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

Section des Unités de recherche

AERES report on the research unit :

UMR 6534 – Laboratoire de Physique Corpusculaire de Caen

From the :

Ecole Nationale Supérieure d'Ingénieurs de Caen

Université de Caen Basse-Normandie

IN2P3/CNRS

November 2010

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

Section des Unités de recherche

AERES report on the research unit :

UMR 6534 – Laboratoire de Physique Corpusculaire de Caen

From the :

Ecole Nationale Supérieure d'Ingénieurs de Caen

Université de Caen Basse-Normandie

IN2P3/CNRS

Le Président de l'AERES

Didier Houssin

Section des unités de recherche

Le Directeur

Pierre Glorieux

November 2010

Research Unit

Name of the research unit : Laboratoire de Physique Corpusculaire de Caen

Requested label : UMR

N° in the case of renewal : 6534

Name of the director : Mr. Jean-Claude STECKMEYER

Members of the review committee

Committee chairman :

Mr. Joseph CUGNON, Université de Liège, Belgique

Experts:

Mr. Florent HAAS, Institut Pluridisciplinaire Hubert CURIEN, Strasbourg, France

Mr. Mats LINDROOS, ESS AB, Lund, Suède

Mr. Nathal SEVERIJNS, Katholieke Universiteit Leuven, Leuven, Belgique

Mr. Eric PLAGNOL, UMR7164/APC/CNRS - Astroparticule et Cosmologie, Paris, France (CoNRS)

Mr. Elias KHAN, IPN Orsay, Université de Paris 11 Paris-Sud, France (CNU)

Observers

AERES scientific advisor:

Mr. Jean-Paul VISTICOT

University, School and Research Organization representatives:

Mrs. J. TRAVERT, Présidente de l'UCBN

Mr. J.-L. LAGARDE, Vice-Président Recherche de l'UCBN

Mr. D. GOUTTE, Directeur Général de l'ENSICAEN

Mrs. B. ERAZMUS, Directrice scientifique adjointe de l'IN2P3

Report

1 • Introduction

The visit of the review Committee took place on the 3rd and 4th of November in the premises of the LPC. An abundant information on the organization, the resources and the scientific output of the laboratory, as well as on the future perspectives, was delivered to the Committee. The latter acknowledges the nice presentations made by the Director of the laboratory and by the members of the different teams. These presentations conveyed the impression of a dynamic and well-balanced laboratory. The interviews with the different groups of the laboratory have been very fruitful, giving a clear view on the working conditions of these groups.

The Laboratoire de Physique Corpusculaire de Caen (LPC) is a "unité mixte de recherche", jointly operated by the Ecole Nationale Supérieure d'Ingénieurs de Caen (ENSICAEN), the Université de Caen Basse-Normandie (UCBN) and the Institut de Physique Nucléaire et de Physique des Particules (IN2P3) du CNRS. This organization scheme generates a well-balanced activity corresponding basically to three different tasks: high-level formation and training of young researchers, the performance of ambitious research programs both on fundamental and applied physics and a diversified array of actions aiming at the dissemination of scientific knowledge. The proximity of the GANIL has allowed a fruitful interaction between the two laboratories. The physicists of the LPC have exploited the beams, instruments and other facilities offered by the GANIL. Reciprocally, the latter has benefited from the collaboration of the LPC, especially under the form of R&D, for the development of several instruments. Presently, a group of the LPC, involving physicists and technical staff, is actively participating in the SPIRAL2 project.

The LPC research activity pertains to three domains: (1) nuclear physics (2) fundamental interactions and (3) interdisciplinary research based on applications of nuclear physics with societal aspects. On the other hand, this activity is spread on six teams (details are given in the part devoted to the various teams).

The other scientific activities involve teaching and dissemination of scientific knowledge. The LPC contains a large component of "enseignants-chercheurs" (18), who assume heavy teaching duties at ENSICAEN and UCBN. As for the third task mentioned above, a particular effort is made concerning research training, hosting trainees, organizing visits, exhibitions and seminars for public at large.

The management team is composed of the Director and the newly appointed "Directeur adjoint". For scientific matters, they are helped by a "Conseil de Laboratoire" and an (external) "Conseil Scientifique".

Here follows the distribution of the Staff members (on the basis of the application file submitted to the AERES).

	Past	Future
N1: Number of researchers with teaching duties (Form 2.1 of the application file)	18	17
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	11	11
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)	13	2
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)	34,8	33
N5: Number of engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)	3	
N6: Number of PhD students (Form 2.8 of the application file)	13	
N7: Number of staff members with a HDR or a similar grade	15	14

2 • Overall appreciations on the research unit

- Summary :

The scientific activity of the LPC is characterized by a strong dynamism and a high-level production in the three tasks assigned to it. The LPC participates to high level formation, conducts ambitious research programs with high quality outputs and is engaged in vigorous actions for dissemination of knowledge and support to community at large. The laboratory has established strong links, with reciprocal benefits, with the GANIL and other facilities in its scientific environment. It is very active in the popularization of research among the high-school network and the public at large.

The research activity is cutting edge and deals with current and important issues fitting to the priorities of the IN2P3 and European and American long-range plans. It is very productive and diversified, implying experimental as well as theoretical aspects. Fundamental and applied physics issues are addressed, in roughly a three to one ratio. The various teams participate to international collaborations in which they usually take a prominent part. The laboratory has among its staff a few personalities who have a high visibility in the international nuclear physics community.

