



## CRAL - Centre de recherche astrophysique de lyon

### Rapport Hcéres

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

Section des unités de recherche

AERES report on the unit:

Centre de Recherche Astrophysique de Lyon  
(CRAL) – UMR 5574

University or school

University of Lyon 1 (UCBL)

June 2010



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

Section des Unités de recherche

Rapport de l'AERES sur l'unité :  
Centre de Recherche Astrophysique de Lyon  
(CRAL) – UMR 5574  
Sous tutelle des établissements et  
organismes  
University of Lyon 1 (UCBL)

Le Président  
de l'AERES

Jean-François Dhainaut

Section des unités  
de recherche

Le Directeur

Pierre Glorieux

Juin 2010



# Unit

Name of the unit : Centre de Recherche Astrophysique de Lyon (CRAL)

Requested label : UMR

No. in case of renewal : 5574

Unit director : Mr Bruno GUIDERDONI

## Members of the expert committee

### Chairperson :

Mr Pierre-Olivier LAGAGE, CEA-Irfu/SAp, Saclay

### Reviewers :

Mr Luis COLINA, CSIC, Spain

Mr Christian GUILLAUME, Observatoire de Haute Provence

Mr Christopher MCKEE, Berkeley University, USA

Mr John PAPALOIZOU, Cambridge University, UK

Mr Guy PERRIN, Observatoire de Paris/LESIA, Meudon

### Reviewer(s) nominated by the staff evaluation committees (CNU, CoNRS, CNAP, CSS INSERM...):

Mrs Simona MEI, CNU

Mr Jean-Gabriel CUBY, CoNRS

Mr Philippe ZARKA, CNAP

## Representatives present during the visit

### Scientific delegate representing AERES:

Mrs Edith FALGARONE

### University or School representative :

None

### Research organisation representative :

Mr Alain CASTETS, CNRS-INSU



# Report

## 1 • Introduction

- Date and conduct of the visit :

The committee visited the laboratory on the 1<sup>st</sup> and 2<sup>nd</sup> of February. The visit was well organized with public presentations from the director and the coordinators of the four scientific teams, and with closed meetings between the committee and each of the four scientific teams, the technical and administrative staff, the PhD students and post-doctoral fellows, the laboratory internal council members, the management team, the head of the André-Marie Ampère research federation that CRAL is part of, and the funding authorities. The meetings were well attended. We also visited the new integration facility building. The committee met in a 1 hour closed session at the end of the first day and the whole afternoon of the second day to debrief and to start preparing the report.

- History and geographical location of the unit and brief description of its field of study and activities :

CRAL was created in 1995 from the merging of the “Observatoire de Lyon”, the astrophysics team of “Ecole Normale Supérieure de Lyon” (ENS-L) and a team specialized in high angular resolution research and development from Paris. It is located on two sites: “Observatoire de Lyon” at Saint Genis Laval and ENS-L at Lyon Gerland, 6.5km apart. The fields of study are fundamental physics (equation of state of dense plasmas...), cosmology, astrophysics (galaxy formation and evolution, stellar astrophysics, exoplanets...), computational astrophysics (star formation, protoplanetary disks...), instrumentation (integral field unit spectroscopy in the visible radiation, Research and Development (R&D) and algorithms for high angular resolution imaging). In addition to research and instrumental activities, CRAL is also performing teaching and public outreach activities.

- Management Team :

The management team is made of the director, the deputy director, the technical director and the administrative director.



- Staff : (according to the dossier submitted to AERES) :

	In the report	In the project
N1: Number of professors (see Form 2.1 of the unit's dossier)	13	12
N2: Number of EPST, (Public scientific and technological institution) or EPIC, (Public industrial and commercial institution) researchers (see Form 2.3 of the unit's dossier)	10	10
N3: Number of other professors and researchers (see Form 2.2 and 2.4 of the unit's dossier)	3	3
N4: Number of engineers, technicians and tenured administrative staff members (see Form 2.5 of the unit's dossier)	22	22
N5: Number of engineers, technicians and non-tenured administrative staff members (see Form 2.6 of the unit's dossier)	10.75	10.75
N6: Number of doctoral students (see Form 2.8 of the unit's report dossier and 2.7 of the unit's project dossier)	17	16
N7: Number of persons accredited to supervise research and similar	12	11

