HIGH ENERGY PHYSICS ADVISORY PANEL
to the
U.S. DEPARTMENT OF ENERGY

PUBLIC MEETING MINUTES

Double Tree Hotel
8120 Wisconsin Avenue – Bethesda, MD 20814

December 5 and 6, 2012

HIGH ENERGY PHYSICS ADVISORY PANEL
SUMMARY OF MEETING

The U.S. Department of Energy (DOE) High Energy Physics Advisory Panel (HEPAP) was convened at 9:00 a.m. EST on Thursday, December 5, 2012, at the Double Tree Hotel, Bethesda, MD, by Panel Chair Andrew Lankford.

Panel members present:

Daniel Akerib	Bonnie Fleming	Andrew Lankford
Edward Blucher	Murdoch Gilchriese	Patricia McBride
Karen Byrum	Douglas Glenzinski	Regina Rameika
Andrew Cohen	Saul Gonzalez	Pierre Ramond
Eric Colby	Donald Hartill	Leslie Rosenberg
Mirjam Cvetic	John Hobbs	Ian Shipsey
Robin Erbacher	Klaus Honscheid	Hitoshi Yamamoto
Peter Fisher	John Kogut	

HEPAP members absent:

Ursula Bassler	Celeste Rohlfing

HEPAP Designated Federal Officer:
Glen Crawford, Director, Detector R&D, Research Technology, Office of High Energy Physics (HEP), Office of Science (SC), U.S. Department of Energy (DOE)

Others present for all or part of the meeting:
David Asner, Pacific Northwest National Laboratory
Barry Barish, Professor of Physics, California Institute of Technology
Gregorio Bernardi, Fermi National Accelerator Laboratory
Steve Binkley, DOE
Gerald Blazey, Assistant Director, Physical Sciences, White House Office of Science and Technology Policy
Greg Bock, Associate Laboratory Director for Particle Physics, Fermi National Accelerator Laboratory
John Boehnlein, Energy Frontier, Physics Research, Office of High Energy Physics, Office of Science, DOE
John Boger, General Accelerator R&D, Office of High Energy Physics, Office of Science, DOE
Tim Bolton, Intensity Frontier, Physics Research, Office of High Energy Physics, Office of Science, DOE
Fred Borcherding, BELLA, Instrumentation and Major Systems, Office of High Energy Physics, Office of Science, DOE
William Brinkman, Director of Science, Office of Science, DOE
Raymond Brock, Department of Physics and Astronomy, Michigan State University
Denise Caldwell, Acting Division Director, Division of Physics, National Science Foundation
Marta Cehelsky, Fermi Research Alliance, LLC
Lali Chatterjee, Computational High Energy Physics, Office of High Energy Physics, Office of Science, DOE

