviewing activities: grant evaluation (public or charities)	yes
Scientific recognition: prizes	11
Scientific recognition: distinctions	14
Scientific recognition: chair of learned and scientific societies	yes
Scientific recognition: invitations to meetings and symposia (out of France)	387

Strengths

APC made very significant contributions in each of its fields of research. These are detailed in the assessments that follow. Particularly notable, and internationally visible, highlights during the past five years include: (i) Publication and fruitful analysis of the PLANCK cosmic microwave background data, with APC contributions particularly in the areas of the Planck sky model, component separation, and simulations to evaluate several instrumental effects. Also in the area of CMB research were the first results from the POLARBEAR experiment. (ii) APC roles in the LIGO/Virgo collaboration, which rang in the era of Gravitational Wave astrophysics. APC also played important roles in the success of the LISA Pathfinder mission. (iii) Successful completion and operation of H.E.S.S. gamma-ray observatory upgrades, and intriguing new results from observations of the galactic center. (iv) new results on fundamental physical parameters governing neutrino oscillations from the Double Chooz experiment. (v) hardware and software developments in some of the world's most important next-generation facilities. (vi) continuation of the vigorous theory program, which gives meaning to the data and provides guidance to the experimental program. (vii) Continued the APC reputation for excellent productivity, including 1105 publications in the review period. Of these, 12 are "renowned" (>500 citations) and 18 are "famous" (250-500 citations). (viii) Numerous prestigious prizes and awards to APC personnel, including the Gruber Prize, the Breakthrough Prize in Fundamental physics, and Unesco-L'Oréal prizes for women in science.

Weaknesses

The Committee identified no major weaknesses in the laboratory. Given the ambitious pursuit of the world's most important projects, it may not be possible to be effective in all of APC's desired roles. In that case, strategic choices will have to be made, in a manner that has "buy-in" by personnel throughout the laboratory. The Directorate recognizes this and has already made choices. See section on Strategy, below.

Assessment of scientific outputs, reputation and appeal

The scientific productivity and quality, both in terms of publications and new hardware, is excellent.

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 01/01/2012 to 30/06/2017	Number
Technical expert or standardization reports,	4
Socio-economic interactions: industrial and R&D contracts	
Socio-economic interactions: Cifre fellowships	
Socio-economic interactions: creation of labs with private-public partnerships	
Socio-economic interactions: networks and mixed technological units	
Socio-economic interactions: start-ups	
Socio-economic interactions: patents, licenced patents and inventions	1
Public outreach: radio broadcasts, TV shows, magazines	36
Public outreach: journal articles, interviews, book edition, videos, etc.	128
Public outreach other popularization outputs	yes
Public outreach: debates on science and society	19

Strengths

In general, the laboratory has fostered these activities well, with a dedicated person. There are many efforts in this direction, given in detail in the group-by-group sections below, which also take advantage of affiliated organizations, such as the Paris Centre for Cosmological Physics (PCCP).

Weaknesses

No major weaknesses were identified.

Assessment of the interactions with the non-academic world

The topics of inquiry at APC are inherently of broad interest throughout society, and the groups are using the opportunities effectively. APC personnel eagerly express excitement and enthusiasm for these activities. Overall, these efforts are judged to be very good. More details can be found in the individual group sections below.

C – Involvement in training through research

Involvement in training through research From 01/01/2012 to 30/06/2017	Number
Habilitated (HDR) scientists	49
PhD students	87
Defended PhDs	53
Mean PhD duration	36
Mean number of publications per student	1-2
Educational outputs: books	3
Educational outputs: e-learning, MOOCs, multimedia lessons, etc.	32

Strengths

A particularly enjoyable part of the Committee visit was the time spent with the many students and post-docs. Their energetic enthusiasm for their own work, and their broad interest in work done across the laboratory, was obvious and contagious. They conveyed a conviction that APC provides an excellent environment for their professional development.

Weaknesses

None identified.

Assessment of the involvement in training through research

APC provides an excellent and exciting environment for students and post-docs.

CRITERION 2: UNIT ORGANISATION AND LIFE

Unit organisation and life From 01/01/2012 to 30/06/2017	Number
Women/men ratio in the unit	29/81
Women/men ratio among unit scientists	12/48
Women/men ratio among unit PhD students	14/73
Women/men ratio among team leaders, unit head and deputy heads.	45 %

Strengths

Scientists associated with the laboratory belong to at least one of the following teams: (1) High Energy Astrophysics, headed by Anne LEMIERE; (2) Cosmology, headed by Ken GANGA; (3) Gravitation, headed by Eric CHASSANDE-MOTTIN; (4) Neutrinos and Dark Matter, headed by Jaime DAWSON; and (5) Theory, headed by Cristina VOLPE. In addition, the affiliated Energy Physics Group is headed by Hassan PEERHOSSAINI. Technical and administrative personnel are assigned to technical and administrative departments, headed by Mr Thomas ZERGUERRAS and Ms Emmanuella FOISSAC, respectively. There are also "Transversal activities", such as Communications, Technology Transfer, and Health/Safety/Radiation protection on the Organization chart. The Board of Directors consists of the Director, Deputy Directors, the Administrative Director, and the Technical Director.

The Directorate understands very well the scientific interconnections, and the related opportunities, among the different teams, which is commendable. An excellent example is provided by the possibility to determine fundamental neutrino properties using a combination of techniques in accelerator- and reactor-based experiments, cosmological surveys, and theory, APC is in an unusually strong position to play world-leading roles in fostering these interconnections. This strength can be exploited over the coming decade.

Overall, the gender balance is good, given the realities of the field, and the laboratory appears to have a welcoming and supportive culture. This requires continuous attention. Some of the groups (*e.g.*, Cosmology) are apparently lagging in this area. See individual team assessments below.

Weaknesses

The Directorate receives advice from several sources, which is good. However, between the high-level, external Scientific Council (SC) and the internal *Cellule de Suivi des Projets*" (CSP), which meets frequently for the management of technical resources, there is an intermediate strategic gap. The Directorate has recognized this gap and is now tasking the group leaders to meet together quarterly to assess strategic processes and outcomes. This has been endorsed also by the SC.

The FACe facility must now move the main APC building. This is not formally a weakness, but it is a major administrative challenge.

There appears to be insufficient administrative workforce in the laboratory, given the large turnover in personnel and increasing bureaucratic requirements. This is of significant concern to the committee.

New students and post-docs are not currently given guidance on navigating the bureaucracy. An early orientation, as well as clear web pages, would be of great benefit. Non-EU personnel have special needs that a laboratory of APC's international stature should address.

