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## LUPM - Laboratoire univers et particules de Montpellier

Rapport Hcéres

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

Department for the evaluation of  
research units

AERES report on unit:

Laboratoire Univers et Particules de Montpellier

LUPM

Under the supervision of  
the following institutions  
and research bodies:

Nouvelle Université de Montpellier

Centre National de la Recherche Scientifique - CNRS



January 2014



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

Department for the evaluation of  
research units

*On behalf of AERES, pursuant to the Decree  
of 3 november 2006<sup>1</sup>,*

- Mr. Didier HOUSSIN, president
- Mr. Pierre GLAUDES, head of the  
evaluation of research units department

*On behalf of the expert committee,*

- Mr. Matteo CAVALLI-SFORZA, chair of the  
committee

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<sup>1</sup> The AERES President "signs [...], the evaluation reports, [...] countersigned for each department by the director concerned" (Article 9, paragraph 3 of the Decree n° 2006-1334 of 3 November 2006, as amended).



## Evaluation report

This report is the result of the evaluation by the experts committee, the composition of which is specified below.

The assessment contained herein are the expression of independent and collegial deliberation of the committee.

Nom de l'unité : Laboratoire Univers et Particules de Montpellier

Acronyme de l'unité : LUPM

Label demandé : UMR

N° actuel : UMR 5299

Nom du directeur  
(2013-2014) : Mr Fabrice FEINSTEIN

Nom du porteur de projet  
(2015-2019) : Mr Fabrice FEINSTEIN

## Expert committee members

Chair: Mr Matteo CAVALLI-SFORZA, IFAE Barcelone, Espagne

Experts: Mr Jules GASCON, IPNL Lyon (representative of CoNRS)

Ms Sabine KRAML, LPSC Grenoble

Mr François LIGNIERES IRAP Toulouse

Mr François MONTANET, LPSC Grenoble (representative of CNU)

Scientific delegate representing the AERES:

Mr Cristinel DIACONU

Representative(s) of the unit's supervising institutions and bodies:

Mr Gabriel CHARDIN, IN2P3 CNRS

Mr Bernard GAUDEL, Université Montpellier 2



## 1 • Introduction

### History and geographical location of the unit

The Laboratoire Univers et Particules de Montpellier (LUPM) was created on January 2011. It is supported by the University of Montpellier 2 and the CNRS. It originates from the parting of LPTA (Laboratory for Theoretical and Astroparticle Physics) and its fusion with the GRAAL (Group of Research in Astronomy and Astrophysics in Languedoc). Its primary administrative tie is IN2P3, its secondary ties are INSU and INP. It is located on the campus of the University of Montpellier 2.

### Management team

Director: Mr Fabrice FEINSTEIN; Adjunct Director: Mr Bertrand PLEZ

AERES nomenclature : ST2

### Unit workforce

Unit workforce	Number as at 30/06/2013	Number as at 01/01/2015
<b>N1:</b> Permanent professors and similar positions	14	14
<b>N2:</b> Permanent researchers from Institutions and similar positions	12	13
<b>N3:</b> Other permanent staff (without research duties)	12,8	14,8
<b>N4:</b> Other professors (Emeritus Professor, on-contract Professor, etc.)		
<b>N5:</b> Other researchers from Institutions (Emeritus Research Director, Postdoctoral students, visitors, etc.)	6	4
<b>N6:</b> Other contractual staff (without research duties)	1,5	1
<b>TOTAL N1 to N6</b>	<b>46,3</b>	<b>46,8</b>

Unit workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	9	
Theses defended	5	
Postdoctoral students having spent at least 12 months in the unit	3	
Number of Research Supervisor Qualifications (HDR) taken	1	
Qualified research supervisors (with an HDR) or similar positions	17	18



## 2 • Assessment of the unit

### Strengths and opportunities related to the context

The composition of LUPM offers a unique interdisciplinary environment because of the different but interrelated research fields addressed by the three groups (Stellar Astrophysics - AS, Experiments and Modelling in Astroparticle physics - EMA -, and Fundamental Interactions, Astroparticle and Cosmology - IFAC) as well as the different specialties present within each group: astronomical observation, theoretical chemistry and stellar astrophysics model in AS, ground- and space-based detection of gamma-rays together with modelling of emission mechanisms in EMA, particle theory and cosmology in EMA. The already observed interaction between groups, if further cultivated, may produce novel research results.

The groups operate in world-leading international collaborations. This is particularly visible in gamma-ray astronomy (EMA group) but also in the activities of the Standard Model, BSM and early universe research of the IFAC group. The internationally recognized research carried out in the AS team builds on unique expertises in key areas of stellar physics.

The excellent outreach program is one of the strengths of the laboratory.

