July 23, 2012

Report of the P2IO Scientific Council

(1st meeting held on June 27-28, 2012

at the "Institut d'Astrophysique Spatiale")

Introduction

As this was the first meeting of the P2IO Scientific Council, the members considered the purpose of this meeting to be primarily for the exchange of information and for the Council to become familiar with the goals of the project and with progress made during its first year of operation. This is a learning process for the Council and for P2IO, a most ambitious project. The Council believes that it is extremely important for P2IO to be successful as it will serve as an example for large-scale cooperation among French universities and research institutes and the benefits they can reap when working together. The Scientific Council is very enthusiastic about and supportive of the P2IO project.

In what follows we will make some preliminary observations and answer the questions that were asked to us at the beginning of the meeting. These recommendations and preliminary comments are not the result of deep and prolonged thought following a thorough study of the P2IO proposal and operations plan, but are our first impression of this enormous undertaking based on a quick reading of the summaries emailed to us and the presentations we viewed over a very full, two-day period. We will focus on the operation of P2IO during the time-frame of the project independently of possible evolution afterwards. We understand the political leverage derived from P2IO's ability to speak with one consolidated voice in charting the future of its member institutes and universities and the importance of this aspect to the P2IO members. However, we choose to concentrate our efforts where they will be most useful and appropriate: the science and the collaborations that might be accomplished and/or enhanced by P2IO and the manner in which the resources expended might have the most impact.

The Council was informed about the P2IO project and goals in a very informative set of high level presentations and concurs with the great ambition and major goals of this project. The close collaboration of laboratories set up independently and supported by various funding agencies looks to the Council like a dream come true. Taking advantage of the synergy and complimentarily of the 12 laboratories in a close environment provides great potential and presents many unique opportunities for new scientific achievements. The Scientific Council is impressed by the number of synergies between the present institutes which have been already identified by P2IO in spite of the early phase of the project. The bottom-up approach to this

organisation offers a strong chance of success where previous top-down efforts failed to promote close collaboration among so diverse a set of scientific research priorities. We concur with the pragmatic approach that P2IO has taken of building upon existing collaborations and promoting the launch of new ones from among those proposed by the researchers themselves.

The Scientific Council took note of the very ambitious plans concerning the future University of Paris-Saclay and the strong role P2IO is playing in its formation. The Council took also good note of the plans regarding important building transformations on P2IO laboratories premises. Although these aspects are somewhat beyond his scope, the Scientific Council will appreciate to be kept informed of these developments.

This is a great start and we congratulate P2IO. We look forward to excellent results.

Questions addressed to the Scientific Council

The Scientific Council was asked to address the following questions:

- Is the general strategy of P2IO correct?
- Is P2IO progressing towards its agreed goals?
- Is P2IO exploiting the available opportunities appropriately?
- Are the scientific priorities of P2IO well defined (interest, scope, impact,…)?
- Is P2IO using the available resources efficiently?
- Are the tools used so far by P2IO the correct ones?
- More generally, how might P2IO improve?

The P2IO Strategy and goals

The Council agrees with the strategy based on three pillars "Explore, Transform and Structure" as defined below by the P2IO management, although the foreshadowing of the new Plateau de Saclay Campus originally defined is now beyond the scope of the project.

Goal: conduct common actions to promote our science in a very ambitious shared vision

P2IO research project is based on three pillars: Explore, Transform, Structure.

- ***Explore will be performed through strong support for innovative interdisciplinary initiatives and new collaborations in the most promising topics in P2IO scientific objectives***
- ***Transform will be performed through a new vision of the collaboration between P2IO members. Joining forces between P2IO labs to create common technological platforms will foster new world-class facilities, boosting P2IO research to unprecedented levels. The P2IO Labex, in prefiguration of the P2IO pole of the new Plateau de Saclay campus, will favour the emergence of one of the five largest subatomic centres in the world with one of the highest degree of excellence and recognition.***
- ***Structure will stem from the integrated governance and its role as a contact point for internal and external collaborations.***

The Scientific Council also agrees with the thematic priorities presented below.

A selection among the most exciting domains in our fields

4 scientific themes

P1: symmetries in the subatomic world
P2: dark components of the Universe
P3: strongly coupled nuclear matter
P4: formation of stellar systems and conditions for the emergence of life

3 technological themes

R1: innovations in accelerator science and their related spinoffs
R2: advanced sensors and spinoffs
R3: data mining and simulation

2 interdisciplinary themes

I1: Energy: nuclear energy for the future
I2: Health, new methods in imagery and therapy

The Scientific Council notes that activities have already been launched in all themes but one. The reasons for not supporting projects in the Energy interdisciplinary themes were not clear, but the Scientific Council felt that the objectives of this theme were worthwhile pursuing in the near future.