Assessment of the unit's life and organization

The overall assessment is that the unit's life and organization are very good. The excellent cross-cutting opportunities coexist with significant remaining issues supporting personnel at an internationally recognized laboratory.

CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

Strengths

The laboratory has evolved considerably, moving from "just" small-scale R&D, data analysis, and theoretical investigations toward having large and visible roles in major projects. This is a positive development, and it carries with it some aspects that need dedicated attention. Specifically, to avoid the tendency of separating physicists from the production of the hardware, it will be necessary to have more permanent scientific staff who works on instruments. In addition, there will be a tension between the academic freedom of laboratory permanent staff to pursue many small R&D investigations versus a small number of large, high-priority projects. The Directorate understands these issues, and has identified near-term priorities: the next new permanent hires will be first in Gravitation and then Neutrinos, both of whom will be instrumentalists.

The laboratory structure has evolved appropriately and strategically, based on the needs of the dynamic fields of research and the needs of the member groups. Given the ample ambitions of APC, limited resources, quickly evolving national and international landscapes, and the need to make choices, clear internal communication at every level is especially important. The coming period with an Interim Director, followed by the appointment of the new Director, further amplifies this need and merits special attention.
The committee was told that, every year, the group leaders document their near-term plans and milestones in the context of their longer-term goals. These are circulated to all managers and, after discussion, form the basis of a priority list that includes the needed technical resources. The committee concurs this is an important practice to maintain. The committee notes that a list of projects is not by itself a strategic plan.

Weaknesses

None identified.

Assessment of the scientific strategy and projects

Overall, the strategic planning at the laboratory is very good. For some of the groups, the strategy is still being developed.

RECOMMENDATIONS TO THE UNIT

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

To maintain focus and excellence, ensure a level of science exploitation of projects with significant APC hardware roles commensurate with the laboratory's stature and potential.

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

Ensure the CSP considers each project as often as needed. This could be done, *e.g.*, by meeting more frequently or by considering more than one project per meeting.

Continue to pay careful attention to internal communication at every level, especially during the period of transition in laboratory leadership.

The University has strongly supported the APC laboratory since its creation through professor and associate professor positions, which has been extremely important. More than a third or the permanent research scientists are university staff, who maintain the strong relationship between the lab and the University and are essential for attracting students. However, as is the case for other university teaching staff in France (enseignant-chercheur, Maître de Conférences, Professeur), the teaching workload is heavy by international standards, creating frustration among the staff that cannot devote enough time for their research activities. Therefore, when possible, the lab management should try to support selected professors and associate professors who need more research time through the existing arrangements (CRCT, Délégation, etc.) or by developing new ones.

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

As the laboratory evolves, to maintain and enhance the laboratory's effectiveness and reputation, ensure there are at least some projects with large, visible hardware roles.
Increase the number of scientist-instrumentalists to ensure a tight connection between the science and hardware.

TEAM-BY-TEAM ANALYSIS

Team 1: Cosmology

Team leader: Mr Kenneth GANGA

TEAM SCIENTIFIC DOMAIN

This group works in the area of Cosmology, primarily by studying the cosmic microwave background (CMB) and a selection of complementary information provided by optical galaxy surveys,

TEAM WORKFORCE

Team workforce	Number 30/06/2017	Number 01/01/2019
Permanent staff		
Full professors and similar positions	2	2
Assistant professors and similar positions	2	2
Full time research directors (Directeurs de recherche) and similar positions	6	6
Full time research associates (Chargés de recherche) and similar positions	3	3
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	1	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	0	0
TOTAL permanent staff	**14**	**15**
Non-permanent staff		
Non-permanent professors and associate professors, including emeritus	0	
Non-permanent full time scientists, including emeritus, post-docs	5	
Non-permanent supporting personnel	0	
PhD Students	7	
TOTAL non-permanent staff	**12**	
TOTAL team	**26**	

CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

A – Scientific outputs and activities, academic reputation and appeal

Scientific outputs and activities, academic reputation and appeal From 01/01/2012 to 30/06/2017	Number
Articles: scientific articles	297
Articles: review articles	
Scientific articles with a unit member as last author	
Medical articles (if relevant)	
Books: monographs, critical editions, translations	1
Books: scientific book edition	
Books: book chapters	
Books : published/edited theses	
Meetings: conference proceedings	43
Symposia, meetings: articles in meeting proceedings	
Meetings: other conference outputs	
Academic research grants: European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	2
Academic research grants: national public grants (ANR, PHRC, FUI, INCA, etc.)	1
Academic research grants: local grants (collectivités territoriales)	
Academic research grants: PIA (Labex, Equipex etc.) grants	
Academic research grants: grants from foundations and charities (ARC, FMR, FRM, etc.)	
Visiting scientists (more than one month in the unit)	29
Post-docs (more than 12 months in the unit)	
Electronic tools and products: softwares	4
Electronic tools and products: libraries and cohorts	
Electronic tools and products: corpus	

Electronic tools and products: tools presented in solver competitions	
Electronic tools and products: decision tools	
Editorial activities: participation to journal editorial boards (books, collections)	4
Peer reviewing activities: participation to institutional committees and juries (CNRS, INSERM etc.)	yes
Peer reviewing activities: reviewing of journal articles	yes
Peer reviewing activities: participation to lab site visit committees (HCERES etc.)	yes
Peer reviewing activities: grant evaluation (public or charities)	yes
Scientific recognition: prizes	0
Scientific recognition: distinctions	1
Scientific recognition: chair of learned and scientific societies	yes
Scientific recognition: invitations to meetings and symposia (out of France)	94

Strengths

The cosmology group has been very productive, with a large number of very high impact publications, thanks in particular to the APC involvement with Planck data analysis in several key areas, including the Planck Sky Model, Component Separation, and simulations for evaluating several instrumental effects. In addition, there have been major contributions to the Polarbear project.

The group is also well positioned in upcoming major optical survey facilities, particularly LSST, for which the group plays important roles in project development (including Camera Controls System and Filter Exchange system) and dark energy science preparations through the Dark Energy Science Collaboration (DESC). Additionally, the group is a member of the Euclid consortium, with APC focusing efforts on science data pipelines and the important complementarity of Euclid and LSST for dark energy studies.

The know-how and technical infrastructure for cryogenic mm-wave detectors development, the associated readout system and expertise in bolometric interferometers are also major assets for post-Planck CMB physics.

