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

Section des Unités de recherche

AERES report on the research unit  
Future Laboratory : Particules, Astrophysique,  
Cosmologie et Théorie (PACT) built out of UMR 5207  
(LPTA) and 5024 (GRAAL)  
From the  
University Montpellier 2  
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From the

University Montpellier 2

CNRS

Le Président  
de l'AERES

Jean-François Dhainaut

Section des unités  
de recherche

Le Directeur

Pierre Glorieux

June 2010



# Research Unit

Name of the research unit 1: Laboratoire de Physique Théorique et Astroparticules (UMR 5207)

Name of the director: M. Alain FALVARD

Name of the research unit 2: Groupe de Recherche en Astronomie et Astrophysique du Languedoc (UMR 5024)

Name of the director: Mrs Agnes LEBRE

Requested label for the new laboratory: Unité Mixte de Recherche

# Members of the review committee

## Committee chairman:

M. Jean ILIOPOULOS, LPT, ENS, Paris

## Other committee members:

M. Christophe BEIGBEDER, LAL, Orsay

Mrs Susanne HOEFNER, department of Physics and Astronomy, Uppsala University, Sweden

M. Manel MARTINEZ, Institute of High Energy Physics, Barcelona, Spain

M. Vladimir PTUSKIN, IZMIRAN Troitsk, Russia

## Committee members suggested by CoNRS, CNU and CNAP:

M. Ulrich ELLWANGER, LPT, Orsay (CoNRS)

M. Pierre KERVILLA, LESIA of Observatoire de Paris (CNAP)

M. François MONTANET, LPSC, Grenoble (CNU)



# Observers

## AERES scientific advisor:

M. Jean BALLETT

## University, School and Research Organization representatives:

M. Eric BUFFENOIR, vice-president of the administrative council of Montpellier 2 University

M. Alain CASTETS, scientific advisor for CNRS/INSU

Mrs Barbara ERAZMUS, deputy director of CNRS/IN2P3

M. Patricio LEBOEUF, deputy director of CNRS/INP

M. Christian PÉRIGAUD, vice-president of the scientific council of Montpellier 2 University

## Invited:

M. Olivier BIENAYMÉ, Observatoire de Strasbourg, observer from CoNRS section 17



# Report

## 1 • Introduction

- Date and execution of the visit

The visit was organized over two days (19 and 20 January 2010). The first morning was common with the visit of Laboratoire Charles Coulomb. The University and CNRS presented the context of the reorganization. It was followed by a presentation of the Physics Institute of Montpellier, then LPTA and its theory teams. During the afternoon the experimental astroparticles team of LPTA was presented, followed by GRAAL and the common project for the PACT laboratory. The day ended with a visit of the facilities and a discussion with the staff representatives. The second morning started with a discussion with the scientific teams, followed by a discussion with the students and postdocs, then with the management. The afternoon consisted in an internal meeting followed by preliminary conclusions.

All Committee members the warm hospitality and fruitful discussions with the management teams and all research, administrative and technical staff of both LPTA and GRAAL laboratories.

- History and geographical localization of the research unit, and brief presentation of its field and scientific activities

LPTA was created in 2005 from a theoretical physics laboratory (LPMT) and an astroparticle laboratory (GAM). GRAAL is an astrophysics laboratory. Both are hosted in the same building of University Montpellier 2.

The Physics Laboratories of the University of Montpellier are in the process of undergoing a vast reorganisation. Starting next year they will join into two units, one, under the name Charles Coulomb (LCC), with all activities in condensed matter physics and most of theoretical physics, and the second (PACT), with Astroparticle physics, Astrophysics and a small group of theoretical particle physics and cosmology. AERES decided to follow this new organisation and formed two panels, one for each future lab, although the evaluation concerns mainly the past scientific activity when the division among labs was different. This panel was asked to evaluate the performance of the teams that will form the PACT laboratory, but, since the theorists belonged, until now, to the same laboratory (LPTA), several of the remarks and appreciations in this report apply to the entire theory group. Whenever necessary, the present report will state explicitly the future division.

