Simon Kwan

National Instrumentation Board

AT CERN, there's a RD xx program with all proposals being reviewed by the LHCC. At DESY, there's the Helmhotz foundation which also reviewed proposals. And of course, there's EUDET which provided funding to selected proposals. In the US, our problem is that we don't have any mechanism or body to vet R&D proposals.

The formation of a National Instrumentation Board is an interesting concept. However, there are quite a number of issues which need to be considered:

1. Where does this board get their mandate?

2. This is not going to be a body to provide funding. How does this board interact with the community, funding agencies, experiments/upgrade projects, and national labs to ensure that their evaluation and recommendation will carry enough weight?

3. How does this board handle proposals that involve foreign collaborators or organized/already or being reviewed by agencies/projects in Europe or Asia?

I would think a National Board should develop a set of guidelines and high priority areas respectively for the Energy Frontier, Intensity frontier and cosmic frontier as the starting point. This board should not review proposals for LHC upgrade projects. It'd be only on generic detector R&D proposals. It'd work together with the National Labs, DOE/NSF on the review process to ensure that its review and recommendation will be respected.

The disadvantage of such a Board as I see it is that we have to avoid that every R&D projects/proposals, no matter how small scale or its early it is in the proof-of-concept stage, will be reviewed. So, a clear definition of the scale or scope of the proposal needs to be applied and applied in order not to stifle new initiatives or new directions in detector R&D.

Creation of targeted resources at National Labs for Detector R&D

The national labs possess a lot of resources which are not readily available to university groups. So, the formation of National Centers at national labs is a very nice concept. At the Detector Workshop last fall, there was some discussion on the formation of a National Center for Microelectronics and Semiconductor detectors at Fermilab. This will help the collaboration of university groups and the national labs. It's interesting to point out that most of the projects at the CERN ASIC groups are done by collaboration between CERN engineers and university people. By forming such centers, we can make sure that national resources will be able to be utilized by more people, that critical mass could be formed, and that the national labs could take on more projects that their own staff could handle.

Such a program should be administered by an Advisory Board with representatives from the labs and the user's community. University people could be offered short term fellowship/studentship to stay at the centers.

National instrumentation fellowship program

This is an interesting idea but I can see a lot of hurdles. Just to list a few, it's difficult to entice students and postdocs to spend much effort on Detector R&D. Unlike Europe, PhD students in HEP in this country could not write a thesis on detector development. Likewise, it'd be extremely difficult for postdoc who spend much

time on detector R&D to get position to further their careers. Unless there is a dramatic change, I don't see how such a fellowship could attract the best and brightest students/postdocs.

It's also not clear how the fellowship could be awarded. Is this based on some original proposal by the candidate or will it be based on the activity or proposal of the PI? In the UK, there's the possibility of CASE studentship. There, PHD students are typically sponsored by industry but are affiliated with a university. Again, I see this requires a big change in the way the PHD program is organized in this country in order to adopt this.

Instrumentation school

I am all for it. I was at the EDIT2011 School and impressed with the effort that was put to it.

Award of academic credit: I am not sure about this. A lot of the people attending the school will be postdocs. For PHD students, do we plan to give them some tests to assess what they have learned or what?

Getting industrial partners to pay to attend the school: I am also not sure about this. Most companies that we are dealing with in HEP are rather small in size and they have limited travel budgets, as I found out from my limited experience with TIPP11.

ICFA also runs an ICFA instrumentation school. It also organizes some semi-permanent regional centers in countries such as Turkey (perhaps also in Mexico). How about establishing a "semi-permanent" school at one of the National Labs? We can run this school a couple of times during the year. Students could attend it as one of their course requirements.

National Prize:

IEEE has a prize established. How does this differ from IEEE?

Interdisciplinary

CERN RD48/50 has a large number of participants outside HEP, in condensed matter, material science, industry etc. The MEDIPIX collaboration at CERN certainly has a large collaboration with participants from a variety of background. So, an interdisciplinary approach for some topics should be encouraged. In fact, in a lot of areas, we are just following the industrial trend and try to adapt what industry or researchers in other disciplines are developing to meet our needs, e.g. 3d packaging, xTCA, optical links etc. Key question of course is why do the other disciplines want to join and what do they expect to get from such collaboration?

Jim Fast

Proposed topics the taskforce will address and proposed method for proceeding. Additional topics may be added. Methods of proceeding may be adjusted by discussion of the taskforce at its first meeting on May 3.

Note: the important issue of generic and project specific research and the related issues of the LHC and next lepton collider research programs is not one of the six initial tasks but will be discussed at the first meeting where we will invite perspectives from both programs internationally and nationally. Subsequent to that meeting we will arrange for broad community input.

Task: A National Instrumentation Board.

What the taskforce will evaluate

Is there a need for a national body to evaluate and/or promote the national instrumentation R&D program? What are the processes for evaluating and promoting the national R&D program through a standing body? Please suggest under which auspices such a body might be organized and indicate possible reporting strategies. Please comment on the appropriate role for a standing panel in the instrumentation R&D programs for upgrades to existing projects and future projects. What are the advantages and disadvantages of creating a National Instrumentation Board?

I think this is a great idea and will couple my response here to that of the following question. The development of specific detectors for specific large-scale projects operates effectively within the national laboratory system and at the well-established and well funded educational institutions. However, there are significant challenges for newer (and hence less well funded) institutions, small institutions and national laboratories that have little operational funding in HEP (i.e. ones that look more like the scale of a University research program) to engage in cutting-edge development.

In response to the next question, I advocate for establishing R&D programs similar to the RD-xx experiments at CERN that would provide a vehicle for collaborative research on specific types of detector systems across independent of physics experiment targets. I believe these collaborations are an excellent mechanism for engagement of smaller institutions and that they provide an excellent environment for innovation that may not exist within the framework of a specific experiments R&D program where the focus is highly directed at delivery of suitable (perhaps not optimal) technology on a very specific time scale. I see the proposed board as a national organizational structure that could prioritize proposed research efforts and work to form broader collaboration among multiple parties proposing similar work. While the major research facilities must play a role in the board, it will be important that they do not dominate the thinking with focused ideas and allow for forward-leaning research to be funded. In addition, since this should cut across all of HEP, there must be significant representation from the non-accelerator based community.

Below I suggest the concept of National User Capability Centers, akin to National User Facilities, that would provide access to the unique capabilities of the national labs. In a similar vein as the National User Facilities, the use of these assets would be at minimal or no cost to the user and would be allocated based on merit review of proposed research. I see the Instrumentation Board as a natural review committee for these research proposals.

Given the proposed role described here I would envision that this board reports directly to DOE-HEP as they would be making fundamental decisions about the instrumentation R&D priorities across the entire landscape of the field. As such it would the board would operate under the auspices of the office at the highest levels. It seems natural that this board would work closely with the entire set of grant monitors that administer institutional funding throughout the HEP office.

Task: The creation of targeted resources at national labs for detector R&D, and the scale of those resources up to fully--- fledged detector R&D center(s) at National Labs.

What the taskforce will evaluate

Might targeted resources be established at each of the five national laboratories in order to specifically support particular instrumentation R&D needs of individual researchers at the universities and the laboratories? This will be in several forms: engineering design time and specific resources for small--- scale collaboration among and between university and laboratory scientists. How might such a program be administered and funded?

As mentioned above, I believe that all but the most established and well-funded institutions are at a severe disadvantage to making the same level of contribution on a per capita basis to the national instrumentation research program because of the inability of small institutions to obtain and maintain the very costly national assets of the laboratories (and some of the larger University programs). I would propose that such national assets be made available, in part, to the broader community as National User Capabilities. Below I list four specific resources and assets that come to mind based on my experience. There are certainly other national capability assets that should be added to such a list.