### Weaknesses and threats related to the context

The 5-year plan is duly ambitious but relies to a large extent on general science funding trends in France. In that respect, the broad range of activities of the unit may suffer if retiring personnel is not replaced by staff with a similar range of experience or if the technical personnel expansion plans are not implemented.

Dilution of efforts should be avoided. There is a danger of this in the EMA group when it gets involved into LSST (Large Synoptic Survey Telescope).

The organization of the engineering/instrumentation activities should be improved.

### Recommendations

Efforts to obtain European funding from all available programs - ERC grants, Marie Curie scholarships, career integration grants, ITNs - should be intensified, while continuing current activities and implementing new plans to obtain funding through national and regional channels and any new opportunities.

Choose soon where to get involved in LSST effort, without being excessively ambitious.

Continue developing contacts between groups and identifying opportunities for collaborative research spanning interdisciplinary boundaries. A monthly colloquium on interdisciplinary subjects, by internal and/or guest speakers, could be helpful in this regards.



### 3 • Detailed assessments

#### Assessment of scientific quality and outputs

Addressing the exploration of the Universe from its elementary constituents to its largest and oldest structures, the Laboratoire Univers et Particules de Montpellier is a unique research unit in that it combines research efforts on these fundamental physics topics by joining observational and theoretical astrophysicists, theoretical particle physicists, cosmologists, particle astrophysicists and space scientists.

Its recent creation (and consequently the evaluation period of only 2,5 years) may be too short to fully evaluate the results of the fusion of formerly separate groups. However it is not too early to assess how the individual research activities have progressed and how the research groups interact within the new structure.

Each of the three groups (AS, EMA, IFAC) has a rich, diverse and internally coherent research program, with very productive interactions between different specialties, for instance theoreticians vs. observers in AS, instrument-oriented physicists vs. analyzers and model-makers in EMA. There is also a further level of collaboration between different groups within the LABEX OCEVU (Origine, Constituants et Evolution de l'Univers). All three groups are strong participants in international collaborations.

In the (2,5 year) evaluation period there have been 158 articles in refereed - mostly high-impact - journals, among which a few are highly cited (e.g., 278 citations for a 2011 PRL article from FERMI-LAT constraining DM models).

Overall, the scientific output of this unit is excellent. More details - including technical realizations - are given for each group.

#### Assessment of the unit's academic reputation and appeal

The high visibility of the LUPM groups is attested to by the 125 talks given at international conferences, of which 25 were invited.

The unit organized 23 conferences and workshops, as the primary organizer of three: CRISM2011 (70 participants), QCD12 (in 2012, 120 participants) and hosting the 2013 conference of the French Society of Astronomy and Astrophysics in 2013 (about 300 participants).

The units' personnel holds scientific and organizational responsibilities in large national and international collaborations (HESS, Fermi, CTA, Gaia, Pollux, Labex OCEVU among others).

The unit itself is attractive to young researchers. Recently, two researchers won a CNRS contest at the CR1 level with a large number of applicants and joined LUPM.

#### Assessment of the unit's interaction with the social, economic and cultural environment

The involvement of LUPM with the local environment is broad and intense. On campus, the LUPM presence is made obvious by a succession of large posters displaying appealing data (e.g., surface temperatures) on the solar system's planets. 20-25 internships are offered to junior high school students every year. High school physics programs are supported, using the astronomical observing facilities on top of the LUPM building. The typical array of outreach programs (Bars des Sciences, Fête de la Science, Planetarium...) is supported. The unit is a partner in the "Les deux infinis" national program, and organizes a summer camp within OCEVU.

In 2012, using to advantage the media repercussions of the Higgs boson discovery, several radio broadcasts featured LUPM personnel and popular science magazine articles were published.

It is noteworthy that there are economically valuable interactions with other scientific and technical fields. The Grid facilities are open to the bio-computing community - for free, currently. In space science, "nanosatellites" provide a potentially very popular teaching tool and an important link with environmental science.



### Assessment of the unit's organisation and life

Organizing the new LUPM and bringing together the components that formed it was a large task, administratively, technically and sociologically, considering that in order to effectively fit and use the opportunities provided by the CNRS a number of procedures and structures must be defined. This process is now almost complete. The three groups are installed within one University building. The IFAC group is not on the same floor as the other two, but is adjacent to the L2C lab, with whose members there are several collaborations. A further program of building renovation will take place in the near future.

The prescribed internal committees have been formed and are functioning. A Scientific Council with internal and external members has been formed. Its role is to advise LUPM on strategic decisions, and has begun doing so in its first two meetings in 2013. The five internal services (administration, finances, computing, instrumentation and communication) have been organized. It was found that the role of the meetings of the directors with the persons responsible for research and services should be clarified to the personnel.

The Unit Council (Conseil d'Unité) meets frequently. It met 6 times during LUPM's first year, as appropriate in the initial stages of a new unit. Overall, the new LUPM appears to be working efficiently, with only one snag - a personnel problem in having an effective technical director. This may be solved in the near future thanks to a recent hiring.