- Management team

The director of LPTA, Alain Falvard, is helped by deputy director André Neveu. LPTA is structured in four teams: an experimental astroparticle team and three theory teams.

The director of GRAAL, Agnès Lèbre, is helped by deputy director Bertrand Plez. GRAAL is a small laboratory with no formal substructure.



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

	LPTA	GRAAL	Future
N1: Number of researchers with teaching duties (Form 2.1 of the application file)	13	9	14
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	19	3	13
N3: Number of other researchers (Forms 2.2 and 2.4 of the application file)	0	0	0
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)	14,5	4,9	15,9
N5: Number of engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)	0	0	0
N6: Number of Ph.D. students (Form 2.7 of the application file)	9	3	N/A
N7: Number of staff members with a HDR or a similar grade	16	7	14

## 2 • Overall appreciations on the research unit

- Summary

The AERES evaluation panel for the future PACT laboratory addressed the entire spectrum of activities of the various research teams, scientific, technical and educational. Before the meeting the committee received complete reports on the scientific productivity and we heard comprehensive presentations covering each one of the scientific teams during the visit.

Based on all this material, as well as the personal expertise of the panel members which covers the entire spectrum of the PACT scientific activities, it came to the conclusion that the teams which will form PACT have developed a high level scientific research and compare favourably with other French Institutions of similar size in their domain. The scientific program is rich and diversified with important experiments either running or being prepared and a sustained theoretical effort.

All teams will face soon the important challenge of building a new laboratory and finding their place in the new University organisation.

- Strengths and opportunities

The main strength of the new laboratory is the good scientific level of its research teams who have succeeded in making substantial contributions in their respective domains. (i) The experimental group of Astroparticle Physics is specialised in the field of high energy gamma astronomy. It participates very actively in international collaborations such as HESS, Fermi and CTA. Although, compared to other groups both in France and abroad, they dispose of a rather modest technical infrastructure, they have succeeded in making important contributions which are highly appreciated and they occupy some positions of responsibility inside the collaborations. (ii) The Astrophysics group, until now in the independent laboratory GRAAL, has developed a comprehensive expertise in stellar physics. They have compiled an impressive data base which is very appreciated by the scientific community. They are involved in the high-profile international project GAIA and in the Direction of the Physics Dept. of the University. (iii) The group of Theoretical Physics was until now part of the laboratory LPTA. They have a very large spectrum of interests and several members enjoy a well-deserved international reputation. The major part of the Fundamental Interactions, Astroparticles and Cosmology team will join the laboratory PACT, an opportunity which may help in creating novel collaborations.



- Weaknesses and threats

The individual teams are small and the experimental team does not have a large technical support. They have succeeded so far in making noticeable contributions but this may become problematic inside the large international collaborations. The research interests of the various teams are very diversified and it is not clear how they may join forces in the new laboratory. The challenge will be more severe for the theorists who will be split between the two laboratories (PACT and LCC). They will have to develop the means to maintain a common scientific policy in theoretical physics coherent with that of the entire Physics Department.

- Recommendations

The Committee believes that the new laboratory will be a success if it manages to go beyond the mere juxtaposition of the existing teams. The scientific council of the laboratory will have the important task of identifying the research projects that help developing collaborations still maintaining high scientific standards. An urgent point is the strengthening of the technical team. The supervising agencies should proceed without delay into the designation of the new direction whose task will be to associate all members, scientists as well as technical and administrative personnel, to the new project. The active participation of all members in common seminars and discussions will help in the cohesion of the new lab.

- Production results

(cf. [http://www.aeres-evaluation.fr/IMG/pdf/Criteres\\_Identification\\_Ensgts-Chercheurs.pdf](http://www.aeres-evaluation.fr/IMG/pdf/Criteres_Identification_Ensgts-Chercheurs.pdf))

	LPTA	GRAAL	Future
A1: Number of lab members among permanent researchers recorded in N1 and N2 who are active in research	29	11	25
A2: Number of lab members among other permanent researchers (recorded in N3, N4 and N5) who are active in research	0	0	0
A3: Ratio of members who are active in research among staff members [A1/(N1+N2)]	0.91	0.92	0.93
A4: Number of HDR granted during the past 4 years	2	2	N/A
A5: Number of PhD granted during the past 4 years	11	4	N/A
A6: Other relevant item in the field			

### 3 • Specific comments

The three teams which make up the future PACT laboratory are clearly distinct. Many specific comments are better addressed at the team level.