The laboratory has established a very good articulation between research teams and highly-skilled technical and administrative staff, which turns out to be very beneficial to the research activity. The working budget is provided by the operating institutions, for about 80% at present. The rest corresponds to the own resources, coming from contracts with Région Basse-Normandie, ANR, EU and others.

- Strengths and opportunities :

Many strong points can be identified. As already stated, the research programs fit the priorities of the operating institutions and are in line with those of the scientific environment, especially the GANIL. The variety of the research themes, a rather unique feature of the LPC, constitutes a richness, to be preserved as far as possible. The somehow flexible structure of the LPC has allowed exchanges and temporary collaborations between the teams. There

is a good equilibrium between fundamental and applied research. The scientific production in terms of papers and PhD theses is excellent, with many key articles in high-impact journals.

One can single out important opportunities. The high scientific level of the research performed has allowed participation with a good visibility to large scale collaborations and the access to large facilities (Modane, PSI, SCK-CEN, etc). The laboratory has succeeded to establish strong links with the laboratories in its direct vicinity (GANIL, Cyceron). It is strongly implied in important projects in this environment, namely the SPIRAL2 and the Archade projects. It benefits from recurrent budgets. The level of own resources may look satisfactory, but has decreased in the recent years. The research activity can take advantage of the support of a performing technical-administrative staff, which shows a great flexibility in response of the needs. Finally, it attracts many PhD students and the average age of the permanent staff is rather low.

- Weaknesses and threats :

Paradoxically, the main weakness of the laboratory comes from one of its strong points, namely the diversity of its research teams and programs. Apparently, this has led to a lack of scientific life in the laboratory. Equally important, due to their year after year slightly decreasing resources, some teams can be considered as below the critical mass.

Let us notice also the fact that budgets have to be applied for on a year-by-year basis, which hampers a flexible planning of expenditures, the relatively too low level of human resources and the uneasy planning of the careers for some groups of the personnel, due to different status of the employees.

A recurrent weak point is the very low number of post-docs, a surprising feature for a laboratory which carries high level research programs with reduced teams.

Another specific weak point has appeared from the visit, in particular from the discussion with the representatives of the operating institutions. There is a lack of identity of the LPC arising from the proximity of and the strong links with the GANIL. It seems that the staff of the LPC is often taken as belonging to the GANIL, in spite of its specific activity.

The Committee has identified some worrisome risks. The first one concerns the financing of the LPC which, regarding some sources, is not guaranteed. This, of course, applies, mainly but not only, to the own resources,

which have decreased in the last two years. The second one is linked to the fact that the LPC has a few top-level physicists with strong reputation, who might be interested by offers from prestigious laboratories.

- Recommendations :

The recommendations echo the points discussed above. The LPC should seriously think over an optimization of the teams (the Committee acknowledges the fact that this work has already started). More specifically, the Committee recommends the setting up of a common strategy for the teams “Aval du cycle” and “Applications médicales”, followed by the merging of the two teams. The reinforcement of the combined team by a new scientist, CR or equivalent, is highly recommended and the Direction is invited to work actively to this goal.

The scientific animation of the laboratory should receive a high priority. The ways to improve this situation are rather well known, but the results are generally obtained after a long time only. Another priority would be the definition of a strategy for enhancing the attractiveness of the laboratory for the key persons alluded above. Along the same lines, an effort for increasing the number of post-docs would be beneficial.

Regarding the financing, the laboratory should try to increase its own resources by applying to various agencies and calls for projects, in particular to the ANR calls. The laboratory should deploy a more willful policy in this respect. The Committee has had the impression that members of the LPC are underestimating their chances of succeeding, arguing of the limited size of the laboratory, where, instead, they can capitalize on their excellence.

Finally, the problem of the identity of the LPC, due to the vicinity of the GANIL, can be solved by a vigorous campaign of communication in the nuclear physics community at large. The LPC should be more active in organizing workshops and/or conferences. This would also enhance the scientific animation of the laboratory.

- Production results :

A1: Number of permanent researchers with teaching duties (recorded in N1) who are active in research	16
A2: Number of permanent researchers without teaching duties (recorded in N2) who are active in research	9
A3: Ratio of members who are active in research among staff members [(A1 + A2)/(N1 + N2)]	0,89
A4: Number of HDR granted during the past 4 years (Form 2.10 of the application file)	2
A5: Number of PhD granted during the past 4 years (Form 2.9 of the application file)	18

3 • Specific comments

- Appreciation on the results

The research of the LPC deals with high level and up to date topics, which are also fitting the priorities of the IN2P3 and European and North American long range plans. The applied physics research topics are among the priorities of France for energy and health policies. Most of the time, the various teams tackle the problems with original methodologies. The quality of the results is cutting edge and has had an important impact on the development of nuclear physics (halo nuclei, variation of the shell closure properties, multifragmentation, liquid-gas phase transition, neutron star physics), on the understanding of some aspects of fundamental interactions (nature of the neutrino, double beta decay, electric dipole moment of the neutron, search for new currents in weak interactions) and on specific applications of nuclear physics and nuclear instrumentation in the field of nuclear energy (aspects of transmutation of nuclear waste and of fast neutron reactors) and radiotherapy (dosimetry, beam monitoring, measurements for hadrontherapy). The research project, based on the accumulated skill and experience of the laboratory as well as on a lucid analysis of the trends in nuclear physics and its applications, is warranting the continuation of a high quality research in the future years.

