Minutes of the joint meeting of SPIRAL2 Scientific Advisory Committee (SAC) and GANIL Scientific Council (SC) held in Belgodère on 28 September 2011

SAC members present: N. Alamanos, B. Blank, G. De Angelis, W. Gelletly, D. Guillemaud-Mueller, M.N. Harakeh (Chair), T. Motobayashi, H. Stöcker, D. Vernhet
Absent with notification: W.F. Henning, F. Iachello, B. Jonson, W. Mittig
SC members present: D. Ackermann, N. Alahari, J. Benlliure, D. Haas, R. Janssens (Chair), E. Khan, W. Korten, R. Krücken; E. Lamour, X. Ledoux; A. Maj, O. Naviliat-Cuncic, T. Stöhlker
Absent with notification: T. Duguet, F. Gulminelli, C. Roy
Ex-officio: A. Cassimi, S. Galès, H. Goutte, M. Lewitowicz
Guest: F. Azaiez

The joint meeting of the SPIRAL2 SAC and GANIL SC (SAC&SC) started with a closed joint session on 28 September 2011 at 08:00 a.m. (see Appendix 1 for the programme of the open and closed sessions). S. Galès welcomed the members of both committees and in particular the new members of the GANIL SC. After a short 'tour de table', where all members introduced themselves, R. Janssens was appointed as new chair of the GANIL SC, after his nomination by the directorate of GANIL was approved unanimously by the members of the GANIL SC.

During the open session which started at 08:30 a.m., presentations of the status reports on all the technical projects connected with SPIRAL2 were presented preceded by a talk on the topic of Fundamental Interactions at GANIL, in which the opportunities for studying fundamental interactions and symmetries making use of low-energy radioactive beams were delineated. Earlier in the week, *i.e.* at the opening of the Colloque GANIL, S. Galès gave an overview of the recent progress with SPIRAL2 and the physics highlights achieved with the present GANIL facilities.

The SAC&SC were impressed with the progress made by all technical projects, but at the same time were worried to hear again that the budget for S3 from "EquipEx" (Equipment of Excellence) will be sufficient to realise completely only the first phase of the S3 separator-spectrometer and that it has not yet been possible to secure the rest budget needed to fully construct the S3 facility. The SAC&SC strongly urge both the S3 project group and the GANIL Directorate to continue negotiating with the funding agencies CNRS-IN2P3 and CEA as well as investigating (inter-)national options in order to secure the complete budget to ensure a full realisation of S3 together with its detection systems, low-energy beam line and related ancillary equipment. The SAC&SC were pleased also to hear that DESIR submitted again an application for EquipEx as advised during the last SPIRAL2 SAC meeting. Hopefully the application will be successful this time after it ended high on the list but wasnot funded last time.

The status reports that were presented in the open session were considered during the closed session that followed. The reports on the recommendations, agreed upon during the closed SAC&SC session, are given below.

Closed session

1. *Short Status report on SPIRAL2 and statistics of LoIs*

At the start of the closed session at 14:00, the following two presentations were made:

- Status of the SPIRAL2 Project by M. Jacquemet, and
- SPIRAL2 – Physics and Collaborations by M. Lewitowicz.

The SAC&SC were very pleased to see the progress made with the construction of Phase 1 of the SPIRAL2 project and the signing of collaboration agreements with a large number of institutes world-wide to participate in the construction of SPIRAL2 and its technical projects as well as to exploit the scientific opportunities that will be provided by the SPIRAL2 project. It seems now that Phase 1 of SPIRAL2 is secured although some worries as expressed above still exist regarding the timely completion of S3. The money obtained from "EquipEx" is not sufficient to complete the S3 project and in particular the ancillary equipment needs special attention. All efforts should be put to secure the completion of S3 in time to profit from the start of SPIRAL2 in 2013. The SAC&SC also had questions regarding the choice of the ion source, which at the start of SPIRAL2 will only be able to deliver one-tenth of the ion-beam intensity that has been promised at the start of the project. This limitation will certainly affect the competitiveness and consequently the scientific output of SPIRAL2 in the first few years of operation until an ion source capable of delivering 10 pμA of ^{48}Ca ion-beam current for LINAG. This is indeed very crucial.