The Scientific Council was asked to evaluate a new thematic that investigates High Energy and Very High Energy gamma rays. The presentation demonstrated that the research priorities of this group were based on a limited field of research. **This limited perspective does not justify, in the Scientific Council's opinion, an additional theme. The scientific objectives of the research are consistent with P2 (and possibly P1) with an updated title possibly as suggested below under the specific comments about P2.** The Scientific Council is therefore not in favour to establish a new research priority for what can be a sub-set of the existing priorities, as these efforts would dilute the resources that can be expended on the original set proposed.

The Scientific Council also agrees that P2IO's complementary goals of Formation/Training, Communication/Outreach and Valorisation have merit. Training of new Ph.D. students as well as students at the Master's level, especially in areas where there is a special need for trained experts and where the students have a high probability of obtaining useful and fulfilling employment, is very important as it is bringing them into the research environment and training them on state-of-the-art equipment and procedures. In this same area, recruitment of excellent students from across France via visits to the labs and facilities of P2IO is meritorious.

Since the activities of P2IO are ultimately supported by the French taxpayers, advertising the research projects and outreach activities for the general public are mandatory. The activities carried out by C. Cougrand (IAS), P2IO communication officer, and supported by her colleagues from the communication staffs of 9 laboratories certainly fulfil this requirement. The web site, brochure and Newsletter (every two months) actively inform the public of the progress made by P2IO in the major research areas. "The Night of the 2 Infinities" appears to be a very popular activity as well. We encourage P2IO to continue such efforts.

In the same vein, Valorisation, the effort to transition a new innovation from the laboratory to the commercial world, can be an important justification for the support of basic research. Though certainly not the only reason for support, commercial spinoffs can occasionally provide very useful commercial products and significant returns on investment. Hiring dedicated engineering support for the transition between a laboratory tool or innovation to an industrialised product is often the only means to bridge the gap into the commercial world. The valorisation of the research supported by P2IO is a long-term issue and we encourage the P2IO to launch activities towards this goal as soon as possible.

Given the importance placed upon the stimulation of cooperative research efforts between and among researchers from different universities and institutes, the Scientific Council was surprised

to learn that the official success criteria for the P2IO Labex did not mention or record successes in this area. While the Scientific Council does agree that easily measured metrics such as the numbers of papers published by researchers supported by P2IO at specific times after the initiation of the project are quite useful, and were accepted by the agencies that sponsored P2IO initially, additional, possibly unofficial metrics that measure success in fostering cooperative research initiatives would be useful to the Scientific Council for measuring progress in this area.

We encourage the P2IO to come up with a more specific proposal on i) how to measure P2IO success, ii) the mid-term plan to be achieved within the next two/three years and iii) the measures on whether the goals are met. For example, one metric could consist in identifying specific initiatives by which new collaborations or shared platforms have been formed and existing ones have been enhanced or a P2IO team winning a substantial project through collaborative proposals. Such successful initiatives have already been reported like on-going collaborations with the sharing of specialised equipment and computing facilities, as well as the acquisition of a test station and bonding machine accessible to all partners.

We would be very interested in reviewing progress in this area at our next meeting.

Specific comments on scientific objectives

P1: Symmetries in the subatomic world

Under the theme P1, "Symmetries in the subatomic world", P2IO addresses current forefront research in particle physics.
Electroweak symmetry breaking is addressed experimentally by P2IO participation in the LHC experiments ATLAS and CMS at CERN. Its timeliness is manifest in these days, as evidence for the existence of the Higgs particle has very recently been demonstrated at CERN. Matter-antimatter asymmetry is addressed within P2IO by collaboration in the B-factory experiments BaBar, Belle and in LHCb, and also by participating in experiments addressing this asymmetry or related topics in the lepton sector: Double-Chooz and T2K. In these projects P2IO scientists have leading roles. At the same time, future experiments are being targeted, most notably the LHC upgrade programme, the International Linear Collider, SuperB factories, rare K-decay, muon decay and double-beta decay experiments as well as accelerator based neutrino physics. In addition, participation in an anti-hydrogen gravity experiment is mentioned.
This is an ambitious programme covering currently very topical themes in particle physics. The manpower involvement seems strong (> 200 people). P2IO sees synergy in increasing the collaboration between theory and experiment and among neighbouring domains.