It is also worth to mention that the laboratory produces sophisticated R&D work for more generic needs than those of the individual teams and for existing or future instruments, such as for the DESIR room at SPIRAL2.

The quality of the results is testified by the high number and high quality of publications, with a remarkable score for publications in high-level journals, like Physical Review Letters and Physics Letters. It is also attested by the large number of communications at international conferences. The number of PhD theses presented during the period 2006-2010 is remarkable for the size of the laboratory.

In spite of its relatively small size, the LPC is engaged in important and solid international collaborations with, most of the time, a very good visibility of its teams.

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

Several staff members have been distinguished by receiving prestigious awards (médaille d'argent du CNRS, prix Joliot-Curie), by being invited to give key talks at important international conferences and by being invited to organize conferences and other scientific events.

The LPC occupies an attractive position in the European nuclear physics landscape. It has hired high level scientists from abroad in the past and uses to attract very good PhD students from the neighboring institutions as well as from outside. It has proved to be able to raise competitive funds (although these have somehow declined in the last two years), to be prompt to join international networks and solid national and international collaborations, and to

search for foreign partners for running experiments. As for the applied physics side, the LPC has been able to establish solid links with industrial partners. Concerning the dissemination of research results, the laboratory has deployed contacts with high school networks and with the community at large.

The LPC has also thigh links with the neighbor laboratories, especially with the GANIL. It has judiciously taken advantage of the beams of the GANIL, in particular of SPIRAL1. If nowadays the teams are looking more for using other facilities, the LPC should secure its privileged relationship with GANIL and look carefully for future collaboration in order not to miss the transition from SPIRAL1 to SPIRAL2.

The LPC is well engaged in the Archade project for hadrontherapy. Its partnership with IBA is a unique opportunity for an amplification and a valorization of its participation.

- Appreciation on the management and life of the research unit

The research unit is organized in six teams. A few staff members belong to two teams and there is some mobility between the teams. The teams can rely on highly skilled technical units, with a flexible organization of the work of these units, concerning the demands of the research teams and more general R&D. The high qualification of the technical staff is maintained by a solid formation program. The running of the research activity benefits from a good collaboration between the Direction team and the Conseil de Laboratoire, not only for the everyday organization of the research unit but also for the initiation and development of new cutting edge programs. Indirectly, the research unit also benefits from the remarkably coordinated action of the operating institutions. There seems to exist also a good communication between the Direction team and the research teams based on regular meetings.

The discussion with the PhD students has also put in evidence the very good working conditions made to them and the excellent formation to research provided by the thesis advisors. On the other hand the lack of a true scientific animation of the laboratory involving all teams at the same time has already been mentioned. The task to palliate this situation has been assigned to the newly appointed Directeur-adjoint, who considers this as one of his first priorities. He is elaborating a strategy in that direction, based on internal seminars and other cross-interesting meetings.

The important contribution of the large number of “enseignants-chercheurs” to teaching in ENSICAEN and UCBN has already been underlined. In particular, this has contributed to provide the PhD students issued from these institutions with a solid background from the very beginning of their thesis.

- Appreciation on the scientific strategy and the project :

The scientific research project for the forthcoming four years is highly attractive. It is based on the skill and experience of the teams and thus appears as a continuation of the past activity. Nevertheless, even though the research themes remain basically the same, the outputs of many proposed experiments are highly waited for by the nuclear physics community. There is thus a good balance in this project between the actions that fully exploit the accumulated competences and those which are more at risk. Furthermore, the used infrastructures are not always the same as before and the choice of the latter results from a shrewd analysis of the trends in the respective fields. The proposed research program contains cutting edge projects in nuclear physics and in the physics of fundamental interactions. The theoretical future activity touches very important issues, in particular in neutron star physics. The foreseen activity in hadrontherapy plainly aims at exploiting the potentialities offered by the future Archade facility and is also very attractive with respect to the societal aspects. On the average, the project relies on larger collaborations than before, each time with an important role for the corresponding LPC team.

The analysis of the required human, technical and financial means is realistic. The regrouping of some teams is contemplated and presently debated, but no decision is taken yet. This analysis points out to the need for increasing the human resources, by the recruitment of a technician (electronics), of an engineer (informatics) and a physicist (level CR). The allocation of the latter to the hopefully regrouped applied physics team is highly recommended by the Visiting Committee. Concerning the required financial support, it appears that the recurrent funding of the laboratory should be moderately increased. On the other, a strategy should be established and an important effort should be made toward attempting to increase the own resources noticeably.

4 • Appreciation team by team

- Team : Interactions fondamentales et nature du neutrino
- Team leader : Mr. G. BAN
- Staff members

	Past	Future
N1: Number of researchers with teaching duties (Form 2.1 of the application file) (ETPT)	3.3	2.8
N2: Number of full time researchers from research organizations (Form 2.3 of the application file) (ETPT)	2.8	2.8
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)		
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)		
N5: Number engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)		
N6: Number of PhD students (Form 2.8 of the application file)	6	
N7: Number of staff members with a HDR or a similar grade	5	4

- Appreciation on the results

This team concentrates its activities on three main research themes: double beta decay and the nature of the neutrino, beta-neutrino correlation measurements to search for exotic weak currents, and the search for an electric dipole moment of the neutron. All three research themes are among the ones that are highly recommended in the European and North-American Long Range Plans and that will improve our understanding of fundamental properties of the neutrino and the weak force. Further, research on each of these three topics is performed in the context of a strong international competition.