The SAC&SC learnt during the presentations that the budget for SPIRAL2 Phase2 is also not fully secured yet, raising the possibility of long delays before this phase is realised. This is a very unfortunate development and can affect the scientific potential of SPIRAL2 considering that other international projects in this domain are going now as planned and could be realised in time to affect the window of opportunity of SPIRAL2. The SAC&SC would like to advise the directorate of GANIL to do all it can in spite of the national financial situation to convince the funding agencies CNRS/IN2P3, CEA, the regional authorities and international partners to help in securing the funding for a successful and speedy realisation of Phase 2. In particular, the building for DESIR, which has applied for EquipEx money, should be a high priority.

The SAC&SC strongly recommend that the GANIL Directorate works together with the DESIR collaboration to ensure that funds are obtained for building the DESIR experimental hall.

2. *Evaluation of status reports of the technical projects and Fundamental Interactions at GANIL*

Fundamental Interactions at GANIL **(**B. Blank):

The report on weak-interaction studies at GANIL summarises the ongoing activities and future plans for beta-decay studies. These include the search for scalar and tensor components of the weak interaction, through measurements of beta-neutrino angular correlations, and the test of the unitarity of the CKM quark mixing matrix, through the study of superallowed Fermi decays and of nuclear mirror decays.
The LPCTrap at GANIL has achieved a 2% statistical and 2% systematic uncertainty of the a_{bn} coefficient of the beta-neutrino angular correlation in the decay of ^{6}He. With the data already taken a 0.5% statistical accuracy can be reached. However, the measurement is limited so far by systematic uncertainties related to understanding of shake-off effects and the ion-cloud temperature. Substantial progress has been made towards a better understanding of these effects and the proponents should be commended for this progress. It remains to be seen what accuracy

will be achievable. However, there is potential for a world-leading contribution. Further studies of angular correlation measurements are planned for ^{8}He in which case the Doppler shift of the associated gamma-ray can be used to determine the angular correlation coefficient. This is another promising avenue that should be encouraged.
The study of 0^+ to 0^+ superallowed Fermi decays provides currently the best measurement of the V_{ud} quark-mixing matrix element. In a number of cases, but in particular for heavy nuclei, the precision of the corrected Ft value is limited by the knowledge of the isospin-symmetry breaking (ISB) corrections, for which predictions from different theoretical calculations vary dramatically. Precision measurements of decay branching ratios on ^{18}Ne and ^{38}Ca are planned for the near term. In the long-term measurements on heavier nuclei such as ^{66}As, ^{70}Br, and ^{78}Y are planned at DESIR. It has to be pointed out that these will not be able to contribute to the precise determination of V_{ud}. However, due to their higher sensitivity to ISB corrections they may enable to check the CVC hypothesis.
A very promising new area of investigation was presented, concentrating on the study of nuclear mirror-decays. Despite the fact that an additional measurement is needed, namely the Gamow-Teller to Fermi mixing ratio, measurements of mirror transitions can provide an alternative means to determine V_{ud} with at least the precision of the measurements using the decay of free neutrons. A number of possible candidate nuclei was presented that would become available at DESIR. The study of these decays seems to be a niche so far unique to GANIL and should be explored.
The weak-interaction programme that has been started at GANIL will be an important ingredient of the low-energy programme at SPIRAL2. The efforts should be strongly encouraged. It will be challenging to establish a competitive programme and one should concentrate on the uniqueness of the facility. At the same time collaboration within the weak-interaction community should be further exploited to establish a unique and competitive programme at GANIL. Teams involved in weak-interaction studies at GANIL may also want to prioritise the variety of topics in the case of insufficient manpower.

