



## Scientific Council, June 6 – 7, 2016

### Preface

This was the fourth Scientific Council (SC) meeting following previous SC meetings in December 2014, September 2013 and June 2012. Due to the close collaboration between P2IO management and the SC, preparations for this meeting were excellent including:

- ❑ *Update of the P2IO SC mandate with specific requirements for this meeting*
- ❑ *Availability prior to the meeting of:*
  - A summary by Philippe Busson of the major P2IO activities since the last SC meeting
  - Major documentation about:
    - The results of the P2IO midterm report and review
    - The P2IO phase 2 plan
    - The approved “flagship” projects
- ❑ *Excellent reactivity of P2IO management to the specific problems of the meeting*
  - Move from LAL to Saclay due to flooding
  - Travel complications due to social strike
  - Philippe’s sickness: Thanks to Pierre-Olivier Lagage for jumping-in at short notice.

The goals of this SC meeting were to evaluate the progress of P2IO to determine:

- ❑ Is the Labex fulfilling its objectives and goals? Is there a need to reconsider them?
- ❑ The relevance and ambition of future plans and of P2IO’s strategy to achieve them.
- ❑ What obstacles and problems exist? Is the Labex funding strategy appropriate?
- ❑ Are there key, overarching scientific questions that may have been overlooked in the current activities? Does the Labex promote the exploration of new frontiers?
- ❑ What success criteria should be applied to the emblematic projects and how should these be evaluated in the future?
- ❑ How can P2IO complement the emblematic projects for more complete coverage of the overall scientific breadth of this LabEx?
- ❑ What is the future of the collaborative projects established via P2IO vis-à-vis the P2I and SPU departments of UPSaclay? Will new projects still cross departmental boundaries?

## **Introduction**

The Council congratulates the P2IO team for their outstanding accomplishments to date as signified by the excellent Mid-Term Review. The many complementary remarks on the high quality of the scientific projects and cross cutting infrastructure, combined with no findings of significant weakness in any area evaluated by the panel testify to the careful planning that brought P2IO into existence and that nurtured the early phases of the LabEx to maturity. The evolution of the management structure through this time demonstrates the levels of trust and cooperation that have grown since the establishment of P2IO. In particular, the Council notes significant progress in the process for the selection of Ph.D. candidates and small research projects that seems to result from the attainment of a true consensus of priorities among participants. The Council notes the high quality of the presentations at the poster session and very much enjoyed the enthusiastic and informed discussions with the graduate students and post doctoral authors. The selection of the Emblematic Projects represents a large step in the creation of a lasting legacy for P2IO and is indicative of the progress made in interdisciplinary and multi-laboratory cooperation. The SC had some recommendations regarding the presentations given by the projects as detailed below. Consideration might be given to addressing the overall balance of the research programs across P2IO disciplines following these selections through allocations of future selection of post docs or small research projects to under-represented areas.

The Council notes that the composition of the P2IO Steering Committee still contains no female members despite the availability of several highly qualified candidates in the various Laboratories. The council recommends that P2IO management and all associated stakeholders give serious consideration to addressing this imbalance in the future.

## **Teaching, Outreach and Communications**

The SC believes that the work of P2IO under these headings continues to produce a wide variety of excellent outputs within a relatively low budget. We noted in the last report that translation of appropriate materials into English would raise the visibility of P2IO internationally. We understand why this might be difficult with regard to the book for school-age children, but we believe that other materials (e.g. posters) could be cost-effectively translated.

Under the heading of *Teaching*, the Summer School continues to be a very valuable part of the program. However the SC wondered whether a survey of student experience at the Summer School was routinely undertaken and evaluated, and if so, what the results were. In addition, it is suggested that P2IO-funded PhD students and PDRAs may benefit from an annual (?) day where they present their work to each other. This would serve several purposes; for example, allowing them to practice their presentation skills in a relatively friendly atmosphere, providing the opportunity for them to make links and share experiences and techniques with other young researchers, and generally add to the “esprit de corps” of P2IO.

In terms of *Outreach and Communications*, we felt it was important to add (or enhance, if they already exist) events linked to spin-off (e.g. Health etc.). This would add a particularly significant dimension to the wider appreciation of the work of P2IO by the general public and national government. It was acknowledged that P2IO’s web site is not the most attractive such

site at the moment and therefore the SC supports the proposed ‘Phase 2’ development. In addition, it is suggested that links to P2IO’s large public events should be added, and that the usage of the site be monitored and regularly reported to P2IO management.