Eric Colby, Director, Advanced Accelerator Research Department, Stanford Linear Accelerator Center
Jean Cottam, Program Director, Particle Astrophysics, Division of Physics, National Science Foundation
Joseph Dehmer, Director, Division of Physics, National Science Foundation
Robert Diebold, Principal, Diebold Consulting
Keith Dienes, Program Director, National Science Foundation
Paul Grannis, Stony Brook University
Tao Han, University of Pittsburgh
Don Hartill, Cornell University
Ezra Heitowit, Fermi Research Alliance, LLC
Norbert Holtkamp, Associate Director, Stanford Linear Accelerator Center
Marcos Huerta, Office of Science, DOE
Hassan Jawahery, University of Maryland
Peter Kim, Detector R&D, Office of High Energy Physics, Office of Science, DOE
Young-Kee Kim, Deputy Director, Fermi National Accelerator Laboratory
Rami Kishek, Research Professor Institute for Research in Electronics and Applied Physics, Electrical and Computer Engineering, University of Maryland
Laurence Littenberg, Brookhaven National Laboratory
L.K. Len, General Accelerator R&D, Office of High Energy Physics, Office of Science, DOE
David Lissauer, Group Leader, Directorate of Nuclear and Particle Physics, Brookhaven National Laboratory
David MacFarlane, Director of Particle Physics and Astrophysics, Stanford Linear Accelerator Center
Ken Marken, General Accelerator R&D, Office of High Energy Physics, Office of Science, DOE
Marsha Marsden, Oak Ridge Institute for Science and Education
Carole McGuire, FRA
Steve Meador, Engineering and Construction Manager, Project Assessment, Office of Science, DOE
Ritchie Patterson, Professor of Physics. Director of CLASSE, Cornell University
Jonathan Petters, AAAS Science and Technology Policy Fellow, DOE
Michael Procario, Director of Facility Operations, Office of High Energy Physics, Office of Science, DOE
Ken Olsen, Superconducting Particle Accelerator Forum of the Americas
Abid Patwa, Energy Frontier, Physics Research, Office of High Energy Physics, Office of Science, DOE
Sherry Pepper, Office of High Energy Physics, Office of Science, DOE
Douglas Ray, Associate Laboratory Director, Fundamental and Computational Sciences Directorate, Pacific Northwest National Laboratory
Natalie Roe, Director, Physics Division, Lawrence Berkeley National Laboratory
Simona Rolli, Theoretical Physics, Office of High Energy Physics, Office of Science, DOE
Jonathan Rosner, Professor, Physics Department, University of Chicago
Randy Ruchti, Program Director, Experimental Elementary Particle Physics, Division of Physics, National Science Foundation
Michael Salamon, Cosmic Frontier, Office of High Energy Physics, Office of Science, DOE
James Siegrist, Associate Director, Office of High Energy Physics, Office of Science, DOE

Anthony Spadafora, Deputy, Physics Division, Lawrence Berkeley National Laboratory
Alan Stone, Intensity Frontier, Physics Research, Office of High Energy Physics, Office of Science, DOE
Bruce Straus, APUL, Instrumentation and Major Systems, Office of High Energy Physics, Office of Science, DOE
Jim Strait, Program Director, Long-Baseline Neutrino Experiment, Fermi National Accelerator Laboratory
David Sutter, University of Maryland
James Symons, Senior Physicist and Director of the Nuclear Science Division, Lawrence Berkeley National Laboratory
Karen Talamini, Program Analyst, Office of Science, DOE
V.L. Teplitz, National Aeronautics and Space Administration
Kathleen Turner, Cosmic Frontier, Office of High Energy Physics, Office of Science, DOE
Michael Tuts, Professor, Experimental High-Energy Physics, Columbia University
Kelen Tuttle, Office of Communications, Stanford Linear Accelerator Center
Costas Vellidis, Fermi National Accelerator Laboratory
Hendrik Weerts, Director, High-Energy Physics Division, Argonne National Laboratory
James Whitmore, Particle Astrophysics Program Director, Division of Physics, National Science Foundation
Andreene Witt, Oak Ridge Institute for Science and Education
John Yates, Office of Science, DOE
Kathleen Yurkewicz, Communication Director, Fermi National Accelerator Laboratory
Michael Zisman, General Accelerator R&D, Office of High Energy Physics, Office of Science, DOE

DECEMBER 5, 2012

OPENING REMARKS

The High Energy Physics Advisory Panel (HEPAP) was convened at 9:00 a.m. EST on Thursday, December 5, 2012, at the Double Tree Hotel, in Bethesda, MD, by Panel Chair Andrew Lankford. The meeting was open to the public and conducted in accordance with the requirements of the Federal Advisory Committee Act. Attendees can visit http://science.energy.gov/hep/hepap for more information about HEPAP.

PRESENTATION OF DOE NEWS

James Siegrist, DOE Office of Science (SC), Associate Director, Office of High Energy Physics (HEP), shared an update on the activities of the HEP.

2012 has been a year of discovery in particle physics with the announcement of the SM Higgs Boson discovery after a 48-year search. The Daya Bay reactor neutrino experiment started in 2006 and brought rapid results, showing that unmeasured neutrino mixing is large on the order of 10 percent. And, the Baryon Oscillation Spectroscopic Survey (BOSS) has measured the characteristic scale of universe. BOSS began in 2009 and is one of many new tools to study cosmology and changes brought about by the discovery of dark energy in the 1990s. These three activities are the result of lengthy investment by DOE and point to pathways in the universe.