ACTAR status report (G. Grinyer):

The SAC&SC congratulate the collaboration for the continuing progress made and acknowledge the efforts to combine the design of ACTAR with the next generation CENBG time-projection chamber "2pTPC". Following the developments on the detector design, two different detector technologies, micromesh gaseous detectors (MICROMEGAS) or gas electron multipliers (GEMs), have been adopted and prototypes have been realised. Tests have been performed for the MICROMEGAS detectors and are planned for the GEMs prototype. The SAC&SC were also pleased to see the developments realised by the General Electronics for TPCs (GET) collaboration, in particular concerning the production of the ASIC chip as well as of other hardware. Concerning the realisation of the full TPC electronics, the SAC&SC encourage the proponents to provide a more detailed financial and time plan. The collaboration is also encouraged to present in the next meeting full simulations of the response of the newly developed detectors for the proposed physics cases.

DESIR status report (G. Ban):

The DESIR status report describes the developments during the past year. It addresses two major thrusts: i) design of the DESIR building and beam-transport sections, including infrastructure

requirements and technical aspects, and ii) advances for some of the major pieces of experimental equipment.
According to the present description of the *building consolidation*, the available experimental area is now very compact and it can only be assumed that scrutinising will be done by expert reviews as indicated, for example, for the optical design of HRS, the high-resolution isobar separator. The description of the radiation-safety considerations seems reasonable. In the discussion it became clear that the beam intensity limitations, *e.g.*, for ^{132}Sn will be acceptable for most experiments to be performed at DESIR.
Overall the progress of DESIR, both in its civil construction and infrastructure design as well as in its experimental facility development, has been noticeable over the past year. It is still necessary to consolidate and optimise the science programme to be able to provide those of the multitude of experiments initially proposed that are finally realised, fully or in part, with the necessary beam time. This is particularly true for the high-statistics, precision fundamental-interaction studies that are under special consideration at this SAC meeting. Realistic simulations, including detailed facility characteristics, need to be performed to establish the effects on the observables for certain assumed parameter values being measured or searched for, such as for example, the S and T coefficients in beta-decay correlations. With respect to the study of fundamental interactions it was pointed out that coupling of collinear spectroscopy with traps, and decay spectroscopy with polarised beams might be interesting.
The SAC&SC noted that the LUMIERE collaboration will move the setup to SPIRAL2 after the campaign at ALTO. Also, a question on applications at DESIR was raised. This topic may be developed further in the next report.
Funding of DESIR will be largely requested via the 2011 EquipEx call for proposals with potential approval in 2012. This time scale is appropriate as DESIR should be completed for phase 2 of SPIRAL2, but since it is a key instrument of SPIRAL2, alternative funding schemes may also have to be envisaged.

EXOGAM2 status report (G. de France):

The SAC&SC were impressed by the steady progress of the EXOGAM2 project. They congratulate the collaboration on the achievements, in particular, on the clarification of the final specifications and the precision with which the project is now defined. The organisation and distribution of tasks appear to also haeenve bclarified. The SAC&SC are pleased to see that the collaboration is working on the synergies (NUMEXO2) with NEDA and PARIS. Especially the decision that the GTS clock frequency will be higher than originally planned (*i.e.* 250 MHz instead of 100 MHz) allows integration of EXOGAM2 electronics with other detectors (*e.g.* PARIS). The SAC&SC encourage all three collaborations to unify the electronics as much as possible.
The status report is well written (although in very technical language, and maybe a bit difficult for possible end-users), and results and future milestones are well identified. The fact that more than three parties have already signed the collaboration agreement is also a positive point and makes the project an international one.
The outlined progress shows that this ambitious project is underway though with some delay. The projected completion date before 2014, when AGATA (1π) with EXOGAM2 compatible electronics will arrive to SPIRAL2, appears to be realistic although rather tight.
Though the major objective of the project is to replace the old electronics, which is losing commercial support, with a modern and advanced one, some measures for improvement in the

detector performance (angle determination, two-event separation etc.) and data-taking throughput should be addressed in the next report. This should be accompanied with giving examples of experiments in which EXOGAM2 will be the most important.