## **On-Going P2IO Research and Platform Development**

A small selection of on-going P2IO activities (R&D projects and platforms) were presented to the SC as oral talks by senior members of P2IO, while a wider selection were presented as posters by graduate students and post-doctoral researchers. Overall, the poster presentations by the highly enthusiastic and very knowledgeable young authors were both enjoyable and quite impressive. Several members of the SC remained in discussion with these researchers well past the time allocated by the Agenda. While the SC will not comment further on individual posters, specific comments regarding the more formal presentations follow.

### *Low Energy Nuclear Recoil Tracker for CLAS12 at Jefferson Laboratory*

The heart of the detector is a very light and innovative drift chamber with carbon wires arranged in stereo view. This design minimizes the material budget, works at very low gain and runs “blind” against less ionizing particles to minimize the background. This is definitely a forefront R&D project, no such chamber exists anywhere else. It is also a very challenging, high risk (high reward) project. Given the unique nature of the project, many unknown surprises are to be expected. The team is encouraged to pursue the R&D activities on carbon wires and, as well, to look for a backup solution to secure the DVCS project (e.g. possibly consider a Au/W wire drift chamber with ~1 cm wire spacing).

### *High Granularity HodoScope for Particle Identification (HIGHSPID)*

The intent is to build and test a prototype electronic chain to read out a Si strip detector to measure the energy and identify the mass and charge of light, charged particles through pulse shape analysis. This is a relatively sound, and not too complicated, solution with large pitch double sided strip detectors. The challenge lies in development of the electronics, in particular, fast sampling/digitization (involved IC development). The team has conducted successful studies and validation of the Pulse Shape Discrimination technique (PSD) with a Si-strip detector. This is remarkable, state-of-art instrumentation in the laboratory. The SC recommends that the team secure the ASIC design and testing support, and plan enough margin in scheduling to compensate for the inevitable delays and problems encountered in such developments.

### *PANAMA Platform*

This is a collection of primarily Material Science instrumentation that will be applied to the characterization of the surface properties of parts and equipment incorporated into accelerators. The SC appreciated the well structured and clear presentation of the platform and acknowledges that the creation of the platform is driven by the P2IO laboratories’ desire for the means to characterize material surfaces to address particle accelerator development. The SC appreciates the objectives set forth by the promoters of the platform and in particular the goals that the instruments will be “easily accessible” to the community and be easy to use. However, the SC feels that the platform is presently driven too much from the eye of the “accelerator developer” as a “user tool” and that small changes in philosophy could lead to long term improvements in the operation of the platform.

The SC is convinced that even for “table top”, user-friendly, material analysis instruments, the platform should employ dedicated, specialized personnel to provide assistance in operating the instruments and analyzing and, most importantly, interpreting the results. The management should secure means for the maintenance and repair of the instruments, and this is particularly important for instruments used by non-specialists. The SC suggests that by enlarging the vision of the platform towards the more routine needs of the materials research community this platform could offer a win-win opportunity where everyone benefits. Graduate students and post-doctoral researchers in materials science undoubtedly have a need for easy access to the equipment in the PANAMA platform to conduct routine analyses before taking samples to more highly specialized and oversubscribed state-of-the-art, research-grade instruments. The presence of materials science researchers in the specialized labs of P2IO will assure that these instruments continue to produce reliable results, will provide a ready group of potential collaborators for the solution to any materials-related problems that might be encountered in the development of accelerator instrumentation and could provide access to a steady source of funding to maintain or improve these instruments into the indefinite future.

## **SC Evaluation of the Emblematic Projects**

Five emblematic projects were recently selected by P2IO that represent a significant fraction of the future resources of the LabEx through its remaining lifetime. The SC was asked to comment on the success criteria that should be applied to the emblematic projects and how these projects should be evaluated in the future. Unfortunately, the presentations concerning these efforts were very uneven in their coverage of several important aspects of the projects, including the criteria that should be used to measure their success and the unique nature of the project. This may be due to the recent formation of these teams or to unclear instructions as to what information should be presented to the SC. Each of these projects will be discussed below.

### *Evolution of matter from the interstellar medium to exoplanets with the JWST*

This program takes advantage of a large base of existing expertise, facilities and previously established scientific collaboration (*e.g.*, MIRI). The team will apply this advantage to model future JWST observations of dust in PDRs and proto-planetary disks, proto-planets and the atmospheres of exoplanets for competitive advantage in winning additional JWST observing time and in the analyses of JWST data. A significant fraction of the budget goes to postdocs and Ph.D. candidates who will work with multiple advisors and thus leverage a much larger budget than that allocated by P2IO.