In the case of double beta decay and the neutron electric dipole moment the team is part of large international collaborations with a long-term project and each time plays an important and clearly visible role, being responsible for several key-contributions. For the beta-neutrino correlation project the team takes advantage of the beams available at GANIL and has developed and optimized a unique Paul trap based set up with which a first measurement was realized using 6He.

The team has published in the period that is evaluated here a total of 17 papers in refereed journals. This may not seem very many, but this is inherent to this type of physics where experiments require a long preparation time. The high quality of the research performed transpires from the fact that these papers were published in high-impact journals, among which 6 in Physical Review Letters and one in Reviews of Modern Physics, while the team has also produced 6 theses and has presented 60 conference contributions.

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

The team is well-seen internationally, it was e.g. regularly asked for invited talks, and has recently attracted a promising young scientist (coming from LPSC-Grenoble). Funding from different sources (IN2P3, ANR, … as well as EU) has been obtained for all three main projects. The team is a member of several EU-funded international networks. All three projects have recently produced high-quality results that were published in highly-ranked journals, for instance a test of Lorentz invariance and the first measurement ever of the transverse polarization of electrons emitted in

free-neutron decay, both published in Physical Review Letters, as well as new results on the double-beta decay of 100Mo and 150Nd.

- Appreciation on the scientific strategy and the project

The team has a clear mid-to-long-term strategy for all three main topics, each being considered by the international community to be among the top priorities for the coming years, and with for each the possibility to significantly advance current knowledge or even realize a possible breakthrough towards new physics.

The fact that only a few members of the team are full-time available for research, does not hamper the progress of the different projects, because most team members are actively involved in several projects.

The temporary absence of O. Naviliat-Cuncic has led the team to decide not to embark on a second phase for the neutron lifetime project, that has recently led to a first result.

- Conclusion :

The research on fundamental interactions is of high quality and the research topics are well-chosen, each of them being among the priorities that are internationally put forward for this field. The team is internationally recognized for the high quality of its research and for its competences.

– Strengths :

Most members of the team are involved in more than one research project ; the activities on double beta decay and on the neutron electric dipole moment are embedded in large and long-term international collaborations ; the Paul trap setup is worldwide unique.

– Opportunities :

Valorisation of the Paul and MOT-trap setups for beta-neutrino correlation measurements; polarizing the trapped nuclei would further improve the sensitivity to new physics.

– Weakness :

The team should take care that the (temporary) absence of Mr. O. NAVILIAT-CUNCIC does not weaken the knowledge on phenomenology in the team, especially with respect to the beta-neutrino correlations.

– Threat :

Long-term projects (double beta decay, neutron electric dipole moment) require continued support as to finances and manpower. A possible non-approval of the extension of the Modane laboratory would hamper the continuation of the double-beta decay project.

– Recommendations

The team members working on beta-neutrino correlations are advised to do an effort to increase their expertise in phenomenology.

- Team: Structure nucléaire
- Team leader: Mr. N. ORR
- Staff members

	Past	Future
N1: Number of researchers with teaching duties (Form 2.1 of the application file) (ETPT)	1	1
N2: Number of full time researchers from research organizations (Form 2.3 of the application file) (ETPT)	3	3
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)	1	1
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)	-	-
N5: Number engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)	-	
N6: Number of Ph.D. students (Form 2.8 of the application file)	1	
N7: Number of staff members with a HDR or a similar grade	1	1

- Appreciation on the results

The activity of the group is focused on very neutron-rich light nuclei: halo structure, spectroscopy beyond the drip-line, and shell structure evolution. Their research contains numerous highlights and the team has developed international expertise in these fields

Both the publication rate and quality are excellent. Publications in high impact journals are made both on the halo topic and on the shell structure evolution. The number of PhD students is significant, compared to the team size, which indicates that the group is dynamic.

The team is involved in more than 5 international collaborations, which are at the forefront of the present field, both on well developed detectors (CHARISSA), or in new projects such as LENA. The current collaborations with UK, Canada and Japan are solid because of the expertise of the groups involved and the good level of communication among these collaborations. The team has undertaken a strategic thinking stage in order to access to the most neutron-rich beams such as those of the Riken faciciliy. Sound scientific reasons have been given for that.

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

The team leader has been awarded several CNRS medals, he is an international expert and is regularly invited to conferences. The resulting international visibility of this team is very high.

Several PhD students have been attracted to this team. Moreover the last hired scientist of the team is a high-skilled experimentalist having performed both research and teaching in IPN Orsay, Riken and Berkeley. The other members of the team are also highly skilled in neutron detectors. The team benefits from a CDD CNRS and also a foreign visitor uses to come and visit on his own funding. However there is a lack of postdocs. The team is involved in numerous collaborations as mentioned above.

Strong involvement in instrumental developments of next generation neutron detector (LENA) and nuclear physics dedicated electronics (FASTER) are undertaken.

The team should develop parallel funding, such as ANR, allowing flexible budget making and expenditure planning on several years.

- Appreciation on the scientific strategy and the project

The team has a clear strategy for a reorientation towards available beams at RIKEN and TRIUMF. However, the possibilities at GANIL and SPIRAL should be carefully considered to assure that no opportunity is missed in the gap before SPIRAL2 comes on-line. The group should also consider other related physics at the neutron-rich side to prepare itself for the richer offer of isotopes at SPIRAL2.

The group is involved in the Franco-Japanese LIA. However the delocalization of the experimental activities will require an increase of the funding.

