Report of the DPF Taskforce on Instrumentation in Particle Physics

Instrumentation in Particle Physics

Commissioned by the Executive Committee of the Division of Particles and Fields, American Physical Society

October 2011

Prepared by the Task Force Members:

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Report to be sent to DPF membership today starting a two week comment period

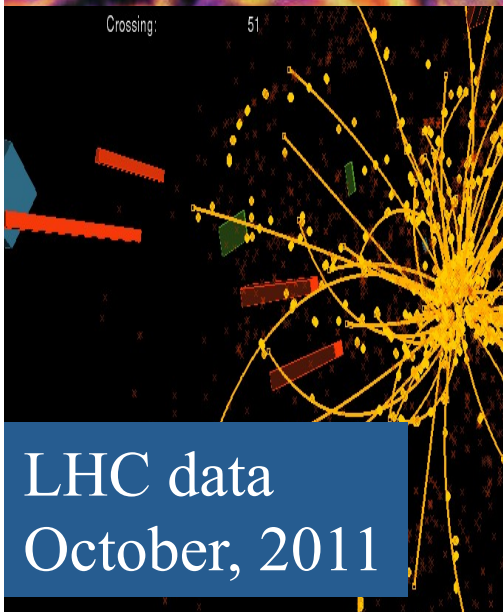
http://www.physics.purdue.edu/dpf_instrumentation_taskforce/

The DPF Taskforce on Instrumentation

- From Universities
  - Marina Artuso, Syracuse
  - Ed Blucher, Chicago
  - Bill Molzon, Irvine
  - Gabriella Sciolla, Brandeis
  - Ian Shipsey*, Purdue
  - Andy White, UT Arlington
- From laboratories
  - Marcel Demarteau*, Argonne
  - David Lissauer, Brookhaven
  - David MacFarlane, SLAC
  - Ron Lipton, Fermilab
  - Gil Gilchriese, LBNL
  - Harry Weerts, Argonne
- Ex-officio
  - Chip Brock, DPF MSU
  - Patty McBride, DPF Fermilab
  - Howard Nicholson, DOE Emeritus

(*) co-Chair

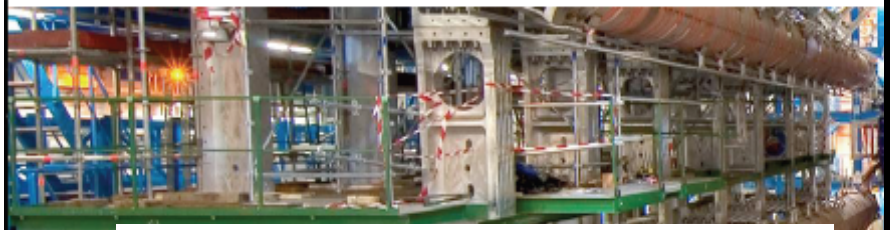
Instrumentation Challenge



LHC data
October, 2011

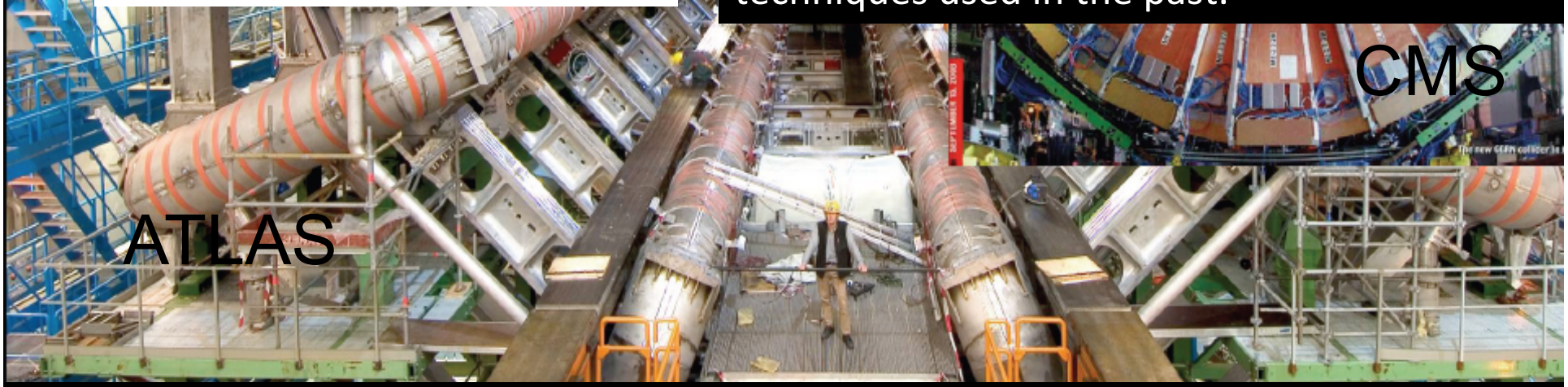
Instrumentation is the great enabler of science both pure and applied. Instrumentation is critical to the mission of High Energy Physics, which is to explore the fundamental nature of energy, matter, space and time. Our field is embarking on a new golden age of discovery with the recent turn-on of the LHC, and with new experiments being planned at proposed new accelerators, deep underground, at the South Pole, and in space that together have the potential to reveal the origin of mass, explain the matter anti-matter asymmetry of the universe, search for extra spatial dimensions, determine the nature of dark matter and dark energy, and may probe the Planck scale. For the very first time we may come to know how our universe was born, how it will evolve, and how it will end.