The SC recommends specifying more clearly and concretely the added value expected from the programme and the goals to be reached within the next 2-3 years, especially in terms of the mentioned synergy aspects.

P2: Dark components of the Universe

The P2 scientific theme is broadly supported by the P2IO institutes with eight of them participating in the different activities including direct and indirect searches for dark matter as well as observational cosmology with satellites. The theoretical endeavour in this theme is quite strong and supportive of the experimental activities. The scientific objectives pursued are at the forefront of research in this field making use of space-based (*e.g.*, present CMB, WMAP, Planck, Fermi, and future BAO, Euclid, LSST, etc.) and ground-based detectors (*e.g.*, Edelweiss I, II and III, etc.). Groups from different laboratories participate strongly and jointly in these most important European/international projects. The numbers of scientists involved in the various projects ensure visibility and impact. The Scientific Council applauds the spirit of cooperation that already exists amongst the P2IO laboratories on these projects and looks forward for its strengthening through P2IO joint projects. These include the presently approved two post-doc positions, three R&D projects and one-year position (Attractivity) for pursuing research on "Modified gravity and cosmological perturbations".

The activity on high-energy and very-high-energy gamma-ray astronomy was presented and proposed to be added to the P2IO scientific themes. Two P2IO laboratories have teams working in this field: the LLR and the IRFU. This topic has a limited scientific scope compared to present P2IO scientific themes but does have scientific and technical synergies mainly with P2, and somewhat with P1, which argues for its incorporation into P2. In such a case, **the title of the P2 scientific theme could be changed to: "Cosmology and dark components of the Universe".**

P3: Strongly coupled nuclear matter

Within the P3 theme P2IO scientists address wide-ranging topics in subatomic physics, from what in first instance seems the simplest, *i.e.* nucleon structure, to the complex nuclear structure to quark-gluon plasma (QGP). Nucleon structure, in particular, its spin structure has been studied by French groups earlier at CERN (EMC and SMC collaborations) and later at DESY (HERMES collaboration). This has led to what is known as the "Spin Crisis". The study of the Generalised Parton Distributions (GPDs) now being pursued at JLab (CLAS and in the near future CLAS12 and COMPASS) and in the future at PANDA-FAIR (in the time-like region) provides excellent opportunities to resolve this problem and have better understanding of the nucleon structure. The research in the low-energy domain has moved emphasis in the last decade *i*) to study of nuclear structure of exotic nuclei to investigate the evolution of shell structure and the emergence of new phenomena and shapes and *ii*) the use of radioactive beams to address important questions in nuclear astrophysics. France avails of the high-priority national/international second-generation radioactive ion-beam facility SPIRAL2-GANIL (figured on the first ESFRI list) which will start operation in 2013 and the facility ALTO at IPN Orsay. Facilities at RIKEN, Tokyo and GSI (FAIR in the future), Darmstadt will also be used for this research. In the high-energy domain,

the QCD phase diagram is being investigated at the highest temperatures through study of Pb-Pb collisions at ALICE-LHC with the hope to create and identify the QGP state of matter. The Scientific Council has noted with the greatest satisfaction the strong theoretical support to this scientific theme and the strong involvement of experimental groups within the P2IO institutions in building state-of-the-art instrumentation for pursuing the scientific objectives. The Scientific Council expects that the P2IO-supported common activities (three post-docs, four one-month visits of internationally well-known scientists to P2IO institutes, and common workshops and conferences) will enhance the collaboration between the P2IO institutes towards achieving the scientific goals.

I2: Health, new methods in imagery and therapy

The I2 interdisciplinary theme encompasses a wide range of health-related applications benefiting from the pool of knowledge, competencies and technological resources present in the other scientific and technological themes of P2IO. While there are several examples of ongoing collaborative projects under this theme among the P2IO laboratories, only one project is currently being supported: the CaLIPSO PET camera development, which redefines the concept of radiation detection in the medical imaging field. The Scientific Council is fully supportive of such upstream technological developments, which could hardly be brought from the laboratory to the bedside based only on funding from health-related programs. The I2 spokesperson indicated that a workshop will be organized during the next year to foster projects based on expressed needs by physicians and that can be supported by P2IO. The Scientific Committee approves this initiative and looks forward to the outcome at next year's meeting.