This project has two main goals for which the SC suggests Success Criteria. The first goal is to create a multi-disciplinary and multi-laboratory team to exploit JWST, and especially MIRI, to produce excellent science. This has been done on paper with the support for the in-house Ph.D. students and postdocs but there was no mention of how the team will work together to educate a larger contingent of investigators who are not already directly associated with the project. The SC suggests that the team set a goal of including some reasonable number of young, French observers into this effort. This is consistent with the second goal of preparing young researchers to propose JWST observations and to analyze and publish their research. How many additional young researchers will be helped via this initiative in addition to the in-house PhD candidates

and post docs? The SC recommends that the team plan to advertise this opportunity within France. Additional quantitative success criteria could (but does not yet) include: How many hours of discretionary observing time does the team and its students win? How many competitive observing projects are won? How many first author papers are produced by all of the young researchers helped by this initiative? The SC recommends that the team set realistic goals for each of these quantitative measures. Finally, analog carbon grains are generated by the team but the silicates used in the project are meteoritic. Meteoritic material is not a good analog for ISM or protostellar materials as it has been thoroughly processed and contains carbon. The SC suggests that the team make and use analog silicates.

#### *Platform for Research and Applications with Electrons*

The project is well thought out and can mobilize a large number of researchers from various Accelerator labs for technology development and the Centre of Proton therapy of Orsay (CPO) for fundamental and applied research and technology development. Its phased approach will allow deployment flexibility, depending on the available resources (manpower and funding) and the project allows the team to reuse the existing accelerator building. Education and training (E&T), even though mentioned in the document, was not stressed during the presentation. The motivation for the various applications was generally weak and could have been presented more clearly. The added value of high-energy electron beams compared to proton therapy from a radiobiological point of view must be documented (Is it presently or will it likely be reimbursed by social security?). Are oncologists already involved in the medical application of the project?

The SC encourages the pursuit of this flagship project and recommends that the team considers the following suggestions. Put more emphasis on the Education and Training dimension of the project. Involve oncologists very early in the process of Axis 2. Assess very quickly if the re-use of the exiting accelerator building is compatible with the new project option, including the “radiobiological dimension” in terms of present day safety and security requirements. Establish an estimate of the full cost and timeline of the project, including the internal manpower committed by the various labs, the costs of the update/upgrade of the existing building, and ongoing operations and maintenance expenses over the life of the project. At this point in the project’s development, there are still too many open questions for the SC to recommend specific realistic and achievable success criteria for this project.

#### *Charting Terra Incognita of Exotic Nuclei*

This is a broad and ambitious program for studying exotic nuclei, first at the ALTO facility at Orsay and later at SPIRAL 2 at GANIL. The physics goal is to measure mass, spin, magnetic dipole and quadrupole moments for neutron rich isotopes in a broad range of Z from iron to above tin. Nuclear interactions of 50 MeV electrons on a uranium target will produce a spectrum of neutron rich isobars. The Polarex detector is being moved to ALTO where it will be used to study magnetic properties of nuclei close to Sm (132). P2IO funding is 95 thousand Euros for a beam line and 75 thousand for a postdoctoral fellow. The MLL Trap is being moved from Munich to ALTO (and later to SPIRAL 2) where it will be used to make high-precision mass measurements. The P2IO contribution is 100 thousand Euros for a postdoctoral fellow and 165 thousand for equipment. In addition IPN is contributing 160 thousand Euros for moving the trap from Munich to ALTO and for equipment. The Lino (Laser induced nuclear orientation) apparatus will be used to do laser spectroscopy of silver and indium states near Sn (132). The

P2IO contribution of 195 thousand Euros is being supplemented by an IPN contribution of 200 thousand Euros for lasers. Finally, heavy elements will be studied at SPIRAL 2 using the exotic beams from S3. Here the P2IO contribution is 210 thousand Euros mainly for the support of a postdoctoral fellow along with student support. This is a timely program of research with experiments done at several French facilities. It is also a highly collaborative effort involving different groups at both Orsay and Saclay that significantly leverages the P2IO contribution. This project seems to be an excellent choice as a flagship P2IO program, though it is not obvious what specific criteria should be used to measure the success of the project.