## 2 • Assessment of the unit

- Overall opinion :

Overall, the activities carried out at CRAL can be qualified as very good to excellent, but fragile in some areas. The unit has managed both to stay at the international front line of its historical fields of excellence (dense plasma physics applied to low mass stars and brown dwarfs, chemodynamics of galaxies, integral field spectroscopy instrumentation, R&D on high angular resolution imaging...) and to make important contributions in fast-growing fields, such as galaxy formation and cosmology, exoplanets, computational astrophysics. The risky and ambitious challenge of taking the overall management of the international Multi Unit Spectroscopic Explorer (MUSE) instrument for the Very Large Telescope (VLT) of the European Southern Observatory (ESO), as well as its assembly, integration and tests, has been met thus far; the new integration facility is there; the first of the 24 spectrograph units has been received and tested. These achievements have been possible thanks to the hiring of high quality staff, a profound reorganisation of the technical part of the laboratory but at the expense of a sustained R&D activity. The next two years will be crucial; the MUSE team is well aware of it and well motivated. An important reorganisation of the science teams has been effective too, especially with the creation of the GALPAC team, which has brought an excellent group momentum. The opening of CRAL to new scientific collaborations within UCBL (IPN-Lyon, André-Marie Ampère Physics Research Federation) is considered of high value. The outreach activity is remarkable. In terms of future, CRAL is facing several "classical" challenges: 1) ensuring a leading role in the scientific return from MUSE, commensurate with the role of CRAL into the technical development of the project, 2) finding a large participation into a major instrumental development in the "post-MUSE era" (for instance in the framework of the European Extremely Large Telescope (E-ELT) ESO project), which may take time and will require an active search for opportunities, 3) increasing significantly the number of permanent staff to meet the ambitious goal of excellence in 3 domains: observational, instrumental and computational astrophysics. CRAL is also facing the unique opportunity to move onto the university campus; such a move would open interesting opportunities for the mid and long term future of the laboratory.



- **Strengths and opportunities :**
  - CRAL benefits from scientists at the best international level, with high to very high visibility.
  - CRAL is leading a large international instrumental project, the VLT MUSE project, under a contract with ESO. This project brings very high international visibility for the laboratory and will bring a large amount of MUSE Guaranteed Time Observations (GTO) (255 nights in total for the whole project) to conduct ambitious scientific programs.
  - The technical staff at CRAL has been re-inforced with emphasis on project management; the staff is competent and well motivated; it brings high credibility to CRAL to play a major role in a future large international instrumental project.
  - CRAL is very active in looking for future instrument projects (involvement in the phase A study of the HARMONI spectrograph for E-ELT).
  - CRAL has demonstrated a high capacity to adapt technically, as well as scientifically (embarking upon emerging fast-growing fields), and managerially (merging of teams).
  - The unit is attractive to young researchers (PhD students, post-docs) and to senior foreign professors.
  - The public outreach towards general public and students is remarkable and benefits from the historical feature of the "Lyon Observatory".
  - CRAL is well integrated in the regional, national and international network.
  - CRAL benefits from new infrastructures (Integration facility, conference room).
  - The unit has been keen in getting contracts with ESO, ESA, EADS... and funding from the recent Research National Agency (ANR).
  - Lyon University "Plan Campus" offers new opportunities.
  
- **Weaknesses and threats :**
  - One major project (MUSE) is taking almost all the technical resources, which implies reduced R&D for other projects.
  - CRAL's next major instrumental project is not yet determined. Such a project is needed for the unit to take full advantage of its newly developed skills in management.
  - The scientific return from MUSE has to be consolidated; there is a crucial lack of observers at CRAL for MUSE, a serious shortcoming in preparation for MUSE scientific exploitation.
  - Developing new areas of scientific research, when existing fields of excellence should instead be secured.
  - Several key scientists on leave, with the risk that they will not come back.
  - Several key technical staff on non permanent positions.
  - Projects requiring a significant increase in permanent positions, which is unlikely.
  - Outreach is not secured on a long term.
  - Many old buildings which require heavy maintenance.
  
- **Recommendations for the unit director :**
  - MUSE must be successful and the committee endorses the first priority given to the project.
  - The scientific return from MUSE has to be consolidated.
  - Further encourage the synergy between teams (AIRI, GALPAC, Galaxies), especially in the context of MUSE.



