

Minutes of the meeting of SPIRAL2 Scientific Advisory Committee (SAC) held at GANIL on 24 and 25 June 2010

Present: N. Alamanos, B. Blank, G. De Angelis, W. Gelletly, D. Guillemaud-Mueller, M.N. Harakeh (Chair), W. Henning, F. Iachello, W. Mittig, T. Motobayashi, D. Vernhet
Ex-officio: N. Alahari, S. Galès, M. Lewitowicz

Absent with notification: B. Jonson, H. Stöcker

The SPIRAL2 SAC met on June 24-25 at GANIL. The open session was held on June 24. In this session, status reports on SPIRAL2, the physics and collaborations around it, S3 and NFS were presented as well as a report on the collaboration workshop that the DESIR collaboration had held at Leuven University on 26-28 May 2010. This was followed by presentations of the updated and new letters of intent (LoIs) for day-one experiments made by the S3 and NFS collaborations. See Annex 1 for a detailed programme. The SAC was pleased to see that the wide interest in the community has led to six new LoIs in addition to the 16 that were presented earlier. During the presentation of the status of the SPIRAL2 project it was learned that the public inquiry will take place between June 14 and July 15. It had been foreseen that the permit for construction would be issued in May 2010, but there will be 4 to 5 months delay because of the delay in the public inquiry. However, most parts of the LINAG accelerator will be ready before the fall of 2011 and the first beams from the LINAG will be delayed by a few months relative to the earlier prognosis of February 2012. Beam tests for the second phase are now foreseen for the middle of 2014. It also became clear that the utilities and equipment of the S3 and the NFS halls and the DESIR building are not yet financially secured.

The status reports that were presented in the open session were considered together with the 22 LoIs for day-one experiments that were submitted by the S3 and NFS collaborations. The reports and recommendations which were made during the closed session are given below.

Closed session

1. *Status of the SPIRAL2 Project*

The SAC was very pleased to hear about the progress made with the construction of the various parts of the LINAG. All seem to go according to plan. The SAC also took note of the incurred delay in the issuing of the permit for construction that in turn will lead to a few months delay in the delivery of the first beams. This is a reasonable delay that does not impact strongly on the project. However, it was quite worrying to learn that the utilities and equipment of experimental halls NFS, S3 and the DESIR building, which are very important for the scientific programme, are not yet fully included in the baseline project. Contingency money could be used to alleviate part of the problem, but doing that may endanger the second phase of the project. It is also important that the decision regarding the construction of DESIR is taken before March 2012 to be effective in exploiting the scientific opportunities that will arise with the completion of phase 2 of the project. It should be noted that the estimated cost of the DESIR building is about 6.5 M€ and its beam lines and facilities 4 M€. This should be seen in perspective; the cost of the experimental set-ups committed by members of the DESIR collaboration amounts to 4.5 M€.

The SAC strongly recommends that the GANIL Directorate and SPIRAL2 Management maintain

at a high priority level their request to the funding agencies regarding the financial means needed to include in the reference project the NFS and S3 halls and equip them fully with the utilities that will ensure their proper functioning when Phase 1 starts. Also, funds should become available in time to allow the construction and full refurbishing of the DESIR experimental hall before Phase 2 starts.

2. *Theory for SPIRAL2*

A report was presented by Héloïse Goutte on the Theory-Experiment Phase 1 Workshop held at GANIL in conjunction with the SAC meeting. The SAC expressed a very positive opinion about this initiative which brought together theorists and experimentalists interested in the physics of SPIRAL2. The SAC encourages the theory group at GANIL to continue along this direction by organising additional workshops and to extend the collaboration between theorists and experimentalists across Europe and indeed the world. This is the first step in the development of a theory programme in the physics of Radioactive Beam Facilities.

The SAC also heard that a programme of collaboration between France and the US, FUSTIPEN, has been funded by the US Department of Energy for travel and visit by US scientists to GANIL. As expressed in the previous report of January 2010, the next and final step should be the formation of a European effort involving several European Countries, EUTIPEN. This initiative has been included in the NuPECC Long-Range Plan and should work coherently with existing structures, in particular ECT*.