The scientific life of the LUPM runs very well. The internal communication lines of the three groups are functioning. The meetings with the younger personnel (postdocs and PhD students) made it clear that they find their scientific environment stimulating, and that they get the help they need from the IT service. However the young people of the EMA group would like to have more informal meetings to review the news in their field.

### Assessment of the unit's involvement in training through research

The B.Sc. degree includes the courses that prepare students for the CCP Master (Cosmos, Champs et Particules). The LUPM staff also contributes to Space and Applications Master of the University of Hanoi and to the Astrophysics Master of Beirut. The Laboratory is a member of the doctoral school "Information, Structures et Systèmes" (I2S, ED166).

LUPM got 8 new PHD students in the 2.5 years ending in mid 2013. In order to place LUPM's training of PhD students in context, it is useful to quote a few University-wide numbers as obtained in a meeting with Doctoral School officers. The Montpellier School has 380 PhD students covering 7 domains. LUPM is one of two physics laboratories, and has 13 of the 70 physics HDR, out of a total of 350 in the entire School. Due to its size, LUPM has no representative in the School - it is represented by the physicists from the larger lab, but despite the small number of HDRs, LUPM is able to get one doctoral grant/year out of the 20-24 yearly grants allotted by the School.

The School management praises LUPM's successful effort in getting external funding for its PhD students. In general, the doctoral school heavily relies on the labs for student training and followup, and considers that LUPM does very well on this task, both during school and after finishing their theses. The School management mentioned in particular the PhD training program for astronomical observations at the Pic du Midi observatory that is open to PhD students from a broader domain.

### Assessment of the strategy and the five-year plan

The LUPM physicists are engaged on many fronts, spanning theoretical chemistry, particle physics and cosmology, astronomical observations, several fields of stellar astrophysics, gamma-ray and cosmic ray astrophysics, Dark Matter searches, observations and modelling of the former phenomena using both space-based and ground-based facilities. The unit's near-term plans aim at continuing on all of these lines of research and starting one or two new projects featuring large collaborations, LSST and SVOM. Internally, the lab wishes to foster the emergence of science at the interface between teams. It is an ambitious plan, yet it seems worthwhile to support it because of the potential benefits of the exciting interdisciplinary research environment present in the lab.

Concretely, over the next 5 years the lab management wishes to replace the 4 upcoming retirements, to broaden its expertise in fields such as MHD numerical calculations and to add 4-6 technical persons to support the ongoing or new projects in instrumental and computing developments. - To build up this additional strength the unit is planning to encourage collaborations at the trans-regional, national and international level and to use all opportunities to have more junior people via Labex, ANR and European channels.

## 4 • Team-by-team analysis

**Team 1 :** ASTROPHYSIQUE STELLAIRE (AS)

Name of team leader: Ms Dahbia TALBI

### Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
<b>N1:</b> Permanent professors and similar positions	9	9
<b>N2:</b> Permanent EPST or EPIC researchers and similar positions	3	3
<b>N3:</b> Other permanent staff (without research duties)		
<b>N4:</b> Other professors (PREM, ECC, etc.)		
<b>N5:</b> Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)	1	
<b>N6:</b> Other contractual staff (without research duties)		
<b>TOTAL N1 to N6</b>	<b>13</b>	<b>12</b>

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	4	
Theses defended	2	
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken	1	
Qualified research supervisors (with an HDR) or similar positions	7	8



## • Detailed assessments

### Assessment of scientific quality and outputs

The scientific activities of the AS team aim at improving our understanding of stellar evolution. While the type of stars and the state of evolution considered are diverse, the fields of expertise of the team are focused on key aspects of stellar physics. The AS team expertise on stellar evolution codes with state-of-the-art modelling of transport processes, stellar atmosphere modelling of hot and cold stars and theoretical chemistry with astrophysical applications is clearly at the best international level. This range of expertise together with the observing skills of the AS team members have led to significant scientific contributions during the evaluation period. There have been real breakthroughs on mixing processes in magnetic massive stars and on the presence of magnetic fields in evolved stars. The publication record is excellent in quality and quantity (63 in peer-reviewed journals and 7 invited conferences over a 2.5 year period) with some highly cited papers and a particularly strong impact in the domain of massive stars.

### Assessment of the unit's academic reputation and appeal

The research conducted by the AS team is fully recognized at the international level in its fields of expertise. The members of the team participate in international scientific projects in spectropolarimetry, stellar atmosphere and stellar evolution modelling and in the ESA mission Gaia. The contribution of the AS team to these international collaborations is highly visible.

Members of the AS team are part of important scientific committees at the international and national levels. In addition, they are involved in key management committees of CNRS and of the University of Montpellier. During the evaluation period the team organised high-profile international and national events including the SF2A meeting that gathered the entire national community of astronomers.