- Develop a strategy for being more successful in the hiring of permanent scientific staff, starting making clear priorities of the needs.
- Assign, as soon as possible, more technical resources to R&D.
- Continue to actively seek participation into a new major project.
- Establish a roadmap with various scenarii for future instrumental projects.
- Several crucial decisions, which will heavily impact the future of the laboratory, will have to be taken in the near future (whether to move to the University campus, whether to incorporate the Earth sciences in the OSU). A task force should be set up to perform a risk analysis.
- Improve internal communication, which is particularly important during a period when major changes (campus, OSU...) are under discussion.
- Help the AIRI team, which is doing an excellent work, to feel better integrated in the laboratory.

- Data on work produced :

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

A1: Number of <i>produisants</i> (professors and researchers whose names appear in a minimum number of "publications" over a 4-year period) listed in N1 and N2 in the project column	20
A2: Number of <i>produisants</i> among the other staff listed in N3, N4 and N5 in the project column	1
A3: Proportion of <i>produisants</i> in the unit $[A1/(N1+N2)]$	0.9
Number of theses for accreditation to supervise research defended	13
Number of theses defended	19
Any other data relevant for the field (please specify)	

### 3 • Detailed assessments

- Assessment of work produced and scientific quality :
  - Relevance and originality of the research conducted, quality and impact of the results :

The research topics developed in the unit are all relevant topics of contemporary astrophysics. The unit has kept its position of international leadership in topics such as the physics of dense plasmas (equation of state), the modelling of low-mass stars and brown dwarf internal structure and atmospheres. The unit has benefited, in terms of scientific return, from the development of integral field spectrographs (SAURON on the William Herschel telescope, SNIFS on the 2.2 meter telescope of the Hawaii university), a domain of excellence of CRAL; of particular high impact are the results from the SAURON 3-Dimensional survey, which has provided new kinematical clues to understand the nature of early-type galaxies. The unit has continued to develop world-class image reconstruction and inverse problems algorithms for high angular resolution astronomy, with an impact that extends beyond astrophysics into medical imaging (MiTiV ANR project).





The unit has embarked upon two very “hot” topics: 1) the interpretation of the acceleration of the expansion of the Universe, developing non conventional cosmological models (inhomogeneous relativistic cosmology) whose impact is rapidly growing, and 2) the study of exoplanets (internal structure, atmosphere, bio-signatures...) with very significant impact in this highly competitive field. The unit has also entered into the field of computational astrophysics, a rapidly developing field thanks to the availability of massively parallel computers, and an essential field in astrophysics; the investment of CRAL (in star formation, accretion disks, supernovae, hierarchical galaxy formation...) is very relevant scientifically. The GALICS semi-analytic model, which allows porting the results of high resolution numerical simulations into the cosmological context, is of high impact.

- **Quantity and quality of publications, papers, theses and other work :**

From 2005 to mid 2009, 316 refereed papers were published from the CRAL researchers, (twice the number from the 2002 - 2005 timescale); out of them, about ¼ have a first author from CRAL. Fifteen papers published between 2005 and 2008 have already more than 60 ADS citation counts. 19 PhD thesis have been passed, compared to 11 during the previous period.

It should also be pointed out that numerous technical and managerial reports have been issued in the framework of the reviews monitoring the development of international projects, such as the MUSE preliminary design review on 2007-07-17, or the MUSE Final Design Review on 2009-03-12.

- **Quality and solidity of contractual relations over time :**

Most of the work at CRAL is in relation with a contract, at the regional level (for example the R2A2 network for public outreach, the new integration facility), at the national level (for example the 12 ANR), at the European level (FP6, FP7, ERC), with European organisations (ESO, ESA) and with industry (EADS). These contracts allow the funding of the hardware for the instrumental projects and of non permanent technical staff; they also allow the funding of students (Elixir FP7...) and postdoctoral positions (ANR, ERC...).

• **Assessment of the influence, appeal and integration of the research unit in its environment :**

- **Number and reputation of the prizes and distinctions awarded to the unit members, including invitations to international events :**

A CNRS silver medal (2006) awarded to a CRAL member, who has also obtained in 2009 a European Research Council Advanced Grant.

Gauss Visiting Professorship from the Göttingen Academy of Science awarded to a CRAL member.