The HEP Strategic Plan was established in 2009, affirmed and adopted in 2009 and 2010, and needs to be updated. Progress is being made in the energy, intensity and cosmic frontiers and each give insight on fundamental forces and particles. At its core, HEP is an accelerator-based experimental science. It can be expected that basic figures in the HEP Plan will change and there will be support for accelerator and detector R&D to develop new technologies.

The Particle Physics Project Prioritization Panel (P5) has offered recommendations to HEP. P5 recommends strong and integrated research in the three frontiers. It also identifies the U.S. Large Hadron Collider (LHC) as the highest program priority, including U.S. involvement in the planned detector and accelerator upgrades. It recommends a world-class neutrino program as a core component of the U.S. program and a high-intensity neutrino source at Fermilab. The P5 recommended funding for the measurement of rare processes and Mu2e support depending on the levels of available funding. Support of the study of dark matter and dark energy was recommended. And, the P5 recommended broad strategic investments in accelerator science.

HEP finished three projects in 2012 – Daya Bay, the dark energy survey, and the Facility for Advanced Accelerator Experimental Tests (FACET). All received Critical Decision 4 (CD-4) approval and are operating. The Berkeley Lab Laser Accelerator (BELLA) will be completed by the end of 2012. HEP is striving to balance its investments across all three frontiers.

Five new Major Items of Equipment (MIE) in a $20M to $40M range received approval in September 2012. These include the next round of the ATLAS and CMS detector upgrades, the new Muon g−2 Experiment, and the second generation dark matter experiment and midscale dark energy spectroscopic instrumentation.

These next investments should carry HEP through FY17 – FY18. HEP will have a case for new projects in around 2015 and 2016. An executive plan will carry HEP but there is need to design what will occur in the out years. The agreement with CERN (the European Organization for Nuclear Research) will end in 2017. Congress was interested in U.S. involvement following the FSC shutdown. It is unknown if that interest will occur again. Detector upgrade work is considered "business as usual". HEP is doing experiments to increase the velocity of machines and will come to do machine upgrades. HEP needs to figure out its arguments about FSC.

The HEP has a new budget structure that will replace a former approach that was tool-based, unbalanced, misaligned with communication about the frontiers, and was set-up based on Congressional reporting constructs. Advocates such as the Office of Management and Budget (OMB) and the Office of Science and Technology Policy (OSTP) have had to determine how things fit. The new structure in FY13 will align things along the frontiers and seek to be agnostic. It will better align with the Strategic Plan and be more transparent to convey what HEP is doing.

A recasting of HEP's FY12 actual and FY13 requested budgets shows growth from $4.873B to $5.001B (2.6 percent). Funding for the cosmic frontier grew by $12.6M (17.3 percent) with a decrease in construction expenses from $28M to $20M (28.6 percent). This request shows HEP's commitments and funding by activities. Research funding will decrease and Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) will increase. All programs have the same substructure making the budget roll-up easier to understand.

HEP budget trends reflect efforts to increase project funding after hitting a low point in FY06. Research support if vital and yet a lack of facilities for experimentation and a drop in facility funding threatens HEP's future.

In the energy frontier, operations at the Fermilab Tevatron ended in September 2011. The LHC at CERN is working with experiments to plan for contributions to "Phase-1" upgrades for

installation in 2017. Experiments in physics are shifting from a search-based strategy to a measurement-based program to see if there is a particle consistent with the SM Higgs Boson.

An issue in this frontier is identifying key elements in the decision tree for energy. There are strong physics cases to be made in light of the LHC results. Another issue is understanding the case for the High Luminosity (HL)-LHC and the key physics issues that should be emphasized. Within Higgs, HEP looks for the expected precision on Higgs properties that LHC will deliver, and in BSM, Higgs is a window to new physics and HEP is seeking a dark matter candidate.

In the intensity frontier, construction on NOvA and MicroBoone will be end in FY14. The program calls for starting Belle-II after a successful B-factory program with 10 to 100 times more data on flavor physics. Mu2e will explore charged lepton mixing and is CD-1 approved. The Long-Baseline Neutrino Experiment (LBNE) will measure neutrino properties, and Muon g-2 will pursue an indication of physics beyond the SM reducing errors by a factor of ~4. Daya Bay, T2K, and NOvA, among others, will lead to an era of precision neutrino physics.