The proposed projects are in the continuity of the past activity of the group, but much remains to be studied in the behavior of light exotic nuclei with respect to halo or shell structure evolution. In order to keep on with the cutting edge character of its activity, the group needs to consider all possible sources of radioactive beams both in Europe and in the rest of the world.

- Conclusion :

The nuclear structure group has a very large international visibility and is highly skilled. Owing to their reorientation towards other facilities, the persons of the group will judiciously take advantage of the most neutron-rich beams worldwide for light nuclei. Still, this strategy will probably require some re-evaluation in a couple of years.

The scientific excellence of the team leader, the variety of skills inside the team, the implication of the latter in instrumental first-line projects and the use of the current world-leading beam facilities (Riken) results in a very high standard. The use of beams in Riken and Triumf facilities, as well as the development of neutron detectors, are unique opportunities to keep a leading position in the field.

The delocalization will result in a rise of the needed funds. The team leader is internationally recognized as a top leader in the field and is presently setting up the strategy of the group. The younger team members need to be given the opportunity to take increased responsibility. This will overall strengthen the group and secure a broad and strong physics program in both time and scope.

– Recommendations

More applications for funding should be made by the group, such as ANR proposals. Also the group should be advised to search for theoretical support through the “Comité de Financement Théorie” of IN2P3: a 3 year CDD theoretician could be present in the team in order to strengthen the experiment-theory link. Of course, the direction team of the LPC should support actively the group in his various funding requests to IN2P3, in order to preserve its excellence for the forthcoming years.

Although the move to foreign facilities resulted from a well-matured scientific choice, it should be soon deeply reconsidered, involving the whole team, in order to be sure not to miss opportunities at GANIL.

- Team : Thermodynamique et dynamique nucléaire
- Team leader : Mr. R. BOUGAULT
- Staff members

	Past	future
N1: Number of researchers with teaching duties (Form 2.1 of the application file) (ETPT)	0.8	0.8
N2: Number of full time researchers from research organizations (Form 2.3 of the application file) (ETPT)	2.75	2.75
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)		
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)		
N5: Number engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)		
N6: Number of PhD students (Form 2.8 of the application file)	1	
N7: Number of staff members with a HDR or a similar grade	3	3

- Introduction

The driving idea behind the study of multifragmentation and of hot nuclei is the hope to determine the equation of state of nuclear matter, to map-out the liquid-gas phase diagram with its coexistence line and spinoidal region and to measure the maximum temperature a "nucleus" may sustain before it vaporizes. Behind this is the hope that a hot nucleus will behave, at high temperature, as a thermodynamically equilibrated system and that the definition of temperature and density are warranted for these systems. In view of the sizes of the systems studied and the way hot nuclei are formed, i.e. by very violent collisions, this is a difficult task which, if achieved, could impact on many other areas of physics, astrophysics and cosmology. The present development of low-energy radioactive beams at SPIRAL2 gives an opportunity to extend this field of research and has initiated both a strong instrumental development with the FAZIA project and a new physics program.

- Appreciation on the results

Over the last 10 years, the INDRA collaboration and the LPC team have accumulated a huge amount of data on the fragmentation of systems over a wide range of masses and excitation energies. The results have been published in numerous high impact journals and the quality of the data is recognized worldwide.

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

All through this effort, the LPC has put together a team whose competences range from instrumental development, data analysis, modeling and theory. As of today, it is close to being the most important group in France and possibly beyond. With respect to other groups, the LPC team has a growing importance and within the international collaboration FAZIA, the team leader already assumes a key position in the scientific coordination. The LPC team itself could, in the future, take a predominant role. The very close link with the theory group is a considerable asset. The funding is well secured and this activity has been actively supported at the French and European level.

- Appreciation on the scientific strategy and the project

The present strategy and the future scientific program relies heavily on the evolution of GANIL and of SPIRAL2. The optimum (high energy) exotic beams for this physics will not be available in the near future and the scientific program for the coming years has to be well thought out and attractive enough not only to maintain the present staff level but also to attract brilliant young researchers.

On the instrumental side, multifragmentation studies of exotic (neutron-rich) nuclear matter implies to measure the charge, the mass and the energy of nuclear fragments. This has led to the FAZIA project which has been very successful and whose results could profit well beyond this community. However, this is a long term project and the full size detector will probably not be completed before 2020.

- Conclusion

This LPC team is well established and has demonstrated its competence over all the different fields of this physics (instrumentation, data analysis and modeling). It has a very large set of data which potentially could keep the group working and publishing for many years.

The strength of this team relies on its many competences and on its strong links with the theory group. The FAZIA project is a great opportunity for it.

The coming years may be more difficult for this physics because it will take some years before high energy exotic beams are available at SPIRAL2 and at EURISOL. Care has therefore to be taken to maintain an exciting physics program at low energy. This situation affects not only the LPC but also the other French laboratories participating in the program. A number of leaders will be leaving this field soon. This is an opportunity for the LPC to increase its influence but it is also a problem of the collaboration as a whole.

– Recommendations

It is highly important that the physics program for the coming years be well analyzed and discussed. It should be attractive and innovative in order to be appealing to young French and foreign researchers and to maintain the interest of the present members of this team.

The impact of the LPC on the FAZIA program should grow in importance. The program is already a success and a more important role on the instrumental aspects could be a low risk, high rewarding investment.