Object	Weight (tons)
Boeing 747 [fully loaded]	200
Endeavor space shuttle	368
ATLAS	7,000
Eiffel Tower	7,300
USS John McCain	8,300
CMS	12,500



Instrumentation triumph

However, we embark on this adventure of discovery with instrumentation that represents both a towering achievement, and, in some cases, a scaled-up version of techniques used in the past.



DIGITAL CAMERAS THE SIZE OF CATHEDRALS

Object	Weight (tons)
Boeing 747 [fully loaded]	200
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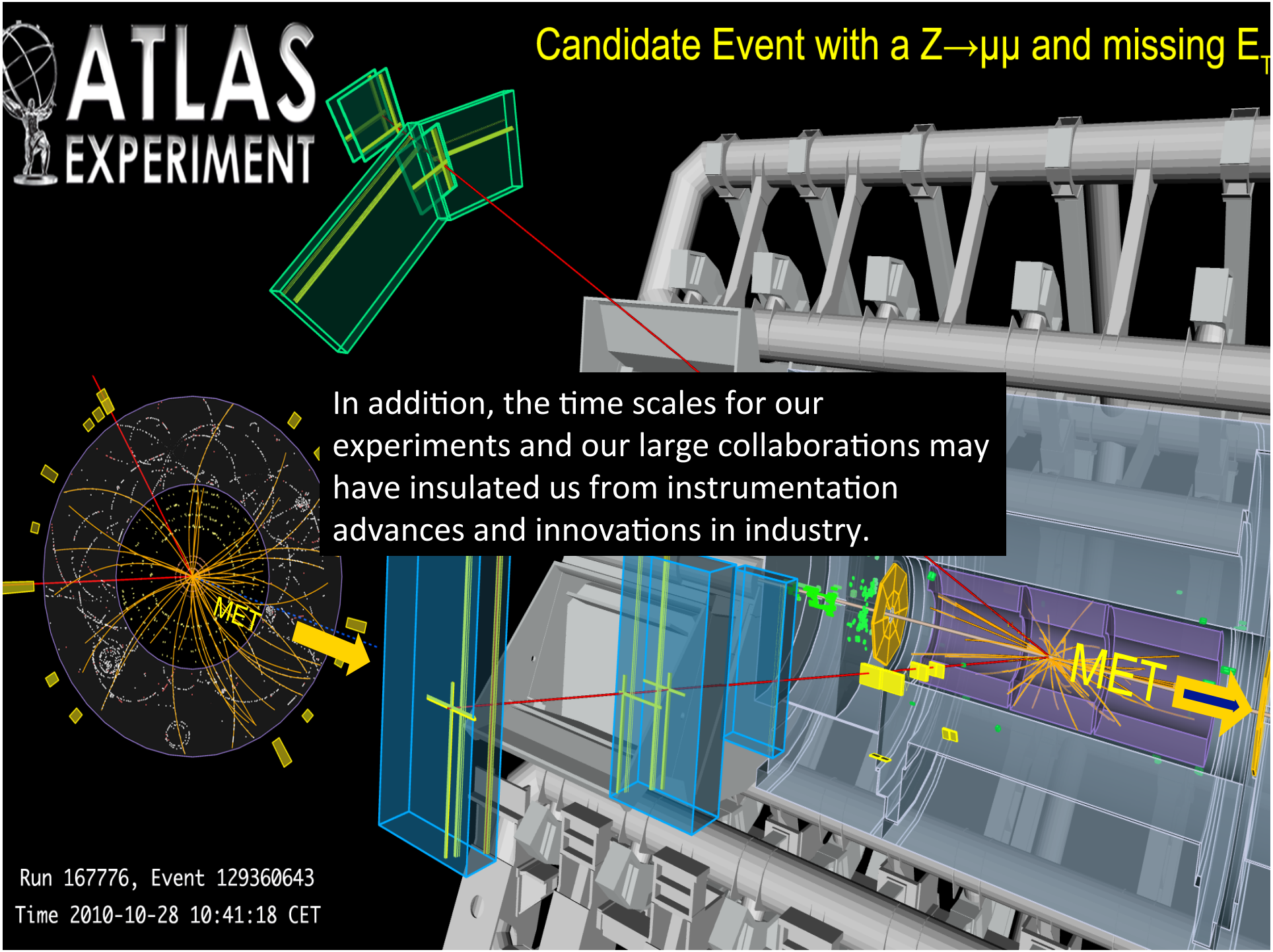
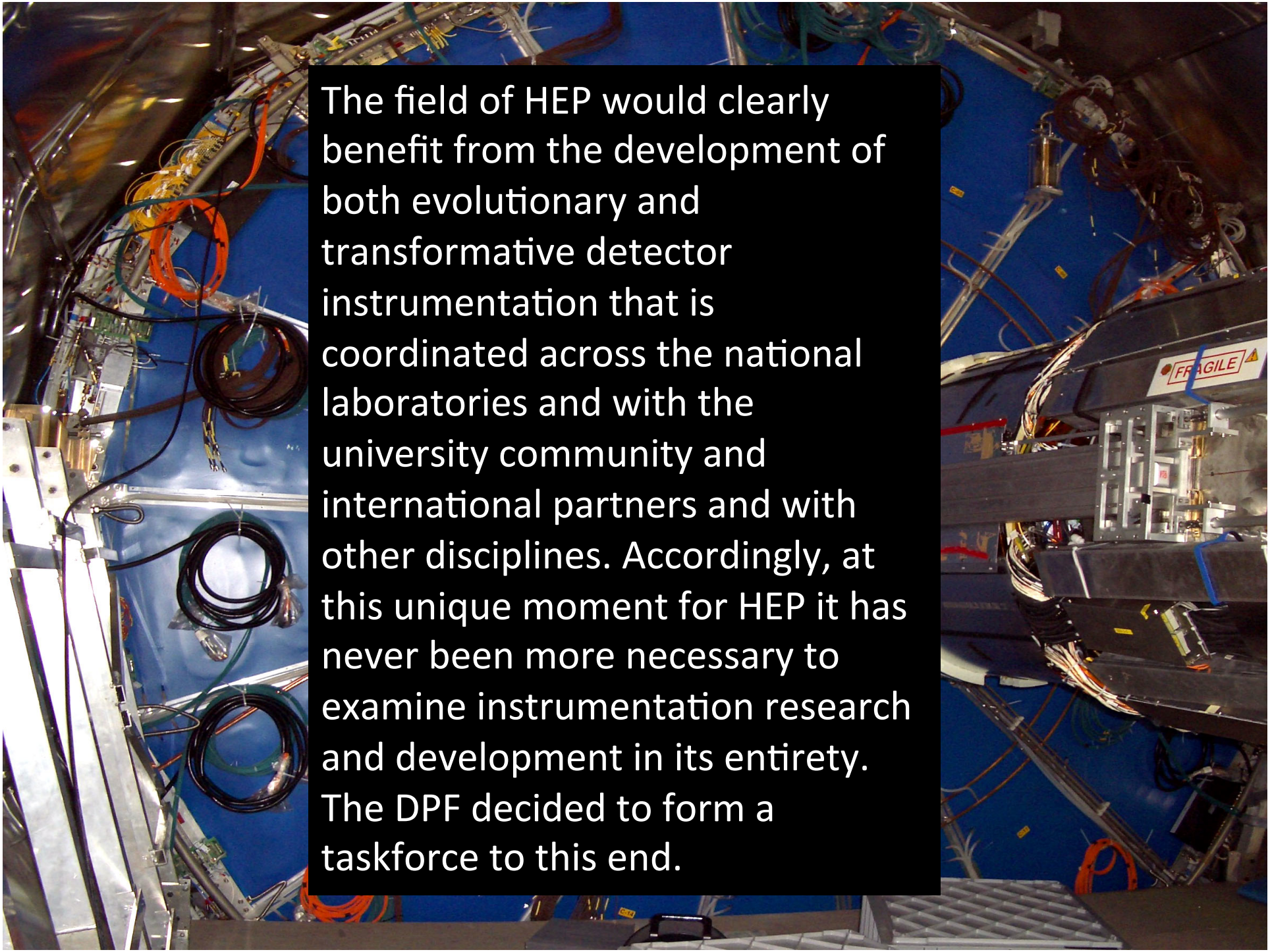
We have gargantuan accelerators equipped with large experiments that have high costs associated with them that are outstripping the internationally available public funding for particle physics. The result is accelerator projects with exceptionally long time scales for construction and completion, and major de-scoping of detectors and their capabilities to the detriment of physics reach to match available resources.