- Appreciation on the results

See the comments on each research team.

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

See the comments on each research team.



- **Appreciation on the strategy, management and life of the research unit**

Until now the research teams which will form the future laboratory PACT belonged to two independent research units, LPTA and GRAAL. The Direction teams of both labs seem to be unanimously appreciated by the members.

- **Relevance of the research unit organization, quality of the management and of the communication policy**

Given their size, the organisation of both labs was rather simple but adequate.

Particularly noteworthy is the commitment of several members of both laboratories to outreach activities bringing Astronomy, Astrophysics and Particle Physics to the attention of students of all ages (Elementary School, High school and University) as well as the general public.

- **Relevance of the initiatives aiming at the scientific animation and at the emergence of cutting edge projects**

Both labs have succeeded in launching and developing innovative research projects in experimental as well as theoretical physics. On the other hand, a common scientific life, expressed through seminars and colloquia, has been almost absent. The Committee advises the senior members to follow the remarkable example of their young graduate students and post-docs who have developed a very successful system of informal scientific meetings to their great benefit and satisfaction.

- **Contribution of the research unit staff members to teaching and to the structuration of the research at the local level**

Several members of the new lab occupy positions of responsibility in various levels of the University and participate in teaching. The new laboratory PACT will contain a rather well-balanced proportion of full-time researchers and researchers with teaching duties, although this overall picture is not homogeneous across the teams. Two PACT members are, respectively, Head (LPTA) and Deputy-Head (GRAAL) of the Physics dept of the University and members of the lab participate in the teaching program at all levels. They are responsible for the MS "Cosmos, Particles and Fields".

- **Appreciation on the project**
  - **Existence, relevance and feasibility of a long term (4 years) scientific project**

The creation of a new lab by joining forces between teams from LPTA and GRAAL is a challenging project. The Committee hopes that it will be successful and will lead to the emergence of new research subjects. It will be the task of the new scientific council, together with the new direction, to identify them and support them.

The Committee sees two immediate difficulties:

The first concerns the theory groups who will be split between the two labs, PACT and LCC. The Committee can only recommend the maintaining of close collaborations and the establishment of a common scientific policy in theoretical physics.

The second problem concerns the administrative and technical personnel. If the scientific staff seems to adhere fully to the project several members of the administrative and technical personnel still hesitate and seem to suffer from what they perceive as a lack of visibility for their future. A clear message from the supervisory institute, accompanied by a quick designation of the new direction appears to be essential. The new direction should make sure that all members are associated to the definition of the project.



– Existence and relevance of a policy for the allocation of resources

It remains to be defined by the new direction. It depends crucially on the size and the scope of the future laboratory. A clear policy for the allocation of resources to the experimental groups may be needed in case several groups invest in technical developments. In this case the notion of formal technical groups could be considered in place of that of 'accompanying research', which actually mixes up administrative people and people involved in experiments. It would lead to a better understanding of the technical perimeter needed for the new developments and the objectives of the new structure, to a better identification of the competence needed and eventually of the associated professional training.

– Originality and existence of cutting edge projects

See the comments on each research team.

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

Team : Stellar astrophysics

Name of the team leader: Mrs Agnes LEBRE (past), M. Bertrand PLEZ (future)

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

	LPTA	GRAAL	Future
N1: Number of researchers with teaching duties (Form 2.1 of the application file)	0	9	9
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	0	3	3
N3: Number of other researchers (Form 2.2 and 2.4 of the application file)	0	0	0
N4: Number engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)	0	4,9	N/A
N5: Number engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)	0	0	N/A
N6: Number of Ph.D. students (Form 2.7 of the application file)	0	3	N/A
N7: Number of staff members with a HDR or a similar grade	0	7	7