- Team : Théorie et phénoménologie
- Project leader : Mrs. F. GULMINELLI
- Staff members

	Past	future
N1: Number of researchers with teaching duties (Form 2.1 of the application file) (ETPT)	0.5	0.5
N2: Number of full time researchers from research organizations (Form 2.3 of the application file) (ETPT)	0.35	0.35
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)		
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)		
N5: Number engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)		
N6: Number of Ph.D. students (Form 2.8 of the application file)	3	
N7: Number of staff members with a HDR or a similar grade	2	2

- Appreciation on the results

The activities of this team are rather diverse. The common goal is the description of strong interaction systems. The research topics include important and challenging issues, such as quantum Monte-Carlo methods applied to ultra-cold atoms and ultimately to nuclei, various approaches to the description of phase transitions in nuclei and neutron stars, and the development of event generators suited to the description of multifragmentation, spallation reactions and physical processes in hadrontherapy.

The originality of the approaches and the importance of the scientific output, especially concerning the thermodynamical approaches to nuclear systems, with applications to phase transitions in nuclei and the physics of the neutron star crust, are to be stressed and are recognized worldly by the scientific community. The excellence of the output is also manifest from the large number of publications with refereeing procedure (29), many in world top journals, and the number of PhD theses (4), during the last four years. The group maintains a strong link with the team “Thermodynamique et Dynamique Nucléaire”, with the INDRA and FAZIA collaborations and with foreign theoretical labs. Quantitatively, the origin of the scientific output is highly unbalanced, as it rests too much on one of the components of the team and results by the strong involvement of the other components in administrative and teaching tasks.

- 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 a high visibility in the international community, which is corroborated by the regular invited talks delivered at international meetings. One of the permanent members has recently received the prestigious JOLIOT-CURIE award from the Société Française de Physique. The permanent members of the group are strongly involved in teaching activities, which allow them to recruit good students. The participation in international collaborations is very good. The team has secured funding. In particular, it benefits from an ANR contract.

- Appreciation on the scientific strategy and the project

The proposed research project is based on the continuation of the present activity and on new items. It is partly motivated by the interaction with the FAZIA collaboration (QMD simulations), the applications in hadrontherapy

(de-excitation models and antisymmetrized molecular dynamics) and the applications in nuclear structure (quantum Monte-Carlo methods). The work on neutron star physics is very promising and involves original methods. The development of a new Hauser-Feshbach code does not present an urgent need since well-tested codes already exist. Finally, it looks like the team has not precisely defined a common strategy.

- Conclusion:

The team is making an excellent work on cutting edge physics. The results are far-reaching for the understanding of nuclear thermodynamics and of neutron star physics.

Its strength is coming partly from the strong involvement of the permanent members in teaching of physics in the UCBN and ENSICAEN, which helps to attract students. Other strong points are the very good interaction with the experimental groups and the excellent visibility of the group in the international nuclear physics community, especially owing to the reputation of the leader of the team.

The weak point comes from the coexistence in the team of members who are strongly devoted to research with others who are largely occupied by their teaching and organizational commitments.

– Recommendations

The team should really think about the proper way to palliate the last weak point. In particular, developing a collaboration with external physicists for the quantum Monte-Carlo calculations would be indicated.

- Team : Aval du Cycle Electronucléaire
- Team leader : Mr. F.-R. LECOLLEY (MC)
- Staff members

	Past	Future
N1: Number of researchers with teaching duties (Form 2.1 of the application file) (ETPT)	1.55	1.55
N2: Number of full time researchers from research organizations (Form 2.3 of the application file) (ETPT)	0.1	0.1
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)		
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)		
N5: Number engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)		
N6: Number of PhD students (Form 2.8 of the application file)	-	
N7: Number of staff members with a HDR or a similar grade	1	1

- Appreciation on the results

The team is working on relevant and challenging issues for nuclear waste incineration and ADS. The two themes are neutron cross-section measurements and tests for hybrid systems. Both subjects are getting increasingly important as nuclear power has a political aspect due to concern for global warming linked to fossil fuels. There is also, even at highest political level, a concern about proliferation linked to e.g. waste reprocessing. The team is small with only

part time staff and one PhD student but has strong links to the nuclear engineering program at the ENSICAEN. The group is publishing and participating in conferences (with proceedings). It has strong links with many international networks and collaborations but without playing a leading role in any of them. The future is oriented towards a completion of work in several programs and towards the Neutron for Science facility at SPIRAL2.

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

The group is small and all members have other activities e.g. teaching and lab direction in parallel to the group activities. They take active part in the scientific community and have had invitations to speak at several international meetings. The strong links to the engineering school means that the group has the opportunity to recruit students through active link to the teaching program. This was stressed at the presentation and it is a bit surprising that they only have one PhD student at present.

Participation in international collaborations is very good and it was encouraging to hear about the completion of the cross section measurements in Uppsala after necessary upgrades of the Uppsala facilities. The target monitor at Guinevere is certainly very important for quality data but it is clear that the group so far hasn't taken a leading role in any collaboration.

The group has secured funds and is getting access to EU funds through the different collaborations they are participating in.

The work has potentially major impact on society through the collaborations they are participating in. It should be a motivating factor for both staff and for students.

- Appreciation on the scientific strategy and the project

A long term strategy exists through the completion of the on-going collaborations and within "Neutrons for Science" at SPIRAL2. However, it wasn't clear from the presentations what the actual contribution of the group would be to any of these programs beyond completing on-going activities.

