

REPORT on IRFU activities

Meeting of the Scientific Council at Saclay – January 14-15, 2015

Scientific Council members: Xavier Barcons, Angela Bracco (*Chair*), Ariella Cattai, Hideto En'yo, Neil Gehrels, Norbert Holtkamp, Peter Jenni, Leonid Rivkin, Natalie Roe, Graham Smith

The committee heartily thanks the IRFU management for organizing very clear presentations and relevant discussions. Additional thanks for taking excellent care of all the logistics connected to this meeting.

The Scientific Council (CSI) of IRFU was requested this time to review the Institute's activities to be focussed on three areas:

- The evolution since the 2013 meeting
- The response to the CSI 2013 recommendations, as well as to those formulated by the AERES evaluation in January 2014.
- Proposals to improve science and management

As a main conclusion of the meeting, the CSI continues to be impressed by the large number and outstanding quality of the scientific and technical contributions by IRFU to national and international R&D activities in the various fields. This is largely based on the dedication of its highly qualified staff and its leadership, which should be both commended.

The committee was also informed with an interesting presentation on the inclusion of the new laboratory denoted as LARSIM. With a few well known personalities LARSIM will contribute to visibility and attractiveness of basic science for the general public.

The following list, enumerates some of the major findings and recommendations of the CSI *in no particular order*:

- The CSI acknowledges that *the contribution to ESS infrastructure* assigned to IRFU will generate funds and significant activity for the next 7 years, and commends the Institute leadership for that achievement. This speaks once again very highly of the reliability of IRFU both in the national and international context. However, the CSI continues to be concerned in that the decrease in “purchase power” of the Governmental contribution to IRFU's budget (resulting from a flat subsidy) has reinforced the fact that *IRFU's activities are potentially driven by funding opportunities, rather than by its own scientific strategy*. Today's situation is such that the Government subsidy just matches permanent staff costs, so there is no option to escape that route. This gives little room to

optimize the return in terms of scientific exploitation of major technical developments conducted at IRFU, as is the case of the ESS contributions. While there is universal recognition that IRFU scientific and technical contributions to international enterprises are of the utmost quality, the *visibility* that IRFU gets in return for those contributions is not always at the level it should be. This is particularly true in the case of some Astrophysics, and to some extent Particle Physics, activities in the framework of large international consortia, where other institutions contributing less often find a way to be recognized in more visible leading roles. This does not do justice to the effort and reliability of IRFU. Given the very long-term development time of some of these projects this cannot be solved on a short timescale, but measures to secure that IRFU gets appropriate visibility commensurate with its engagement in international future projects need to be adopted.

- We welcome and applaud the addition of a third pillar to IRFU's mission (as proposed by management) related to "*Teach, Train and Inform*". This should have a strong impact in supporting staff efforts into raising societal awareness of R&D activities developed at IRFU, an activity that always needs being strengthened and recognised.
- The regular turn over in the division leadership and management, populated by *young and brilliant researcher leaders*, is regarded as a very positive sign reflecting a very active scientific life at the Institute.
- *Promoting PhDs in the "technical" divisions is strongly supported* by the committee. Besides being part of a valorization strategy of the work done under these divisions, this will help propagating the in-house technical expertise in critical areas.
- IRFU's involvement in *the two Saclay thematic campus initiatives* is endorsed by the committee as a means to interact in a most constructive manner with its immediate environment. Once more, IRFU's outstanding and unique position in the area should be recognised by appropriate visibility and leadership.
- The CSI does not fully understand how *specific strategic decisions*, such as involving the Institute in particular projects of various sizes, are adopted. Long-term plans prepared by the Science and Technology Divisional Councils (CSTs) appear to play a role in this. The CSI would like to see the divisional strategic plans. We recommend that strategic decisions are taken with maximum buy-in from the involved staff. We offer to review and advise on such plans if so requested by IRFU management.

- IRFU needs to urgently develop and deploy a fully-fledged *internal communication* strategy, affecting not only the internal issues at the division level, but most importantly institute-wide communications. This is something that any institute with 800 staff and at least 3 management layers (Direction, Division heads, Laboratory and project leads) needs to address, but in the case of IRFU there are additional reasons like geographical scatter of the divisions around the Saclay plateau and difficult financial times. Specifically the CSI applauds the initiative of publishing an internal Gazette, but this has to be accompanied by other measures to favour a proper two-way communication. The frequency of all-hand meetings (both division internal, but most importantly institute-wide) might be increased among other measures. Staff needs to feel that it is listened to before important decisions are taken by the management.
- Recruiting talented *technicians* continues to be a challenge, even more than engineers and scientists staff. Technicians are essential to keep know-how at the Institute, and a dedicated retention and recruiting strategy for that sector of the staff should be put forward.
- *Industrial Valorization*
The CSI congratulates CEA to a very successful program on industrial collaboration and technology transfer. We encourage IRFU to continue and build out this program. CEA as well as other government agencies should recognize the successful tech transfer program at IRFU. IRFU obviously leverages its impressive business portfolio and combines it with a long-standing tradition of technology transfer. As a result, licenses and patents are consistently issued at a rate of approximately 5-7 per year over the last decade. These intellectual properties have been successfully monetized by IRFU through direct sales and through commercial relationships with companies, resulting in a growing income of ~€1.1M in 2015 and ~€1.5M in 2016.
- *European Projects and the need for external resources.*
In recognition of the need to acquire new projects on a regular basis in order to sustain the present business model, IRFU management has created a separate office (four FTE) to interface with agencies and laboratories and help its staff to submit a large number of proposals (e.g. 164 for the FP7 program alone). The CSI believes that this is strategically a good decision and has put the laboratory into position to have a significantly higher success rate on proposals as compared to the national average.