The SAC entertained also the possibility, as an intermediate step, of a joint theory programme involving the two facilities GANIL-SPIRAL2 and GSI-FAIR-NuSTAR. In whatever form it may take place, the SAC strongly supports any theory effort aiming at elucidating the physics of SPIRAL2. This effort should be in coordination with existing initiatives and its aim should be of enlarging current efforts with the addition of positions for young researchers.

3. *Evaluation of the technical status reports*

The **DESIR facility** status report:

A report was presented by Dr. P. Campbell on the SPIRAL2-DESIR facility physics workshop held in Leuven, Belgium, 26-28 May, 2010.

The SAC found the scientific content of the report excellent, with its three main subjects:

- Beta-decay spectroscopy and associated detection techniques (BESTIOL facility)
- Collinear laser spectroscopy and related studies of spins, charge radii and nuclear moments (LUMIERE facility)
- Trapped-ion techniques for mass measurements and studies of fundamental interactions

The workshop report touched upon a large number of interesting developments, such as the neutron-multiplicity and neutron-energy arrays, the anticipated increase in sensitivity of up to 6 orders of magnitude expected for collinear laser spectroscopy at LUMIERE, and many others with regard to ion and atom trapping, etc. Obviously they will be presented and justified in detail in the upcoming proposals for Phase-2 experiments. The SAC is looking forward to the detailed plans for both, the science programme and the instrumentation. Unique aspects of the latter will allow the SPIRAL2 programme to obtain a leadership role in the science. This facility promises to be one of the highlights of SPIRAL2.

During the workshop, a collaboration agreement was signed by which members of the international community committed themselves to providing major equipment to be installed permanently or for long periods in the DESIR hall. The combined estimated cost of the equipment is about 4.5 M€. This is to be compared with the cost of the building and utilities of 6.5 M€ and beam lines of about 4 M€. Part of the equipment committed by the collaboration already exists or is presently being built and commissioned. Other parts are not funded yet and are at the stage of proposals. The SAC strongly advises the collaboration to secure funding for the missing parts by applying to the appropriate agencies.

The SAC strongly endorses the signing of the agreement and encourages the successive writing up of a Memorandum of Understanding.

Neutrons for science (NFS) status report:

The NFS collaboration is moving steadily towards a satisfactory design for the facility. It is now properly organised with individuals having clearly defined responsibilities for various aspects of the facility. They should continue to press ahead with all due speed.

There is a significant number of related LoIs, which would require large amounts of beam time if they are to be successful. The SAC recalls that more than one beam line was considered at an earlier stage. The SAC would like to be satisfied that this decision has been thoroughly considered not just from the point of view of any background generated and the costs but also in terms of satisfying the latent demand. The Collaboration is advised to look again into the possibility of constructing and using several neutron channels at different small angles.

Many of the LoIs justify their proposals in terms of a general appeal to the application of the data in the context of Generation IV and fast breeder reactors and also healthcare applications. It would be more convincing if, in the future, more specific reference is made to examples of why the data are needed and how they would be used.

The SAC notes that Dr. B. Band'Etat is responsible for measurements related to materials. No LoI has been put forward in this area. Accordingly the SAC would like to see a status report on progress and prospects in this area and a presentation of the CIRIS 2 set-up at its meeting in January 2011.

The SAC took note that the commissioning of NFS will take place in November 2012. It would appreciate receiving an overview of the total budget involved in the MoU signed by the collaboration.

S3 status report:

The SAC was impressed by the overall progress made towards a technical design of S3 and its target stations that can be finalised in the near future. It is very encouraging that the simulated folded transmission is greater than 60%. The general strategy to rely on an expert committee for the final choices seems a good way to reach the best decision. However, the experts should meet in the very near future in order to be able to remain within the time schedule. A decision has to be made soon regarding the cryogenics, *i.e.* whether to rely on the cryogenics of SPIRAL2 or have individual cryo-generator for S3. Furthermore, the use of the S3 energy-dispersive image plane for energy determination should be considered in order to leave open the possibility to install position-sensitive tracking detectors there.

In a future meeting of the SAC, the detection systems for S3, with a discussion of the use of existing or new devices and of electronics, should be developed. In addition, the collaboration should start thinking about a commissioning strategy.

4. Evaluation of the LoIs

LoI_Day1_1: Fast ion-slow ion collisions - FISIC project

E. Lamour *et al.*

The general physics programme of this project is considered very interesting, original and challenging. This experiment will provide quantitative results in controlled initial conditions for the first time in this domain of physics, and is strongly supported by the SAC. It is an experiment that needs important special equipment in the S3 layout, implying important investments. The SAC fully endorses funding requests which should be done soon.