The neutron cross section measurements are important but standard. However, the work at Guinevere is different. The project itself is cutting edge and the group is using its know-how in detector technology to make an original and important contribution. The team should seriously study the possibility of continuing research on hybrid systems after the Guinevere experiment and of joining the MYRRHA project, under the auspices of the IN2P3.

- Conclusion and recommendations

The group is doing important work on neutron cross section measurements and is contributing to a key study for waste incineration. The good links to the ENSICAEN is a strength and it should be further explored to get more students involved in the work. It also seems right to us to aim for contributions which are in line with the other activities of the LPC, e.g. detector and instrument development. However, there is a strong need for an overall strategy which clearly spells out the long term goals of the group (even if the national context still might be undecided). The small team votes in our view for a merger with the medical physics team. Furthermore, this so-created united application group clearly needs the recruitment of a full time researcher who can give continuity, help formulate a vision for the team's work, strengthen the publications and, last but not least, have the time to take a leading role in e.g. NFS at SPIRAL2. This future group would then have critical manpower to make major impact at different experiments at different times and assure that the activities on the "Aval du cycle" have a future, independent of the future French research strategy for nuclear waste incineration.

- Team: Applications médicales
- Team leader: Mr. Jean COLIN
- Staff members

	Past	Future
N1: Number of researchers with teaching duties (Form 2.1 of the application file) (ETPT)	1.2	1.2
N2: Number of full time researchers from research organizations (Form 2.3 of the application file) (ETPT)	0.5	0.5
N3: Number of other researchers including postdoctoral fellows (Forms 2.2, 2.4 and 2.7 of the application file)		
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)		
N5: Number engineers, technicians and administrative staff without a tenured position (Form 2.6 of the application file)		
N6: Number of Ph.D. students (Form 2.8 of the application file)	2	
N7: Number of staff members with a HDR or a similar grade	3	3

- Introduction

The LPC team is strongly involved in an interdisciplinary project where nuclear techniques in medical applications connected with ionizing radiations are used for therapeutic purposes (radioprotection, dosimetry, beam handling, etc). A major engagement of the team is actually the Archade project, a European resource center for hadrontherapy, based on a superconducting cyclotron accelerator to be installed in Caen.

- Appreciation on the results

During the actual quadriannual plan, the team has valorized its 'know-how' in the fields of dosimetry, radioprotection and beam control through collaborations and contracts with GANIL, CIMAP, IRSN and IBA, the world-leading constructor of medical cyclotrons with which the collaboration will be strongly strengthened for the Archade project. In Carbon-therapy, a precise knowledge of the delivered dose depends on the fragmentation process of the incident ions. In collaboration with teams from IPHC Strasbourg and IPN Lyon, the LPC team has initiated an experimental program to measure 12C fragmentation cross-sections at 95 MeV/nucleon. Experiments have been performed at GANIL with thick tissue-like targets (in 2008) and thin target experiments are planned in 2011. During the period 2006-2010, 6 articles have been published, 3 theses presented and one patent taken out.

The results of the Ganil experiment and of the simulation calculations should be published in a near future.

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

The LPC team is engaged in the definition and writing of the scientific program of Archade as well as in the connected R&D hadrontherapy techniques. These engagements have recently been consolidated by the creation of a GIS between IN2P3 and Archade. The LPC is also implicated in the research program of the GDR "Modélisation et Instrumentation en Imagerie Biomédicale". The experimental program at Ganil is performed in collaboration with teams from IPHC Strasbourg and IPN Lyon. In the case of IPN, a strong partnership is particularly recommended because this IN2P3 laboratory is involved in the project Etoile, a hadrontherapy center to be built in Lyon.

- Appreciation on the scientific strategy and the project

For the Archade project, which is certainly a great opportunity for the LPC Caen, the team "Applications Médicales" has an important role to play in the conception of control devices for the accelerated proton and carbon beams and of the set-ups of the experimental area. The construction of Archade is going to start at the end of 2011 with a first beam probably delivered in 2015.

In the period 2011-2015, the team will perform new experiments mainly at Ganil but also at GSI (experiment First) to get a better description of the fragmentation process and thus to improve the simulations needed for a future TPS (Treatment Planning System). The results of these new studies will be a strong guide to the Archade experimental program.

- Conclusion and recommendations

The teams "Aval du Cycle" and "Applications Médicales" are essentially composed of Enseignants-Chercheurs. These two teams are engaged in important interdisciplinary research programs, which are among the priorities of the LPC. The Archade project is a unique opportunity for both teams. Their "coming together" is thus highly wanted and will significantly increase the visibility of the group in the project. This will not remove the problem of the "undercritical" size, which comes from the limited time that the Enseignants-Chercheurs of the two teams can devote to research. The reinforcement of the combined group by the hiring of a CNRS "Chargé de Recherche" in 2011 would be of great help to the LPC involvement in Archade. As said before, the LPC will have to strengthen its collaboration with the other IN2P3 laboratories and in particular with the IPN Lyon to develop concerted and coherent actions for the hadrontherapy projects Archade and Etoile. The strategy of the LPC for Archade in the short range term is well defined; the laboratory should now start preparing a long range research plan for the period after 2015.