IRFU owns a large number of accelerator science and technology related infrastructures. Saclay's initiative to generate support from a broad science community is commendable. The CSI shares the opinion that a healthy technology platform is necessary to allow new science areas to be developed. The

Committee encourages the approach to seek understanding and follow on support from the European funding agencies and we hope that this initiative is successful.

In parallel it is impressive to see the large number of proposals in a broad range of science. While we understand the frustration from the researchers seeing a low success rate, such a situation is not uncommon. It will be necessary and we recommend for IRFU to develop a strategy to incentivize its researchers to continue to submit a large number of proposals. Every successful proposal should come with recognition for the individual PI(s).

We also recommend to improve the web page, this represents also a needed action for valorization and for internal communication.

Astrophysics division (SAp)

The CSI commends the SAp by the most recent successes in the projects they are involved in. An outstanding example is the successful deployment of the Artemis camera on the APEX submm telescope, following an agreement with ESO, and the start of a fruitful scientific exploitation of this instrument. This capitalises on the long-term accumulated expertise in the development of such infrared/submm devices following ISOCAM on ISO and PACS on Herschel, as well as on a very high scientific capability to exploit such instruments at IRFU.

Continuing R&D activities on enabling technologies for the development of instruments, both for ground-based and space missions, in areas where SAp/IRFU is able to capitalize on their future scientific return, should proceed with high priority.

The CSI applauds the progress on the SVOM space mission. The collaboration with the Chinese on this gamma-ray burst satellite will produce significant scientific return following launch in 2022. We appreciate that it was difficult to negotiate the work shares and MOU for this project. With the success in reaching agreement, SVOM can be a pathfinder for future Sino-French collaborations.

SPP has significant work activities in astrophysics experiments including Planck, CTA, BOSS, eBOSS, and DESI. The CSI is concerned that there is adequate contact and planning between SPP and SAp for these experiments. We welcome the designation of a single IRFU point of contact for CTA and recommend furthering coordination between SPP and SAp in the general astrophysics area. Developing a common strategy in cosmology across the two divisions is becoming increasingly important and urgent, given the major investments committed in coming projects like EUCLID.

Particle Physics Division (SPP)

The panel noted with great satisfaction that SPP has progressed with excellent research work in their ambitious activities, with very significant physics results, and including preparations for the future.

The upgrade work for phase-1 of ATLAS, with a substantial and leading responsibilities in the New Small Wheel (NSW) end-cap muon detectors and new trigger electronics for the LAr electromagnetic calorimeter, is well defined and fully underway. The Panel iterates that the phase-2 upgrade plans for CMS and ATLAS should be developed in a timely way.

There is a broad spectrum of activities in the neutrino physics which has produced important results in the past. The Panel recommends that a careful strategic planning is undertaken to maximise IRFU's contribution in a focussed way onto the most competitive experiments. A decision on IRFU's role in future long baseline neutrino experiments should be undertaken in a timely way so as to ensure a compelling role.

SPP has a strong portfolio of experiments in cosmology. There is significant scientific overlap with activities in SAP, and an effort to develop a combined strategy would help to maximize the visibility of IRFU in cosmology.

The Panel noted the healthy contingent of PhD students, but it was somewhat concerned about the low number of post-docs, who are essential for fulfilling the ambitious physics goals of SPP.

Nuclear Physics division (SPnN)

In general this division is doing very well with all the ongoing projects and with developments for the future. Impressive are the results obtained in the last 18 months for experiments and theory. They concern the ALICE experiment at LHC on quark-gluon plasma, the COMPASS and JLAB experiments on hadron physics, AGATA at LNL and MINOS at RIKEN for nuclear structure. The n-TOF activity is well conducted particularly in view of the future involvement of IRFU at the Neutron for Science facility at SPIRAL2.

Our request from the last report concerning the plans with AGATA at Ganil was well answered in the presentation of the division leader.