- **Appreciation on the results**

Over the evaluated period, the GRAAL has oriented its research towards combined studies of interiors and atmospheres of stars, by systematically adding competence in stellar evolution modelling to their previously existing theoretical and observational expertise in stellar atmospheres and circumstellar matter. In particular, massive stars in various phases of their evolution are a recent and valuable addition to their field of competence. This approach is efficient and original, both in France and on the international scene. This work resulted in the important POLLUX database that is now available to the community, and has gained a high visibility. It is accessible worldwide as part of the theoretical Virtual Observatory. The record of publications of the GRAAL in the stellar physics field has significantly improved over the last four years, and is now at an excellent level. The non-publishing researchers in the group are now a very small minority.

The GRAAL also pursues an original line of research in astrochemistry, i.e., understanding the role of molecules in the early history of the Universe, in addition to studying the chemical reactions happening in interstellar and circumstellar media. The interstellar and circumstellar chemistry axis is particularly productive in terms of publications.

- **Appreciation on the impact, the attractiveness of the team and of the quality of its links with international, national and local partners**

The numerous collaborative links developed by the group both at national and international level are well reflected in the authorship of the publications. These partnerships are enriching for the research developed in the laboratory, and also enhance its international impact. A majority of the GRAAL members have been invited to give presentations at international conferences, which indicates an excellent and remarkably homogeneous impact in their different subjects of research. The committee expects that their leadership in international collaborations will become even more visible in the future through first author publications which are specifically recognized in this field of research.

The recent recruitment of several outstanding young scientists on CNRS and CNAP positions proves the attractiveness and dynamism of the laboratory. The GRAAL also successfully obtained ANR and other competitive funding. The committee notes that no post-doc was present at GRAAL over the evaluated period. This situation is due essentially to the lack of funds and/or good candidates. The recruitment of qualified post-doctoral researchers would certainly further enhance the dynamism and productivity of the team, and should be a priority for the future.

The laboratory is involved in the GAIA satellite project at a high responsibility level. This investment is a key project of French and European astronomical research. It should be pursued and strengthened, in order to optimise the scientific return for the laboratory in the mid- to long term (satellite launch in 2012, first results in 2017).

- **Appreciation on the strategy, management and life of the team**

The organisation of the laboratory was described very clearly both in the activity report and the presentations. The relatively small number of laboratory members allowed the close participation of all to the laboratory Council, which included all permanent personnel and a representative of the non-permanent personnel. This general involvement of the staff led to an excellent internal communication. A very positive appreciation of the management was unanimously formulated by the personnel during the interviews with the committee.

Over the evaluated period, the laboratory has benefited from a renewal of its computer equipment, an essential element for the research conducted at GRAAL. This in turn contributed to the increase of its scientific productivity. This active policy combined with a careful management of the limited financial resources for the general operation of the laboratory has created a favourable environment for research, and therefore had a very positive impact on the dynamism of the laboratory research.

The scientific structure of the laboratory is based essentially on two axes: stellar physics (interior and atmosphere), and astrochemistry. While they exhibit a clear potential for common studies, e.g. in circumstellar environments, the internal collaboration of the scientists involved in these two axes is not fully reflected in the excellent publication record of the team. However, promising projects have been initiated towards a common research between stellar physics and astrochemistry specialists.



In the recent past, contacts have been initiated between the GRAAL and the LPTA astroparticle group, to foster the development of collaborations on subjects of common interest. This action, currently in its early phase, will undoubtedly result in a better integration of the teams in the new PACT structure foreseen for 2011.

Most of the researchers of the GRAAL have moderate to heavy teaching duties. The statutory volume of teaching is 7 FTEs, for 9 teaching personnel. It is accomplished in totality, and even exceeded by a significant fraction. Many members of the GRAAL are also contributing part of their own research time to the administration of research at the local (laboratory, University) and national levels (scientific councils of national laboratories, national programs, CoNRS, etc.). The Committee was particularly impressed by the outreach activities in which several members of the group are engaged. They aim at popularising the latest developments in Astronomy and Astrophysics towards students of all ages, as well as the general public. A related activity, which sounds very original, concerns the preservation of the national heritage of old astronomical instruments and books.