The local expertise in Euclid, LSST, and CMB analyses will be a powerful combination over the coming 15-20 years.

Weaknesses

The level of involvement for the scientific preparation of LSST and Euclid is not yet at the same level as that of the hardware preparation.

Assessment of scientific outputs, reputation and appeal

Given the accomplishments in Planck, and the valuable connections between CMB and optical surveys, the APC Cosmology group is assessed as excellent.

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 01/01/2012 to 30/06/2017	Number
Technical expert or standardization reports,	1
Socio-economic interactions: industrial and R&D contracts	
Socio-economic interactions: Cifre fellowships	
Socio-economic interactions: creation of labs with private-public partnerships	
Socio-economic interactions: networks and mixed technological units	
Socio-economic interactions: start-ups	
Socio-economic interactions: patents, licenced patents and inventions	0
Public outreach: radio broadcasts, TV shows, magazines	10
Public outreach: journal articles, interviews, book edition, videos, etc.	21
Public outreach: other popularization outputs	yes
Public outreach: debates on science and society	1

Strengths

Cosmology is of broad interest to the general public. The affiliation with the PCCP provides natural opportunities, internationally. Group members have participated in a number of public outreach activities, including radio and TV or magazines, benefiting also from the visibility provided by the publication of Planck results. They have also contributed to APC/PCCP managed outreach program "Enseigner l'Univers" course for college professors.

Weaknesses

No weaknesses have been identified.

Assessment of the interactions with the non-academic world

The contributions by this group for public outreach activities are very good.

C – Involvement in training through research

Involvement in training through research From 01/01/2012 to 30/06/2017	Number
Habilitated (HDR) scientists	11
PhD students	19
Defended PhDs	12
Mean PhD duration	39
Mean number of publications per student	
Educational outputs: books	0
Educational outputs: e-learning, MOOCs, multimedia lessons, etc.	6

Strengths

The APC cosmology group has attracted a large number of PhD students (19) , spread over the full spectrum of their activities, from instrumental development to cosmological interpretation of observations. Most of those who have finished have been able to obtain a postdoctoral position, and some have been able to obtain a permanent position after few years of postdoctoral work. Group members are also involved in university courses at different levels, as well as PhD program management at the Ecole Doctorale, and in an international master-level program with Vietnam.

Weaknesses

None identified.

Assessment of the involvement in training through research

The group accomplishments have been excellent.

CRITERION 2: TEAM ORGANISATION AND LIFE

Team organisation and life From 01/01/2012 to 30/06/2017	Number
Women/men ratio in the team	1/13
Women/men ratio among team scientists	1/13
Women/men ratio among team PhD students	0/7

Strengths

APC is involved in significant ways with a variety of projects. This is remarkable and close to unique. As combining the information from these projects has the potential to provide breakthrough advances, effective and efficient methods to ensure cross-group communication and collaboration at all levels, especially among students and post-docs, are essential. This is also true for interactions between Cosmology and all of the other APC teams.

Weaknesses

The gender imbalance of the cosmology group is particularly noticeable.

Assessment of the team's life and organization

Overall, the group is maintaining a very good team life and organization. The gender imbalance is a concern.

CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

Strengths

The group involvement in LSST & Euclid projects gives it a clear, secure path and a very attractive research program in dark energy and dark matter in the next decade. The group expertise in CMB and clusters give them the possibility to carry joint analysis, combining probes and constraints from both CMB observations and optical surveys. The high level of expertise in CMB data analysis is an asset on which the group can build a comprehensive post-Planck CMB program. Moreover, the group can benefit from the synergies with the theory and neutrino groups to carry cutting-edge analysis on neutrino properties.

Weaknesses

The group has the challenging task of refining its future direction and strategic plan. Indeed, the end of the scientific exploitation of the Planck mission, and the lack of a clear French or European roadmap for future large-scale CMB ground-based or spaced-based facilities represents a challenge for the group, which has invested heavily in the development of CMB analysis methods and instrument development, as well as proposal preparation in response of ESA/CNES call for proposals (PRISM, CORE).

Assessment of the scientific strategy and projects

The strategy and project mix at this time are assessed as very good overall, with excellent choices in optical surveys.

RECOMMENDATIONS TO THE TEAM

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

The group should actively engage in LSST & Euclid science preparation, with involvement of PhD students, postdocs, and a larger dedicated fraction of the permanent staff.

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

The group should understand the causes of the current gender imbalance and vigorously pursue better outcomes.

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

The team is encouraged to foster the timely development of a coherent and realistic roadmap for CMB and to clarify their strategy for involvement in the next generation B-mode CMB experiments.

Although the current plans and near-term goals of the QUBIC project are well defined and should be pursued, the advantages of the bolometric interferometer concept and availability of necessary resources should be carefully assessed, in the context of a broader CMB roadmap, before engaging further with a larger scale instrument.

The activities for cryogenic mm wave detector developments should be consolidated and better integrated into a strong national program.

Obtain sufficient travel support to ensure continued large impact by APC personnel on international projects during integration, commissioning, and science operations.

The group should engage more actively in the preparation of scientific exploitation of LSST and Euclid.

Team 2: Gravitation

Team leader: Mr Eric CHASSANDE-MOTTIN

TEAM SCIENTIFIC DOMAIN

This group works in the area of Gravitational Waves.

TEAM WORKFORCE

Team workforce	Number 30/06/2017	Number 01/01/2019
Permanent staff		
Full professors and similar positions	0	0
Assistant professors and similar positions	2	2
Full time research directors (Directeurs de recherche) and similar positions	2	3
Full time research associates (Chargés de recherche) and similar positions	1	1
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	0	0
TOTAL permanent staff	**5**	**6**
Non-permanent staff		
Non-permanent professors and associate professors, including emeritus	0	
Non-permanent full time scientists, including emeritus, post-docs	2	
Non-permanent supporting personnel	0	
PhD Students	6	
TOTAL non-permanent staff	**8**	
TOTAL team	**13**	

CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

A – Scientific outputs and activities, academic reputation and appeal

Scientific outputs and activities, academic reputation and appeal From 01/01/2012 to 30/06/2017	Number
Articles: scientific articles	114
Articles: review articles	
Scientific articles with a unit member as last author	
Medical articles (if relevant)	
Books: monographs, critical editions, translations	0
Books: scientific book edition	1
Books: book chapters	3
Books : published/edited theses	
Meetings: conference proceedings	27
Symposia, meetings: articles in meeting proceedings	
Meetings: other conference outputs	
Academic research grants: European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	1
Academic research grants: national public grants (ANR, PHRC, FUI, INCA, etc.)	2
Academic research grants: local grants (collectivités territoriales)	
Academic research grants: PIA (Labex, Equipex etc.) grants	
Academic research grants: grants from foundations and charities (ARC, FMR, FRM, etc.)	
Visiting scientists (more than one month in the unit)	5
Post-docs (more than 12 months in the unit)	
Electronic tools and products: softwares	3
Electronic tools and products: libraries and cohorts	
Electronic tools and products: corpus	