Some technical questions should be clarified. As vertical focussing of the beams is mandatory to achieve the required luminosities, non-interceptive beam diagnostics is essential and should be looked into as soon as possible. Furthermore, it should be shown that the rotating stripper target for S3 will withstand the intensities needed. A more detailed analysis of the beam dump between D1-D2, as well as that of the used beam, should be presented. An important parameter in the experiment is the collision angle. A scheme how to change this angle without major rearrangement should be considered.

The SAC has noted the time line proposed by the proponents and strongly advises them to have a good understanding with the S3 spokesperson so that the installation of the FISIC complex equipment does not interfere with the commissioning of S3. The experiment can be scheduled after the commissioning of S3. Therefore, the SAC advises the collaboration to make a detailed roadmap in consultation with the S3 spokesperson.

LoI_Day1_2: Production and spectroscopy of heavy and super-heavy elements using S3 and LINAG

P. Greenlees, K. Hauschild, A. Korichi, Ch. Theisen, S. Christelle *et al.*

The SAC acknowledges the progress made in the preparation of experiments with heavy and superheavy elements at S3. It thinks that these experiments are very well-suited for the first experiments to be conducted at S3 and the physics case is sound and interesting.

In particular with regard to the update provided for the June 2010 meeting, the SAC feels that proposing the study of isomers in ^{254}No as a first specific experiment is a prudent and scientifically very interesting choice. The ^{48}Ca -induced fusion reaction has a relatively high cross section for this heavy-mass region, which has led to some basic nuclear structure knowledge from previous experiments. But key information is inconsistent. More importantly, the ^{254}No nucleus sits right at the deformed $N=152$ shell gap and the potential discovery of, *e.g.*, the yet unknown neutron 2-quasi-particle isomer(s) will provide crucial information on effective interactions. Little is known for the relevant single-particle states in this heavy-mass region and new experimental information will be important for model calculations of super-heavies. In addition, there are some indications that hexadecupole deformations may be significant which might pull down the missing 2-quasiparticle states and provide a better chance to find them.

The authors' concern that, by the time (~2013) that SPIRAL2 and S3 will be operational, some of this information might already have become available has some merit. But the high beam

intensities needed for advanced studies will most likely only be available from the mid-term future at SPIRAL2; the S3 mass spectrometer will provide good efficiency and high background reduction. In the SAC's opinion it is unlikely that most of the important information will have been measured and encourages the collaboration to continue planning for the proposed studies.

The SAC has some experimental suggestions for the collaboration to consider, if it has not already done so. The first concerns the possibility to develop a fast event trigger to sweep off the beam once a relevant event has been tagged by the focal-plane detector. The known isomers have several hundreds of microseconds (or, for the known 8^- state, even hundreds of milliseconds) half-lives which suggest that this approach might be (at least for part of the studies) helpful. The second concerns the fact that at the F3 focal plane of the S3 mass separator, the energy (velocity) dispersion allows to establish recoil momentum (and reaction mode) of events. This is presently considered as a valuable tool to set energy (velocity) slits and thus reduce background. On the other hand, if a (very thin and only mildly interfering) detector system could be developed it might allow a broad(er) range operation which could provide important information on reaction processes that have generated the nuclei observed in the mass spectrum at the S3 focal plane. Finally, the SAC encourages the collaboration to study more in detail the detection setup needed at the S3 focal plane including detectors for conversion electrons which might be important for the study of heavy elements.

The SAC also strongly suggests to the collaboration to investigate the possibility of a first study with a more ambitious goal to produce nuclei of a superheavy element where one can take advantage of S3 as a mass separator with good mass resolution, notably to pin down the masses of the "Dubna chains". We acknowledge that this is not necessarily a day-one experiment; however, it could nonetheless run rather early after the start-up of LINAG and S3.