Cross-divisional activities for neutrino physics have been improved. CSI appreciates that IRFU took this initiative since the last review report. In the activities like STEREO, CeSOX or Nucifer particularly, IRFU (together with other research potentials in CEA-Saclay) has very unique and advantageous background compared to other institutes in the world. The future planning in this area should take advantage of such facts.

The personnel has been reduced not only in relation of the closing of the activity on safety and decommissioning. In the future some addition in personnel is needed, as also

suggested in the AERES report. This will be essential for IRFU to establish a strong position in the physics program of SPIRAL2 phase 1 and to be influential for deciding the start of phase2 of SPIRAL2. It is important to harvest in term of physics from this project in which IRFU has invested much in its construction and technology.

Accelerator, Cryogenics & Magnetism (SACM)

The division owns and maintains a large number of key technologies for the Laboratory. With that, IRFU has been able to build up some very unique infrastructures within Europe and also in the world.

Recently established IRFU stewardship of the in-kind contributions to the European Spallation Source confirms the strong role the institute plays as key accelerator technologies development platform. In view of the shrinking operations budget provided by the Government this helps maintaining financial health of the institute in the years to come. This and other in-kind contributions to external projects also help to maintain this important infrastructure. Other accelerator projects have contributed and will contribute in the future in a similar manner. In addition the cryomodule assembly project for XFEL has set new standards worldwide on the rate at which these complicated systems can be produced (going to one cryomodule per every four days).

Light ion sources

In the past year SACM confirmed its position as the world leader in light ion sources, supplying the major projects like IFMIF and SPIRAL 2 and FAIR with very stable, fast rise time high intensity and high brightness sources. Vigorous R&D program on a new ALISES pulsed ion source coupled with plasma simulations performed on a local high performance computer is under way. Test infrastructure is impressive and technology transfer to industry mark continuing good progress in this success story.

FCC

The engagement in FCC is consistent with the European strategy on High Energy Physics and is therefore important for IRFU to engage in. IRFU/SACM's early involvement in the FCC study in aspects that include superconducting magnets and beam dynamics insures attractiveness of the institute for young researchers interested in the field of accelerator sciences. The involvement of technical as well as physics divisions is seen by the CSI as a right step to help re-establish internal coherence of the institute.

System Engineering Services (SIS)

We were presented with a large number of projects that are ongoing as well as with a large number of technical capabilities from the engineering organizations.

The scientific capabilities and the complete spectrum of competencies of IRFU scientists that include conception, design and construction of complex detectors, electronics and controls within large technological platforms, was highly appreciated.

The committee is impressed with the progress over the last eighteen months and with the core capabilities the laboratory can maintain. We appreciate the number of PhD's and Masters in the engineering and technical divisions. We encourage further development of connections to the engineering and technical schools in the area.

Many innovative tools are successfully used to conceive and design detectors and experiments, thus contributing to keep on progressing and allowing IRFU to be on the cutting edge of technology (e.g. mastering the cryomechanics challenges, thermal management computation in micro-structures ...). All effort should be done to promote the use of these breaking news tools in the various fields of applications (medical domains, micro-electronics...).

Control Systems

The delivery of integrated systems, whether for accelerators or space missions, requires controls and control systems as a core capability in the institute. We were presented with nice examples (LIPAc, SPIRAL II, IFMIF and ESS) and support maintaining controls / control systems as a core capability.

We suggest developing a consistent business model that allows charging back operations and investment cost including the reinvestment and write off. This business model should be transparent to the customers and consistent from project to project to the extent possible.

Thermal Analysis

Good core competency.

Electronics, Detectors, and Computing Division (SEDI)

The committee acknowledge the large variety of detectors technologies pursued and promoted in the Institute which contribute to its valorization, foster the contact with industry and can be exploited by several civil environments.

The committee highly appreciates the extensive expertise on detectors technologies accumulated over many years by IRFU researchers and, as well, their active presence in large experiments.

On the specific detector aspects, the “building-block” approach of MicroMegas was particularly appreciated. It allows to provide a complete detection system (from the active detector to the read-out) to any group who needs to exploit the MM technology. The group is highly encouraged to clearly advertise this strategy, such that the technical competences of IRFU people receive the appropriated visibility. The IRFU team plays a key role for demonstrating the large-scale production feasibility of MicroMega for the ATLAS upgrade. It is highly recommended that the IRFU team contributes, as well, to the teaching and training program for other ATLAS groups participating to the MM chambers production.

In the electronics domain IRFU is internationally recognized and has long traditions. Again many successful examples were illustrated: low noise front-ends electronics, analog memories, monolithic pixel sensors (MAPS), cryogenic electronics, real-time systems and more. The Division is encouraged to pursuit these successful activities paved in many years of successful work in international collaboration.

The committee appreciates and congratulates the appointment of a Quality Assurance Correspondent and the introduction of QA, risk analysis and workflow definition for all complex or large projects. Yet, we look forward to deem these activities in the next SC.