Electronic tools and products: tools presented in solver competitions	
Electronic tools and products: decision tools	
Editorial activities: participation to journal editorial boards (books, collections)	3
Peer reviewing activities: participation to institutional committees and juries (CNRS, INSERM etc.)	yes
Peer reviewing activities: reviewing of journal articles	yes
Peer reviewing activities: participation to lab site visit committees (HCERES etc.)	
Peer reviewing activities: grant evaluation (public or charities)	yes
Scientific recognition: prizes	6
Scientific recognition: distinctions	0
Scientific recognition: chair of learned and scientific societies	0
Scientific recognition: invitations to meetings and symposia (out of France)	14

Strengths

The group is at the forefront of the main international scientific collaborations in the field of gravitational wave astronomy. The hardware contributions to Advanced Virgo helped put it into operation in time for the recent headline-producing discoveries. Group personnel have been in the writing/coordination teams for the three most prominent papers reporting the recent Virgo/LIGO discoveries and have had leading roles fostering the multimessenger astrophysics results from GW170817. APC personnel have been in the LISA Pathfinder core data analysis group, thus sharing the credit for the outstanding results of the mission. The gravitation group has contributed significantly to the LISA science case in preparation of the mission proposal. The group has been extremely successful in coordinating the interest of the French scientific community in LISA, and was, through their LISA co-PI, instrumental In pushing the mission throughout all crucial phases of its approval.

Weaknesses

None identified.

Assessment of scientific outputs, reputation and appeal

As the leading French Lab for LISA, and one of the major contributors to VIRGO analyses, the overall contributions by APC are excellent.

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 01/01/2012 to 30/06/2017	Number
Technical expert or standardization reports,	1
Socio-economic interactions: industrial and R&D contracts	
Socio-economic interactions: Cifre fellowships	
Socio-economic interactions: creation of labs with private-public partnerships	
Socio-economic interactions: networks and mixed technological units	
Socio-economic interactions: start-ups	
Socio-economic interactions: patents, licenced patents and inventions	0
Public outreach: radio broadcasts, TV shows, magazines	10
Public outreach: journal articles, interviews, book edition, videos, etc.	6
Public outreach: other popularization outputs	yes
Public outreach: debates on science and society	4

Strengths

As common in the gravitational wave (GW) community, the APC group is sensitive to need for public scientific outreach, and it is very active in this area. This activity reached an outstanding high with the MOOC that involved the whole group and was an enviable example of good public outreach.

Weaknesses

None identified.

Assessment of the interactions with the non-academic world

The group is assessed as very good.

C – Involvement in training through research

Involvement in training through research From 01/01/2012 to 30/06/2017	Number
Habilitated (HDR) scientists	4
PhD students	13
Defended PhDs	7
Mean PhD duration	36
Mean number of publications per student	
Educational outputs: books	1
Educational outputs: e-learning, MOOCs, multimedia lessons, etc.	11

Strengths

The team is among those with the highest number of PhD students at APC. Students appear to form a lively group with a good level of interaction, and to be enthusiastic about their PhD work. The committee notes, positively, that the team has been appealing to students with diverse national origins.

Weaknesses

None identified.

Assessment of the involvement in training through research

The group is assessed as excellent.

CRITERION 2: TEAM ORGANISATION AND LIFE

Team organisation and life From 01/01/2012 to 30/06/2017	Number
Women/men ratio in the team	0/5
Women/men ratio among team scientists	0/5
Women/men ratio among team PhD students	1/12

Strengths

The team has a rather low average age. It also appears to be well organized with regular team meetings and seminars. The relatively large fraction of postdocs and students also contributes to a lively team atmosphere.

Weaknesses

None identified.

Assessment of the team's life and organization

The group's life and organization are excellent.

CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

Strengths

The team has a solid position in both LISA and in Virgo and both these projects have clear plans, at least for the next 5 years. In addition, the team track record, expertise, and visibility should guarantee them a significant role in the development of the third-generation ground-based detectors. This position is particularly robust in data analysis, where the team has a good record on both LISA and Virgo. The team has plans for, and has already made some successful attempts at, having the two efforts cooperate and interact.

Weaknesses

The tragic loss of the former LISA Co-PI may significantly change the scientific standing of the group within the space-based GW community. In data analysis from ground-based detectors, the GW environment will become increasingly competitive. The relatively small size of the group may limit their ability to tackle large tasks and may have a significant influence on determining the group visibility. On the Virgo and 3rd generation detectors hardware development, one possible weakness is again the size of the group. As compared to other groups within Virgo France, the APC team is not among the largest.

The LISA strategy may encounter two different difficulties. On data analysis and the preparation of the ground segment, the long time scale of the mission development, of order of 15 years, may make difficult to maintain momentum and a significant scientific output. On the instrument side, the role of APC is still not very well defined. The activity is, for the time being, foreseen as consisting of the development of some not yet identified optical and electronic ground support equipment.

Assessment of the scientific strategy and projects

The choice of the projects is strategically excellent. The plans for their implementation carry significant risk.

RECOMMENDATIONS TO THE TEAM

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

None.

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

None.

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

The long-term effect of the loss of the LISA co-PI should be monitored, and the group should be supported to maintain its reputation.

To mitigate the negative effect of the limited size of the group on ground-based data analysis activities, the team should be encouraged to continue and, possibly, strengthen the procurement of external resources for doctoral and post-doctoral collaborators.

The committee understands that actions are already in place to strengthen the instrumental effort on ground-based detectors, and it supports these actions. The further strengthening of doctoral and post-doctoral opportunities is also encouraged.

The role in LISA hardware is still poorly defined and should be monitored. The lack of a solid leadership role on some critical aspect of the mission hardware may weaken the position of the team within the collaboration.