LoI_Day1_3: In-source resonant laser ion spectroscopy of ^{94}Ag

LoI_Day1_4: In-source resonant laser ion spectroscopy of the light Sn isotopes $A = 101-107$

LoI_Day1_5: In-source resonant laser ion spectroscopy of $Z \geq 92$

I.G. Darby *et al.*

The SAC appreciates the strategy adopted by the collaboration and the significant progress made thanks to the test bench available in Louvain-la-Neuve. The tests of the selective production of Ag isotopes have been very successful with measurements of Ag isotopes from $A = 96$ to 102. The preparatory work for the coming day-one campaign seems to be in an excellent shape for the element silver. The prospects for production of the most interesting isotope, ^{94}Ag , are slightly disappointing but the expected gas cell rate of 0.14 pps seems to be a "worst case" estimate. The successful measurements elsewhere with similar rates is, however, encouraging and one feels more and more that ^{94}Ag could be one of the first experiments since the efficiency for the Laser Gas Cell, which will be installed at S3, could be improved. The SAC encourages a stronger communication between the Jyväskylä and the SPIRAL2 programmes which could be of mutual benefit.

The SAC also appreciates the work on possible ionisation schemes for a more efficient production of Sn isotopes, looking forward to continue to be updated on this development. The same is true for the test experiments on ^{215}Ac which is planned for the spring of 2011.

LoI_Day1_6: Single-proton states and proton-neutron interaction in ^{100}Sn
L. Cáceres, F. Azaiez *et al.*

The SAC appreciates the significant progress made by the collaboration in updating the LoI as well as the strategy adopted to reach the proposed goals, which now appear much more focused. The SAC appreciates also the effort done in providing a detailed estimate of the production rates as well as in evaluating the contamination from competing reaction channels. It considers the proposed solution based on the use of a gas catcher, a gas cooler and a high-resolution spectrometer (added to S3) appropriate even if there are doubts whether with this certainly interesting set-up this LoI can still be considered a day-one experiment.

The SAC finds the objectives of the LoI very interesting and encourages the collaboration to continue. Concerning the Phase 1 of the LoI, the SAC encourages the collaboration to complete the simulation also for the low-energy branch separator. Concerning the Phase 2 ^{58}Ni beam, the SAC asks the proponents to clarify the gain factor with respect to the present GANIL infrastructure.

LoI_Day1_7: In-beam gamma spectroscopy of neutron-rich nuclei studied with PARIS at the intermediate focal plane of S3
I. Stefan *et al.*

During its meeting on September 11, 2009 the SAC examined this letter of intent. The physics motivation of this proposal was considered good. The experimental method presented is to take advantage of the high-intensity primary beams of SPIRAL2 to produce neutron-rich nuclei following deep-inelastic or quasi-fission reactions. These neutron-rich nuclei can be used in secondary reactions at the mid-point focal plane of S3 to populate excited states in even more neutron-rich nuclei. As mentioned in the LoI, the cross sections near zero degrees are crucial for the proposed method of producing beams for secondary reactions. The question debated in the SAC meeting was whether this method can compete with or is superior to other methods, like fragmentation-based production of exotic beams, in populating excited states with good statistics. The SAC advised the collaboration to study the exit-channel properties of the $^{48}\text{Ca}+^{238}\text{U}$ reaction at existing facilities. An experiment was performed by this collaboration at GANIL using the VAMOS and EXOGAM spectrometers to measure the production of neutron-rich nuclei with a 10 MeV/u ^{48}Ca beam impinging on a thin 0.1 mg/cm^2 ^{238}U target. Preliminary results were presented during the SAC meeting, including the observation of a ‘new’ gamma-ray transition. The analysis of this experiment should allow a precise study of the production cross sections for exotic nuclei and the background due to beam tails of other charge states to be investigated.

The SAC congratulates the collaboration for this experimental investigation and looks forward to a quantitative analysis of the results presented.

LoI_Day1_8: Shell structure, isospin symmetry and shape changes in $N = Z$ nuclei; Coulomb excitation of ^{104}Sn : probing large-scale shell model calculations; Coulomb excitation of the T=1 bands of the odd-odd ^{62}Ga , ^{66}As and ^{70}Br nuclei.
G. De Angelis, B. Wadsworth *et al.*

This LoI consists of three parts with three different physics motivations. Although all three measurements are interesting, the SAC suggests that the proponents should order their priorities and decide on which experiment to do first. The SAC found particularly interesting the proposed

measurement of the $B(E2;0^+ \rightarrow 2^+)$ value in ^{104}Sn . Also, the SAC suggests that, if possible, it should be combined with a measurement of the $B(E2)$ value in ^{106}Sn which, at the present time, has a large error bar. This will also serve as a calibration for the new measurement in ^{104}Sn .