The POLLUX database of stellar spectra, labelled a "Service d'Observation" by INSU, also contributes to the team's national and international visibility. Team members have won ANR grants and a prestigious national prize. During the period, two university positions have been opened and attracted outstanding young scientists. Overall, and considering its relatively small size, the visibility of the team is excellent.

### Assessment of the unit's interaction with the social, economic and cultural environment

The involvement of the AS team in outreach activities is impressive. All team members have participated in these activities which have taken very diverse forms and have been directed towards a varied audience. The outreach activities go from school visits to movie scenarios for the planetarium and included weekly 15-minute radio broadcasts during a two-year period. Overall, the team thoroughly exploits the opportunities given by the popularity of Astronomy with the general public.

These outreach efforts have been fully acknowledged by the university representatives.

### Assessment of the unit's organisation and life

The internal organization of the team reflects well the variety of the team's objectives and its strengths both in its theoretical and in its observing activities. Indeed, the internal structure of the AS team is well defined and coherent. Regular scientific and information meetings such as the wednesday coffee break, the twice-a-month "astrocafé" and the yearly "Journée AS" ensure a lively scientific animation and internal communication. It is a very positive sign that new collaborations between AS members have emerged during the evaluation period and already led to common publications.



### Assessment of the unit's involvement in training through research

Three-quarters of the team members have teaching duties and a large fraction is qualified for PhD training. They are heavily involved in teaching at the CCP Master of the University of Montpellier; in addition, they give significant teaching contributions at the international level by giving regular lectures in Master programs of Astrophysics and Space Science in Hanoi and Beyrouth. Members of the AS team have also been invited to give lectures in international summer schools.

At the doctoral training level, AS team members have set-up an original course that consists in training PhD students for Service Observing at Telescope Bernard Lyot of Pic du Midi. The number of doctoral students trained in the AS team has been relatively high (6 students during the evaluation period) thanks to an active and successful search for additional funding. Overall the involvement of the AS team in training through research is judged to be excellent.

### Assessment of the strategy and the five-year plan

The five-years strategic plan of the AS team is rightly centered in areas where the team should have the strongest scientific impact. It builds on the existing expertise and the ones brought by two recent recruitments. The plan aims at exploiting the present and future observational facilities to progress in the understanding of the effects of rotation, magnetic fields, binarity and mass-loss on stellar evolution. It makes use of the complementary skills present in the team, state-of-the-art stellar evolution codes, stellar atmospheric model and observing skills, to propose coherent project on these subjects.

The development of the Pollux database and the preparation for the Gaia exploitation are part of the duty services of the 3 astronomers but also constitute great scientific opportunities for the team. The local visibility of the database will improve following the attachment of the AS astronomers to the local OSU OREME.

The strategic plan in theoretical chemistry, consisting in the calculation of collisional cross-sections for NLTE radiative transfer, will help strengthen the collaboration within the team. While not specifically quoted, the AS team could take advantage of its expertise on cool evolved stars to exploit the unprecedented constraints on internal transport processes provided by the seismology of these stars. Overall the plan and the future opportunities for the young AS team are excellent.

### Conclusion

#### ▪ Overall assessment of the group:

The AS team has internationally recognized domains of expertise in key areas of stellar physics. The global coherence of the scientific activity together with the recent recruitments offer great opportunities for the future. The team is very well positioned to scientifically exploit present and future world-leading projects in stellar physics such as Kepler/Plato, Narval/Spirou and Gaia. The team is very active in the outreach and PhD training activities.

#### ▪ Strengths and opportunities:

The AS team could greatly benefit from the developments of the Pollux database and the activities of the Gaia mission.

One challenge for this young team over the next five years will be to fully exploit the potential of collaborations within the team. Another will be to seize the opportunities to take the leadership of large national and/or international collaborations.

#### ▪ Weaknesses and threats:

As a result of the creation of LUPM in January 2011 there could be some loss of visibility within INSU, which is now a secondary tutelle.

Technical support for the exploitation of the Pollux database and preparation activities in view of the Gaia mission's results are not yet secured.


**Team 2 :** EXPERIENCES ET MODELISATION EN ASTROPARTICULES (EMA)

Name of team leader: Mr Georges VASILEIADIS

## Workforce

<b>Team workforce</b>	<b>Number as at 30/06/2013</b>	<b>Number as at 01/01/2015</b>
<b>N1:</b> Permanent professors and similar positions	3	3
<b>N2:</b> Permanent EPST or EPIC researchers and similar positions	6	7
<b>N3:</b> Other permanent staff (without research duties)		
<b>N4:</b> Other professors (PREM, ECC, etc.)		
<b>N5:</b> Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)	2	2
<b>N6:</b> Other contractual staff (without research duties)		
<b>TOTAL N1 to N6</b>	<b>11</b>	<b>12</b>

<b>Team workforce</b>	<b>Number as at 30/06/2013</b>	<b>Number as at 01/01/2015</b>
Doctoral students	4	
Theses defended	2	
Postdoctoral students having spent at least 12 months in the unit	2	
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions	5	5



## • Detailed assessments

### Assessment of scientific quality and outputs

The EMA group is involved in two experiments that lead the field of gamma-ray astronomy: the ground-based observatory HESS (High Energy Stereoscopic System) in Namibia and the Large Area Telescope (LAT) of the FERMI satellite. It also participates in the preparation of the largest project in the field, the Cerenkov Telescope Array (CTA).