Numerous invitations (>10 a year) of CRAL scientists who give talks in international conferences.

- **Ability to recruit top-level researchers, post-doctoral and other students, especially foreigners :**

Excellent in terms of non permanent positions. The number of students, 17, has to be compared to the number of faculty, 22; eight of these seventeen students have passed their master's degree in a University abroad. Ten postdocs were present at the laboratory at the date of the AERES committee visit; eight of the twelve postdocs present in the unit during the 2005-2009 period come from a laboratory abroad. In terms of permanent positions, two foreign senior professors have been hired, one at UCBL and one at ENS-L, which is excellent. However, there has been a net decrease of 4 faculty members in the unit between 2005 and end of 2009, because of only 1 recruitment from CNAP while 5 CNAP members were retiring and no recruitment from CNRS.



- Ability to obtain external financing, to respond to or launch calls for tenders and to participate in the activities of competitiveness clusters :

Excellent. Funding obtained from ESO, ESA, FP6, FP7, and ANR... For example ESO funds CRAL for the MUSE project at the level of 2.85 M€ (hardware); in the framework of MUSE, CRAL has managed to obtain a funding of 1.7 M€ from CNRS, UCBL and local authorities for a new integration hall and specific laboratory equipments. The unit has also been very successful in obtaining funding from ANR, (12 projects, with of the order of 200 k€ in 2007 and 2008). One contract has been signed with EADS-Astrium for CRAL to provide the "Science Support" of the NIRSpec instrument on board the future NASA James Webb Space Telescope (JWST), for a total amount of 1 M€ over 6 years. The unit has also obtained funding from the "Région Rhône-Alpes" for the R2A2 outreach network ("Réseau Rhône Alpin d'Astronomie") at the level of 70 k€ per year for 4 years.

- Participation in international or national programmes, existence of important collaborations with foreign laboratories :

Most (if not all) of the CRAL programs are part of national or international collaborations. For example, six European institutes located in France, Germany, Netherlands and Switzerland are involved in the MUSE project.

- Valuation of research and socio-economic or cultural relations :

Contacts and expertise transfer with the Winlight company, through the co-development of the 24 image slicers and spectrographs of MUSE. Transfer of knowledge to another community: astronomical data analysis methods transferred to medical imaging (MiTiV ANR project). Successful public outreach, which benefits from the historical site of the observatory; the two open house week-ends hosted of the order of 5000 visitors.

- Assessment of the strategy, governance and life of the unit :
  - Relevance of the unit's organisation, quality of its governance and internal and external communication :

First we want to emphasize that the CRAL management has performed a very good job and has a remarkable perception of the laboratory, its strengths and weaknesses, its opportunities and threats.

A profound reorganisation of the unit, both in terms of scientific teams and technical staff, has been achieved. The reorganisation was absolutely needed to make CRAL a modern laboratory, able to compete at an international level. The reorganisation is a real success. Adjustments have still to be done, in particular concerning two small scientific teams, the Transfert team and the Galaxies team, which should be merged into other teams. The synergy between the AIRI team and the GALPAC team should be enhanced, especially in the framework of the MUSE scientific exploitation, for which the AIRI team possesses the required expertise. Access to technical staff by the AIRI team should also be improved.

Concerning the technical team, emphasis has been put on project management; a strong management team has now been built, which represents a considerable advantage for the future of the laboratory. The number of technical staff on a non permanent contract (28% of the technical staff) is relatively high according to French standard.

The meeting with the technical staff has revealed worries. Everybody is aware that the MUSE project is a crucial project for the laboratory, that has to be successful; but a legitimate worry about "putting all the eggs in one basket" has been expressed. However this statement has to be mitigated by the fact that CRAL is participating in the phase A study of the E-ELT HARMONI project and is investigating the possibility of participating in several mid-size projects. Worries have also been expressed about the possible move of the laboratory onto the La Doua campus. Such a move has many attractive features (closer to students, all the staff in a single new building, easier link with other laboratories on the campus (IPNL...)), as discussed in the laboratory scientific project, but it also raises potential difficulties (practical for people leaving near the observatory, public outreach, loss of the support from the Saint-Genis-Laval city ...) that must be addressed. Such worries are understandable, and while it is difficult to communicate on rapidly evolving subjects, it is highly desirable that the direction of the laboratory communicates as much as possible on these sensitive matters.