- ASIC design and fabrication
    - This is an extremely costly capability to stand up. For instance, one seat of CADENCE design software is ~$300k. Good mixed-signal and analog design talent is rare and often takes many years of experience to develop, particularly for low noise applications which are often present in HEP instrumentation.
- Mechanical/thermal/electrical/systems engineering expertise
    - Often smaller institutions or R&D efforts require some fraction of an FTE or require talent in these areas intermittently as different projects develop. This makes maintaining all of this talent in-house impractical. Having worked on this side of the HEP instrumentation field for many years, I also appreciate that working with physicists is a unique experience for engineers and the experience required to understand the unique constraints and requirements of instrumentation for HEP can take a few years to develop. There is enormous efficiency in working with engineers who already "get it". In most cases it is simply impractical to farm this work out to job shop engineering houses because of significant integration issues, ill defined and/or conflicting requirements, etc.
- Composites design and fabrication
    - Composites have found wide-spread use in HEP instruments because of their high stiffness to radiation length ratio. While there are many composites job shops that one can go to with defined problems, developing new techniques and non-standard structures is outside the comfort zone of most vendors. Two examples I have experienced are a) the need to integrate metal into the composite structure in order to provide grounding of the conductive fibers and b) integration of extremely low mass cooling channels into these structures. As with other items on this list, there is significant infrastructure cost for establishing the required equipment to do this work, the materials costs are high (for minimum order quantities), and the benefit of years of experience is invaluable. The facilities at FNAL Lab 3 could provide users with a venue for developing ideas.
- Metrology and precision assembly
    - This asset exists at multiple locations in different forms. The SiDet facility at FNAL is an excellent example. The precision optical assembly benches used for the Babar DIRC bar assembly are another example where different metrology techniques were required. Again, the cost of standing up this capability are non-trivial and in most cases the equipment is only needed a small fraction of the time. In addition, as in the other cases discussed, a large part of the national capability in this area is the people with extensive experience that can be tapped. They have unique insight and can be invaluable in providing guidance around the pitfalls are problems they have encountered in the past.
- Plastic Scintillator Facility
    - There is little question that the FNAL/NICADD extrusion facility is a unique asset. However, that asset would have far less value if not for the talented and experienced polymer scientists and staff that have developed the facility and capability. Again, the National Capability embodies both the facility and the experienced scientific stall that underpin it.

These, and other, National Laboratory Capabilities could provide a network of National User Capabilities that provide unique technical capabilities, and in most cases facilities and equipment. The proposed mechanism for

access would be by competitive proposal to a review board in much the same way that one would request test beam time or access to other National User Facilities. In building the structure for proposal review, I would advocate for preferential consideration of small and/or modestly funded institutions or collaborations that could not otherwise have access to this level of capability or technology. As mentioned above, a National Instrumentation Board (NIB) would be a natural review organization. In practice the laboratories that host these capabilities must administer the personnel and facilities and manage priorities between access by Users and demands from construction projects. Perhaps the NIB would act in a similar vein as the PAC, but I would favor the NIB taking the lead role on reviewing proposals and passing the "winning" proposals on to the Laboratories to integrate into the facility/personnel schedules.

An additional recommendation would be to establish CERN RD-style research projects within the US HEP system. This is complicated in the US, as compared to the EU, by the existence of 5 Laboratories each with unique capabilities and assets rather than a single focal point like CERN. In addition, HEP encompasses a significant program both within and outside the laboratories in non-accelerator physics. Hence the concept of an NIB to act as a common clearing house across the field seems appropriate in the US. I would envision that this body would review proposals for RD experiments and make recommendations for what to fund to DOE-HEP. They would then be the scientific body that would provide technical review of the projects to provide feedback to the DOE about the program. The aforementioned National User Capabilities, along with National User Facilities such as test beams, would be the critical assets and infrastructure these programs could draw on to execute their research efforts. This structure would enable smaller teams and even single PIs to conduct research and development that requires talent, equipment and facilities that would otherwise be impossible to muster.

I would like to pursue a further thread regarding the National Capabilities at the HEP labs. At present these assets are extremely difficult for people from other fields who could benefit greatly from access to them. As an example, there is no obvious mechanism for a researcher in another field to make use of these capabilities and leverage the investment that has been made by the nation to develop and foster them. This is not completely true, as the multi-purpose labs share these assets between their programs so that elements within the Nuclear Physics and National Security world do have access. Fermilab, however, has capabilities that are not obviously available through existing mechanisms. Even at the multi-purpose labs it is often the case that one most establish a collaboration with scientists in the other discipline that in turn leads to access to the technical capabilities at that lab, rather than having a direct mechanism to request access to those capabilities regardless of intellectual interest in the research among the scientific staff at that institution. The National User Capability model could provide a well-defined and open access channel to these unique national capabilities to anyone interested in using them, whether that request is related to HEP, NP, Medical physics, National Security or any other research field. Granted, a fee structure would be required in order for HEP to recover actual costs of services provided to those outside HEP, at least there would be an established route to requesting access to those capabilities and a mechanism for prioritizing requests and providing access.

Task: A national instrumentation fellowship program.

Rationale: support training of young scientists in instrumentation

What the taskforce will evaluate

Please comment on the suggestion that a national instrumentation fellowship program be created by the NSF and DOE and Industry for Ph.D. students and postdoctoral scholars to encourage and support research in instrumentation. How should industry be involved and what industries should be targeted?

A possible model: create high--- stipend fellowships with travel budgets to be tenable at National labs and universities. Competitive proposals would determine where the fellowships were located. The successful institutes will then be

responsible for filling the fellowship through an advertisement. Some fellowships might be sponsored by Industry in reciprocation for access to instrumentation schools (see below). Already at the March HEPAP meeting DOE and NSF officials indicated interest in the idea of national instrumentation fellowships.

> No question that this is a great idea, but how to engage industry in this? I think a key may be to consider what skills the industry partners are looking for in future employees and ensure that programs are built to foster development of people for industry as well as for the future of HEP. My experience has been that the field is biased towards educating students and Postdocs solely to follow research faculty or national laboratory scientific staff career tracks and provides little collateral training and experience to aid in developing alternative careers. Yes it would be great if the majority of the people in these programs go on to become the future instrumentation specialists in HEP, but it will also be of great value to the field even if these people go on to careers with the industry partners that are vital to the fields future.
> Given the extreme timelines of experiment construction it is ever more difficult for students to gain real hardware experience during their PhD programs and even through a postdoc in some cases. These are vital skills that must be fostered in the community, particularly between major construction projects (say, for instance, between LHC turn on and sLHC or ILC….) It is possible in today's environment that whole generations of experimental physicists have had relatively little detector development experience. This is not healthy for the future of the field.

Task: Instrumentation school

What the taskforce will evaluate

The accelerator community has a dedicated accelerator school with academic credits. The recent EDIT school for instrumentation and technology at CERN was a great success where academia and industry sent members of their staff to attend. What are the thoughts of the committee members on establishing an EDIT style instrumentation school at the US labs (possibly rotating between them), possibly with academic credits. How would the school be organized?

Idea: EDIT school has attendance by a few members from industry. EDIT offers a far higher level of product than the National Instruments Labview Courses Industry for example is willing to pay for. Advertise the school to industry. Two options

(a) Ask industrial partners to pay to attend the school. Use proceeds to partially support national fellowships in instrumentation named after the donor company.