The impact of the group members in the scientific output of these large international collaborations is larger than could be expected by its relatively modest size (9 permanent members, 2 postdocs and 4 PhD students on 06/2013). Over the 2,5 years covered by the present evaluation, the group had an active role in 24 articles in refereed journals of the HESS collaboration, and 18 for the FERMI/LAT collaboration. To this must be added 13 publications concerning theoretical aspects related to these data, or analyses combining observations at other wavelengths. A first example of significant contributions are those on the 2011 FERMI paper on the constraints on Dark Matter models derived from the FERMI/LAT data on the Milky Way satellites, with 278 citations as of January 2014. Another is the leading role taken for the 2013 paper on the first FERMI/LAT catalog of gamma-ray bursts (GRB), which represents a significant step toward the systematization of the studies of these objects. The steady output of articles on theoretical and multi-wavelength analyses is due to the rare opportunity of having two modeling experts in the experimental group. As a result the group produces very original work such as the 2013 study on the interpretation and modeling of thin X-ray emitting filaments observed in young SuperNova Remnants and the potential of the CTA project to observe these structures in the gamma-ray domain in order to ascertain their role as potential sources of high-energy cosmic rays.

The impact of the group to the instruments themselves is limited by the size of the technical facilities and its staff, but is compensated by the choice of specific contributions that are clearly characteristic of the LUPM and are well recognized by the international collaborations as key element for their successful scientific production. Specifically, in FERMI, the group is responsible for the French contribution to the data and simulation processing pipeline at the Centre de Calcul de l'IN2P3, representing a very significant fraction of the production of the entire collaboration. In HESS, the group is responsible for the calibration of the uniformity of the camera's response. It is also responsible for monitoring of the atmospheric conditions using the LIDAR technique, and for exploring how the quality of the observation of gamma-ray showers can be improved by this added information. Based on these contributions to HESS and FERMI, the group contributes to the evaluation of distributed computing and of atmospheric monitoring techniques for the CTA project.

Finally it is worth pointing out that until 2011 LUPM staff provided a space-capable GPS module and NASA-certified software for the AMS satellite, important for analyzing signals from transient source.

### Assessment of the unit's academic reputation and appeal

Given the large size of the international collaborations in which the group is involved, the relative small size of the group and the relative early stage in the career of the team members, it is not too surprising that none of them are Principal Investigators of these projects. However, members of the group have positions of strategic importance in the collaboration. These high-level responsibilities in international collaborations include the coordination of the HESS working group on the study of SuperNova Remnants and Pulsar, and in working group studying the Galactic center, and in FERMI, the responsibility of the Gamma-Ray Burst Science Group, and of the Diffuse Emission Group. On the technical level, these responsibilities also reflect the well-planned concentration of the efforts of the group on a few key aspects: calibration in HESS, data and simulation pipelines in FERMI, and preparation of these aspects for CTA.

The group is active in conferences. Notably, in 2011 it organized in Montpellier a conference on a subject pioneered by the group, namely the interplay of Cosmic Rays and InterStellar Medium (CRISM 2011).

The group is active on the steering committees that oversee these themes in the LABEX OCEVU.



### Assessment of the unit's interaction with the social, economic and cultural environment

The EMA team members participate actively to the outreach program of the LUPM, and contribute to its high impact in the region. Beyond collective activities in events like “Fete de la Science”, “Bar des Sciences” and interventions in Collèges and Lycées, one can note three conferences on the theme of “L’Univers violent” at the Montpellier Planetarium. Over the evaluation period, there was one interview for an international outreach program, and two interviews in local radio and television networks.

### Assessment of the unit's organisation and life

A notable strength of the EMA team is the coherence of the scientific activities of its team. All are articulated around the theme of gamma-ray astronomy. The aspects covered by the group (calibration, monitoring, observation, data processing, simulation, multi-wavelength analyses and modelling) complement each other very well. The team benefits from a steady access to the pooled technical resources of the entire laboratory. As it is by far the heaviest user of the computing and instrumentation services of the laboratory, the group has a large weight in the steering of these resources. Notably, the number of permanent support position of the LUPM as increased from 10 to 12 over the period covered by the evaluation, with one more being added in January 2014.