In terms of careers, there is a large difference between technical and administrative staff from CNRS and from UCBL; indeed they depend on two different government departments, and when staff from CNRS has a reasonable perspective of career, the one from UCBL has very limited perspective of career. The reasons for this difference between the carrier paths of CNRS and University people are structural and have nothing to do with the unit; it is nevertheless a real source of difficulties that has to be underlined here.

The meeting with the students and the post-docs has shown that they are well-integrated and satisfied with their working conditions and environment.

A lot has also been done by the management to improve the infrastructure, so that the working conditions have indeed improved. This should be acknowledged, and we note the undisputable role that the MUSE project has had in enhancing the general working conditions in the laboratory.

The internal communication is mainly done via the internal laboratory council; it has been expressed that there were not enough discussions on important matters during the meetings of the council.

- **Relevance of initiatives aimed at scientific coordination and the emergence and taking of risks :**

There are regular (on a weekly basis) seminars, alternatively on the site at Saint Genis-Laval and the site at Gerland. Since 2006 and on a two years basis, CRAL has been organizing international meetings, attended by 80-100 researchers. CRAL members have also taken the initiative of organizing an international meeting in Chamonix (2007) (130 participants). Numerous international meetings are held in the framework of instrumental projects, especially MUSE.

Proposing projects to the ANR is a recent way to take scientific initiatives and risks. CRAL has been very good in participating in such projects; indeed it is involved in 12 projects, out of which 5 came from a CRAL initiative.

- **Involvement of the unit's members in teaching activities and in organising research in the region :**

Strong implication in teaching, with two professors, 3 assistant professors, as well as CNAP astronomers whose duty includes teaching.

CRAL has established collaboration with the IPN-Lyon and is part of the Research Federation in Physics, named "André-Marie Ampère". CRAL is involved in the discussion of the evolution of the UBCL "plan campus" and is in front line in the discussion about the re-establishment of the OSU, which would include Earth Sciences.

CRAL has organized the outreach in the region through the R2A2 network funded by the Rhône-Alpes region.

- **Project assessment :**
  - **Existence, relevance and feasibility of a medium- or long-term scientific project :**

An ambitious overall project has been clearly developed. The scientific objectives are clear and all fully relevant. The lack of knowing yet the next instrumental project is not yet a problem; but it increases the risk of having a gap between projects.

The feasibility of the full project relies on an increase of the permanent staff. Indeed the project aims at developing in parallel three activities: instrumentation, observations and numerical simulations. Having these three activities and encouraging synergy between them is an excellent scientific strategy. Nevertheless for a laboratory like CRAL, with a relatively small number of staff, such a strategy can only be successful if associated with an increase in permanent staff. During the 2005-2009 timeframe, the number of permanent staff at CRAL has remained constant, but with a decrease of permanent faculty (-4; retirement not replaced, especially from CNAP) and an increase of technical staff (mainly project management). In addition, there are 3 key scientists on leave and a fourth one will be on leave in 2010. They have taken up interesting positions at ESO, ESA, Oxford and Exeter universities, and their leave is unrelated to the situation in the institute; in fact, most of them plan to come back. Unfortunately, this temporary situation strongly affects the available scientific resources. For the 2011-2014 period, the project is calling for an increase of 5 technical staff and 7 faculty members.



It seems unlikely to expect such an increase from new positions; indeed, from the discussion with the funding agencies, we heard that there is little margin in terms of technical staff because of few retirements. In terms of new faculty positions, the situation at CNRS and CNAP is probably more open and really depends on how good the candidates are; the unit should have an aggressive strategy towards candidates, trying to attract the best candidates, and also towards the hiring agencies, for example to get a 'coloriage' or 'fléchage'. In addition, CRAL is an attractive laboratory, and faculty from another laboratory could move to CRAL.

- Existence and relevance of a resource allocation policy :

The technical director is in charge of the technical staff resource allocation. At the moment, given that one project, the MUSE project, is absorbing almost all the resources, the resource allocation is limited.

- Originality and risk-taking :

Few astrophysics laboratories are developing excellence simultaneously in instrumentation, observations, theory and numerical simulations. This is risky but can lead to very interesting synergies. The laboratory is also embarking upon emerging fields, which is risky; but given that astrophysics is a fast evolving science, only "moving" laboratories can stay in the race. CRAL has definitely this spirit.