LoI_Day1_9: Quadrupole Moments of isomeric states using the Tilted-foils Technique at S3
G. Georgiev *et al.*

It is clear that measurements of moments are important in nuclear structure physics. It is particularly difficult to determine the sign of the quadrupole moment and the methods proposed here are very important in that regard. It is based on the tilted-foil polarisation method, which is particularly well suited to ^{96}Pd , which is close to the mid-shell. The experiment requires both a reduced size of the beam spot and the selection of a single charge state which should be available on the S3 beam line. All of the techniques and expertise are in place for a potential programme of measurements.

The SAC thought that the question addressed in this day-one experiment, namely how good the seniority quantum number is in these nuclei, is an interesting one and would make a good experiment to start with.

LoI_Day1_10: Precision study of the superallowed beta decay of heavy odd-odd $N = Z$ nuclei
B. Blank *et al.*

The SAC is of the opinion that the main contribution of this proposal will be a test of nuclear models to understand the Z dependence of the nuclear correction factor. This is justified by CVC and the recent observation that the CKM matrix is unitary. This will allow very precise comparison of model predictions and experiment. This implies that nuclear theory should be considered from the start, and be part of the proposal. This subject could yield one of the early results from the DESIR Facility with beams from either SPIRAL2 or from S3. The expected production rates for the nuclei proposed to be studied have been estimated with the PACE code, which the proponents point out that it gives an overestimate. The resulting production yields are, however, sufficient for a start of the programme where the nuclides of ^{66}As can be measured. It might be a bit difficult to get enough yields for ^{98}In , but this would only give a minor effect on the programme in general. The needed purification of the beams with a Penning trap mass spectrometer is planned. The measurements of branching ratios will be done together with LPSC in Grenoble and the Spanish-UK collaboration. The very precise Q -value of the decay, to be indirectly measured with the MLL trap through precise mass measurements, is an indispensable complement to the life-time. This may considerably delay the evaluation of the data. It will be necessary to re-evaluate the timelines of the proposal once the date of the installation of the trap in DESIR Hall is better known. In general, it seems that this group has the background to bring the proposed experiment to success.

LoI_Day1_11: ^{100}Sn factory – studies of the structure of nuclei in the ^{100}Sn region
D. Seweryniak *et al.*

The proposed experiment is valuable in connection with alpha-clustering in medium-heavy nuclei. In view of its feasibility and scientific impact, the experiment is one of the best candidates for a day-one experiment.

The expected production rate is similar to the one at RIKEN RIBF. Careful consideration on competitiveness to possible measurements at RIKEN RIBF is necessary. A question is if the flight time of the product to reach the detector after magnetic analysis is short enough to measure alpha-decays with the expected short life-time.

LoI_Day1_12: Fragment angular distributions in neutron-induced fission of actinide nuclei
L. Tassan-Got, L. Audouin *et al.*

The proponents of this LoI are considering to perform the experiment at another facility in the very near future. Therefore, they decided not to present it at this SAC meeting. At the same time, they did not wish to withdraw it. This LoI should be presented at the next SAC meeting if it is to remain under consideration.

LoI_Day1_13: Study of the pre-equilibrium process in the (n,xn) reaction
X. Ledoux *et al.*

The SAC has noted the progress in the design of this experiment especially for the measurement of the neutron energy spectra in coincidence with the neutron multiplicity using NE213 scintillators and the CARMEN detector. It recommends that the background seen by the neutron detector CARMEN, which impacts the precision of the measurements, should be studied in detail.

The SAC felt that the experiment could certainly be carried out reliably and successfully in the early stages of the facility operation.

LoI_Day1_14: Comparison between activation and prompt spectroscopy as means of (n,xn) cross section measurements
M. Kerveno *et al.*

Since this LoI was not presented but also not withdrawn, the SAC has no particular comments at this time. It will be important for this LoI to be presented in January 2011, if it is to remain under consideration.

LoI_Day1_15: Fission-fragment distributions and neutron multiplicities
D. Doré, F. Rejmund, M. Aïche *et al.*

The proposal makes the case for additional accurate fission data for actinides. It proposes to measure neutron-induced fission-fragment characteristics and neutron multiplicities over the energy range from 500 keV to 20 MeV incident neutron energy.