#### *CANEVAS: CAmera NEctarcam VAValidation at Paris-Saclay*

The goal of this project is to build a camera designed for the Medium Size Telescopes of CTA and then test a first prototype with astronomical data to validate the design and operations of NectarCAM. NectarCam is a major CTA international project on very high energy gamma rays and it is important that P2IO researchers continue to play significant roles in this development. This project builds on a great deal of expertise and preparatory work that has already been done in P2IO institutions, including previous experience with HESS. CEA-IRFU, LLR, and IPNO are actively involved (within NectarCAM). P2IO LabEx synergies strongly increase the visibility and impact of P2IO groups within CTA. The technical risks appear low and the program is well managed. The SC appreciates the plan to include an outreach element in the project. The best measure of success would be the successful installation, commissioning and validation through observations of a camera mounted on a telescope in the Canaries. The SC strongly supports the pursuit of additional funding with IAC to build the full 8 degree field-of-view camera.

#### *High Granularity Calorimetry for Future Collider Experiments in High Energy Physics*

The project aims at taking a general approach to advanced calorimetry by exploiting the “particle flow” concept: CALICE (ILC), HGCAL (CMS), HGTC (ATLAS). The general subject is important for the future of particle physics at the high energy frontier. The project plans to complete the mechanical design of the instrument, ASIC development and the characterization of the calorimetric performance. The team plans to maintain a leading role in advanced calorimetry for high rate/radiation environments. There seem to be many challenging goals, and it appears that it will be almost impossible to achieve all of them simultaneously: e.g., operation at high radiation levels with good S/N, extreme timing requirements. It was not clear to the SC where the P2IO effort is separate from (or better, acting in the common good) ongoing efforts when compared to the “independent” collaborations within CALICE, CMS and ATLAS. Is there a goal beyond these three projects? This is a good initiative to address the future of calorimetry at large in high energy physics and to explore how large an impact different performance levels (e.g., less timing precision, less money for hundreds of m<sup>2</sup> Si) will have on the resulting physics. Because of an inability to distinguish the goals of this specific project from the goals of the already funded research efforts of the P2IO laboratories along these same lines, it was impossible for the SC to recommend specific success criteria for this effort.

#### *Coverage and complement of the emblematic projects*

Overall, the emblematic projects are well selected to cover the various P2IO themes (all except R3 [data mining] and Energy), as shown in the table below, though there are some aspects of the P2IO community (e.g., Theory) for which these large projects did not seem to be appropriate. The SC notes that the larger emblematic projects could be complemented by allocating a few

additional R&D projects, Ph. D. students or post doctoral researchers, as appropriate, related to the themes less covered by the emblematic projects in the future to ensure more uniform allocation of resources throughout the P2IO LabEx.

Emblematic	P1	P2	P3	P4	R1	R2	R3	Energy	Health
JWST				X			(partially)		
PRAE			X		X	X			X
CANEVAS		X			X				
CTIEN			X						
HGCFE	X								

## P2IO in the context of Université Paris-Saclay (UPSaclay)

The SC strongly supports the attractive and ambitious project that was presented to us and is pleased to realize the progress that has already been achieved since the last SC meeting in December, 2014. We note the common diploma, the move of many institutions to the Paris Saclay area, and the number of new buildings and facilities either already built or under construction. We appreciate the difficulty of the strategy of merging various institutes with significantly different cultures into one single body while maintaining the individual strengths of each institution. *Good balance is essential but is also critical and challenging: “Science comes from diversity.”* This balance does not yet seem to be well defined, though the university appears to be adopting a realistic and progressive approach (“donner du temps au temps!”). The present involvement of some laboratory directors in key university positions is an important reflection on the current organization and on the mechanism likely to be employed in building-up UPSaclay in the future. Some P2IO researchers expressed concern that P2IO activities are distributed over two different university departments. Yet P2IO was forged by the interaction of twelve different institutes funded by five separate agencies all with very different goals and cultures. The SC suggests that the laboratory directors consider providing their (possibly common) technical view about the best way to maintain the productive collaborative environment that defines P2IO in a constructive, bottom-up approach as the LabEx transitions to this new organization.

## Appreciation

The SC expresses its appreciation to all speakers for their thorough preparation; to the P2IO management for the excellent scientific organization (in spite of the various problems that were encountered during the time of the meeting) and the very complete information package that was provided before the meeting. We thank the lab directors for their (constructive) input as well as for their flexibility, and we thank the staff for excellent administrative support. Congratulations for the very effective start of the new P2IO management team (Philippe Busson, Pierre-Olivier Lagage and steering committee) during the last 17 months. Finally, we wish Philippe a good and speedy recovery.