FAZIA status report (R. Bougault):

The collaboration has shown important progress during the last year, both in technical and managerial issues. The beam tests performed at different facilities with prototypes of the detection cells have provided impressive results concerning the performances of the new silicon detectors when they fulfil the specifications in terms of doping and channelling effects. Both identification techniques based on standard E-ΔE measurements and pulse-shape analysis with a single detector show outstanding resolutions in charge and mass. Moreover, most of the results obtained during the R&D phase have been published.
A minor concern is related to the detection thresholds that seem rather high, in particular when considering the typical energies of the SPIRAL2 beams. Other questions that have not been addressed in this report are the mass identification by time-of-flight and the feasibility of neutron detection.
At this moment the collaboration is ready to initiate the construction of a demonstrator made of 192 detection cells of Si-Si-CsI. The technical design of the detection cells and the mechanical frame has been completed and now the collaboration concentrates on the design and construction of integrated electronics.
Most of the previous concerns expressed by the SPIRAL2-SAC were answered in an adequate way. The damage of the silicon detectors was carefully investigated in dedicated experiments. The results indicate that only the most forward detectors could suffer some damage if ion implantation exceeds 10^7 ions/cm^2. The second concern was the massive production of silicon wafers with such demanding conditions on the doping uniformity and controlling channelling-like effects. At the moment the collaboration has enough of such detectors for the construction of the demonstrator (192 detection cells).
Concerning managerial issues the collaboration has decided to phase the construction of the detector and a first Memorandum of Understanding has already being signed by the major contributors to the construction of the first phase, the 192 detection-cell demonstrator. A concern common to most of the more complex and expensive detectors for SPIRAL2 is the funding for the full construction. Since this is probably not guaranteed at the moment, the collaboration should show the physics potential of the demonstrator when coupled to other devices like INDRA or CHIMERA.

GASPARD status report (D. Beaumel):

The SAC&SC find that GASPARD is one of the most important and useful devices for SPIRAL2. This is evidenced by the fact that 13 LoIs for day-one experiments at SPIRAL2 Phase2 plan to use GASPARD. The SAC&SC appreciate the progress made by the collaboration to finalise the simulation package, which now includes different γ-ray detector arrays (PARIS, AGATA, and EXOGAM2) as well as specific detector characteristics as the cooling layers. As already stated in the previous report the SAC&SC encourage the collaboration to provide for the next meeting full simulations of the performances of the apparatus in particular for the proposed day-one experiment. The SAC&SC appreciate also the R&D done on the solid hydrogen target

and encourage the group to finalise the tests in particular concerning the effects of the target inhomogeneity.
Since the identification of low-energy light particles is of crucial importance for reaction studies, the SAC&SC encourage the group to establish the method that should be employed in GASPARD. Solutions for the time reference needed for particle identification should be provided.
Moreover, the SAC&SC appreciate the development work done on the pulse-shape discrimination for mono- and multi-strip detectors and in general the undergoing R&D activity presently performed on different prototypes. The SAC&SC also appreciate the new Indian contribution to the development, but encourages the collaboration to converge on the final detector design.
A figure of merit could be provided by the collaboration to indicate the improvement in performance as compared with MUST2 for typical reactions of interest. Since the schedule is tight, it is desirable to define the time line and milestones of the project including the production phase.

NEDA status report (J.J. Valiente-Dobon):