The justification arises on the one hand from theoretical studies of the fission mechanism: Scission point properties are critical for a full understanding and will be reflected in the fission fragment distributions, the total kinetic energy and the sharing of energy between the fission fragments, and these in turn will determine neutron multiplicities. As shell effects are supposed to disappear with excitation energy, studies as a function of incident neutron energy are important.

The second motivation arises from the need for accurate data for nuclear applications. Fission-fragment mass distributions determine the production of delayed neutrons, the major ingredient to control reactivity. They also determine the level of fuel poisoning. Going beyond thermal fission

in future reactors, in accelerator-driven systems, and in transmutation devices will require additional accurate data on specific reference nuclei and on the minor actinides.

The SAC appreciates the work done on this LoI since the last presentation to improve the experimental set-up for a better Z determination and in terms of total detection efficiency. The experimental method proposed now is, in principle, well-established: fission fragment coincidences that provide kinetic energy for each fragment and time-of-flight. From conservation of momentum and relative flight time, information on pre- and post-evaporation masses is obtained; the nuclear charge can be determined by an energy-loss measurement. Key issues are the respective resolutions. The authors report that relative mass resolutions of about 1.5 to 2 mass units is obtained for each, the pre- and post-evaporation mass. This puts a large error bar on the neutron multiplicity which is obtained from their difference.

In the subsequent SAC discussion, the authors argued that, while this is true for an individual fission event, the centroid of a multiplicity peak can be much better defined with statistics. The SAC has doubts since the experimental mass distribution (given the resolution of ~ 1.5 mass units) will be rather continuous and the centroid method will not be applicable. If this can be clarified in the future proposal, the SAC invites the authors to submit the letter. If not, an alternative (or improved) detector setup needs to be proposed, which is optimised for the best A and Z resolution. Alternatively, the authors have to make the case why the limited mass resolution would suffice for the goals of the proposal.

LoI_Day1_16: Proton and deuteron induced activation reactions

P. Bém, M. Avrigeanu, U. Fischer, S.P. Simakov *et al.*

The aim of these experiments is to measure p and d interaction cross sections for an ensemble of elements which are important for radioprotection calculations in the energy range from the threshold of activation up to 40 MeV. During its meeting on September 11, 2009 the SAC examined this letter of intent and agreed that these measurements are important and that the existing tabulated data deserve strong improvement. In response to comments made by the SAC, the proponents have examined the radioprotection issues and brought clear answers to most of the SAC's requests.

The SAC advises the authors to contact the relevant GANIL teams in order to verify the practical feasibility of these measurements and to ensure that it will be possible to remove the irradiated foils from GANIL for further analysis.

LoI_Day1_17: Detailed spectroscopy of proton-rich nuclei around $N=82$ through recoil decay-tagging and proton emission from isomeric states

C. Petrache, P. Woods, D. Seweryniak *et al.*

Isomeric states provide us in general with a great opportunity to study nuclear states with high-purity single-particle configurations. Production of isomeric states enables clean spectroscopy of lower states as well.

Therefore, the proposed isomer study will be of importance when the new capability of isomer production at SPIRAL2 will be realised. To have high priority as a day-one experiment, the physics motivation should be clarified, the goal more clearly specified with focus on the most interesting cases and the impact of the proposal on nuclear-structure physics in the relevant region assessed.

LoI_Day1_18: Evolution of the $Z=40$ sub-shell while approaching the π -dripline / Laser spectroscopy of neutron-deficient zirconium isotopes with SPIRAL2

B. Bastin *et al.*

Although the proposal was not very well written with some essential information missing, the SAC found the discussion following the presentation very useful. The SAC considers the science and experimental approach of this proposal of high quality and strongly supports the development of the corresponding proposal.

The proposal aims at the laser-spectroscopic study of the hyperfine structure of neutron-deficient zirconium isotopes, in particular ^{80}Zr , with its (doubly-magic) sub-shell closures but very large inferred ground-state deformation, and its neighbouring isotopes. The focus for the initial phase is on isotope shifts and ground-state deformation utilising the recently developed technique of laser-ionisation spectroscopy. Optical resonance(s) excitation and laser auto-ionisation of stopped zirconium atoms in a gas cell allow to extract isotope shifts. Subsequent studies (on odd isotopes) can provide nuclear moment measurements with an RF trap behind the gas cell. Lifetime and nuclear decay spectroscopy will be possible if the ions are transported through the high-resolution mass separator following S3 to the planned S3 tape station.