## 4 • Team-by-team and/or project-by-project analysis

Five scientific teams appear on the CRAL organizational chart. One team, the Transfert team, is made of a single researcher, and was not considered right from the beginning (not in the agenda), as we are not supposed to make individual evaluation. A second team, the Galaxies team, is only made of two faculty members, plus two students. One of the faculty members is also head of the public outreach division and, in fact, has devoted most of her time to this activity. That is why, we have considered that evaluating the team would be very close to an individual evaluation and we eventually decided not to report on the team. From the presentation and discussion with the Galaxies team, we realize that it would make sense, at the laboratory level, to merge the Galaxies team with the GALPAC team; a common interest could be the use of MUSE GTO. An organizational chart without the two small "teams" would appear more adequate to external reviewers. Then we are left with reporting on three teams: the AIRI team, the ENS team and the GALPAC team.



Name of the team : AIRI (Astrophysique par Imagerie aux Résolutions de l'Interférométrie)

Name of team leader : M. Éric THIÉBAUT

- Team staff or staff allocated to the project (at the date of the visit) :

N1: Number of professors (see Form 2.1 of the unit's dossier)	1
N2: Number of EPST, <i>Établissement public à caractère scientifique et technologique</i> (Public scientific and technological institution) or EPIC, <i>Établissement public à caractère industriel et commercial</i> (Public industrial and commercial institution) researchers (see Form 2.3 of the unit's dossier)	4
N3: Number of other professors and researchers (see Form 2.2 and 2.4 of the unit's dossier)	2*
N4: Number of engineers, technicians and tenured administrative staff members (see Form 2.5 of the unit's dossier)	
N5: Number of engineers, technicians and non-tenured administrative staff members (see Form 2.6 of the unit's dossier)	1**
N6: Number of doctoral students (see Form 2.8 of the report unit's dossier and 2.7 of the project unit's dossier)	5***
N7: Number of persons accredited to supervise research and similar	1

\* a 6-month visitor, a post-doc

\*\* 2 volunteers

\*\*\* including 4 co-sponsorships

- Opinion :

The team is doing an excellent work, which would deserve to be better advertised beyond the specialists of high angular imaging.

The team is conducting original and world-class R&D activities in two main areas :

- Image reconstruction and inverse problems algorithms for high angular resolution astronomy (deconvolution, interferometry image reconstruction (MIRA), interferometric data modeling (LITPRO), application to medical imaging).
- Adaptive optics for Extremely Large Telescopes, (efficient control algorithm).

The team has developed national (with the Jean-Marie Mariotti Center for example) and international collaborations (ESO for example) and has obtained contracts with the main agencies in Europe: Framework Program from the European Commission (FP6: OPTICON/Interferometry, OPTICON/Adaptive Optics), ESA (DARWIN), ESO. The team has also initiated collaborations beyond astrophysics, as for example for the MiTiV bio-medical imaging project (funded by ANR). The team has a regular flow of PhD students (5 at the time of the visit) with good quality thesis works and a steady flow of 1 post-doc. There has been no permanent position recruitment in the past 4 years, but 1 mobility. From 2005 to mid 2009, 26 refereed papers were published from AIRI team members, out of which about 1/5 have a first author from AIRI; worth noting the very high publication rate in non-refereed journals such as SPIE, which count as rank-A journals for instrumentalist candidates in the CNRS and CNAP recruitment and evaluation committees. The team suffers within CRAL from the priority given to MUSE by not getting access to the technical staff to work on their projects.



- Strengths and opportunities :
  - World-class expertise in the expanding area of the high angular imaging techniques.
  - Quasi-ubiquitous use in worldwide optical interferometers of the algorithms developed by AIRI.
  - Participation to the E-ELT through its adaptive optics control algorithm expertise.
  - Technology transfer and applications of imaging techniques to medical sciences.
- Weaknesses and threats :
  - Currently low visibility compared to the actual impact of the team; while the attachment of the team to remain on R&D activities is understandable considering their unique expertise, the team should consider some participation into large projects that would give them broader visibility. The leading position of the team in the MiTiV project and in the POLCA project submitted to ANR is good in this respect.
  - Small team with limited short term perspective of recruitment, given the priorities of the laboratory.
- Recommendations :

The scientific strategy to invest in inverse problems and in R&D is good. The team should better promote its activities and results at various levels:

- Reinforce astrophysics modeling/interpretation of data through collaborations (inside CRAL, e.g. with the GALPAC team, and outside) and through the accretion of dedicated post-docs.
- Seeking collaborations and / or participation in large-scale, high visibility, projects.
- Broader advertisement of its achievements to improve its visibility on the national scene, and to improve the carrier path for its members.