The NEDA neutron wall is an important weapon in the arsenal of gamma-ray spectroscopists. Many of the experiments with AGATA or EXOGAM, or some combination of the two, will be aimed at nuclei far from stability. The nuclei of interest will be produced in reactions with small cross-sections and, in particular, a small fraction of the total cross-section. As a result there is a premium not just on the resolving power and position resolution of the gamma-ray detection system, but also on the selectivity and cleanliness of selection of ancillary systems. NEDA is one such tool. The SAC&SC appreciated the ongoing studies (including a submission to NIM) made to compare various detector materials and geometries to optimise the identification of 2-neutron events and the figure of merit. The group has also made good progress in exploiting the synergies with both EXOGAM2 and PARIS.
The SAC&SC welcome this addition to the detection systems. A final design (including approximate costs and choice of detector material) based on full scale simulations of a number of key reactions will be required at the meeting in SPIRAL2 Week in January 2012. This should include all the effects of scattering/cross-talk between segments of NEDA, the effects of using the time-of-flight between segments, estimates of the efficiency of *n*-*n* and *n*-*n*-*n* coincidences including true-to-random rates for both. It is important that this is done for several key, representative reactions. The SAC&SC would also like the collaboration to explore the possibility of combining efforts with the DESCANTES detector from TRIUMF.

PARIS status report (A. Maj):

The Paris detector has been presented many times in the SPIRAL2-SAC meetings. It is an important and complementary detector to AGATA. With PARIS, one can detect high-energy gamma rays and study in particular the decay of high-energy modes.
The physics case of PARIS was extensively discussed in earlier meetings and the community has proposed some flagship experiments. The technical aspects have been extensively discussed during the present joint SAC&SC meeting. Some tests have been performed with 4 phoswich detectors, composed of $LaBr_3$ crystals backed by NaI ones, that have been delivered by Saint Gobain this year. The general performance is very good. Both the LaBr3 crystals and the NaI

crystals were of varying quality resulting in differing energy resolutions, but the linearity was very good for all detectors. The result for the NaI crystals is not understandable since growing NaI crystals is an old technology, which should be completely under control. The SAC&SC realise that there has been contact with Saint Gobain about this issue but still advise the collaboration to work closely with Saint Gobain to improve quality control and ensure similar performance of the LaBr3 and NaI crystals that will be delivered in the future. On the other hand, the SAC&SC would like to congratulate the PARIS collaboration on this milestone, in which the concept of phoswich detectors for PARIS has proven to be the correct choice as indicated by the successful tests which reproduce the simulations made earlier.
The collaboration has a very well established R&D programme concerning the future steps to be fulfilled. This is described in the conclusions of their document. In particular, the collaboration plans to explore the performances of a cluster of nine phoswich detectors.
The PARIS collaboration is well organised. However, it is now important that the collaboration signs an MOU between the collaborating parties in the very near future and address the problem of the financial contribution of the different laboratories.

Neutrons for science (NFS) status report (X. Ledoux):

The spokesperson presented the status report on NFS, a very important facility for SPIRAL2 Phase1, as well as the main points of the MOU under negotiation.
The SAC&SC noted that the project is well under control. According to the planning presented, the design work is almost complete, and the construction of the various elements (converter, clearing magnet, beam dump, collimator, etc.) will be completed by the end of 2012. The financing of the project (about 3 M€) is also ensured by the partners in the MOU. The SAC&SC noted that two uncertainties remain, namely: a) the choice of the design of the proton beam-dump (in the case where the line is used with a thin target, which would mean that the beam is not stopped in the target), and b) those uncertainties related to the final construction and possible parasitic neutron contribution from scattering and reactions in building material and equipment. Risks of delays are, however, considered to be small at this stage.
Concerning the general description, it was noted that there was a lack of information presented on the end of the line (TOF line and detectors), probably due to the fact that this equipment is mostly already available, and has been reported on in earlier meetings. Nevertheless, in a future meeting, a full description of the whole line and its expected performance should be given.
In relation to potential future experiments, it would be nice to present in 2012 a study of the facility's capability for experiments (if already done, an update would be good), in comparison with other similar infrastructures, taking into account of existing European projects of infrastructure support (*e.g*. ERINDA under FP7 EURATOM). The importance of being able to work with trans-uranium elements was stressed. On another level, the potential for the study of materials damage using the proton/deuteron beam should be explored further at a later stage, although it simply constitutes a potential use at the design stage, due to the low fluxes available.
The fact that nine parties are ready to sign the MOU was recognised as a positive step towards the full implementation of the project.