There is strong scientific interest in understanding the structure of this proton-rich mass region and in extracting information on the collective properties as well as on the relevant single-particle states. This new approach (and its predicted future sensitivity based on ongoing technical developments) is particularly promising for the refractory zirconium isotopes (and other refractory elements) where traditional ISOL techniques usually work poorly. With the beam intensities expected for SPIRAL2 and the channel separation and mass determination of S3, this new method creates the opportunity of a very powerful, largely unique nuclear-structure programme for ground-state properties and moments (and possible decay spectroscopy). It will, in particular, allow to extend the study of nuclei of refractory elements far into the proton-rich and neutron-rich regions.

The SAC strongly supports the development of this overall programme. It finds the focus on the ^{80}Zr region for the day-one studies excellent. The calculated production cross sections render this first study very feasible. The added future capabilities through an RF structure and coupling to the high-resolution mass separator and S3 tape station suggest a step-wise approach and careful planning. However, given the unique science opportunities that the concept promises it might be useful to start on these additional conceptual and technical developments early, perhaps also by encouraging additional groups to join.

LoI_Day1_19: Letter of Intent for use of STEFF spectrometer at NFS

A.G. Smith *et al.*

It is unfortunate that no one attended the SAC meeting to present the LoI. There is insufficient detail in the written LoI for it to be judged and the SAC members would have a number of questions. Although the SAC felt that the information to be gained would be useful it was not possible to judge if the claims made for such parameters as the A and Z resolution are justified. It is essential that the LoI is presented at the next SAC meeting. The material presented should show clearly that the proponents can meet their specifications. They should also present evidence to show that the applications they mention really demand the data.

Up to now only a single beam line is proposed for NFS. This LoI would make large demands on beam time. This is something that should also be addressed within the NFS collaboration and in the presentation to be made in January 2010.

LoI_Day1_20: Direct measurement of (n,xn) reaction cross sections on ^{239}Pu
G. Bélier *et al.*

The SAC considers that a good knowledge of (n,xn) reaction cross sections is very important for the future design of nuclear power plants.

The proposal aims to perform a direct measurement of this reaction on ^{239}Pu by using the neutron ball CARMEN together with a highly efficient fission active target. This active target will act as a fission veto. The SAC finds that the use of this veto should guarantee a good determination of the different (n,xn) cross sections.

Moreover, it considers that the $^{239}\text{Pu}(n,xn)$ cross-section determination should provide a good test of the technique for future experiments and will constitute an interesting demonstration of the feasibility of such measurements.

LoI_Day1_21: Light-ion production studies with Medley
S. Pomp, C. Gustavsson *et al.*

The SAC is very positive about this experiment which envisages the measurement of double-differential cross sections for neutron-induced light-ion (p , d and alpha particles) production from a number of isotopes relevant for medical, electronics, construction-material and energy applications. Data at low neutron energies, in the range of 14 to 40 MeV, are scarce and the only measurement at neutron energies comparable to those that will be available at NFS suffers from high thresholds for proton and alpha detection. The proponents propose to use an upgraded version of the Medley set-up of the The Svedberg Laboratory, which has been effectively used in the past to measure light-ions (p , d , t , ^3He and α particle) in neutron-induced reactions. Eight telescopes, each having ΔE_1 and ΔE_2 silicon surface-barrier detectors (SSBD) backed by a CsI(Tl) detector, are used to detect the light charged particles. To alleviate shortcomings of earlier measurements, a 25 μm SSBD will be used to lower the identification thresholds for protons and alphas to 1.3 MeV and 5 MeV, respectively. To obtain reasonable count rates, it is proposed to use targets of thicknesses between 12 to 20 times that of the ΔE_1 SSBD. This raises concerns regarding the target-thickness corrections for the light-ion energy spectra. The SAC asks the proponents to present simulations for such corrections during the next SAC meeting.