Team 3: High Energy Astrophysics (HEA)

Team leader: Ms Anne LEMIERE

TEAM SCIENTIFIC DOMAIN

The HEA team is the APC's largest, both in terms of researchers and of projects, all with the common scientific aim of studying the most powerful phenomena in the Universe. The team does this by being actively involved in the detection of a variety of different cosmic messengers: X-rays and soft γ-rays, very-high energy (VHE) γ-rays, neutrinos, and ultra-high energy cosmic rays (UHECRs). The team is complemented by two groups working on the phenomenology of Galactic cosmic rays and on high-performance computing.

TEAM WORKFORCE

Team workforce	Number 30/06/2017	Number 01/01/2019
Permanent staff		
Full professors and similar positions	1	2
Assistant professors and similar positions	4	3
Full time research directors (Directeurs de recherche) and similar positions	1	4
Full time research associates (Chargés de recherche) and similar positions	9	10
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	4	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	0	0
TOTAL permanent staff	**19**	**19**
Non-permanent staff		
Non-permanent professors and associate professors, including emeritus	0	
Non-permanent full time scientists, including emeritus, post-docs	4	
Non-permanent supporting personnel	0	
PhD Students	7	
TOTAL non-permanent staff	**11**	
TOTAL team	**30**	

CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

A – Scientific outputs and activities, academic reputation and appeal

Scientific outputs and activities, academic reputation and appeal From 01/01/2012 to 30/06/2017	Number
Articles: scientific articles	235
Articles: review articles	
Scientific articles with a unit member as last author	
Medical articles (if relevant)	
Books: monographs, critical editions, translations	
Books: scientific book edition	
Books: book chapters	
Books : published/edited theses	2
Meetings: conference proceedings	98
Symposia, meetings: articles in meeting proceedings	
Meetings: other conference outputs	
Academic research grants: European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	1
Academic research grants: national public grants (ANR, PHRC, FUI, INCA, etc.)	2
Academic research grants: local grants (collectivités territoriales)	
Academic research grants: PIA (Labex, Equipex etc.) grants	1
Academic research grants: grants from foundations and charities (ARC, FMR, FRM, etc.)	
Visiting scientists (more than one month in the unit)	42
Post-docs (more than 12 months in the unit)	
Electronic tools and products: softwares	11
Electronic tools and products: libraries and cohorts	
Electronic tools and products: corpus	

Electronic tools and products: tools presented in solver competitions	
Electronic tools and products: decision tools	
Editorial activities: participation to journal editorial boards (books, collections)	2
Peer reviewing activities: participation to institutional committees and juries (CNRS, INSERM etc.)	yes
Peer reviewing activities: reviewing of journal articles	yes
Peer reviewing activities: participation to lab site visit committees (HCERES etc.)	yes
Peer reviewing activities: grant evaluation (public or charities)	yes
Scientific recognition: prizes	0
Scientific recognition: distinctions	4
Scientific recognition: chair of learned and scientific societies	yes
Scientific recognition: invitations to meetings and symposia (out of France)	61

Strengths

The activity of the experimental sub-teams has been lively and multifaceted, touching both instrumental and physics aspects, the former thanks to the collaboration with the technical departments of the APC. The track record in instrumentation is remarkable, for example in approaching the completion of the XGRE instrument for Taranis or in fulfilling the APC responsibilities on the ECLAIR instrument for SVOM. The scientific production has been rich, with team members leading major publications in prestigious journals. The team's international visibility and reputation are evident by its large number of responsibilities, some of them at very high level, such as the leadership of Antares. The strength of the team resides in the interconnection of the studied messengers, granting them a forefront position in multi-messenger astronomy, with both space- and ground-based observations. The multi-messenger character is augmented by the interactions with phenomenologists and simulation experts, as well as by the interactions of the team with other APC teams, especially Gravitation, Neutrino, and Theory.

Weaknesses

The large number of researchers relative to other APC teams means that APC will likely place higher priority on reinforcing those other teams in the coming years. Moreover, the spread of HEA personnel across a large number and variety of activities at the boundaries between fields, and between space and ground observations, poses a risk that the team will fall between French scientific communities, with insufficient priority or visibility in any of them.

Assessment of scientific outputs, reputation and appeal

The HEA team is not the leading French group in some of its projects, but the interconnectedness makes the team strong. The scientific outcomes of the team are excellent and well-recognized also within international collaborations.

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 01/01/2012 to 30/06/2017	Number
Technical expert or standardization reports,	
Socio-economic interactions: industrial and R&D contracts	
Socio-economic interactions: Cifre fellowships	
Socio-economic interactions: creation of labs with private-public partnerships	
Socio-economic interactions: networks and mixed technological units	
Socio-economic interactions: start-ups	1
Socio-economic interactions: patents, licenced patents and inventions	1
Public outreach: radio broadcasts, TV shows, magazines	5
Public outreach: journal articles, interviews, book edition, videos, etc.	4
Public outreach: other popularization outputs	yes
Public outreach: debates on science and society	4

Strengths

Thanks to its expertise in developing high-energy radiation instruments, the HEA team has been involved in the development of the Gamma Cube project, which is an R&D aiming to localize charged particle interactions and tracks in a novel scintillating detector. A patent was filed in 2013 with an application to a medical gamma camera. The outreach activities conducted by the team are numerous and varied, spanning from participation in science bars and "fetes" to presentations in public, writing articles, and giving radio and video interviews.

Weaknesses

None identified.

Assessment of the interactions with the non-academic world

The team has a very good track record of interactions with the non-academic world in a variety of ways.

C – Involvement in training through research

Involvement in training through research From 01/01/2012 to 30/06/2017	Number
Habilitated (HDR) scientists	8
PhD students	20
Defended PhDs	13
Mean PhD duration	36
Mean number of publications per student	
Educational outputs: books	0
Educational outputs: e-learning, MOOCs, multimedia lessons, etc.	3

Strengths

The wide variety of activities, both on instrumentation and physics analysis, offers the students an attractive spectrum of opportunities. About half of the staff members are university teachers, thus fostering the visibility of the team among undergraduate students.

Weaknesses

The ratio of students and post-docs to permanent research staff is low, especially in comparison to the rest of APC.

Assessment of the involvement in training through research

The involvement in training through research is very good.

CRITERION 2: TEAM ORGANISATION AND LIFE

Team organisation and life From 01/01/2012 to 30/06/2017	Number
Women/men ratio in the team	3/16
Women/men ratio among team scientists	3/16
Women/men ratio among team PhD students	6/14

Strengths

The HEA team relies on the interrelations between all of its activities to create a natural and effective synergy among different energy domains and messengers as well as among observation, phenomenology, and simulation. With the aim to promote cohesion and to foster interactions, the team has established a weekly scientific meeting where the whole HEA team meets and where general information, discussions of scientific news and presentations by group members or visitors are given as well as dedicated seminars or journal clubs. The existing interactions with other APC teams have fostered and will foster the multi-messenger character of the team.