S3 status report (H. Savajols):

The S3 status report presented at this meeting has shown important progress with respect to the previous report. In particular, the optical layout of the spectrometer-separator has been fixed and

validated by the steering committee. All optical elements are designed or are in the process of being designed. Progress has also been made regarding the target. A first real test has been performed with a prototype for the actinide targets, where convincing results have been obtained. From the collaboration side, the Leuven team has joined "en force" the project and is strongly engaged in the low-energy branch. This contribution is particularly important in view of the present funding situation. Finally, the proposed staged approach, especially for the detection setup, seems to be reasonable in view of the funding status.
The future steps should include simulations of the dipoles with fringe fields. It is not clear to which extent this will modify the resolutions expected for S3. High-intensity tests of other targets, in particular very robust targets which are supposed to take the full primary beam intensity, should be performed. The fact that S3 can really take the full primary beam intensity of LINAG is an important topic to verify. Finally, it seems to be timely to establish a complete detailed project schedule which clearly shows the critical points and milestones.

3. *Topics, date and place of the next meeting*

The **next joint meeting** of the SAC&SC will take place on **Thursday and Friday 26-27 January 2012** in Caen and will be part of the **SPIRAL2** Week, *i.e*. 23-27 January 2012.

The following topics will be discussed at the next joint SAC-SC meeting:

- Evaluation of some of the status reports of the SPIRAL2 technical projects and detectors
- Final evaluation of the LoIs for SPIRAL2 Phase 1
- Merging of SPIRAL2-SAC and GANIL SC into one advisory board for GANIL.

4. *AOB*

A suggestion of a letter to GANIL management asking that equipments for SPIRAL2 be supported was shortly discussed. It was agreed that the chairpersons of the SAC and SC will coordinate this further.
It was remarked that as this was a joint meeting of the SAC and SC, issues connected to existing GANIL should, in principle, have been discussed. The agenda of this meeting was set too early to take this into consideration. Future joint meetings of SAC and SC could indeed consider issues of both existing GANIL and SPRAL2.
There being no other points on the agenda the meeting was closed at around 18:00.

Appendix 1
Agenda of the joint SPIRAL2 Scientific Advisory Committee (SAC) and GANIL Scientific Council (SC) meeting on September 28, 2011

Wednesday September 28th; Belgodère, Corsica
08:00 - 08:30 Closed joint session GANIL SC and SPIRAL2 SAC
- Presentation of new SC members
- Appointment of the SC Chair

Open Joint session of SPIRAL2 SAC and GANIL SC
Fundamental interactions and SPIRAL2 detectors
08:30 - 10:40
Chair: R. Janssens, Chairperson of the GANIL SC

08:30 - 09:00	Fundamental Interactions at GANIL - B. Blank (25'+5')
09:00 - 09:25	ACTAR status report - G. Grinyer (20'+5')
09:25 - 09:50	DESIR status report - G. Ban (20'+5')
09:50 - 10:15	EXOGAM2 status report - G. de France (20'+5')
10:15 - 10:40	FAZIA status report - R. Bougault (20'+5')
10:40 - 11:00	*Coffee Break*

SPIRAL2 detectors
11:00 - 12:45
Chair: M. N. Harakeh, Chairperson of the SPIRAL2 SAC

11:00 - 11:25	GASPARD status report - D. Beaumel (20'+5')
11:25 - 11:50	NEDA status report - J.J. Valiente-Dobon (20'+5')
11:50 - 12:15	PARIS status report - A. Maj (20'+5')
12:15 - 12:30	NFS status report - X. Ledoux (12'+3')
12:30 - 12:45	S3 status report - H. Savajols (12'+3')
12:45 - 14:00	*Lunch*

14:00 - 18:00 Closed joint session of the GANIL SC and SPIRAL2 SAC
- Status of the SPIRAL2 Project - M. Jacquemet (20' +10')
- SPIRAL2 – Physics and collaborations - M. Lewitowicz (15'+10')
- Evaluations of the topics presented at the open session
- Place, date and topics of the next joint SAC&SC meeting
- AOB