Discussions within the team concerning its involvement in new projects like SVOM and LSST are conducted in a lively manner. They are well inserted in a structured reflexion that involves the proper channels of councils and authorities at the laboratory and national level.

The life of the LUPM team is also importantly and positively structured by the life of the large international collaborations in which they are involved.

### Assessment of the unit's involvement in training through research

The group has 5 members with the *habilitation* required to supervise a thesis. Despite the small number of available grants, two PhD theses were defended in the group in the 2.5-year period under evaluation. The large international collaborations provide a stimulating scientific environment that is well appreciated by PhD students. Some efforts could be done to improve the local scientific animation for the students and postdoc by instigating journal-club like activities.

One team member coordinates the Space Science Master program at the Hanoi Science and Technology University in Vietnam, identified by the Université Montpellier 2 as one of its major international collaboration program. This recently created Master program has not had yet an impact on the LUPM physics activities, because students are based in Hanoi until the latest stage of their studies, however it impacts very positively on the local visibility of the LUPM because its involvement in this program is extremely well regarded by the university.

### Assessment of the strategy and the five-year plan

The five-year plan of the team is balanced between the scientific exploitation of the current involvement in HESS and FERMI/LAT, the strengthening of its participation to CTA, and the exploration of potential new projects like LSST and SVOM.

In FERMI, the group is well positioned for the scientific exploitation of the recently improved data set, with a larger acceptance especially at low energy. In HESS, the strategy is to exploit and develop present expertise (laser monitoring of atmospheric conditions, studies of the Pulsar Wind Nebulae and the SuperNova Remnants, multi-wavelength analyses). These assets, as well as the work on distributed computing for FERMI, are to be continued in order to apply them to CTA. This plan is clear and coherent, and maximizes the potential for scientific return from past work.

The possible participation of the group in new or future initiatives (LSST and SVOM) are properly inserted in a structured reflexion involving the proper channels and authorities at the local and national level. These reflexions are still ongoing. In the case of LSST, they should converge soon if the group is to find its place in this very large collaboration that is rapidly maturing. Scientific opportunities consistent with the team's expertise have to be identified. For SVOM, the strategy should take into account the uncertainties in schedule and funding levels.



## Conclusion

### ▪ Overall assessment of the group

The group has a healthy, varied and coherent research program. The activities are wisely chosen to optimally use its resources.

### ▪ Strengths and opportunities:

The chosen activities ensure a productive participation in CTA on all fronts: instrumental (calibration, atmospheric monitoring), distributed computing, data analysis. By focusing its efforts on well-identified subjects and tasks well suited to the size of the group its international visibility is maximized.

It is worth noting the increase in technical staff in the last years, and the arrival of a permanent researcher, replacing one departure (that took place just beyond the official evaluation period).

### ▪ Weaknesses and threats:

The group's size may not be sufficient to bear the pressure of participating in a large international collaboration such as LSST, whose science lies outside its traditional core of expertise. A dilution of efforts should be avoided.

There are uncertainties in SVOM's schedule and funding.

### ▪ Recommendations:

Several general recommendations are implicit the preceding analysis. At a detailed level, the group is encouraged to (i) explore further the implications for physics analysis of its LIDAR effort, (ii) to rapidly identify any possible contribution to LSST and (iii) to follow the example of other LUPM groups in animating seminars by doctoral students.



**Team 3 :** INTERACTIONS FONDAMENTALES ASTROPARTICULES ET COSMOLOGIE (IFAC)

Name of team leader: Mr Cyril HUGONIE

Workforce

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
<b>N1:</b> Permanent professors and similar positions	2	2
<b>N2:</b> Permanent EPST or EPIC researchers and similar positions	3	3
<b>N3:</b> Other permanent staff (without research duties)		
<b>N4:</b> Other professors (PREM, ECC, etc.)		
<b>N5:</b> Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)	3	2
<b>N6:</b> Other contractual staff (without research duties)		
<b>TOTAL N1 to N6</b>	<b>8</b>	<b>7</b>

Team workforce	Number as at 30/06/2013	Number as at 01/01/2015
Doctoral students	1	
Theses defended	3	
Postdoctoral students having spent at least 12 months in the unit	1	
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions	5	5



## • Detailed assessments

### Assessment of scientific quality and outputs

The research interests of the small IFAC group span a broad range of theoretical particle and astroparticle physics as well as cosmology. Specifically, the group members have been working on (i) Higgs and supersymmetry phenomenology, in particular in the context of the Next-to-Minimal Supersymmetric Standard Model (NMSSM), (ii) dark matter phenomenology including relic density calculations and the theoretical analysis of direct and indirect DM detection data, (iii) cosmic-ray physics, (iv) the physics of the very early Universe, including Big Bang nucleosynthesis and cosmic magnetic fields, and (v) non-perturbative QCD and hadron physics. The members of the group are internationally recognized experts in their respective domains and have a very good publication record. They make important contributions to the field by theoretical calculations, interpretation of experimental results, as well as the development of computational tools, including the widely used public code NMSSM tools.