Weaknesses

None identified.

Assessment of the team's life and organization

Despite of the large number of researchers and spectrum of projects, the cohesion is apparently strong, thanks in part to excellent internal organization and communication.

CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

Strengths

The experimental projects to be pursued in the coming years appear to be clearly defined and reduced in number with respect to the past. Also, the transitions from existing to future projects appear to be well in line with the expertise of the involved team members, *e.g.*, in the passage from Integral to Taranis/SVOM, from HESS to CTA, from Antares to KM3NET. The phenomenological and numerical projects related to multi-messengers physics appear also well-defined in supplementing the observational activities.

Weaknesses

Future experiments, in particular ground-based ones, are growing in size, while the APC involvement in them appears relatively small in terms of hardware contributions or numbers of involved scientists. There is a significant risk that the impact of APC on new projects might not be as great as it was for prior projects. In that case, more strategic choices will be needed.

Assessment of the scientific strategy and projects

The strategy is assessed overall as very good at this time. The strategy for VHE gamma-ray astrophysics is still being developed, pending choices within CTA.

RECOMMENDATIONS TO THE TEAM

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

None.

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

Increase the number of students and postdocs where possible.

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

The transitions that the many projects are undergoing will require careful monitoring and re-evaluation for continued impact of APC.

Team 4: Neutrinos

Team leader: Ms Jaime DAWSON

TEAM SCIENTIFIC DOMAIN

This group studies the properties of neutrinos and seeks to uncover the identity of dark matter.

TEAM WORKFORCE

Team workforce	Number 30/06/2017	Number 01/01/2019
Permanent staff		
Full professors and similar positions	4	5
Assistant professors and similar positions	1	0
Full time research directors (Directeurs de recherche) and similar positions	0	2
Full time research associates (Chargés de recherche) and similar positions	3	3
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	1	0
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	0	0
TOTAL permanent staff	**9**	**10**
Non-permanent staff		
Non-permanent professors and associate professors, including emeritus	1	
Non-permanent full time scientists, including emeritus, post-docs	7	
Non-permanent supporting personnel	0	
PhD Students	4	
TOTAL non-permanent staff	**12**	
TOTAL team	**21**	

CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

A – Scientific outputs and activities, academic reputation and appeal

Scientific outputs and activities, academic reputation and appeal From 01/01/2012 to 30/06/2017	Number
Articles: scientific articles	71
Articles: review articles	
Scientific articles with a unit member as last author	
Medical articles (if relevant)	
Books: monographs, critical editions, translations	
Books: scientific book edition	
Books: book chapters	2
Books : published/edited theses	
Meetings: conference proceedings	77
Symposia, meetings: articles in meeting proceedings	
Meetings: other conference outputs	
Academic research grants: European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	3
Academic research grants: national public grants (ANR, PHRC, FUI, INCA, etc.)	1
Academic research grants: local grants (collectivités territoriales)	1
Academic research grants: PIA (Labex, Equipex etc.) grants	
Academic research grants: grants from foundations and charities (ARC, FMR, FRM, etc.)	
Visiting scientists (more than one month in the unit)	22
Post-docs (more than 12 months in the unit)	
Electronic tools and products: softwares	1
Electronic tools and products: libraries and cohorts	
Electronic tools and products: corpus	

Electronic tools and products: tools presented in solver competitions	
Electronic tools and products: decision tools	1
Editorial activities: participation to journal editorial boards (books, collections)	5
Peer reviewing activities: participation to institutional committees and juries (CNRS, INSERM etc.)	7
Peer reviewing activities: reviewing of journal articles	10
Peer reviewing activities: participation to lab site visit committees (HCERES etc.)	4
Peer reviewing activities: grant evaluation (public or charities)	6
Scientific recognition: prizes	1
Scientific recognition: distinctions	6
Scientific recognition: chair of learned and scientific societies	yes
Scientific recognition: invitations to meetings and symposia (out of France)	35

Strengths

The neutrino and dark matter group members have well recognized positions within their respective collaborations at the national and international levels. During the period covered by this report, the neutrino group achieved major results, which have had a clear impact in the field: under the coordination of a group member, the Double Chooz experiment performed key analyses; the APC team played a major role in JUNO in the design of the photomultiplier system, pioneering the concept of double calorimetry; the KM3Net activities of APC members have been essential for establishing the physics case for Orca; the group has a visible role in the SOX experiment, which should bring important results by 2019; and members of the neutrino group are playing leading roles in the development of liquid argon TPCs for the next-generation long baseline experiment, a major international project.

The academic reputation of the neutrino group is clearly highlighted by the successes of several initiatives, including getting 1 visiting professor from US, 1 Blaise Pascal Chair, 2 Marie-Curie fellowships, 1 ANR grant, 3 labex fundings, 1 Idex funding and a large number of PhD students.

Weaknesses

The sub-teams involved in the Darkside and JUNO projects are critically small, relying essentially on a single permanent researcher. To be productive, these groups strongly depend on the possibility of getting funds for postdocs in the coming years. The medium term evolution is not clear.
The neutrino-Dark matter group is involved in a large number of projects compared with the number of staff and the available research time.

Assessment of scientific outputs, reputation and appeal

All the results obtained by the APC neutrino & dark matter group are of high quality with major contributions brought to the field of neutrino physics. The scientific output and reputation are overall very good, with several activities viewed as excellent.

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 01/01/2012 to 30/06/2017	Number
Technical expert or standardization reports,	2
Socio-economic interactions: industrial and R&D contracts	
Socio-economic interactions: Cifre fellowships	
Socio-economic interactions: creation of labs with private-public partnerships	
Socio-economic interactions: networks and mixed technological units	
Socio-economic interactions: start-ups	
Socio-economic interactions: patents, licenced patents and inventions	0
Public outreach: radio broadcasts, TV shows, magazines	5
Public outreach: journal articles, interviews, book edition, videos, etc.	62
Public outreach: other popularization outputs	yes
Public outreach: debates on science and society	3

Strengths

The neutrino & dark matter group is working very well on public outreach. The members are contributing to different public actions, interviews, radio, magazines and public debates. During the period, they did 67 contributions to outreach which is impressive given the group size. Individual initiatives are done at different levels from national actions to local events. They are very enthusiastic and active in this field.

Weaknesses

None identified.