Instrumentation Challenge

DIGITAL CAMERAS THE SIZE OF CATHEDRALS


ATLAS
EXPERIMENT
Candidate Event with a Z→μμ and missing E_T
In addition, the time scales for our experiments and our large collaborations may have insulated us from instrumentation advances and innovations in industry.
MET
MET
Run 167776, Event 129360643
Time 2010-10-28 10:41:18 CET

Instrumentation R&D has the potential to transform this situation, from novel new acceleration techniques such as plasma wake-field, to novel new detectors that provide enhanced capabilities with significantly reduced cost. However, there has been a decline in DOE and NSF funding for instrumentation research and development during the last two decades at universities and national laboratories. If this funding trend is not reversed declining capabilities will surely lead to a dramatic change in how our field functions, and we will confront a different kind of future for HEP– the golden age of discovery will be stalled and its goals unfilled. Energy, matter, space, and time will remain enigmas.



The field of HEP would clearly benefit from the development of both evolutionary and transformative detector instrumentation that is coordinated across the national laboratories and with the university community and international partners and with other disciplines. Accordingly, at this unique moment for HEP it has never been more necessary to examine instrumentation research and development in its entirety. The DPF decided to form a taskforce to this end.

How the taskforce came to be

- Summer 2009: A review of the detector R&D programs at the five national laboratories urged development of a coherent national instrumentation program & self-organization of the community
- October 2010 A workshop dedicated to an overview of Detector R&D in the country was organized. This was a first.
- The workshop was informative and positively received by the community. A great deal of high quality R&D is being carried out.
- There seems to be an acute awareness that for a sustained viability of the field renewed investment in instrumentation development with the appropriate organization is needed
- A DPF taskforce has been established to address the organization of HEP instrumentation

Taskforce Charge

Charge organized in three broad areas

I. Structure for a National Instrumentation R&D strategy
    I. Need, merit and process for evaluating and promoting the national R&D program through a National Instrumentation Advisory Panel
    II. Appropriate role for a standing panel on instrumentation vis-à-vis existing and new projects
    III. Models for universities-laboratory collaborative projects
    IV. Strategic links to other scientific disciplines
    V. Strategic links to industry
II. Models for Entrepreneurial Instrumentation Science Strategy
    I. Availability of targeted resources at each of the five national laboratories to specifically support particular needs of individual researchers at the universities and the laboratories?