Specific comments on Formation/Training

P2IO plans to particularly address a new teaching platform. The Scientific Council took note and is in strong support of this goal. The Scientific Council also recognises that in order to create such a platform which should be attractive to students, a detailed planning of curricula is mandatory with firm commitments of the scientific staff to the teaching terms**. We therefore recommend the P2I0 management to present a teaching sheet/plan containing the curricula offered during the next 2-3 years and to include in this planning the commitments of the participating scientific staff.**

P2IO Issues regular calls for proposals for:

- *Post-docs,*
- *R&D: small upstream projects*
- *R&D: new structuring platforms*

Has long term programmes for

- *Support of Platform operations*
- *Formation Communication/Outreach*

And supports onetime events

- *Animations, conferences, invitations...*

The P2IO Budget and Tools

The Scientific Council was asked to comment on the P2IO budget and on how effective it was in achieving the goals of the Labex. The Scientific Council endorses the distribution of resources in the initial phase of this project from 2011-2012. However, **we suggest that some redirection of these resources in the future may be more appropriate, with less emphasis on post docs (except for the theory groups) and more emphasis preferably on activities fostering collaborations or shared platforms. To maximise the impact of the limited resources, the SC suggests that P2IO management considers sharing the costs of approved joint proposals (students, postdocs, R&D, etc.) through matching funds where possible between P2IO and the collaborating institutes.** In the case of postdocs this may facilitate a fixed-term contract of two + one years, a more desirable appointment that may help in recruiting better candidates.

The Scientific Council considered the project selection process and finds it a useful method to foster collaborations among researchers from across P2IO. Several different tools are used for this purpose as noted above including annual calls for postdocs, calls for small research projects in odd years and for large projects in even years. A programme to form a joint computing centre is in progress and discussions are on-going on a P2IO machine shop that might house future advanced-equipment purchases to be used for the benefit of all the institutions.

Suggestions for possible improvements

- **Consider the use of matching funds from participating institutes (where possible) in the selection among proposals for students, post-docs, research projects and collaborations.** That would leverage the P2IO limited resources and guarantee the interest and support of the participating institutes.
- **Consider calling for proposals of all kinds (post-docs, small R&D projects, new infrastructures and platforms) every year, instead of separately every other year as presently done, and allocate funds to the best proposals (with possibly a minimum yearly funding for each category).** That would allow more flexibility and avoid delaying good proposals when generated in the "wrong" year.
- **Develop valorisation by enhancing contacts with industries & end-users and by considering Intellectual Property Protection as an important part of this effort.**
- Be sure to **consider the original dialog between individuals from different institutions as part of your success.** Sharing common information is extremely important and will help identifying future opportunities.

- **Define specific "metrics" as success criteria and to assess whether the P2IO goals are met**. An internal "unofficial" list of metrics to be defined by P2IO management is suggested as a self-evaluation tool.

Concluding remarks

The Scientific Council recognises that P2IO has considerable value above and beyond simply promoting research collaborations of various scales among members of the different institutions.

Internal to the project, P2IO promotes a very intense dialog between lab directors. This can be very effective in strengthening the links among the various components of the P2IO scientific community, not only through the funded joint projects but also through the interactions in internal committees, working groups, communication. This may lead to a much better mutual understanding of the different laboratories and their potential.

Outside of P2IO we expect this Labex to be a key actor of the IDEX and will play an important role inside the future Paris-Saclay University. We also expect that numerous collaborations and new projects will come from interLabex exchanges. P2IO will help to bring regional coherence with colleagues in the Paris area and will increase the attractiveness of working with or visiting P2IO laboratories. This should be one of the major permanent benefits of the P2IO endeavour.

Future Meeting

The next meeting of the Scientific Council should occur by the Fall of 2013. The agenda for this meeting should be focused on actions, results and future plans supported by P2IO funding, especially changes since this past meeting and progress towards fulfilling both the official as well as unofficial success criteria. Speakers should be given a common format for their presentations to more efficiently provide the data required for the Scientific Council to give informed advice to P2IO management. We would hope that there would be more time available for committee discussion, and that such discussion occurs as soon as possible after the presentation of information on a particular topic where input from the Scientific Council is desired. For that purpose, it would be desirable that all presentations under a given theme be grouped by sessions to allow the Scientific Council to provide a coherent assessment of the domain.

Acknowledgement:

The Scientific Council thanks all speakers for their excellent preparation. We thank the P2IO management for the excellent scientific organisation as well to the two Catherine(s) for the efficient and friendly administrative support**.**