In the context of the national research in astronomy, it appeared clearly to the committee that the visibility of the work of the GRAAL with respect to INSU and other "tutelles" will be improved if this team, or even the future joint PACT laboratory as a whole, joins the Observatoire des Sciences de l'Univers (OSU OREME) in Montpellier. Such an integration, which is fully justified on scientific grounds, would also allow a better recognition of the "tâches de service" executed by the CNAP personnel of the GRAAL (POLLUX database, contribution to GAIA).

- **Appreciation of the project**

The clearly-structured description of future research plans outlines several major lines of investigations based on the competences of the current team members. Special attention is given to new expertise brought in by young researchers/new team members (physics of massive stars, molecular chemistry), major national/international projects (e.g., GAIA, POLLUX database), and projects making use of new internal collaborations, in particular, combining chemistry with stellar astrophysics, and massive star research with astroparticle physics.

The plans are well thought-through and feasible if resources are directed towards key areas, e.g., hiring or improving support of researchers bridging the current gap between chemistry and stellar activities, and bringing in expertise in hydrodynamic modelling, needed to combine existing massive star research with particle physics projects. Continuing the successful strategy of hiring personnel with complementary expertise, as well as focusing existing competence and resources on key projects should result in the establishment of a centre of expertise in stellar astrophysics with a major impact on the national and international level.

- **Conclusion :**

Over the last few years, the GRAAL has undergone a substantial rejuvenation of its staff, and the recruitment of new personnel has been used strategically and successfully to focus the research activities towards fields where the team can make significant impact based on internal, national and international collaborations. As a result, the scientific productivity and visibility has increased substantially. The publication record per researcher is now very competitive compared to other research teams both at national and international levels, and the scientific impact is documented by a very good citation rate.

In particular, new collaborations within GRAAL (stellar astrophysics - chemistry) and within the new PACT (massive stars - astroparticle physics) have great future potential, if additional resources are directed towards these fields which are currently in danger of becoming sub-critical. In order to keep the positive trends regarding productivity and visibility, adequate support should be given to projects commonly identified as key areas of local competence.



Team : Experimental astroparticles

Name of the team leader: M. Georges VASILEIADIS

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

	LPTA	GRAAL	Future
N1: Number of researchers with teaching duties (Form 2.1 of the application file)	3	0	3
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	6	0	7
N3: Number of other researchers (Form 2.2 and 2.4 of the application file)	0	0	0
N4: Number engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)	7	0	N/A
N5: Number engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)	0	0	0
N6: Number of Ph.D. students (Form 2.7 of the application file)	3	0	N/A
N7: Number of staff members with a HDR or a similar grade	4	0	5

- Appreciation on the results

The group has focused its scientific activity in the field of high and very high energy gamma astronomy, one of the most dynamical and active fields of astroparticle physics at present, which is producing a wealth of extremely important results and is becoming a cornerstone for high energy astroparticles. The broad relevance of these results is witnessed by the fact that a sizable fraction of them are being published in journals such as Science and Nature.

They participate very actively in the three main international collaborations in the field at present, namely H.E.S.S., FERMI and CTA. The first two are active producing first-class quality results while the later one is in preparation. For the two running experiments they have made very relevant instrumentation and software contributions in atmospheric monitoring, instrument calibration and data pipelines. For CTA they are very active in the design of the readout electronics, the atmospheric monitoring and the site selection studies.

They also took technical Project leadership during this time in a relevant part of the AMS detector, the GPS subdetector.

On top of this experimental work they are also active in theoretical developments such as the code MARCOS, a numerical tool for the simulation of multiple time-dependent non-linear diffusive shock acceleration and the detailed calculation of signatures from dark matter annihilation in sources such as Dwarf Spheroidal Satellites. These two subjects allow close collaboration with the nearby astrophysics and particle theory groups respectively, an interaction which is likely to be boosted with the creation of PACT in which the astroparticle physicists of LPTA, the astrophysicists of GRAAL and most of the particle theorists and cosmologists will belong to the same laboratory.