Taskforce Charge

III. Graduate Student and Post Doctoral Training

I. Role of experience in instrumentation R&D in the life of US graduate students

II. Academic, intensive, US-based instrumentation experience for graduate students with academic credits, within the context of a global program of coordinated instrumentation schools

III. National instrumentation fellowship program for Ph.D. Students and postdoctoral scholars to encourage and support research in instrumentation.

Perspective, broad input, ownership
International Advisors

Asia: Yoshitako Kuno, Geoff Taylor, Yifang Wang,Hitoshi Yamamoto

Europe & Canada : Ariella Cattai, Joachim Mnich, Tatsuya Nakada, William Trischuk, Peter Weilhammer

National Advisors

David Asner, Daniela Bortoletto, Jim Brau, Joel Butler, Karen Byrum, Chris Bebek, Priscilla Cushman, Su Dong, Juan Estrada, Jim Fast, Bonnie Fleming, Paul O'Connor, Mike Crisler, Carl Haber, Chris Kenney, Steve Holland, Simon Kwan, Ron Lipton, Ted Liu, Hogan Nguyen, David Nygren, Paul O'Connor, Erick Ramberg, Natalie Roe, Aaron Roodman, David Saltzberg, Sally Seidel, Abe Seiden, Wesley Smith, Mani Tripathi, Jerry Va'vra, James White, Minfang Yeh

~30 provided multi-page answers to detailed questions related to the themes and scope of the charge. They have continued to provide advice, and some have also joined subgroups of the taskforce

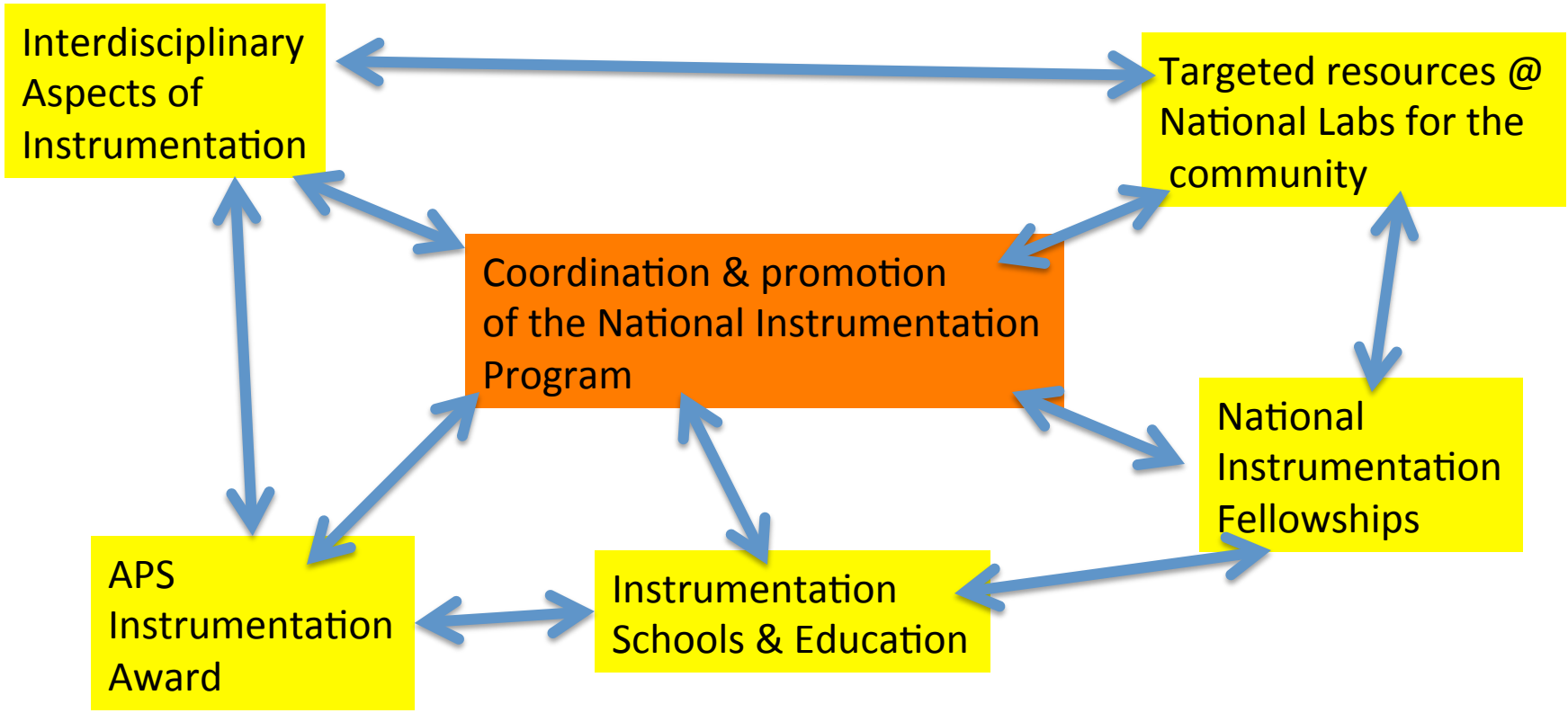
Subgroups and Position Papers

(Membership Updated August 11 2011)

In response to the charge, recognizing its breadth & scope we formed six subgroups. These met in parallel, to develop position papers and report back to the taskforce frequently

1. Coordination of National Program
2. Targeted Resources @ the National Labs for the community
3. National Fellowships
4. Instrumentation Schools and Education
5. Interdisciplinary Aspects of Instrumentation
6. APS Instrumentation Award

We encouraged the community to join subgroups



The subgroups were interconnected & communicated with each other for example; education Involves subgroups on National Fellowships, and instrumentation schools. The National Instrumentation R&D strategy involves all of the other subgroups

The sub group initial targets formed an important part of our work, but by no means all of it. Education is not equal to the sum of National Fellowships and instrumentation schools. Recognizing this subgroups expanded their scope in a coordinated way, and two subgroups Coordination of the national program and targeted resources merged.