(b) Or, probably more effective at generating goodwill and support (and independent voices for our field in Washington), offer the school free but subsequently when the national fellowship program from DOE and NSF is put into effect, ask companies who have benefitted from the school to sponsor some fellowships with their company name being attached to the fellowship.

Again, A very good idea. The USPAS, CERN schools and NATO summer school are great examples of programs that are very productive and beneficial to the community and to the students. As mentioned in the last section, the time scales for HEP experiments has become so long that it is not difficult for a student to simply miss out on any opportunity to work on instrumentation related to their thesis experiment. Even when they do, it is often extremely focused on a narrow sub-system. Having a series of courses that explore instrumentation in a similar manner as the USPAS courses cover accelerator science would be great (I must admit I am not familiar with EDIT so that may be a far better example). However, the challenge in instrumentation is that the course (at least beyond an intro course) should include practical, hands on experience in the lab. This is a unique challenge that USPAS does not face.
This is another case where I would emphasize that HEP has a large and growing element beyond the accelerator-based programs and this should be placed on equal footing in a school. In some ways these other activities in HEP more closely resemble the technology employed in other arenas (National Security, Environmental Monitoring, Health Physics, much of Nuclear Physics) and therefore provide a better transferrable skill set for those who chose not to remain in HEP or are unable to get permanent positions in the field. The set of Universities that offer a program focused on

instrumentation for nuclear/particle physics or nuclear engineering appears to be very limited, though not as limited as those offering programs in accelerator physics. Making courses available to the HEP community at a national level to fill that educational gap would be great. As there is significant overlap into other fields (NP, NucE, Medical Physics) it may be worthwhile to consider how to position such a program to grow to encompass that broader community as it is developed.

Carl Haber

National Instrumentation Board: This is the first question on the list I was given and is perhaps the most difficult. The way the question is posed already indicates considerable ambiguity. If the role of the Board is to "promote" the field then that is less troubling and is rather easy to support. Such a board could organize workshops, meetings, create reports on the national program and so forth. Such a board could either come from DPF or start of as a HEPAP or interagency sub-panel or study group, for example. If the role is to "evaluate" the program then of course it has to report to funding agencies, and it is for the agencies to constitute. Stepping back from all this, it is always natural to look at Europe and see what they do. I usually think that Europe, and in particular CERN, does a better job than the US in fostering and supporting a vibrant detector R&D community, in the form of the RD-XX collaborations. I do not know what the overarching management structure is there and perhaps that would be worth some study.

In summary, a promotional board could function under the banner of the DPF, or be appointed, and task itself with organizational jobs, meetings, reports, and so forth. An evaluation board needs to be embedded in a valid management structure, in concert with DOE/NSP. It would be an important component of and RD-XX like system if we could constitute one in the USA.

Targeted Resources at National Labs: A bit unclear exactly what is being proposed here so I will give a few responses.
1) Of course the National Labs have a mission to support the university/researcher community. So yes there should be resources available.
2) How would this be funded? University groups could pay for this in the Lab "work-for-others" scheme. The university researcher might conclude this is very expensive. Universities could make proposals to the Lab which, if funded, could be supported out of LDRD. DOE could fund this in either a very specific, project centered way, or as a general thing to provide some "beam-time" to outside users.
3) With regard to full fledged "Instrumentation Centers" at the National Labs, particularly as it relates to the multi-program labs, I believe such centers need to serve the broader community there (HEP, NP, Astro, Photo Science, EM, Materials, Bio, Environmental, Medical, Security, etc.) It is becoming much more widely appreciated by researchers themselves (perhaps still less so by managers) that targeted instrumentation R&D is needed for all these areas of science at present. I think DOE should elevate the support of such centers at the Labs to a priority and at least partially fund them across HEP, NP, and BES (and others?) at some significant percentage of their operating costs.

National Instrumentation Fellowships: For post-docs and graduate students, in the US university system this is still problematic since a) no degree is granted for instrumentation work, and b) post-docs know that it will be hard to make an academic career based upon instrumentation. Perhaps some university(s) want to take the bold step and break from this system. In this case it would be easier to support such an idea. Even the National Labs are uncomfortable with post-docs spending too much time on instrumentation as it will lower their job marketability. Perhaps we could have such a fellowship in the USA but restrict it to European visitors? I will mention something else relevant to this. At Lawrence Berkeley Lab we have a position called Post-Baccalaureate Fellow. This is a 1-2 year appointment for people between undergraduate and graduate school who want to "observe" research in the lab before starting their graduate career. We find increasingly that students are drawn to this because they believe it will improve their chances of admission to competitive graduate programs. If a National Fellowship could be funded perhaps it could target similar appointments at all the Labs?

I have very little experience with Industry funding such things so I would not know how to finesse that. DOE includes education as a mission, so perhaps there is a pot there?

Instrumentation Schools: In general yes, there are good things. Sharing with Europe, and taking into consideration other training opportunities, are good ideas. For example, how effective are the IEEE NSS short courses? Who attends these? Could instrumentation schools be made more widely interesting to also people in NP, Photon Science, Astro, Bio, Security, Environmental etc?

In the case of Accelerators, I believe this arose from the need to build up a community of accelerator physicists and help people make the transition from HEP "research" in the usual sense (and other fields) to accelerator physics, since a) the

subject was not usually taught in university, and b) there were actually jobs working at accelerators. The model does not simply apply to Instrumentation since there are not the same sort of opportunities and needs. Instead the instrumentation school is targeted at graduate students and post-docs who are typically planning to stay the normal academic course by want some additional background.

Joel Butler

To: Task Force on Instrumentation

From: Joel Butler

Subject: Some partial answer to your initial questions

Dear colleagues,

First let me think you for undertaking this difficult and very important task and for giving me the opportunity to participate in it as an advisor to the task force. Second, let me wish you success in your endeavor. In the following, I try to provide my response to the issues raised in your letter concerning your initial proposed topics for the task force.

General comments:

1) One key issue that I think you have to address is the view of faculty members who are high energy physicists at U.S. universities. Specifically, do they see the field as continuing to play a major, direct role in the development, construction and operation of HEP experiments or do they imagine these tasks being taken over by "professional" engineers, technicians, and computer scientists? Do they now and do they plan in the future to use proficiency in detector design and construction as at least a criterion in their hiring of new faculty? I recognize that demonstrated analysis and teaching ability is and should be the primary "mandatory" requirements. I am interested in whether proficiency with hardware is taken into account at all, perhaps as a highly desirable skill that could serve as a tie-breaker between closely matched candidates. Are post doc candidates with hardware experience given preference to candidates with similar analysis experience and accomplishments, but no hardware experience? If this task force could make known to the U.S. funding agencies that these activities are appreciated and are taken into account, as I believe that they are, it might help to dispel the notion, often heard in DOE and NSF, that universities only care about analysis capability and that "physics research" refers exclusively to data analysis. In fact, DOE is beginning to apply this idea to the scientific staff at national labs who are now regarded as part of a "research program".
2) R&D of any kind is, by its nature, difficult to direct. The first requirement in advancing an R&D program is to create an environment in which individuals with good ideas receive encouragement and have the resources to pursue them until they either succeed or are shown to be unworkable. However, given limited resources, not even all good ideas can be supported with resources. Someone or some institution has to guide the program simply because of the limitations of resources. However, I would urge the task force to be very careful about trying to establish new control mechanisms for determining what research gets. I hope it will focus more on how to provide better guidance and advice to our funding agencies and perhaps develop methods of promoting partnerships with industry.

Comments/ Answers to questions:

Based on comment #2 above, I divide your questions into two groups.