Over the 2.5 year evaluation period the group published 35 articles in peer-reviewed journals. Among these we note a highly cited work on the 125 GeV Higgs boson and pioneering work on the evolution of primordial cosmic magnetic fields. Nonetheless it has to be noted that the activities of the group have slowed down over the last year. This is clearly due to the heavy administrative load that befell on two team members.

### Assessment of the unit's academic reputation and appeal

The group's members enjoy an excellent international reputation in their respective fields. The group maintains a strong link with the particle and astroparticle theorists of Laboratoire Charles Coulomb (L2C), which results in fruitful collaborations.

The group is well established within the LabEx OCEVU, as well as in several national scientific networks (GDR Terascale, LIA-ILCP, FAPESP and others). The IFAC collaboration with experimentalists in Marseille was indeed the seed for the creation of OCEVU. In addition, there are good direct connections with other groups in France and abroad, which lead to mutual visits and common publications. This also resulted in the participation in an ANR-JCJC project that ran from 2009 to 2013. A group member regularly makes long-term visits to Stanford and Berkeley. The only qualification of this very positive evaluation is that no one in the group is the PI of a large national or international research activity.

Furthermore, the IFAC team is very active in organizing conference and workshops. In particular they have a long tradition of holding in Montpellier a very popular international QCD conference. More recently, a group member has been organizing the HEP-MAD conference series in Madagascar. The group is also setting up workshops on current questions in dark matter, and hosting important national network meetings. Their expertise is also visible and recognized in refereeing activities, in scientific organizations (OCEVU, ANR, Theorie-IN2P3), committees (GDR Terascale, École de Gif, IDM2012, African School of Physics) and advisory boards (École de Physique des Astroparticules).

Last but not least, the group attracts many candidates for CNRS and university positions.

### Assessment of the unit's interaction with the social, economic and cultural environment

The group members are all involved in several outreach activities, typically within the annual "Fête de la Science". The activities comprise high schools lectures on high energy physics, popular science conferences on dark matter and on the Higgs discovery, participation in public debates and local press interviews. Indeed, the IFAC theorists are often solicited by the local media regarding major physics results. Noteworthy in this context are a long article in "Midi Libre" concerning the Higgs boson, featuring one group members, and a review article "Les trous noirs de masse intermédiaire" by another group member in "Pour la Science". Finally, the group regularly provides internships for high-school students.



### Assessment of the unit's organisation and life

The scientific life of the IFAC group of LUPM is closely linked with that of the respective group of L2C. Indeed, in many aspects the IFAC group and their colleagues from L2C effectively act as one team. For instance, they jointly run a very active and varied seminar program as well as a journal club. As already noted, the members of these groups have fruitful collaborations, leading to joint publications. This close interaction is helped by the fact that the two theory groups are located on the same floor.

Within LUPM, part of the IFAC group usefully interacts with the EMA group on questions of dark matter and more generally on cosmic ray physics. QCD activities remain on a side and may be phased out with the next retirement (in about 3 years).

The group members are taking responsibilities in the laboratory (CU, CS), in the university, as well as in the scientific council of the LabEx OCEVU. They are quite successful in obtaining external funding, which accounts for about one-half of the group's budget.

### Assessment of the unit's involvement in training through research

The IFAC group is responsible for the master "Cosmos, Champs et Particules" and is very involved in its teaching program. The group regularly supervises internships at the Master-1 and Master-2 levels. A very notable activity is training of foreign students, particularly in Madagascar, through the HEP-MAD Institute.

Over the evaluation period, 3 PhD theses have been defended. Currently, there is only one doctoral student present in the group. This is partly due to the lack of doctoral scholarships but partly also due to the lack of HDRs in the group. The training resources will be enhanced in the near future when two more group members get their HDR. The lack of scholarships might be alleviated by co-tutelles with experimentalists, for instance from the EMA group, and/or if funding for a doctoral student can be obtained from the LabEx OCEVU.

### Assessment of the strategy and the five-year plan

The research directions put forward by the group are essentially a continuation of their current activities. The topics addressed concern relevant open questions and promise interesting results. While the plans regarding astrophysics and cosmology are well delineated, the Beyond the Standard Model (BSM) and collider physics aspects remain somewhat vague - specifically, no clear plan regarding Higgs and BSM physics is illustrated. (However it must also be said that the future of these issues crucially depends on the experimental findings in the next phase of LHC running at 13-14 TeV.) On the QCD side, the goal put forward is to continue improving existing predictions, but no strategy or long-term vision is developed, and there is no mention of the retirement of one group member in a few years.