LoI_Day1_22: Fission fragment angular distribution and fission cross section measurements relative to elastic np scattering with Medley
S. Pomp, C. Gustavsson *et al.*

The authors of this proposal envisaged the measurement of cross sections and angular distributions for neutron-induced (n,p) fission of ^{238}U . The measurements will be carried out using an adapted version of the Medley set-up. This set-up has recently been used for measuring double-differential cross sections for light-ion (p , d , t , ^3He and α particle) production in carbon induced by 96 MeV neutrons at the cyclotron facility of the Uppsala laboratory. It has

demonstrated its efficiency for measurements of this type and it is obviously well suited to the proposed investigations.

These measurements could provide absolute cross sections which are probably more difficult to determine in other experiments *i.e.* (LoI_Day1_15). The SAC acknowledges the quality of this proposal and expresses its support to the authors in their quest to construct or find the missing PPAC detectors.

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

The **next meeting** of SPIRAL2-SAC will be on **Wednesday, Thursday and Friday 26-28 January 2011** in Caen and will be part of the SPIRAL2 week, 24-27 January 2010.

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

- Evaluation of the status reports of the new SPIRAL2 detectors
- Evaluation of the LoIs Phase 2
- Theoretical developments for the SPIRAL2 physics

6. *AOB*

It was strongly suggested that in the future the text of LoIs and other reports should be put on the SAC Web site as soon as they arrive in order to give more time for reading.

There being no other points on the agenda the meeting was closed at around 16:00.

Annex 1

Agenda of the SPIRAL2 SAC meeting on June 24 & 25, 2010

Thursday June 24th Maison d'Hotes, GANIL

9:00 - 12:30 SAC Open session 1

- 9:00 - 9:05 Welcome - S. Galès (5')
- 9:05 - 9:30 Status of SPIRAL2 - M. Jacquemet (20'+5')
- 9:30 - 9:50 SPIRAL2 Physics & Collaborations - M. Lewitowicz (15'+5')
- 9:50 - 10:10 DESIR report - P. Campbell (15'+5')
- 10:10 - 10:30 NFS status report - X. Ledoux (15'+5')

10:30 - 10:50 Coffee Break

- 10:50 - 11:10 S3 Status report - H. Savajols (15'+5')
- 11:10 - 11:25 LoI 1 U - E. Lamour (10'+5')
- 11:25 - 11:40 LoI 3,4,5 U - I. Darby (10'+5')
- 11:40 - 11:55 LoI 6 U - L. Cáceres (10'+5')
- 11:55 - 12:10 LoI 7 U - I. Stefan (10'+5')
- 12:10 - 12:25 LoI 8 U - G. De Angelis (10'+5')

12:25-14:00 Lunch

14:00 - 16:00 SAC Open session 2

- 14:00 - 14:15 LoI 9 U - G. Georgiev (10'+5')
- 14:15 - 14:30 LoI 11 U - D. Seweryniak (10'+5')
- 14:30 - 14:45 LoI 13 U - X. Ledoux (10'+5')
- 14:45 - 15:00 LoI 14 U - M. Kerveno (10'+5')
- 15:00 - 15:15 LoI 15 U - D. Doré (10'+5')
- 15:15 - 15:30 LoI 16 U - P. Bém (10'+5')
- 15:30 - 15:50 LoI 17 - C. Petrache (15'+5')

15:50 - 16:20 Coffee Break

- 16:20 - 16:40 LoI 18 - B. Bastin (15'+5')
- 16:40 - 17:00 LoI 19 - A.G. Smith (15'+5')
- 17:00 - 17:20 LoI 20 - G. Bélier (15'+5')
- 17:20 - 17:40 LoI 21 - S. Pomp (15'+5')
- 17:40 - 18:00 LoI 22 - S. Pomp (15'+5')

20:00 Dinner

Friday June 25th GANIL

9:00 - 16:00 SAC closed session

1. Evaluation of the S3 and NFS status reports
2. Evaluation of the LoI for Day 1 experiments with SPIRAL2 Phase 1 (S3)

10:30 - 11:00 Coffee Break

3. Evaluation of the LoI for Day 1 experiments with SPIRAL2 Phase 1 (S3)

12:30 - 14:00 Lunch

3. Report from the Theory-Experiment Workshop (H. Goutte) (20')
4. Theory for SPIRAL2
5. Evaluation of the LoI for Day 1 experiments with SPIRAL2 Phase 1 (NFS)
6. Topics, date and place of the next meeting
7. AOB