The first group is aimed at considering ways to create a positive environment for detector R&D. These include

- A national instrumentation fellowship program: Depending of course on the detailed implementation, this could be very helpful in encouraging young physicists to take an interest in instrumentation and detector design and development. I think the task force needs to think hard about how to create a program that will have a sustainable impact on the university community. If fellowships do not position the recipients for positions at good HEP research universities, then it will not be a complete success. One may want to consider providing some support to untenured and even tenured faculty to participate in detector R&D along with their students and post docs.
- Instrumentation school: Again, this is an excellent idea that should be pursued. Doing schools properly is a big effort, but is well worth it. There have been ICFA Instrumentation schools and the recent EDIT school that provide models. Industry involvement would be welcome.
- A national prize: Again, this is an idea that I support. It would have to set very high standards but there are many examples of meritorious development of instruments and techniques that already provide a backlog of potential recipients of such an award.
- Interdisciplinary: The interdisciplinary aspects of our instrumentation efforts are evident. Nuclear physics experiments are now in many cases similar to HEP experiments . Some of the R&D done in NP are similar to what we are doing in HEP. Collaboration cold be useful. . Obviously, particle astrophysics experiments and non-accelerator nuclear physics use many of the same techniques. As far as material sciences, electronics, and computer science, we stand to learn a great deal. Materials science is producing materials that can help us solve many vexing problems and only recently are we beginning to take advantage of the progress in this area. In fact, one area where the task force could immediately make an impact would be to commission an effort to collect up a list of useful apparatus and relevant areas of work going on within our universities. I notice that many of our HEP groups are not well informed about the R&D in other areas of their own university. There has been recently a large expansion in microelectronics infrastructure in engineering departments and it is hard to keep up on all the new facilities. Beyond the university and national labs, industry offers additional opportunities for collaboration but one has to be realistic about the possibilities since most commercial partners must focus on the relatively short term and on their bottom line and may view us more as customers than partners.

The second group seems aimed more at determined what instrumentation R&D actually is supported. Here there are significant dangers that must be weighed carefully against the possible gains.

- A National Instrumentation Board: Well, to start with this is an alarmingly general title. If it had said “National Instrumentation Advisory Board”, with idea that it would advise the agencies on their detector R&D programs, then that might make some sense. Since the Board would provide no funding (at least I don’t think anyone is proposing that), it really can only be advisory. If the implication is that it would advise the agencies on upgrades to experiments, it seems that would simply add a layer, and not necessarily a very good one, to an already pretty cumbersome process. If it were simply there to administer and oversee the projects in the first group above, then that would make some sense. In order to evaluate this idea, it would have to be given more definition in a concrete proposal.
- Directed resources at national labs: I take this to mean that each lab would provide a set of resources in particular areas to the R&D community. It seems that it includes the notion that there would be some fixed amount of funds committed to serving the R&D community. This seems to me awfully difficult to implement. It is perfectly reasonable to establish a list of laboratory competency and let grant PIs purchase the needed services from a lab under standard work-for-others arrangements . Alternatively, they could use a commercial vendor to do their work. While it might seem that having “directed resources” would guarantee more support and higher priority than using a work-for-others arrangement, I don’t really believe that. Labs always have a core mission and will direct resources to that whenever they can. I would imagine that the directed resources would be somehow diverted if the lab wanted to do it. The one counter argument that I can think of is that even national labs may have trouble continuing to support various kinds of engineering and technical groups and if we want to keep those capabilities within the field, we ought to make sure that we encourage HEP work on instrumentation R&D to come to our labs to keep them viable as centers of detector R&D and construction. I have to think about this one a little more. It would be best to have a strawman proposal to react to.

Mike Crisler

On the need for a National Instrumentation Board

With HEPAP and its various prioritization and scientific assessment subgroups, we have a robust national process for establishing scientific priorities in High Energy Physics and Astrophysics. That process has served us well, providing us with prioritized lists of overarching scientific goals or "mission needs" and providing us with prioritization of the various projects and experiments that have been proposed to address those goals.

A National Instrumentation Board would seem to be a natural extension of our existing process, and could play an obvious and very useful role in assessing the state of instrumentation technology with respect to our prioritized scientific goals. The assessment should take a broad view of instrumentation that would include sensors, electronics and readout, and instrumentation infrastructure such as data acquisition and controls hardware and software. The assessment could look at the capabilities of our university and national laboratory groups as well as commercial vendors of instrumentation products. The assessment could identify the specific weaknesses in the current state of the art, and could recommend specific R&D pathways that should be pursued.

I think that a regularly updated assessment of the state of instrumentation technology for high energy and astrophysics research would be an extremely useful tool to inform the process by which the funding agencies assess instrumentation R&D proposals. It would also be useful to the managers of national laboratory engineering resources who need to assess the capabilities and performance of their organizations, to individual researchers looking for instrumentation R&D opportunities, and to private instrumentation companies looking for opportunities to serve the research community.

Another area in which a National Instrumentation Board might play an important role is in the evaluation of the larger picture of instrumentation R&D funding as it flows through our national system. I don't know if I can enumerate all of the instrumentation funding pathways that currently exist. Some instrumentation development work is implicit in the operations of our ongoing experiments and facilities. We also have instrumentation development work that is implicit and explicit in our experiment construction and upgrade projects. Instrumentation R&D is funded through programs at our national laboratories, through grants awarded to individual researchers at universities and national laboratories, and to private companies through the SBIR program. I think that all of this is healthy for the field, but it would be very useful to have an overarching assessment of the performance of these various funding pathways. A National Instrumentation Board could play an important role in providing such an assessment.

On the value of Targeted Resources at National Laboratories

My view is that the strongest Instrumentation R&D program we can create is one based on grants to individual researchers or collaborations, whether from universities or national laboratories, based on peer-reviewed proposals. If the proposed research is to be carried out at a national laboratory, then the grant should include appropriate SWF funding to cover the engineering and technical staff required.

This is the successful model by which we fund experiments and projects, and it will always be the case that national laboratory resources are distributed according to the priorities of the large projects, ongoing experiments, and facility operations that are underway. The best way for a small R&D project (or a small experiment) to thrive in the national laboratory environment is to have control of the necessary SWF budget.

For similar reasons, I am skeptical of a "bricks and mortar" R&D center at a national laboratory. While instrumentation R&D researchers might be tempted by the prospect of dedicated engineering, design, and technician resources, the flip side of dedicated resources is that instrumentation R&D would likely *lose* access to the rest of the engineering staff. I think that an R&D effort managed as a small-scale version of our large projects would provide the best access to the full array of capability and competence that our national laboratories have to offer.

Where I do see an important role for the national laboratories is in the maintenance of R&D infrastructure. A typical small instrumentation project will require electronics and data acquisition tools. It might also require industrial controls like heating/cooling, machine vision, or motion control. I suspect that our current R&D budget pays over and over again for the tools, the software, and the training for a variety of ways to solve these basic problems. The national laboratories might take the lead in developing some standardized approaches and in providing a repository for standardized tools. This could be reflected in the training programs offered in our Instrumentation Schools.

Another area where the national laboratories and universities can make a contribution is in the maintenance of specialized test setups. Obviously this would include test beam facilities. It could also include other facilities like photo-detector characterization laboratories, specialized probe stations, and coordinate measuring machines. If the availability of existing elements of useful R&D infrastructure is widely advertized in the instrumentation R&D community, then we can ensure that existing capabilities are not unnecessarily replicated and that existing facilities are fully utilized.