Assessment of the interactions with the non-academic world

The interaction with the non-academic world is very good.

C – Involvement in training through research

Involvement in training through research From 01/01/2012 to 30/06/2017	Number
Habilitated (HDR) scientists	9
PhD students	13
Defended PhDs	9
Mean PhD duration	32
Mean number of publications per student	
Educational outputs: books	1
Educational outputs: e-learning, MOOCs, multimedia lessons, etc.	3

Strengths

The group is active in supervising PhD students in all the sub-teams, including several international co-supervisions. The group has maintained a regular flow of PhD students, with about 2 defenses per year. The activity at the university level is important, with half the group also teaching. Some of the members are teaching courses at the Masters level and are involved in the coordination of the NPAC master program.

They have also participated in the production of 1 MOOC for teaching and to 2 international schools. Three members of the group are at the 'Institut Universitaire de France'.

Weaknesses

One third of the potential PhD supervisors of the group have not yet obtained their HDR. The rate of PhD students seems to be decreasing, and the group apparently has difficulty to get new PhD students.

Assessment of the involvement in training through research

The group has very good involvement in teaching and supervising students.

CRITERION 2: TEAM ORGANISATION AND LIFE

Team organisation and life From 01/01/2012 to 30/06/2017	Number
Women/men ratio in the team	3/6
Women/men ratio among team scientists	3/6
Women/men ratio among team PhD students	1/12

Strengths

The rotation of the group leadership every two to three years gives a good opportunity for the different projects to have visibility in the laboratory management. The regular monthly meeting helps in keeping cohesion among the students, postdocs and the different projects. The neutrino group has a good gender parity at the level of the permanent staff.

Weaknesses

The gender parity of the PhD students is not good.

Assessment of the team's life and organization

Overall, the team's life and organization are very good.

CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

Strengths

The neutrino physics plan is well defined from the scientific point of view. After the dismantling of Double Chooz and the results obtained in 2018, important results may come from Borexino/SOX on sterile neutrino search by 2019. The implication of the laboratory in both Orca and Juno to address the mass hierarchy determination with the 2 major experiments in the world on this topic and benefitting from local expertise in the technologies guarantees an excellent physics outcome before the DUNE physics program starts.

The key hardware contributions for the three projects are coherent with the expertise and provide a very good visibility in the projects.

Weaknesses

The JUNO, Orca and DUNE projects would need strong groups in each of them to keep a high visibility. The technical resources needed to complete the program are not guaranteed. The lack of technical resources may impact the involvements in some projects such as the electronic read out cards for DUNE. The interest of the group to pursue a 20t detector of Darkside and the wish to work for Argo is very ambitious compared to the size of the team involved.

Assessment of the scientific strategy and projects

The scientific strategy and the choice of neutrino projects are very good, with important visible contributions and goals, though they will be very challenging to pursue successfully.

RECOMMENDATIONS TO THE TEAM

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

Complete the analysis of Double Chooz and vigorously pursue analyses of Borexino/CeSOX data on sterile neutrinos.

Pursue vigorously the simulation and analysis activities in both Orca and DUNE projects.

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

With sub-teams on several different projects, it is important to keep a high level of communication among the members and to develop common discussion also with other fields linked to neutrino and dark matter, such as the cosmology group.

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

The group should ensure it continues to have very good visibility and substantial contributions to the Orca, JUNO, and DUNE projects in both hardware and analysis contributions.

Team 5: Theory

Team leader: Ms Cristina VOLPE

TEAM SCIENTIFIC DOMAIN

The theory group covers most of the research topics of the experimental groups, namely astroparticles, neutrino physics, cosmology, and gravitation, together with more formal aspects of quantum field theories as holography, higher spin theories, and quantum field theories in curved spacetime.

TEAM WORKFORCE

Team workforce	Number 30/06/2017	Number 01/01/2019
Permanent staff		
Full professors and similar positions	3	2
Assistant professors and similar positions	3	3
Full time research directors (Directeurs de recherche) and similar positions	5	4
Full time research associates (Chargés de recherche) and similar positions	1	2
Other scientists ("Conservateurs, cadres scientifiques des EPIC, fondations, industries, etc.")	0	2
High school teachers	0	0
Supporting personnel (ITAs, BIATSSs and others, notably of EPICs)	0	0
TOTAL permanent staff	**12**	**13**
Non-permanent staff		
Non-permanent professors and associate professors, including emeritus	2	
Non-permanent full time scientists, including emeritus, post-docs	8	
Non-permanent supporting personnel	0	
PhD Students	8	
TOTAL non-permanent staff	**18**	
TOTAL team	**30**	

CRITERION 1: QUALITY OF SCIENTIFIC OUTPUTS AND ACTIVITIES

A – Scientific outputs and activities, academic reputation and appeal

Scientific outputs and activities, academic reputation and appeal From 01/01/2012 to 30/06/2017	Number
Articles: scientific articles	280
Articles: review articles	
Scientific articles with a unit member as last author	
Medical articles (if relevant)	
Books: monographs, critical editions, translations	12
Books: scientific book edition	3
Books: book chapters	
Books : published/edited theses	
Meetings: conference proceedings	48
Symposia, meetings: articles in meeting proceedings	
Meetings: other conference outputs	
Academic research grants: European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants	3
Academic research grants: national public grants (ANR, PHRC, FUI, INCA, etc.)	4
Academic research grants: local grants (collectivités territoriales)	
Academic research grants: PIA (Labex, Equipex etc.) grants	
Academic research grants: grants from foundations and charities (ARC, FMR, FRM, etc.)	
Visiting scientists (more than one month in the unit)	20
Post-docs (more than 12 months in the unit)	
Electronic tools and products: softwares	0
Electronic tools and products: libraries and cohorts	
Electronic tools and products: corpus	

Electronic tools and products: tools presented in solver competitions	
Electronic tools and products: decision tools	
Editorial activities: participation to journal editorial boards (books, collections)	7
Peer reviewing activities: participation to institutional committees and juries (CNRS, INSERM etc.)	yes
Peer reviewing activities: reviewing of journal articles	yes
Peer reviewing activities: participation to lab site visit committees (HCERES etc.)	
Peer reviewing activities: grant evaluation (public or charities)	yes
Scientific recognition: prizes	2
Scientific recognition: distinctions	3
Scientific recognition: chair of learned and scientific societies	yes
Scientific recognition: invitations to meetings and symposia (out of France)	179

Strengths

The scientific output of the theory group is quite high, with papers published in numerous prominent journals. The group is recognized internationally, as demonstrated by the citations and numerous invited talks. Members of the group obtained one ERC advanced grant and one ERC starting grant. Additionally, 3 "primes d'excellence scientifique (PES)" and one "prime d'encadrement doctoral et de recherche (PEDR)" have been obtained by team members.