Our overriding goal was to begin to create the conditions that will lead to a vigorous national program of transformative instrumentation development that will enable our science. The program will have strong international interconnections. The program will change the way instrumentation is viewed in the U.S.

We can begin by producing a compelling report.
This required each subgroup and the taskforce as a whole to think broadly and creatively, and it required- and still requires- broad community input and buy-in. Town halls and surveys are part of this process.

Membership of the subgroups

Coordinating Panel

Chairs: Murdock Gilchriese (LBNL, co-chair), David MacFarlane (SLAC, co-chair)

Members: Marina Artuso (Syracuse), David Asner (PNNL), Ed Blucher (University of Chicago), Chip Brock (Michigan State University), Priscilla Cushman (University of Minnesota), Jim Fast (PNNL), Ron Lipton (FNAL), David Lissauer (BNL), William Molzon (UC Irvine), Wesley Smith (University of Wisconsin, Madison), Harry Weerts (ANL), Andy White (UTA)

Instrumentation Schools

Chairs: Ariella Cattai (CERN), Adam Para (FNAL)

Members: David Asner (PNNL), Chip Bock (Michigan State University), David MacFarlane (SLAC), Gabriella Sciolla (Brandeis University), Sally Seidel New Mexico)

Interdisciplinary

Chair: Harry Weerts (ANL)

Members: Marina Artuso (Syracuse), Priscilla Cushman (University of Minnesota), Murdock Gilchriese (LBNL), Jim Fast (PNNL), Ron Lipton (FNAL), Andy White (University of Texas at Arlington)

National Instrumentation Fellows Panel

Chairs: Bruce Schumm (UCSC)

Members: Ron Lipton (FNAL), David MacFarlane (SLAC), Gabriella Sciolla (Brandeis University)

National Prize

Chairs: William Molzon (University of California at Irvine)

Members: David Lissauer (BNL)

Taskforce Timeline

December/January Charge written

February Taskforce members identified

March/April National and International Advisors identified

March Expressions of interest & encouragement from agencies (at HEPAP mtg)

End April Working groups created to address charge

May 2 taskforce kickoff meeting (APS, Anaheim)

June 8 face to face meeting (TIPP, Chicago)

June 9 Town Hall satellite meeting for community input

regular subgroup meetings and taskforce meetings by phone throughout period with pace picking up second half of July.

A typical virtual meeting:

Agenda of the Instrumentation Taskforce August 1 12:00-13:00 CDT

https://indico.fnal.gov/conferenceTimeTable.py?confId=4663#20110801

DPF Taskforce Phone meeting August 1 Noon CDT

01 August 2011 *Virtual meeting*
US/Central timezone

- Overview
- Scientific Programme
- **Timetable**
- Contribution List
- Author index

Mon 01/08

Print | PDF | Full screen | Detailed view | Filter

12:00	**News and Update and presentation for townhall on June 9**	*SHIPSEY, Ian et al.*	
	Virtual meeting, Virtual meeting		12:00 - 12:05
	Detector R&D Coordinating Panel & Targeted Resources at the National Labs	*GILCHRIESE, Murdock*	
	Virtual meeting, Virtual meeting		12:05 - 12:25
	Instrumentation School & Education	*CATTAI, Ariella et al.*	
	Virtual meeting, Virtual meeting		12:25 - 12:35
	National Fellowships	*SCHUMM, Bruce*	
	Virtual meeting, Virtual meeting		12:35 - 12:45
	Interdisciplinary	*WEERTS, Harry*	
	Virtual meeting, Virtual meeting		12:45 - 12:55
	Instrumentation Prize	*MOLZON, Bill*	
	Virtual meeting, Virtual meeting		12:55 - 13:00

Taskforce Timeline

August main ideas and recommendations well-advanced and available for community comment and input

August 8 draft positions papers available to community

along with background information and the charge

- via DPF 2011 webpage.
- https://indico.cern.ch/conferenceTimeTable.py?confId=129980#20110812

August 11 The taskforce face-to-face meeting at DPF

August 12 launch taskforce webpage:

http://www.physics.purdue.edu/dpf_instrumentation_taskforce/

DPF

http://www.physics.purdue.edu/dpf_instrumentation_taskforce/

Task Force on Instrumentation

Search: Enter Search... Submit

Participants

Universities

- Marina Artuso - Syracuse
- Ed Blucher - Chicago
- Bill Molzen - Irvine
- Gabriella Sciolla - Brandeis
- Ian Shipsey (co-chair) - Purdue
- Andy White - UT Arlington

National Laboratories

- Marcel Demarteau (co-chair) - Argonne
- David Lissauer - Brookhaven
- David MacFarlane - SLAC
- Ron Lipton - Fermilab
- Gil Gilchriese - LBNL
- Harry Weerts - Argonne

Ex-Officio

Welcome to the **DPF Instrumentation Task Force.** Read the Taskforce Charge to understand the purpose and scope of the taskforce and its work. Links to the position papers produced by the taskforce are available below, along with the members of each subcommittee.