Longer-term goals are needed in the intensity frontier to guide the development of the neutrino program. Common ground is needed on how to measure. This question is important to answer in order to justify the wide variety of experiments to stakeholders as they are looking for HEP to succeed in this area. This helps defend critical experiments and the investment strategy for neutrino factories since small errors may require higher beam intensities. Other areas were summarized in the intensity frontier workshop in 2011. A situation analysis is needed for each main area to determine capability gaps and to show a steady flow of results on a range of topics.

The cosmic frontier program features several operating experiments (Fermi/GLAST, Veritas, Auger, and AMS) for high-energy cosmic and gamma rays. There are also several dark energy programs underway using existing telescopes and cameras. Plans call for second generation dark matter experiments to probe most of the preferred weakly interacting massive particle (WIMP) and axion phase space. A mid-scale dark energy spectroscopic instrument is also planned.

Next steps in the cosmic frontier include work in dark energy and addressing the HEP strategy as delineated in the Rocky III report. This is an excellent example for Snowmass conveyors. If the Rocky III studies times up to the Large Synoptic Survey Telescope (LSST) is dark, then there is a need to determine the tools that HEP needs and what things are needed after the LSST operations. A reason for this is pressure on the National Science Foundation's (NSF) astronomy budget. A portfolio review found that some facilities may be divested and there is potential for impacts to astronomical facilities. HEP needs to consider all of the U.S.' investments and telescope access if a dark energy follow-up is needed. HEP also needs to consider science in the same manner as the Rocky III report. Understanding the assets that are needed can enable discussions with NSF. The project strategy for now works through DES to MS-DESI to LSST. This limits involvement in alternative approaches and HEP is discussing implementation strategies with NSF.

In dark matter, the FY13 R&D funding proposal results will be available in early 2013. There will likely be further selection and identification of projects that could move to fabrication in one year and start fabrication no earlier than FY14. The G3 R&D planning continues as a low level.

HEP recently provided guidance to the Cherenkov Telescope Array (CTA) collaboration to support high energy gamma ray work. After Astro2010, HEP sees NSF as the lead for project consideration. HEP has no identified funding for the CTA and no plans to fund associated R&D. Siegrist commented that the whole question of gamma rays needs more discussion.

Dark energy was an issue within the cosmic frontier that was well-covered by the Rocky III report. Regarding dark matter, the rationale for requesting multiple isotopes needs understanding.

Some work may need to be done internationally. Siegrist wondered if work needs to get all way down to the irreducible neutrino floor. He also noted that there is no obvious answer on whether the enthusiasm for WIMP searches is modulated by LHC results; there is still dark matter whether LHC finds it or not. HEP needs to determine the decision trees for this area of work and the impact of an LHC or indirect detection discovery.

Another issue in the cosmic frontier is articulating the role of other particle astro areas in HEP. A number of experiments are running and as part of understanding the impact on ATP, Siegrist wondered if more pilots to explore this are necessary. He also noted that astronomy and astrophysics are wonderful but not within the DOE mission. There is a need to understand how the universe works but wants to avoid mixing-up mission studies at NSF and NASA. Siegrist commented that astrophysical background is sometimes needed to advance.

Comparative university grant review panels were held in November with results coming in January 2013 and grants to start in May. Comparative laboratory research reviews were held in summer 2012 with reports to be available soon. The SC career panel review will occur in January 2013 and about 10 HEP awards are expected. This is become a standard annual practice.

The HEP plans to institute reviews of operating experiments on a regular schedule. The cosmic frontier operations review was held in Sept 2012, and the intensity frontier operations review will occur in January 2013. The intent is to look at multiple options for operations. The review will examine experiments that do not have an operations phase to set operations budgets and schedules.

Project reviews will continue using the same established process.