Name of the team : ENS

Name of team leader : M. Gilles CHABRIER

- Team staff or staff allocated to the project (according to the dossier submitted to AERES) :

N1: Number of professors (see Form 2.1 of the unit's dossier)	3
N2: Number of EPST, <i>Établissement public à caractère scientifique et technologique</i> (Public scientific and technological institution) or EPIC, <i>Établissement public à caractère industriel et commercial</i> (Public industrial and commercial institution) researchers (see Form 2.3 of the unit's dossier)	4
N3: Number of other professors and researchers (see Form 2.2 and 2.4 of the unit's dossier)	4
N4: Number of engineers, technicians and tenured administrative staff members (see Form 2.5 of the unit's dossier)	
N5: Number of engineers, technicians and non-tenured administrative staff members (see Form 2.6 of the unit's dossier)	
N6: Number of doctoral students (see Form 2.8 of the report unit's dossier and 2.7 of the project unit's dossier)	4
N7: Number of persons accredited to supervise research and similar	6



- **Opinion :**

The team is excellent by all measurement standards. Two members have been awarded a price; one member has obtained an ERC advanced grant. The large number of post-docs is also a positive indicator of the dynamism and attractivity of the team, as well as the ability to recruit top-level researchers. In terms of publications, 112 refereed papers were published from ENS team members in the 2005 to mid 2009 period; out of those, about 1/3 have a first author from ENS; four of the papers published between 2005 and 2008 have already more than 60 ADS citation counts; 3 papers published during the 2000-2004 period have more than 300 ADS citation counts.

- **Strengths and opportunities :**

- Strong link between fundamental physics and astrophysics; for example, new work on equation of state (from fundamental principles) highly relevant.
- World leadership on very important topics, such as exoplanets and brown dwarfs, equation of state...
- Very relevant work on terrestrial planets, both atmospheric modelling and exobiology implications.
- Strong link with observational results. For example, in position to model exoplanets as they are discovered, extending to lower/terrestrial masses & addressing new problems as they arise.
- New topics being opened, ambitious and timely project (e.g. on 3D stellar modelling).
- Collaborative work on star Initial Mass Function is of 1st quality, plus original improvements to the RAMSES code put the team in a position of potential leadership on new computational astrophysics projects.

- **Weaknesses and threats :**

- Heterogeneity of the publication record.
- Pursuing collaboration with former team member who left or are on leave may prove difficult on the long term.
- Covering a broad range of novel topics.
- A greater dependence on external collaboration.
- Visibility of the institution may be less as a result.

- **Recommendations :**

- Team must keep leadership on exoplanets & brown dwarfs, equation of state (+ terrestrial atmosphere modelling and exobiology).
- We recommend that the team regains its former strength in the field of biomarkers/atmospheres, and that permanent staff should be replaced if lost.
- Collaboration with other CRAL groups should not be adopted as a policy; interactions are naturally weak (extra- vs intra-galactic interests).
- Support recruitment of an engineer for the computing centre.



Name of the team : GALPAC (GALaxy Physics And Cosmology)

Name of team leader : M. T. BUCHERT

- Team staff or staff allocated to the project (according to the dossier submitted to AERES) :

N1: Number of professors (see Form 2.1 of the unit's dossier)	5
N2: Number of EPST, <i>Établissement public à caractère scientifique et technologique</i> (Public scientific and technological institution) or EPIC, <i>Établissement public à caractère industriel et commercial</i> (Public industrial and commercial institution) researchers (see Form 2.3 of the unit's dossier)	3
N3: Number of other professors and researchers (see Form 2.2 and 2.4 of the unit's dossier)	2
N4: Number of engineers, technicians and tenured administrative staff members (see Form 2.5 of the unit's dossier)	
N5: Number of engineers, technicians and non-tenured administrative staff members (see Form 2.6 of the unit's dossier)	
N6: Number of doctoral students (see Form 2.8 of the report unit's dossier and 2.7 of the project unit's dossier)	7
N7: Number of persons accredited to supervise research and similar	4