On the Virtue of National Instrumentation Fellowships

I am generally supportive of the idea of a national instrumentation fellowship, and I am confident that such a fellowship would produce an excellent educational experience for a young researcher. My only caution is that, like any fellowship program, it should be crafted with an eye toward successfully promoting the future career of its recipient. Certainly a young researcher who successfully completed an important instrumentation project under such a fellowship would be attractive to a national laboratory for many of our positions. I'll leave it to my university colleagues to comment on how such a background might affect a candidate for an academic position.

On the Value of Instrumentation Schools

I would strongly support instrumentation schools as offering many important benefits to the instrumentation program and to our research program in general. Formal schools in the model of the Accelerator School provide an excellent and proven model which is ideal for young people or those learning the technology for the first time.

I would also encourage the committee to consider the continuing education needs that affect us all. In Ian and Marcel's letter, they made reference to the familiar reality we face in projects of long duration. We freeze the technology early on and spend years working with it. When the project is complete our expertise is obsolete. I suspect that an instrumentation school could provide an excellent service by making available specialized training covering the current trends in data acquisition hardware and software, analysis tools, new technologies.

Chris Kenney

National Instrumentation Board

Useful for organizing the instrumentation school and the National Instrumentation Fellowships as well as serving an interface between the National Labs and the funding agencies.

Targeted Resources at National Laboratories

National labs can serve as resource centers for university group who need access to special technical expertise or facilities.

National Instrumentation Fellowships

A good idea as it provides direct encouragement for pursuing a career in instrumentation.

Instrumentation Schools

An annual or semiannual school in which graduate and perhaps select undergraduate students receive an overview of instrumentation as employed in high-energy physics would be an efficient means to transmit this knowledge to a new generation. Most universities have few if any courses focused on experimental techniques, therefore in general students must acquire these skills in a haphazard manner. Although there is no replacement for extensive hands-on experience, an integrated set of lectures covering various techniques and detectors would give beginning scientists a head start compared to those in previous years.

The question of the best audience for such a school is important, It should certainly include those pursuing an advanced degree in particle physics. I would argue that students intending to specialize in theoretical particle physics should be encouraged to attend, as it is clear to me that an understanding of how experiments are performed tends to enhance their interactions with experimentalists, which benefits the field. Whether it should be open to postdocs or more senior researchers would partially be determined by how popular the school turns out to be and the ability of the host institution to accommodate a large number of students.

Such a school would bring together students from diverse parts of the country and from a broad range of experimental subfields from within particle and particle astrophysics, giving them a chance to network and cross-fertilize.

A summer school lasting about three full days and covering the central instrumentation techniques used in particle physics and particle astrophysics. I would favor a covering many topics in modest depth.

Ideally the lectures would be recorded and made available on the web.

If such a school is established, SLAC National Accelerator Laboratory would welcome the opportunity to host the inaugural event.

Erik Ramberg

Ian & Marcel:

Thanks for asking me to comment on the several issues you've outlined for national coordination of HEP instrumentation. I've included below some of my thoughts on these issues.

A National Instrumentation Board.

> "Is there a need for a national body to evaluate and/or promote the national instrumentation R&D program? What are the processes for evaluating and promoting the national R&D program through a standing body? Please suggest under which auspices such a body might be organized and indicate possible reporting strategies. Please comment on the appropriate role for a standing panel in the instrumentation R&D programs for upgrades to existing projects and future projects. What are the advantages and disadvantages of creating a National Instrumentation Board?"

I think that a National Instrumentation Board (NIB) could play an important role as a body that promotes instrumentation research and disseminates information about it. A NIB could easily act as a forum for deciding about targeted resources at the national labs (see following question). In fact, one would need to create such a panel to make the targeted resources work. In addition, a NIB could make choices for a fellowship program. Additionally, it could help support detector schools and conferences. However, I don't think it makes sense as a national evaluation or approval forum. This is because DOE and NSF already act as this type of national review and they are free to create targeted sub-committees to address outstanding questions. Adding this role to the NIB would be too much, I think.

Task: The creation of targeted resources at national labs for detector R&D, and the scale of those resources up to fully---fledged detector R&D center(s) at National Labs.

> "Might targeted resources be established at each of the five national laboratories in order to specifically support particular instrumentation R&D needs of individual researchers at the universities and the laboratories? This will be in several forms: engineering design time and specific resources for small---scale collaboration among and between university and laboratory scientists. How might such a program be administered and funded?"

In my mind this would be the most important addition to the U.S. detector program. A very large array of engineering and infrastructure resources exist at the national laboratories, some of which are under-utilized, while the talented and imaginative researchers at universities suffer from lack of those same resources. The need and solution seem obvious to me. I think DOE should ask the national laboratories to set aside a portion of their resources, both labor and material budget, to support university based projects. The amount of this set-aside would have to be determined by a conversation between the labs and DOE, I think. The NIB discussed above could act as a decision making body that matches projects with labs.

Task: A national instrumentation fellowship program.

> "Please comment on the suggestion that a national instrumentation fellowship program be created by the NSF and DOE and Industry for Ph.D. students and postdoctoral scholars to encourage and support research in instrumentation. How should industry be involved and what industries should be targeted? A possible model: create high---stipend fellowships with travel budgets to be tenable at National labs and universities. Competitive proposals would determine where the fellowships were located. The successful institutes will then be responsible for filling the fellowship through an advertisement. Some fellowships might be sponsored by Industry in reciprocation for access to instrumentation schools (see below). Already at the March HEPAP meeting DOE and NSF officials indicated interest in the idea of national instrumentation fellowships."

A fellowship in HEP instrumentation is a good idea. I think the national program could support a few of these fellows each year. I am dubious about the role of industry simply because HEP research is far more basic science oriented than most of the other physical sciences. Trying to force an equal role for industry may detract from things like neutrino or dark matter detectors. An exception may be a focused outreach to the X-ray light sources (APS at ANL, LCLS at SLAC, etc.) The NIB could act as the deciding body for the fellowships.

Task: Instrumentation school

> "The accelerator community has a dedicated accelerator school with academic credits. The recent EDIT school for instrumentation and technology at CERN was a great success where academia and industry sent members of their staff to attend. What are the thoughts of the committee members on establishing an EDIT style instrumentation school at the US labs (possibly rotating between them), possibly with academic credits. How would the school be organized? Idea: EDIT school has attendance by a few members from industry. EDIT offers a far higher level of product than the National Instruments Labview Courses Industry for example is willing to pay for. Advertise the school to industry. Two options (a) Ask industrial partners to pay to attend the school. Use proceeds to partially support national fellowships in instrumentation named after the donor company. (b) Or, probably more effective at generating goodwill and support (and independent voices for our field in Washington), offer the school free but subsequently when the national fellowship program from DOE and NSF is put into effect, ask companies who have benefitted from the school to sponsor some fellowships with their company name being attached to the fellowship."

The EDIT instrumentation school held at CERN in February showed that there was a great demand in the community for this kind of focused, expert training in HEP instrumentation for young researchers. Fermilab will be hosting the second EDIT school in February, 2012. I think this school can continue on a yearly basis. Its location should rotate among a select group of international laboratories (CERN, DESY, KEK, FNAL, SLAC, BNL, ANL). Some attention will have to be paid to coordinate this with the ICFA instrumentation school. I do not think that it should be tied in to industry. The options proposed here seem to complicate the simple task of training young researchers.

Task: Interdisciplinary

> "Please comment on the relative importance of developing strategic links to, for example, nuclear physics, materials science, condensed matter physics, and electrical and computer engineering both in academia and in industry to the future of HEP instrumentation as the complexity of our experiments increases. How might these links be developed and sustained?"