On the whole, while the strategy of the group could have been worked out better, this is not to be seen a serious weakness. Theoretical physics is often done on a very individual basis, and much of the success depends on having the right idea in the right moment. Furthermore, as mentioned, much depends on experimental findings in the near future. The expertise present in the group as well as the past experience with analyzing and interpreting experimental results should allow for a rapid response to new developments.

### Conclusion

#### ▪ Overall assessment of the group:

The small IFAC group works on a broad range of topics in theoretical particle and astroparticle physics and cosmology. The research carried out concerns relevant open questions in all these domains and leads to results that have a clear impact on the field.

#### ▪ Strengths and opportunities:

The small size of the group is compensated by its very productive relationship with the particle theory group of L2C, present at the same location. The hiring of a new MCF, foreseen in 2014, will significantly strengthen the group. Most of the theoretical work is directly related to ongoing or future experiments, either by interpreting current experimental results or by making testable predictions.



▪ **Weaknesses and threats:**

Two group members are excessively loaded with administrative responsibilities.

The training potential of the groups is underused, due to the dearth of pre-doctoral scholarships.

The team receives regular funding from LUPM, and secured additional funding from the IN2P3 theory program. However the intrinsic uncertainty of the latter funding makes it difficult to robustly plan future activities

▪ **Recommendations:**

First and foremost the strong and fruitful interconnection with the IFAC-L2C group should be maintained.

The large load of administrative tasks weighing on two group members should be much reduced to allow them to spend more time on research. This is particularly important for the recently hired CR who has to develop his profile for a successful scientific carrier.

The planned defense of two HDRs is strongly encouraged.

An active exchange with the EMA and AS groups of the LUPM is clearly important and enhances the scientific life at LUPM. At the same time the IFAC theorists should remain free to pursue their individual research interests, to explore new paths and develop new ideas.



## 5 • Conduct of the visit

### Visit dates :

Start : Monday January 20 at 12:30  
 End : Wednesday January 22 at 12:30

Visit site : Campus of Université Montpellier 2  
 Institution: Laboratoire Univers et Particules Montpellier  
 Address : Université Montpellier 2,  
 CNRS/IN2P3, CC72,  
 Place Eugène Bataillon, F-34095 Montpellier Cedex 5, France

Specific premises visited : Laboratory, computing facilities, laboratory's telescopes

### Conduct of the visit :

#### 1st day:

12h30 - 14h00	Closed session of Committee (preparation, cold lunch)
14h00-17h00	Plenary session
14h00-15h15	Director of LUPM: Summary and plans
15h15-16h45	Team highlights (+discussion): 3 talks
16h45-17h05	Break
17h05-17h45	Labex OCEVU - (talk)
17h45-18h00	Visit of Grid facility
18h00-19h00	Closed session

#### 2nd day: Closed session

9h00 - 10h15	Meeting with EMA group
10h15 - 11h30	Meeting with IFAC group
11h30 - 12h15	Meeting with technical groups (engineers, technicians, admin.staff)
12h15 - 13h30	Lunch
13h30 - 14h45	Meeting with AS group
14h45 - 15h30	Meeting with the "Conseil d'Unité"
15h30 - 16h15	Meeting with PhD students and postdocs
16h15 - 16h30	Meeting with postdocs only



16h30 - 17h15	Meeting with “tutelles”: IN2P3, UM2
17h15 - 17h30	Break
17h30 - 18h15	Meeting with teaching staff and doctoral school
18h15 - 19h15	Debriefing; meeting with director

**3rd day: Closed session**

08h30 - 12h30	Discussion, report, recommendations.
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## 6 ● Supervising bodies' general comments

Le Président

Montpellier, le 14 avril 2014

M. Didier HOUSSIN  
Président de l'AERES

M. Pierre GLAUDES  
Directeur de la section des unités de  
recherche

AERES  
20, rue Vivienne  
75002 Paris

**Objet** : Réponse de l'établissement support au rapport d'évaluation de l'unité LUPM  
(UMR 5299)

Réf. : rapport d'évaluation S2PUR150008432

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Affaire suivie par :  
Ingrid CHANEFO,  
Directrice de la Recherche et des  
Etudes Doctorales

Messieurs,

Je tiens à remercier le comité de visite pour la qualité de son rapport d'évaluation concernant l'unité de recherche LUPM - Laboratoire Univers et Particules de Montpellier (UMR 5299), dirigée par le professeur Fabrice FEINSTEIN.

J'ai bien noté les remarques formulées dans le rapport.

En tant que tutelle universitaire de cette unité de recherche, je ne formulerai aucune remarque supplémentaire .

Je vous prie d'agréer, Messieurs, l'expression de mes salutations les plus respectueuses.

Le Président de l'Université Montpellier 2,

  
Michel ROBERT



Pièce(s) jointe(s) :

Relevé des erreurs factuelles à rectifier dans le texte du rapport  
Observations générales formulées par le directeur