At the level of physics analysis the group has specialised in first-line subjects such as dark matter, Gamma-Ray Bursts and the interaction of supernova shells with molecular clouds, in which they are pioneering the connection between H.E.S.S. and FERMI results.



- Appreciation on the impact, the attractiveness of the team and of the quality of its links with international, national and local partners

The H.E.S.S. results have been awarded two important recognitions: the European Descartes Prize for research 2006 and the Rossi Prize of the American Astrophysics Society 2010. The Montpellier Group, in spite of its modest size and the broad spectrum of its activities, has contributed in a very visible way to this success as demonstrated by the responsibilities some of its members have taken or have been offered (convener of Supernova Remnant Group and Convener of Dark Matter Group). The members of the Group are corresponding authors of a sizable number of H.E.S.S. articles, a fact that confirms the impact of their work in the collaboration.

The Fermi observations, for which the harvest of results has just started, are a real revolution in our view of the universe in the high energy gamma ray domain and the contribution of the Montpellier Group is again very visible in the analysis of dark matter candidates and in the detection of GRBs. One of its members is the convener of the GRB working group.

Their participation in the Design Study work for the CTA Project is also very visible and has been recognised by offering one of its members the convenership of the Site Search Work Package, a position which implies being a member of the Executive Committee.

The group also demonstrates the attractiveness of its activities to young researchers (6 PhD theses completed in the period 2005-2009, 3 in progress, 2 post-doctoral in the same period, 2 currently). In the same time period, 3 young and very active researchers were hired on permanent positions. Partnership and international exchanges were established through ECO-NET resulting into a short term invited professorship.

One should stress that the junior component of the team was instrumental in the remarkable contributions and responsibilities in the competitive framework of large international collaborations, the more senior members being very much involved with high level academic duties (institute direction, physics dept direction etc...). The PEO activities lead by members of the team is also worth being underlined.

The team has been successful in participating to three competitive funding projects through the ANR.

- Appreciation on the strategy, management and life of the team

A distinctive strategic characteristic of this astroparticle group that the committee finds very positive is that, in spite of its modest size, it does cover the whole spectrum of relevant capabilities, namely from the development of relevant instrumentation contributions to performing competitive theoretical calculations.

The group, in spite of its short lifetime, has managed to participate in a very visible manner in the most important projects in their field with a modest investment of resources and manpower. This demonstrates the excellence of its members but also a very wise and excellent management.

The LPTA laboratory is also engaged in outreach activities with the efficient help of its technical team. Particularly impressive were the models they have built of the HESS telescope and the Large Hadron Collider.

- Appreciation of the project

The future plans of the group envisage continuing in future satellite experiments as well and in ground-based installations through their participation in the CTA project. They should keep taking advantage of these two lines and profit from their interplay. But, given the very large size of the CTA consortium in particular, they should try to reach the critical mass necessary to be visible in such a project.

- Conclusion :

As a summary, on the whole our evaluation of the scientific work of the LPTA experimental astroparticles group is very highly evaluated.



As main strengths it is worth mentioning that, in spite of its modest size, the group is certainly strong and, given its broad-spectrum expertise and the excellence of its members and its management, it is playing a very visible role, with high impact, in the most important experiments in its field. The close collaboration they have already with the phenomenologists of LPTA and the one they want to strengthen with the GRAAL Astrophysicists will undoubtedly make them even stronger. Finally, working at the same time in satellite and ground-based instruments is a unique opportunity that they have started exploiting as well.

As main weaknesses the team has a critically small size marginally compatible with the variety of studied scientific problems.

For the future it would be very helpful to increase short-term visitors from other national and international institutes working in the field of astroparticle physics and the defence of at least one more HDR. In addition an increase in the team of instrumentalists (physicists and technical staff) will also be highly desirable to allow the group to keep its visibility at the instrumentation level without depending much on the availability of technical help from other groups.

The committee also recommends that they take advantage of keeping the satellite and ground-based experimental lines and profit from their interplay while at the same time trying to reach the critical mass in both lines.

### Team : Fundamental interactions, astroparticles and cosmology

The theoretical physics group of the LPTA has developed three main lines of research:

- 1) Fundamental Interactions, Astroparticles and Cosmology (IFAC),
- 2) Field Theory and Mathematical Physics,
- 3) Complex Systems and Nonlinear Phenomena.