The connection from HEP to nuclear, condensed matter, and materials science seems to run through the light sources. Argonne NL seems particularly well suited to make a coordinated national level connection, since the APS has the largest user community. I would recommend that the ANL HEP division survey the national light sources to find out which of their instrumentation needs could be met by the HEP community. Coordinating any response will obviously be a difficult task, and I don't have any suggestions at this point.

Collected Comments

Yifang Wang

Dear Ian and Marcel,
I read your document and find out that I can provide very little information to you. Please find in the following an account of current status in China. I believe a National Instrumentation board is a great idea and should be put in place. It can help the field to support more R&D efforts in a coordinated way, and get more attention from all related parties. I am extremely interested in how this board is going to be functional and willing to follow the development.

Unfortunately such a board does not exist in China, nor any discussions yet. Concerning the role of national labs, I believe there is no useful experience from China. In fact, Universities and National Labs all have very limited resources for R&D, and most of the activities are project related. Supports from national labs to universities are now mainly schools and workshops. We are actually starting now to help universities to train young fellows, give courses, and fund little joint R&D projects. There is no national price in China dedicated to the instrumentation, but an experimental physics price (Wang Ganchang price) may be given to achievements on accelerators and detectors.

Best regards and see you probably at Fermilab in June for the TIPP conf.

Yifang

Minfang Yeh

Dear Ian & Marcel

Please see my comments in attachment for each listed task. IF any changes, I will update it later. Hope this is useful.

Overall I have few quick comments:

1. One prioritized item is to find the sponsor for this taskforce. What are the responses from DOE/NSF? We should invite them for the taskforce meeting.
2. How do we avoid the overlap of instrumentation (detector R&D) from others? It seems overlapping to some existence programs already; should we focus our program on Instrumentation for Detector R&D only? Will this loss other links?
3. How to make the R&D funding for instrumentation bigger? if so, we might be able to open and include all aspects of physics.

I will be at Anaheim for the kickoff meeting.

Best regards
Minfang Yeh

Dear Ian and Marcel:
My answer to some of your questions and other thoughts (before responding to the specific questions). First I should say I am answering as a university physicist, so I don't really know how well lab funds for detector R&D are being used and for what purposes. I am not in favor of further centrallizing R&D at labs, although

using engineering resources at labs in a collaborative fashion for projects I am sure would benefit a number of groups. In general I think an ideal time for graduate students to participate in detector R&D (one of our central goals) is during the early years in graduate school before being attached to a specific analysis project. During this time, being resident at the university is important and so being able to do projects at the home university would allow a larger number of students to participate. This has unfortunately been a casualty at many universities of the severe funding situation, including rather negative attitudes within DOE to supporting technical personnel (except in very exceptional cases). If it can be reversed in some fashion I think it would benefit student training, as well as broaden possible contacts with other univ. departments. So to me the overarching goals should be:
1) Convince the agencies to put more funds into detector R&D (highest priority) analogous to the importance of supporting accelerator R&D. Have they bought into the work of your committee? If is remains only an APS issue without the agency buy-in I think progress will be limited.
2) Reinvigorate university participation, including students, in detector R&D,.
3) Make sure the program is supporting the efforts needed for upgrades to existing experiments and effort needed for nearly existing experiments (I assume the labs will have a strong interest in this). The needed funding needs to be defined carefully (a major role role for your instrumentation board?) although management of specific efforts and priorities within the efforts need to come from the experiments themselves.
4) Make sure we are able to fully use commercial advances (I believe we have done well in this regard in the area of electronics and computing), including advances in materials and simulations of material properties often available mostly outside our community (perhaps another role of the instrumentation board?).

On to some of your questions:
Instrumentation Board: Everyone is very busy so adding something like this requires a careful understanding of what it will do. This is a comment regarding both the board and the possible time it might take to respond to it.
So I would suggest sharpening the issues it would address (I gave some possibilities above but I haven't thought a lot about it) and then coming back with a much more specific set of options. I would, however, only suggest doing something like this if the agencies have acknowledged it and support the role.

Your items involving students all seem good but I think can't replace decent university funding for detector R&D, which I think would be the higher priority. However, this is all probably a part of a process about changing the perceptions in the agencies about detector R&D and so going ahead soon with some of the items probably would be good. Of your three items listed in this category I think the one I would favor most is the instrumentation school since it has the potential to affect the largest number of students and perhaps even students whose advisers are not too involved in instrumentation.

Good luck with your effort on all of this.
Best Regards, Abe

Karen Byrum

Hi Ian & Marcel,

Am having trouble attaching a word file. So text is just inserted below. cheers
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Task: The creation of targeted resources at national labs for detector R&D, and the scale of those resources up to fully---fledged detector R&D center(s) at National Labs.

Taskforce asked to evaluate whether targeted resources might be established at each of the five laboratories in order to specifically support instrumentation R&D needs of individual researches at universities and the laboratories in the form of engineering design time, etc.. up to detector R&D centers.

Task: Interdisciplinary

Here are a few comments that the taskforce should consider in their evaluations. These comments are Argonne biased.

Background:

Mostly, engineering effort at a national laboratory is not funded from the base program, but rather from the project funds as the project is being designed and built (usually, there are large amounts of funds for engineering support in the design & construction phase of a project) and from the operating funds once the project has been commissioned (usually there are small amounts of funding for engineering support in the operations phase of a project) . Scientists are usually categorized, for DOE funding purposes at least, by the projects they are part of as they ultimately are the ones who collect the data and write the papers.

Development of ideas at the earliest stages usually always requires teams of scientists and engineers. At multi-disciplined laboratories like Argonne, LDRD plays an important role in supporting these initial engineering costs. Since, scientists are part of the base; they are able to freely spend part of their time developing new ideas, as long as they are contributing to the science of the projects they are part of.

Engineers at laboratories on the other hand, are always in search of the next project since they are not supported once the design, building and commissioning of a project is completed. In my conversations with laboratory engineers, they do not want to be considered as a job shop as they consider themselves part of the scientific teams of the projects within their prospective labs. Finding engineering jobs that have no connection to the scientists and specific programs at a laboratory would alienate the overall program. LDRD funds are often a bit tricky at multi-disciplined laboratories (like Argonne) since high energy physics is competing with many other science disciplines for these limited funds and it is often difficult to compare the impact of R&D in different areas of science. The committees that evaluate these LDRD proposals often have at most one HEP representative (out of up to 20 persons).

Suggestions:

I do not see a path to support laboratory engineers for general use by the whole community.

The available funds for basic R&D (LDRD, ADR and MRI) are all PI driven. Large projects and experiments within HEP are team driven. Recently, DOE has invested funds at Argonne to support and manage a large team for developing new economical large area photodetectors. I encourage the task force to study this R&D and the way it is being performed. The R&D of these new photodetectors is a "collaboration" and a project. It includes multiple laboratories, multiple disciplines within argonne, multiple universities and multiple small companies within industry all working together to develop new technology that is targeting HEP, but the new technology would benefit other areas in science and technology. So while the development of these new photodetectors is similar to a project within HEP, it is different because it includes expertise and companies outside of HEP. The scale of the research is larger than what an individual LDRD, ADR or MRI grant would support.

It is the scale of the R&D (new economical large area photodetctors for example) that qualifies it as a national program. Such an effort would never have been funded within LDRD, ADR or MRI alone. In fact, (this is my opinion) there were multiple coincidences that all came together that allowed this particular R&D effort to be funded. The DOE mission need of a future neutrino detector that required >$100M of photomultiplier tubes; Hamamatsu being the only company making these phototubes, the DOE program manager of the detector R&D program, Howard Nickelson, had vision, Dennis Kovar believed there should be parts of his program that were higher risk, higher payoff, and a failing US economy which resulted in millions of ARRA funds being available to get America back to work.