They are also highly involved in "commissions of trust" activities: evaluation of national and international grants and fellowships, CNRS commission. The most prominent scientific contributions of the group were in modified gravity, gravitational waves, cosmic rays, neutrino physics in astrophysical environments, gauge/gravity correspondence, and quantum chromodynamics (QCD).

Weaknesses

None identified.

Assessment of scientific outputs, reputation and appeal

The theory group has excellent scientific output, international reputation of its world-class experts, and appeal. It fulfils its transversal role in an experimentally driven lab.

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 01/01/2012 to 30/06/2017	Number
Technical expert or standardization reports,	
Socio-economic interactions: industrial and R&D contracts	
Socio-economic interactions: Cifre fellowships	
Socio-economic interactions: creation of labs with private-public partnerships	
Socio-economic interactions: networks and mixed technological units	
Socio-economic interactions: start-ups	
Socio-economic interactions: patents, licenced patents and inventions	0
Public outreach: radio broadcasts, TV shows, magazines	5
Public outreach: journal articles, interviews, book edition, videos, etc.	32
Public outreach: other popularization outputs	yes
Public outreach: debates on science and society	7

Strengths

The group has very strong outreach activities as demonstrated by the books, media presentations, articles, presentations in science popularisation conferences, schools, and debates.

Weaknesses

The retirement of a member of the group who was exceptionally commited to outreach activities will likely have some impact.

Assessment of the interactions with the non-academic world

The team has very good outreach activities. They are highly visible in the broader community.

C – Involvement in training through research

Involvement in training through research From 01/01/2012 to 30/06/2017	Number
Habilitated (HDR) scientists	14
PhD students	19
Defended PhDs	11
Mean PhD duration	35
Mean number of publications per student	
Educational outputs: books	1
Educational outputs: e-learning, MOOCs, multimedia lessons, etc.	6

Strengths

The group is highly involved in training through research at different levels. Almost all of the members of the group have the "habilitation à diriger des recherches (HDR)". They have a large number of Ph.D. students for a French theory institution, and a large number of master students. Most of the members of the group are involved in teaching at the university at the different levels, and some teach at master courses outside the university (Ecole Normale Supérieure de Paris, Ecole Polytechnique à Palaiseau). The group has produced an extremely successful MOOC on gravity.

All of the Ph.D. students of the group obtained good positions after graduation : most obtained post-doctoral research positions, and a few opted for non-research positions (mainly in finance).

Weaknesses

None identified.

Assessment of the involvement in training through research

The group is very successfully involved in training through research.

CRITERION 2: TEAM ORGANISATION AND LIFE

Team organisation and life From 01/01/2012 to 30/06/2017	Number
Women/men ratio in the team	5/7
Women/men ratio among team scientists	5/7
Women/men ratio among team PhD students	1/18

Strengths

The group seems extremely lively, and there is a lot of interaction among the members. Despite having insufficient funds for external seminar speakers, they organise a weekly seminar and additionally the post-docs organise a weekly journal club, which are both well attended. The management and communication of concerns and lab policies within the group seems highly effective.

The ratio of women/men among permanent members within the theory group is higher than that of the lab as a whole, and is much higher than the average in French institutions in theoretical high-energy physics (about 10% in all stages).

Weaknesses

There is a notable gender imbalance in the current PhD student group.

Assessment of the team's life and organization

The team is extremely lively, and the management and communication appear highly efficient. The current gender imbalance among PhD students is a concern.

CRITERION 3: SCIENTIFIC STRATEGY AND PROJECTS

Strengths

The five-year plan of the group is good, with the natural continuation of current research lines. The arrival of a cosmologist will significantly enhance that area of the group, opening new lines of research. The strategy in the astro-particle and gravitation sections are particularly stimulated and in line with the experimental groups.

Weaknesses

The group had only one (very recent) hire in the last ten years, and is thus strongly lacking permanent young researchers.

Assessment of the scientific strategy and projects

The strategy of the group is good. It is a natural continuation of current research lines.

RECOMMENDATIONS TO THE TEAM

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

Maintain, and look for opportunities to increase further, collaborations with experimental groups at APC.

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

None.

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

None.

CONDUCT OF THE VISIT

DATES

Start: November 29, 2017 at 08:00

End: December 1, 2017 at 15:00

VISIT SITE

Institution: université Paris Diderot - APC

Address: Bâtiment Condorcet - Case 7020 - 75205 Paris Cedex 13

CONDUCT OR PROGRAM OF THE VISIT

November 29, 2017

09:00 - 09:30	Committee closed meeting
09:30 - 10:30	General overview of the laboratory by the director, Stavros KATSANEVAS
10:30 - 11:15	Presentation Cosmology Group Permanents & non-permanents of the group and direction
11:15 - 11h30	Coffee break
11:30 - 12:15	Presentation Gravitation Group Permanents & non-permanents of the group and direction
12:15 - 13:00	Presentation High Energy Physics Group Permanents & non-permanents of the group and direction
13:00 - 14:00	Lunch Buffet Permanents of the lab, committee and direction
14:00 - 14:45	Presentation Neutrinos Group Permanents & non-permanents of the group and direction
14:45 - 15:30	Presentation Theory Group Permanents & non-permanents of the group and direction
15:30 - 15:50	Presentation hosted group: Energy Permanents & non-permanents of the group and direction
15:50 - 16:35	Presentation Technical Department Permanents & non-permanents of the group and direction
16:30 - 17:00	Coffee break
17:00 - 18:30	Visit of the Laboratory/Platforms

November 30, 2017

08:15 - 08:30	Welcome The whole laboratory
08:30 - 09:15	Meeting with representatives of researchers and academic staff
09:15 - 10:00	Meeting with engineers and administrative staff
10:00 - 10:15	Coffee break
10:15 - 11:00	Meeting with doctoral and postdocs
11:00 - 12:00	Meeting with the Funding Instances - Closed session
12:00 - 13:30	Work of the committee - Closed session
13:30 - 16:30	Parallel sessions of the committee members with the groups and technical departments
16h30-17:00	Meeting with the direction - Closed session
17:00 - 18:30	Work of the committee - Closed session

December 1, 2017

08:00 - 12:00	Writing of the report - Closed session

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2 rue Albert Einstein
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