- Opinion :

GALPAC has been created recently (2008) from the merging of the Cosmology and TIGER teams; the team is already well united. Merging of the two groups is providing new synergies and opportunities of collaborations between theoretical and instrumentalist groups. GALPAC has a high international visibility, not only due to instrumental developments (SAURON, SNIFS... in the past, MUSE, NIRSPEC... currently) and associated observations, but also due to numerical simulations in the areas of chemodynamical simulations of galaxy evolution, semi-analytical models, and alternative cosmological models. From 2005 to mid 2009, 126 refereed papers were published from members of the GALPAC team, out of which about  $\frac{1}{4}$  have a first author from GALPAC; eleven papers published between 2005 and 2008 have already more than 60 ADS citation counts.

The group has been very successful in attracting PhD students (9 at the date of the visit) and in hiring high level scientists at both junior (numerical simulations) and senior level (theoretical cosmology). The group has also been very successful in obtaining funds through competitive selection processes both at national level (6 ANRs) and international level (ELIXIR ITN, EU-FP7; MUSE contract, ESO...), and with industrial partners (NIRSpec, EADS/ASTRIUM).

All projects are executed in collaboration with other national and international institutions. GALPAC has a strong record of well established international collaborations with leading institutions such as Oxford University, ESO, the MUSE consortium, and the NIRSpec/JWST science team. GALPAC is strongly involved in the phase A studies of instrument (HARMONI) for the E-ELT to continue to play a major role in the development of instrumentation for future international facilities.

For next four years, GALPAC main focus will be on cutting edge projects such as the integration and delivery of MUSE, the scientific exploitation of MUSE GTO, and the development of new numerical simulations to interpret large surveys as well as detailed physics of individual galaxies.





- **Strengths and opportunities :**
  - Leading roles in instrument developments, such as MUSE, NIRSpec.
  - Complementary expertise, instrumentalists/observers and theoreticians (numerical simulation & cosmology group) within the same team.
  - Scientific exploitation of MUSE through GTO.
  - Possible exploitation of NIRSpec.
- **Weaknesses and threats :**
  - Several key team members on leave (or about to be).
  - Lack of observational astronomers to exploit the instruments.
  - Too small a team for the large number of projects.
- **Recommendations :**
  - Seek closer and balanced collaborations with other groups at CRAL (AIRI, Galaxies) in certain areas like algorithm developments (MUSE), and observational skills.
  - Increase the expertise in observational astronomy both with recruitment and attraction of researchers from the outside.

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

Villeurbanne, le 06 Avril 2010

M. Pierre GLORIEUX  
Directeur de la section des unités de l'AERES  
20 rue Vivienne

75002 PARIS

Monsieur le Directeur,

Je vous remercie pour l'envoi du rapport du comité de visite concernant l'unité de recherche :

«Centre de Recherche Astrophysique de Lyon» rattachée à mon établissement.

Ce rapport n'appelle pas de commentaire particulier de la part de l'université.

Je vous prie de croire, Monsieur le Directeur, à l'expression de ma meilleure considération.

Le Président de l'Université



Lionel Collet

**Bruno GUIDERDONI**

**Director**

CRAL – UMR 5574

Observatory of Lyon

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Saint-Genis-Laval, March 31<sup>st</sup> 2010

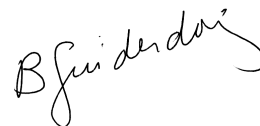
### AERES Report on the Unit :

### Comments

The direction team and the personnel of the CRAL acknowledge the quality of the work achieved by the visiting committee.

They thank the committee for its recommendations and suggestions, and they will do their best to implement them. One specific point to emphasize is that there is a strong willingness to pursue the reorganization of the teams, and to strengthen the collaborative links between the teams. Several ways are already being pursued, or are under study. We will proceed with the merging of the GALPAC and Galaxies team, as suggested in the report.

Finally, the CRAL hopes that the message about the quality of the work achieved here will draw the attention of supervising institutions to the necessity of sustaining the dynamics of the laboratory, especially in terms of permanent positions.



Bruno Guiderdoni

Director of the Observatory of Lyon