Intitulé UR / équipe	C1	C2	C3	C4	Note globale
Laboratoire de Physique Corpusculaire (LPC)	A+	A	A	A	A
Interactions fondamentales et nature du neutrino	*A+*	*A*	*Non noté*	*A+*	*A+*
Structure nucléaire	*A+*	*A+*	*Non noté*	*A*	*A+*
Thermodynamique et dynamique nucléaire	*A+*	*A*	*Non noté*	*A*	*A+*
Théorie et phénoménologie	*A+*	*A+*	*Non noté*	*A*	*A*
Aval du cycle Electronucléaire	*A*	*A*	*Non noté*	*A*	*A*
Applications médicales	*A*	*A*	*Non noté*	*A*	*A*

C1 – Qualité scientifique et production
C2 – Rayonnement et attractivité, intégration dans l'environnement
C3 – Gouvernance et vie du laboratoire
C4 – Stratégie et projet scientifique

Statistiques de notes globales par domaines scientifiques

(État au 06/05/2011)

Sciences et Technologies

Note globale	ST1	ST2	ST3	ST4	ST5	ST6	Total
A+	6	9	12	8	12	11	58
A	11	17	7	19	11	20	85
B	5	5	4	10	17	8	49
C	2	1	2				5
Total	**24**	**32**	**25**	**37**	**40**	**39**	**197**
A+	25,0%	28,1%	48,0%	21,6%	30,0%	28,2%	29,4%
A	45,8%	53,1%	28,0%	51,4%	27,5%	51,3%	43,1%
B	20,8%	15,6%	16,0%	27,0%	42,5%	20,5%	24,9%
C	8,3%	3,1%	8,0%				2,5%
Total	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Intitulés des domaines scientifiques

Sciences et Technologies

ST1 - Mathématiques
ST2 - Physique
ST3 - Sciences de la terre et de l'univers
ST4 - Chimie
ST5 - Sciences pour l'ingénieur
ST6 - Sciences et technologies de l'information et de la communication

ENSICAEN
ÉCOLE NATIONALE SUPÉRIEURE D'INGÉNIEURS DE CAEN
& CENTRE DE RECHERCHE

Caen le 11 avril 2011.

Nos réf. DG/BM.11020

Monsieur le Directeur,

Je vous remercie pour l'envoi du rapport du comité de visite concernant le Laboratoire de Physique Corpusculaire (LPC, UMR 6534) rattaché à mon établissement. A mes remerciements j'associe ceux des établissements et organismes avec lesquels nous partageons la tutelle de ce laboratoire.

Je me réjouis des appréciations très positives du Comité de visite et je joins à ce courrier la réponse à l'AERES de son Directeur Jean-Claude Steckmeyer.

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

ECOLE NATIONALE SUPÉRIEURE D'INGÉNIEURS DE CAEN & CENTRE DE RECHERCHE
ENSICAEN

Dominique Goutte

Directeur Général

Monsieur Pierre Glorieux
Directeur de la section des unités de l'AERES
20 rue de Vivienne
75002 Paris

LABORATOIRE DE PHYSIQUE CORPUSCULAIRE DE CAEN
- U.M.R. 6534 -

ENSICAEN — I N2 P3 - CNRS — UNIVERSITE DE CAEN BASSE-NORMANDIE

INSTITUT NATIONAL
DE PHYSIQUE NUCLEAIRE ET DE PHYSIQUE DES PARTICULES

Caen le 30/03/2011

Réponse au rapport d'évaluation
du
Laboratoire de Physique Corpusculaire
UMR 6534

Nous remercions le Comité de visite de son rapport d'évaluation. Les recommandations du Comité seront très utiles dans la mise en œuvre de la future politique scientifique du laboratoire.

A propos de l'évaluation de l'équipe « Théorie et phénoménologie » et plus particulièrement de la recommandation du Comité sur les approches Monte-Carlo quantiques et leurs applications interdisciplinaires (page 15), nous souhaitons apporter les précisions suivantes : les travaux menés depuis 2007 concernent les isolants de Mott dopés et les gaz quantiques ultra-froids. Les résultats obtenus ont été présentés et discutés avec les équipes théoriques du CRISMAT (ENSICAEN) et du LKB (ENS-Paris) laboratoires experts en ce domaine. Une thèse utilisant ces méthodes en physique nucléaire est en cours. L'ensemble de ces travaux fera l'objet de publications.

Jean-Claude Steckmeyer
Directeur du LPC

LPC – ENSICAEN – 6 boulevard Maréchal Juin – 14050 CAEN CEDEX 04

Téléphone secrétariat : **02 31 45 25 00** — Téléfax : **02 31 45 25 49**
Téléphone personnel : **02 31 45 29 66** — Courrier électronique : **Jean-Claude.Steckmeyer@lpccaen.in2p3.fr**

Institut national de **physique nucléaire**
et de **physique des particules**

www.in2p3.fr

3 rue Michel-Ange
75794 Paris Cedex 16

T. 01 44 96 40 00
F.01 44 96 53 40

JM/EA/VK/110209DIR

Monsieur Pierre Glorieux
Directeur de la section des
Unités de Recherche
AERES
20 Rue Vivienne
75002 Paris

Paris, le 4 mai 2011

Objet : Observations de l'IN2P3 sur le rapport d'évaluation du LPC Caen.

Monsieur le Directeur,

J'ai pris connaissance du rapport d'évaluation du Laboratoire de Physique Corpusculaire de Caen (UMR 6534). Je remercie le comité d'évaluation pour la qualité du travail accompli.

Les conclusions du rapport représentent un guide précieux pour la politique scientifique future du laboratoire. Des corrections factuelles ainsi que les remarques du directeur du laboratoire vous ont été transmises avec mon approbation par l'ENSI CAEN.

Recevez, Monsieur le Directeur, l'assurance de ma considération.

Jacques Martino,
Directeur de l'IN2P3