A national detector and instrumentation program should have vision and take risks! It should fund programs that are beyond the LDRD, ADR and MRI level. Ideally, it should have a few large projects /collaborations at any given time. The criteria could be based on DOE mission. Laboratories which already have the infrastructure and facilities should manage the funded projects, but projects should also include university and industry partners (like the large area photodetector R&D).

David Asner

Dear Ian and Marcel

I will be in Southern California this weekend with my family.
Although I will not be attending the APS meeting, I will attend the task force kickoff meeting in person.

Here is some input to the task force as you requested in your invitation letter.
I hope there will be the opportunity to discuss these topics with the task force during the meeting.

Task: A National Instrumentation Board.

Is there a need for a national body to evaluate and/or promote the national instrumentation R&D program?

Need is probably too strong a word. A National Instrumentation Board would be valuable. It would benefit University researchers as they determine the future direction of their research programs and inform DOE Grant Monitors/Program Advisors as they evaluate/decide what research to fund.

What are the processes for evaluating and promoting the national R&D program through a standing body?

A model to consider would be analogous to HEPAP. - or perhaps a HEPAP sub-panel on instrumentation. Producing the instrumentation analog to "Accelerators for America's Future" would be valuable - although this is broader than just HEP.

Please comment on the appropriate role for a standing panel in the instrumentation R&D programs for upgrades to existing projects and future projects.
The role will vary depending on whether the experiment is domestic and the size of the US role in the experiment or subdetector system.
It would be beneficial to discuss specific examples at the task force meeting.

What are the advantages and disadvantages of creating a National Instrumentation Board?
Advantages: A National Instrumentation Board would be able to both focus and coordinate research, avoid

duplication of effort, and promote collaboration among researchers with common interests/
Disadvantage: A diverse research program is important. The consensus of a large group of experts tends to be too focused and/or too conservative.

Task: The creation of targeted resources at national labs for detector R&D, and the scale of those resources up to fully---fledged detector R&D center(s) at National Labs.

Three things come to mind

1) Access to beam time at National Labs
2) Access to engineering resources at National Labs
3) The CERN RD collaborations - such as RD42 and RD50

It would be beneficial to have a centralized decision making body for access to beam time, engineering resources and other capabilities at National Labs that are needed by University researchers but for a variety of reasons are not capabilities that individual universities can maintain.

For some resources , a proposal call would be appropriate. Proposals could be ranked into three categories. 1) Approved and fully funded by Laboratory 2) Approved but some or all funding from University grant (pay to play) 3) rejected.

The CERN RD collaborations are a good model. Broad guidance, access to key resources/facilities and seed funding is provided by the host laboratories. The R&D program is driven by the (mostly) University collaborators and most of the funding is provided by grants obtained by University PI's. The National Instrumentation Board could help determine which US based instrumentation R&D collaborations are warranted. Distributing these new RD collaborations among the US labs based on existing capability is a reasonable approach.

Task: A national instrumentation fellowship program.

Regarding industries to be targeted. The data is out there.
1) Review the APS statistics on where HEP physicists are employed. These industries are (a subset of) the industries to be targeted.
2) Review the industries that do frequent business with and/or have facilities near National laboratories.

Task: Instrumentation school

I would like to bring to the attention of the committee the
International School of Trigger and DAQ - http://isotdaq.web.cern.ch/isotdaq/isotdaq/Home.html

This school is run by Gokhan Unel (UC Irvine, ATLAS) and was featured in the CERN courier.
http://cerncourier.com/cws/article/cern/42097/2

Task: A national prize

A national prize for instrumentation is good idea. That fact that the Panofsky prize has been awarded several time for instrumentation speaks to the importance of advances in instrumentation to our field. I have no opinion on whether a prize or a medal is more appropriate.

David

Jerry Vavra

Hello Ian and Marcel,
I cannot come to your meeting as I go already to New York to visit a company in Middletown, which is making optical pieces for the FDIRC. But I would say that sending written comments to the meeting is better as I have time to work it out.

It is hard for me to make comments, but let me try.

1. **Task: A National Instrumentation Board**
Might targeted resources be established at each of the five national laboratories in order to specifically support particular instrumentation R&D needs of individual researchers at the universities and the laboratories? This will be in several forms: engineering design time and specific resources for small---scale collaboration among and between university and laboratory scientists. How might such a program be administered and funded?

Let me start from a different end by quoting the previous model for the instrumentation development.
The previous model was to create an instrumentation group within each lab, usually around some person, who was appointed by the lab director. Each group would have 5-10 people, some permanent some visiting. These groups were semi-independent, and were supposed to breed new ideas. Examples of these groups are:
a) Charpak's group at CERN. It created many other groups as people left to various institutions. Sauli was a head of this group later on.
b) Breskin's group at Weizmann Inst.
c) Anderson's group at Fermilab.
d) Majewski's group at Jlab.
e) Radeka's group at BNL.

This model has some advantages, namely that there are some independent resources (fast scopes, rare instruments, etc.), lab space, easy access to technicians and engineers, and a "know how" within the group to initiate new ideas very quickly. It is also very good for teaching students to become experts in the instrumentation. Clearly Charpak has bread many people, who started later on new instrumentation groups. A kind of avalanche multiplication process. This model also provides a continuity as one goes from one project to another.
However, such model is always under attack from other groups, who do not have similar resources, and who target a specific physics experiment. These groups would argue that they really do not need what that particular instrumentation group is doing at the moment, never mind that it might be a breakthrough in 5 years. Therefore, for example, SLAC has never created a similar instrumentation group a'la Charpak. Instead there were many large physics groups doing their own focused detector development, when needed, and driven by a particular physics need. But times have changed. Even these groups are now under threat of elimination, and they are not as strong as they once were.

Therefore, the National Instrumentation Board may play a role of a judge what is worthwhile to pursue and what is not. But it is a "horrendous" task, if one thinks about it, as many initial instrumentation ideas are very fragile initially. Again, a good example is DIRC. Initially it looked impossible to build, and yet now after 12 years of BaBar successful operation many people are trying to copy it. Another examples are GEM, or thick GEM, or Micromegas. Very initially it looked suspicious to some people. So, very tricky to decide these issues initially !! Nevertheless, probably there could be some positive outcome from such board, if it recognizes a great idea

correctly and give a young researcher a "protection" and some money. However, additional questions immediately emerge: lab space, general lab instrumentation, software support, engineering support, etc. When dust settles, it could still be that the best breeder of new ideas is the instrumentation group, because it is simply more equipped.

2. **Task: The creation of targeted resources at national labs for detector R&D, and the scale of those resources up to fully---fledged detector R&D center(s) at National Labs.**

Might targeted resources be established at each of the five national laboratories in order to specifically support particular instrumentation R&D needs of individual researchers at the universities and the laboratories? This will be in several forms: engineering design time and specific resources for small---scale collaboration among and between university and laboratory scientists. How might such a program be administered and funded?