Each of these lines covers in fact a large spectrum of activities and the overall scientific level is very good. There have been cross collaborations between researchers following different lines. Only a part of the first team (IFAC) will join the laboratory PACT. In the following the report shall concentrate mainly on this one, although many of our comments apply to all three. The evaluation of the other two teams can be found in the report on the Laboratory Charles Coulomb. The experts on theoretical physics of both panels have endorsed the evaluation of the entire Group of Theoretical Physics.



**Name of the team leader:** M. Jean-Loïc Kneur (past), M. Cyril Hugonie (future)

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

	LPTA	GRAAL	Future
N1: Number of researchers with teaching duties (Form 2.1 of the application file)	3	0	2
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	5	0	3
N3: Number of other researchers (Form 2.2 and 2.4 of the application file)	0	0	0
N4: Number engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)	N/A	0	N/A
N5: Number engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)	0	0	0
N6: Number of Ph.D. students (Form 2.7 of the application file)	3	0	N/A
N7: Number of staff members with a HDR or a similar grade	4	0	2

- Appreciation on the results

The research domains of the IFAC group cover several aspects of elementary particle physics and cosmology. Members of the group have become internationally acknowledged specialists in subjects they have often helped to develop. Such domains include hadronic physics, the implications of supersymmetric models for colliders and dark matter, primordial nucleosynthesis, and cosmology. Overall the research results of the group are of high level and have attracted international recognition.

- Appreciation on the impact, the attractiveness of the team and of the quality of its links with international, national and local partners

The group has developed fruitful collaborations with experimentalists of the LPTA and other French laboratories. They have very good connections with other theory groups in France and abroad, which lead often to common publications. They are very active in animating conferences, attracting foreign visitors and postdocs. In particular, they organise regularly an International Conference in Montpellier which is well-known in the field. They are members of two GDRs, and succeeded in gaining two ANR projects. They participate in teaching at various levels in the University, and have several graduate students.

- Appreciation on the strategy, management and life of the team

Until now the team was part of the theory group of LPTA. As such, the practical questions, such as administrative and technical support, mainly in the domain of maintaining the computer network, were well taken care of. This is expected to continue in the new lab PACT.

The group has not benefited from substantial recruitments over a long period. Attracting new members is judged essential for its long term development.



- Appreciation on the project

In the forthcoming reorganisation of the Physics laboratories in Montpellier the group has been split in two, some members joining the future PACT and some others following the other theorists in Charles Coulomb. The Committee hopes that this separation will not affect their scientific activities neither their potential for collaborations and common ventures. The organisation of a common seminar will certainly help maintaining a coherent scientific programme.

- Conclusion : (It applies to all theory groups)

The overall appreciation of the research done by all three Theory groups is very good. Most members are very active with an excellent publication record and enjoy a good international reputation. Two members occupy positions with high responsibility in the University.

It is expected that under the new structure in which the theorists are split in two labs, this atmosphere of creativity will continue. It is up to them to invent the means to continue across the lines collaborations. A common policy for future recruitments is judged desirable. In particular, the Committee recommends a more balanced recruitment policy between University and CNRS positions for all three groups.

Practical matters, such as the continuation of the administrative and technical support, should be timely addressed.

Note de l'unité	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l'environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
A	A+	A	A	A

Nom de l'équipe : Astrophysique Stellaire

Note de l'équipe	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l'environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
A	A+	A	A	A

Nom de l'équipe : Expériences en Astroparticules

Note de l'équipe	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l'environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
A	A+	A	A	A



Nom de l'équipe : Interactions Fondamentales, Astroparticules et Cosmologie

Note de l'équipe	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l'environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
A	A	A	A	A

La Présidente

**Monsieur Pierre GLORIEUX**  
Directeur de la section des unités de recherche  
AERES  
20, rue Vivienne  
75002 Paris

**Cabinet de la Présidence**

Tél. +33(0) 467 143 015  
Fax +33(0) 467 144 808  
presidence@univ-montp2.fr  
www.univ-montp2.fr

Place Eugène Bataillon  
34095 Montpellier cedex 5  
France

Affaire suivie par :  
Christian Périgaud  
vpcs@univ-montp2.fr

Monsieur le Directeur,

Je souhaite remercier le comité d'expertise pour l'évaluation de l'unité "**Particules, Astrophysique, Cosmologie et Théorie (PACT)**".