Latest Draft of the report is available (October 27, 2011) here

Meetings of the Taskforce

May 2, 2011: Kickoff meeting at the APS Meeting, Anaheim, CA
June 2, 2011: Task Force Phone Meeting
June 8, 2011: Task Force Face-to-Face Meeting
June 9, 2011: Town Hall Meeting at the TIPP Conference
August 1, 2011: Task Force Phone Meeting
August 11, 2011: Town Hall Meeting at the DPF Conference

Taskforce subcommittees & position papers

Membership updated: 01-Aug-2011 | (C)=Chair (*)=National Advisor

Detector R&D Coordinating Panel and Targeted Resources at the National Labs

Position Paper	Program Coordination and Resources

Taskforce Timeline

August 12	Town Hall Meeting
	Add community input to position papers
September 23	Engage DOE/NSF & National & International Advisors
	in critiquing and augmenting position papers.
October 4	subgroups sign off on papers
October 11	1st draft of report to DPF Executive Committee
October 23	2nd draft of report to DPF Executive Committee
October 28	Present Report at HEPAP Meeting
October 28	Report distributed to DPF members for two week
	comment period
November 15	Final Report

Detector R&D Coordinating Panel

- Advisor & Community input: A coordinating panel will elevate & champion instrumentation, community voice, representative of the community ensure complete coordinated balanced program, promote cooperation across community, decadal perspective, advocate with congress and industry & other disciplines, can be used by DOE as a source of advice (when asked to do so)
- *The primary recommendation of the Taskforce report is that a standing Detector R&D Coordinating Panel (DRDCP) be formed, under the auspices of the DPF Executive Committee*
- Recommendations
  1. A standing body – Detector R&D Coordinating Panel - should be formed to promote and stimulate the national instrumentation detector R&D program.
  2. The DRDCP should be largely self-organized and consist of representatives from the national HEP labs and the university community to form a representative panel of outstanding capability in detector and instrumentation R&D.
  3. The primary role of the Detector R&D Coordinating Panel should be to promote and assist in generic detector R&D

Detector R&D Coordinating Panel

- Role of Panel(see longer list in Task Force Report)
  - "…promote national detector R&D and stimulate new ideas in instrumentation development.
  - Improved coordination among the national HEP laboratories and university groups engaged in detector R&D……."
  - "…. help facilitate utilization of targeted resources at the national laboratories…."
- Not role of Panel
  - Acting as a Program Advisory Committee ……
  - Acting as a standing review body for proposals …. or for peer review of proposals;
  - Providing a "roadmap" for the national detector R&D program. (But would be aware of roadmap for field)

- **Formation and function**
  - The DRDCP would be initiated under the auspices of the DPF Executive Committee
  - The DRDCP would not be managed by any national laboratory, the DPF or the funding agencies. (i.e. self-organized)
  - However, the DRDCP would inform the laboratories, the DPF Executive Committee (or designated individuals), the funding agencies and the community at large of its work on a regular basis.
- **A possible model for membership of the DRDCP is the following:**
  - One representative from each of the five HEP national laboratories (ANL, BNL, FNAL, LBNL and SLAC);
  - At least an equal number of representatives from the university community.
  - The DRDCP may wish to consider if observers from outside the U.S. would be appropriate.
  - It would be the responsibility of the management at each of the national laboratories to appoint the appropriate representative. In this regard, we note that the laboratories typically have an individual that is responsible for HEP generic R&D (KA-15 supported work) as a POC. In some cases it may be that these individuals are the most appropriate as the laboratory representatives
  - Membership from the university community is critical to the success of the DRDCP. The DPF Executive Committee could act to select university representatives for the DRDCP (as was done for this Task Force). It is essential that the university representatives be active in detector R&D. It is also essential that there be a balanced representation, taking into account support from both the NSF and DOE.

DRDCP is difficult to pronounce.
Some have dubbed it the “acronym panel”

Competition to find a better name
to be announced when report is circulated
to DPF for two week comment period

Submit suggestions to
taskforce@lists.purdue.edu
$100 prize for the winning entry

Coordination of instrumentation resources at National Labs for HEP community

- Background:
  - 5 National Labs pursue both directed R&D for upgrades & projects, short term program specific and generic detector R&D long term often transformational development of new capabilities
  - Levels of generic R&D vary by an order of magnitude across the labs, ranging from specialized facilities to broad capabilities: sensor/detector fab. Electronics design and test, DAQ design and engineering, test beam facilities
  - Generic R&D supported by facilities & core engineering, with existing significant University-Laboratory collaboration
  - Labs have all designated a manager as POC for generic R&D, who establishes priorities for manpower & facilities

- Advisor input: Collaborative use of resources at labs is a good idea.

"Essence of lab + university partnerships in instrumentation." Create centers of excellence @ labs each with own specialty, needs national coordination.