Again, in principle a good idea. Let's workout a specific example. Say, I designed the FDIRC to be used with H-8500 MaPMTs, but some young postdoc will come, and say, hey Jerry, I would like to use SiPMTs instead. I will say, OK, but I will have to be convinced by many measurements. In addition, you need a technical help, and some money. If you want it to push it, write a proposal to the National Instrumentation Board. Let's assume that the Board will approve it and he gets some money. Then we have to find lab space, get all sorts of general instrumentation to get it going (this instrumentation may be used in parallel for something else, and therefore not necessarily available !!), get a technician, get an access to an electrical engineer and a PC board designer, etc. It might work out. How well ? I do not know. In the old model, Charpak would say, it is a good idea, here is a space, talk to Bouclier to build it, go and meet this particular electrical engineer, and I'll give you 10k, and go ahead and start tomorrow. Which model is better ? Probably the second one. Another example I want quote is my own case of FDIRC, which I designed. Our group does not have mechanical and electrical engineers any more. To make it happen, I am pushing to make the quartz optics to be built in this country with three sources of money (SLAC, Japan, Italian), an italian mechanical engineer 10,000 miles away makes a design of mechanics, the University of Hawaii and LAL in Orsay will make an electronics, and I am pushing for a full size prototype at SLAC. It will happen because there are enough people who want to do it as a part of the SuperB project. I would bet that it would not be supported by the National Instrumentation Board as a stand alone instrumentation project, as it is too big and too expensive.

One last comment: I think great guys like Edison or Tesla had basically Charpak's model. Correct me if you think that I am wrong.

3. **Task: A national instrumentation fellowship program.**

Please comment on the suggestion that a national instrumentation fellowship program be created by the NSF and DOE and Industry for Ph.D. students and postdoctoral scholars to encourage and support research in instrumentation. How should industry be involved and what industries should be targeted?

I do not have any experience accessing the industry. It seems a huge effort to jump start it. And I am afraid, it might not work. The best way to train a young student is in the instrumentation group, as I said earlier. But that cannot happen unless that group has some minimum critical mass. You cannot do it with one person.

4. **Task: Instrumentation school**

The accelerator community has a dedicated accelerator school with academic credits. The recent EDIT school for instrumentation and technology at CERN was a great success where academia and industry sent members of their staff to attend. What are the thoughts of the committee members on establishing an EDIT style instrumentation school at the US labs (possibly rotating between them), possibly with academic credits. How would the school be organized?

The instrumentation schools take a huge amount of effort from teachers in these schools, who are in parallel actively involved in some experiment and must scramble for resources (scopes, instruments, computers, etc.). To prepare some working setup is actually a lot of work, unless you do it often and have spare resources around. To give just lectures is somewhat easier, but still a lot of work. It is not clear to me why in Europe they have more luck with this. May be more people in HEP overall ? If I judge this looking from my immediate surroundings, I do NOT see that I could do it, as I feel alone. For example, I have said "no, I cannot do it " to Ch. Joram , after a few months of consideration, to participate in the CERN instrumentation school with my MCP-PMT setup. Perhaps, it would be possible, if there would be more people involved, but that is impossible to imagine at present. Again it points to a model of the instrumentation group, which could produce such resources more easily, as it has a range of available skills (Ch. Joram has a group, for example). Again, I have no idea how to include the industry. Seems like a lot of work for somebody.

5. **Task: Interdisciplinary**

Please comment on the relative importance of developing strategic links to, for example, nuclear physics, materials science, condensed matter physics, and electrical and computer engineering both in academia and in industry to the future of HEP instrumentation as the complexity of our experiments increases. How might these links be developed and sustained?

SLAC has eliminated the old Garwin's material science group. A big mistake, in my opinion. I used this group once a year at least in the past. Instead we have a huge ES&H group... Anyway, if one can establish a cooperation between different fields, it is always good. Again, the instrumentation groups have easier time to do it, as the capacitor is bigger....

6. **Task: A national prize**

The APS has the annual Sakurai prize for theoretical particle physics and the annual Panofsky prize for experimental particle physics. What are the committee's thoughts on the establishment of a named prize for instrumentation in experimental high energy physics? Is there a benefit to having a medal versus a prize? To guide the discussion see the APS webpage on prizes and medals:

I think the Panofsky prize might be a good avenue to recognize somebody in the instrumentation. But it seems to zero in on a huge achievements mainly at the end of a person's career, group leaders. Is that the goal ? May be some new prize for young promising people ?

Jerry

David Saltzberg
Dear Ian and Marcel,

I am sorry for the delay. I will do my best to answer your questions but I would be more comfortable doing so after we had a chance to discuss them at the meeting. So I am sorry that I am brief below, but I just don't know what to say yet.

1. Is there a need for a national body to evaluate and/or promote the national instrumentation R&D program?

I'm sorry but I really don't know how to answer this before we have discussion. Off the cuff, I think this would have to be something that was wanted by the funding agencies. Otherwise it risks being just another powerless body. The DOE is very good at ignoring panels that they did not create or ask to be created.

2. What are the processes for evaluating and promoting the national R&D program through a standing body?

Again, it is hard for me to have an opinion before I know much about it. Evaluation of individual efforts is typically done by peer review.

3. Please suggest under which auspices such a body might be organized and indicate possible reporting strategies.

To take a short in the dark, it could be a HEPAP subpanel. But I will know more about it after we meet.

4. Please comment on the appropriate role for a standing panel in the instrumentation R&D programs for upgrades to existing projects and future projects.

The science case of upgrades to existing projects and projects should be done by a board with a wider charge than just R&D. However, this board could advise to whatever committee is judging these projects on the feasibility and timescales of the technology involved.

5. What are the advantages and disadvantages of creating a National Instrumentation Board?

Disadvantages: a) Yet another committee.
Advantages: a) more attention to the importance of R&D to our field.

Best,
David

Aaron Roodman

Ian and Marcel,

Here are some comments for the task-force on instrumentation:

1) National Instrumentation Board: I think there is a big difference between evaluating and promoting here. I hope that your committee will be helpful in promoting instrumentation research, but it would be hard to convene a body to both promote and evaluate. I think more progress can be made on the promotion side of things, which doesn't necessarily point to a standing national group.

2) Targeted resources at labs for detector R&D: I think you asking a very important question here: can the labs serve the HEP community in additional ways, given that the labs still have technical resources, but these have continued to shrink in university groups. Personally, I am interested in any ways we can develop a new kind of lab user, where the collaboration is on a technical level. Collaboration on detector R&D is potentially a fruitful avenue. However, there is one tension, which is that we have always insisted that there be real scientific collaboration, as opposed to working with technical resources as a "job shop". Still, I believe there are already some examples of collaborations on detector R&D, somewhat independent of developments for a particular experiment, and I think that discussion by this committee of ways to promote this further would be quite positive.

3) National instrumentation fellowship: Frankly I'm not sure that a dedicated national postdoc fellowship in instrumentation, funded by the agencies, is a great idea. There is no likely prospect of new $ for this, so a prize fellowship would just come out of the existing budget in instrumentation. Especially in this area, postdocs need a tight coupling to R&D funding and lab or university group support, and a stand-alone postdoc fellowship may not be well aligned here. However, the mention of industrial funding is a very interesting

one. Given what I know of technology companies, there may be a great challenge to get them to be interested, but perhaps they would support a fellow who would go to work for them immediately after the postdoc, or would support fellows with clear connections to their interests.

4) Instrumentation school. I think this is a good idea, and agree that this might be a way of fostering ties with industry. My experience dealing with the US scintillating crystal companies some years ago demonstrated very clearly the need for such education in "hi-tech" industry. I believe there may be such a school in the nuclear physics community - Knoll (well known text book author) used to offer a course if I remember correctly.

5) Interdisciplinary links: Sounds good, but what specifically? An instrumentation school would benefit from such links. Are there ways to foster collaborative research projects?

6) National prize: the Panofsky prize has gone several times for instrumentation - Nygren, arguably Breidenbach, Willis, and Menzione & Ristori were all instrumentation awards – so do we really need a separate prize here?

regards,

Aaron