Comme nombre d'autres sites universitaires en France, le site de Montpellier est en cours d'évolution avec la récente création d'un pôle de recherche et d'enseignement supérieur (PRES), ayant deux missions essentielles : accompagner les trois universités montpelliéraines dans un processus de fusion et assurer la mise œuvre de l'opération Campus.

Dans le respect de nos engagements, cette évolution s'est traduite récemment au sein de l'Université Montpellier 2 par la création de Pôles de Formation et de Recherche (PFR) permettant d'accroître la visibilité de notre activité scientifique à l'échelle nationale et internationale.

Le PFR MIPS (Mathématiques, Informatique, Physique, Structures et Système), auquel le laboratoire PACT est rattaché, est l'un des grands PFR créés par l'Université Montpellier 2 qui ont pour missions :

- de promouvoir l'excellence de la formation, de la recherche, de l'innovation et de la culture scientifique sur les champs thématiques qu'il porte, d'en renforcer la visibilité internationale et d'organiser les interdisciplinarités en interne et avec les autres PFR;
- de promouvoir la mise en cohérence des politiques de formation et de recherche en son sein ;
- de mutualiser en son sein, les plateaux techniques, les ressources documentaires, mais aussi d'harmoniser les services en charge de la communication, des relations internationales et de la valorisation, des structures de recherche impliquées dans le pôle, dans le cadre de la politique de l'établissement;
- de fournir aux services centraux de l'établissement les données pertinentes en matière de formation et de recherche, mais également d'insertion, de valorisation, et de gestion des ressources humaines, nécessaires au pilotage de l'établissement en matière de politique pédagogique et scientifique.



**1809-2009**  
Bicentenaire de l'UM2

Cette nouvelle organisation de notre établissement est associée au sein de la physique montpelliéraine à une restructuration importante, se traduisant par la recombinaison des quatre laboratoires existant dans l'actuel contrat quadriennal (GRAAL, GES, LCVN, LPTA) en deux nouvelles unités (L2C et PACT) pour la période 2011-2014.

A ce titre, comme exprimé lors de l'évaluation, notre Université aurait souhaité que l'ensemble de la physique montpelliéraine soit rassemblée dans une seule UMR. Un tel projet aurait probablement levé les craintes exprimées dans ce rapport quant au positionnement particulier de la physique théorique qui se trouve dans la configuration proposée présente au sein des deux unités L2C et PACT.

Inscrite dans le cadre de l'Opération Campus, la construction sur le site du Triolet d'un bâtiment destiné à rassembler l'ensemble des physiciens devrait permettre de répondre à cette inquiétude. L'Université Montpellier 2 veillera néanmoins à ce que les interactions au sein de cette communauté soient préservées.

Il est bien évident que le trop bref intervalle de temps entre l'envoi de la lettre de mission des tutelles et la tenue du comité d'évaluation ne permet pas à cette date de porter une analyse approfondie du projet scientifique comme de son modèle d'organisation.

Néanmoins, en réponse aux recommandations exprimées par le comité de visite, l'Université Montpellier 2 sera, là encore, particulièrement attentive à ce que les recommandations formulées par le comité de visite soient prises en compte. En particulier, nous veillerons, en concertation avec l'autre tutelle de ce laboratoire, à ce que le projet scientifique reflète une réelle ambition permettant de dégager une synergie entre les trois équipes et intègre dans sa définition l'ensemble des personnels.

Je vous prie d'agréer, Monsieur le Directeur, l'expression de mes respectueuses salutations.

A handwritten signature in black ink, appearing to read 'D. Hérin', with a long, sweeping horizontal stroke extending to the right.

**Danièle HÉRIN**  
Présidente de l'Université Montpellier 2