Coordination of instrumentation resources at National Labs for HEP community

- Proposed initial steps
  - Lab POC represents natural point of entry for coordinating University-laboratory collaboration on generic R&D
  - POC may be a member of the DRDCP, allowing better coordination of Lab resources nationally & making the nature of these facilities & capabilities more widely known and accessible

Some labs are considering a further step in accessibility by the creation of e.g. "Centers for Sensors and Detectors"

National Instrumentation Fellowship

- Goal: to increase participation of young US scientists in leading-edge instrumentation R&D, to maintain and enhance impact of U.S. to detector instrumentation, and contribution of instrumentation expertise to society (via those that leave HEP to work in industry)
- Advisor/community input: Very popular. Exists in Europe CERN+ univs. Some suggested 50% instrumentation research 50% data analysis others 100% instrumentation. Will be hard to get industry funding- target companies with many HEP PhDs/companies near national labs
- Recommendation:
  - establish prestigious named post-doctoral fellowships as a way to encourage support & greater participation in instrumentation R&D.
  - support graduate students later in their studies that have demonstrated significant acuity in instrumentation R&D

National Instrumentation Fellowship

- Oversight by DRDCP
- Selection through competitive proposals from labs and universities
- Implementation:
  - Explore possibility of industry sponsored fellowships (new funding)
  - Funding agencies (especially NSF Division of Fellowships) successful proposals from the competition to be submitted by proponents (this would be a way to gain new funding – HEP has had few fellowships from this division)
- Career Development:
  - Post Doc. Fellows would be expected to work predominantly on instrumentation-oriented research, and would be expected to subsequently vie successfully for instrumentation-related positions at the National Labs, and for faculty or continuing career instrumentation positions at Universities.
  - Graduate fellowships for Ph.D. in instrumentation
  - Also possibly support instrumentation rather than teaching during early stage in graduate student career

Detector Schools and Education

- Due to the very long timescales of HEP experiments, opportunities to participate in the design, prototyping and building of detectors are infrequent. In consequence the level of instrumentation experience and expertise among young experimentalists in HEP has declined
- This is correlated with the overall decline of construction, technical staff, and infrastructure at universities.

Advisor /community input:

Very popular. Many good schools exist: EDIT International Sch. IEEE NSS short courses popular etc. Many noted school is no substitute for working in an instrument group @ Uni, or lab. & with test beam where a systematic training program of generic (but useful) measurements could be undertaken

Detector Schools and Education

- A poll conducted by the ICFA Instrumentation Panel 2/2010 [1,2] found that:
  - A significant fraction of experimentalists are lacking good understanding of their own detectors.
  - The principal mode of education in the instrumentation area is 'on the job training' and instruction from peers. A diminishing role of university-based instrumentation training among the youngest scientists.
- An additional informal poll of various US universities by this taskforce [3] indicates detectors and instrumentation are poorly covered in the course, although there are examples of interdisciplinary courses at several schools that partially compensate.

References at http://www.physics.purdue.edu/dpf_instrumentation_taskforce/

[1] Adam Para, Reflections on Understanding of Detectors and Instrumentation, talk at the Detectors R&D Workshop, Fermilab, October 2010.

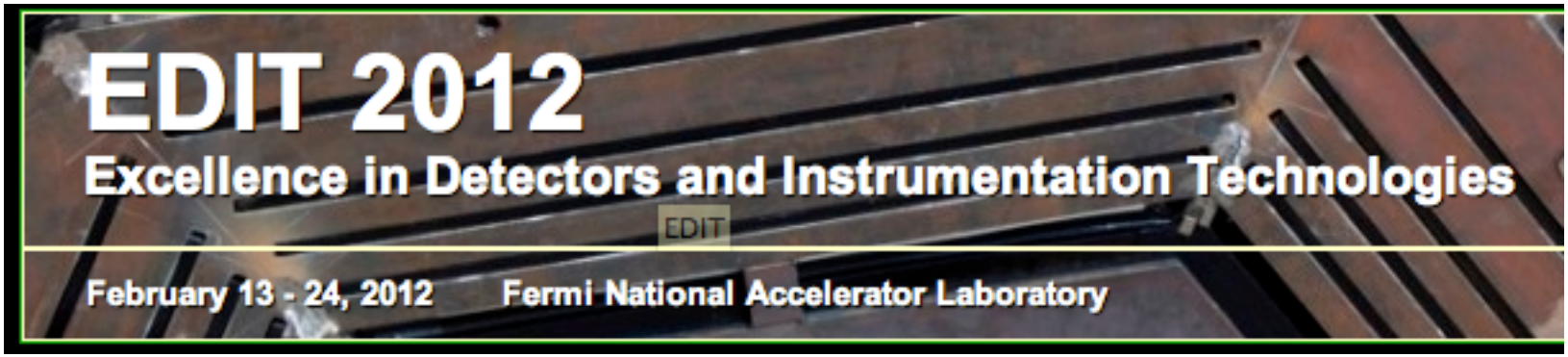
[2] Ariella Cattai and Adam Para, Preliminary results from the survey on the necessity of a Detectors and Instrumentation School, April 2010

[3] Informal Survey of US Universities on the education in Detectors and Instrumentation [Ron Lipton, Sally Seidel]

Recommendation:
Organization of and participation in the ICFA-initiated and sponsored school (EDIT, ICFA Instrumentation School) should be strongly supported. Development of a common set of lectures and laboratory courses would be very beneficial.

1st EDIT School at CERN a spectacular success 89 students, 120 teachers

2nd EDIT School at FNAL will be a spectacular success. Student application deadline November 6



Recommendation:
The US Particle Accelerator School (USPAS) provides educational programs in the field of beams and their associated accelerator technologies not otherwise available to the science and technology community. It is a well-recognized consortium providing graduate-level education (academic credit) with a very successful organization and considerable experience in the organization of academic-level courses. Broadening the range of courses to include detectors and instrumentation would be a very positive development. In the longer term it is desirable to organize a new session dedicated entirely to detectors only, perhaps held at various national laboratories on a rotating basis.

Recommendation:

Some of the national laboratories offer various summer programs for students from universities and high schools. These programs offer a unique opportunity for young interested students to participate in research activities. Dedicated detector and instrumentation courses offered for these summer students could provide a deeper understanding of the activities they are participating in and, at the same time, could enhance general knowledge of instrumentation and attract more young people to this area of research.

Recommendation:

Advanced topical schools focused on specific detection techniques or detector systems could be instituted. They could be held at national laboratories or at universities where the relevant infrastructure and expertise is located. Such schools would be aimed at a relatively advanced audience and they could be of potential interest to industry; serving as a platform for the dissemination of knowledge of the latest industrial technological advances, and simultaneously providing education for the technical staff from industry engaged in R&D efforts.

The companies that benefit from these schools are potential sponsors of National Instrumentation Fellowships

Recommendation:
Develop detector technology teaching facilities based on parts of retired experiments such as D0, CDF, BaBar, CLEO, etc. Establish a dedicated test beam facility for demonstration and examination of various detection techniques. [5]

Recommendation:
Schools are too short to provide the education needed to design, construct or operate a modern experiment. However, this can be achieved, in part, by semester long courses on particle detectors. Unfortunately these courses have become a rarity at U.S. universities due to limited resources and relatively low enrollment. These courses could be developed by consortia of universities and/or in collaboration with national laboratories or CERN

(All references may be found at the Instrumentation Taskforce homepage http://www.physics.purdue.edu/dpf_instrumentation_taskforce/ .)

[5] Adam Para, John Hauptman and Hanna Arnold,
The CDF and D0 detectors as laboratories for students

APS Division of Particles and Fields Award for Excellence in Instrumentation Development

- Goal: recognize and reward important contributions to our field by colleagues who excel in instrumentation development – not universally recognized, e.g. in career advancement at Universities
- Background: excellence in instrumentation development (broadly defined) has been recognized by the Panofsky Prize (TPC, asymmetric collider, liquid argon and transition radiation, atmospheric fluorescence, D0 detector, silicon strip detectors) and by the Nobel Prize (wire chambers, bubble chamber, cloud chamber, cyclotron, SPS collider and UA1)
- Proposal: establish a substantial award for instrumentation development
  - Reward work shortly after it has been done
  - Emphasize work done by scientists early in their careers
  - Don't compete with Panofsky or Wilson prizes
  - Set the threshold so that the award can be given each year
- Implementation:
  - Identify the funding: 5-10 year commitment of support, goal of $5000 award
  - Assess the candidate pool
  - DRDCP could provide oversight, and be involved in the selection

Interdisciplinary Aspects of Instrumentation

"HEP to other sciences"

Development by HEP, transfer to others

"Other sciencesto HEP"

Development for HEP with technologies from others

- Both activities exist (examples given report)
- HEP has different approach to instrumentation than "others": define measurement ➔ develop instrument; "others" use available instruments

- Not a process initiated by HEP.
- May be stimulated by HEP, but the need has to arise in the other science(s).
- HEP should reach out to other sciences.

- Needs initiation by HEP
- Need examples .See how it works.
- A two way street: both sides need to benefit

Export: expertise

Import: material science, new technologies +++

Stay at cutting edge…….

Advisor Input

Exchange programs and targeted workshops that engage other disciplines broadly
Interdisciplinary connections win HEP friends possibly leading to useful independent advocacy for HEP in Washington D.C.

Recommendations:
The field of high-energy physics should reach out to other communities. This should start somewhat locally by establishing a closer relationship with the Office of Nuclear Physics (NP) and the Office of Basic Energy Sciences (BES) of the Office of Science. A workshop, or a series of workshops, intended to bring those communities closer and foster interaction and collaboration with mutual benefit should be held. This should also include the corresponding NSF funded communities.

Closer connections should be established with the medical community, NASA, and national security community. These should take into account existing relationships.

The Detector R&D Coordinating Panel should have input on which topics in instrumentation should be encouraged in the yearly SBIR/STTR proposal calls.

The Detector R&D Coordinating Panel should establish a repository of examples of migration of technologies and instrumentation for other sciences into high-energy physics or, even better, a repository of possible new developments in other fields that might benefit the development of new sensors or instrumentation in general.

The Detector R&D Coordinating Panel should establish a repository of available equipment at U.S. universities that could be used for instrumentation development

Concluding Slides

For HEP to have a bright future, priority within the field must be given to investment in the development of both evolutionary and transformative detector instrumentation that is coordinated across the national laboratories and with the university community, international partners and other disciplines. While the fundamental science questions addressed by HEP remain compelling there is acute awareness of the challenging economic situation and the prospects for flat or declining funding for almost all branches of fundamental science, at least near term. Both the HEP laboratories and the universities are affected. In the laboratories, which are the engines for large facilities and the management of large projects, funds available for generic instrumentation R&D and the associated infrastructure are very limited. In the universities, which have also made extremely important contributions to instrumentation and have been key partners in the development and construction of HEP detectors, there has been a significant and sustained decline in support of technical infrastructure. Economic reality suggests that, with few exceptions, the decline in university technical infrastructure and the sustained fiscal pressure on laboratory instrumentation capabilities will not be substantially reversed. In this challenging environment it is essential that the community optimize the use of the available resources to develop new innovative, cost-effective instrumentation, as this is our best hope to successfully accomplish the mission of HEP. Rebalancing the DOE OHEP portfolio to increase the fractional support instrumentation should be considered.

Next Steps

October 28	Present Report at HEPAP Meeting
October 28	Report distributed to DPF members for two week comment period
	Incorporate comments from HEPAP & DPF membership
November 15	Final Report

If well-received, creation of panel in December