HEP's budget plan puts into place a comprehensive program across all three frontiers. Within five years, NOvA and Mu2e g-2 will be running. CMS and ATLAS upgrades will be installed, the DES new mid-scale microscopic instruction will have begun operation, and the LSST and LBNE will be underway. HEP needs to begin planning what will come next.

There are boundary conditions that dictate HEP progress. Physics is vital but there are more considerations to be made. The fiscal environment is undefined meaning that "brute force" spending on new facilities or capabilities will not work. Anything beyond a cost of $1B has to be justified and is hard to get approved. There are ideas that can lead to new physics capabilities and some that do not, but HEP hopes to get to experiments it wants to do. Projects that are well-received usually build on previous investments scientifically or through infrastructure recycling.

Following the CSS2013 summer study, HEP will have another P5 panel to generate input for the next round of priorities and budget projections. An updated plan is expected in 2014. Siegrist noted that HEP needs more projects in the pipeline than it can support so that allotted funding can be spent, to reduce the vulnerability of the HEP budget, and to leverage the movement of construction funds of around $200M per year from one project to another.

A community planning meeting identified key questions for HEP. The energy frontier will require high-energy LHC running and a response to the real physics of the TeV scale. In the intensity frontier, plans will be informed by experiments taking data or underway. And in the cosmic frontier, there is a process for dark matter but a question as to whether all dark energy techniques agree on the scale and time dependence of phenomena. For now, NASA has continuous challenges and DWST dominates the program so there is no space for larger things. The Snowmass process is important as are European and Asian HEP strategies.

The community will have to adapt to conference attendance rules. Snowmass does not fit within the new rules. The format has to be modified and there is work to do prior to Snowmass

and the EBF meeting in August 2013. HEP awaits the discussion of scientific opportunities, but Siegrist urged consideration of timescales, resources, and technological maturity.

Siegrist closed by sharing that strategic planning has led to a prioritized, executable program that can convey HEP's interests and importance to non-HEP audiences. He contends, however, that some in the community are unfamiliar with the plan and some substitute a personal vision for the community plan with little or no prompting. Doing so fails to convey the community's goals and compromises international understanding of the goals. Siegrist urged the HEPAP to understand the community position and share the community's thinking with colleagues and government officials, prior to defining one's personal position. The position from the P5 helps to reduce noise. Siegrist noted that the implementation of LBNE seems to have suffered from communication deviations that also undermine the U.S. HEP at an important fiscal juncture.

2012 has been a great year for physics and for research in all three frontiers. The DOE is on track to complete all of the elements of the 2008 HEPAP/P5 Strategic Plan. The enabling of new projects while maintaining facilities in a flat budget environment necessitates reductions in research. However, DOE will continue to support the American Physical Society's Division of Particle Field's (DPF) community process for future planning and there remain many questions to be answered in this process. DOE will also be starting a new P5 process.

Roundtable discussion

Erbacher shared that the perception of Snowmass is to look at what experiments and facilities make the most sense to pursue for physics. Yet, fiscal conservatism was highlighted in Siegrist's update. Restrictions can limit coming up with the best physics. Siegrist noted that physics cases come first but there is a need for things such as a follow-on machine for the Higgs discovery. Priorities have to be carefully evaluated to determine which experiments will generate earth-shattering results and help justify the cost of a new facility. The intent is not to look at particular issues but for the community to understand the capabilities under certain conditions. If a process requires a $10M to $20M machine, then HEP may not want to make that commitment.

Erbacher asked about pushing for specific line item activities outside of the HEP budget and if there are advocates for this. Siegrist responded that this is coupled with SC issues and other construction projects. HEP is unique as it has few experiments, most take place at Fermilab, and these are already in the operations budget. Increases for facilities in Basic Energy Science bring about increased operating costs. This has to be balanced with negotiations with CERN on upgrades. If Japan develops a new facility, then there may be reasons for U.S. participation. HEP needs to understand the physics argument in advance in order to estimate the potential results. From a scientific view, HEP wants to understand dark matter and might need to diversify its experiments and build better theories.

Byrum asked about getting P5 in place before Snowmass. Siegrist shared that the end of Summer 2013 is a good time to get started on P5. HEP wants a Snowmass report to inform this.

Karen Talamini, SC Program Analyst, addressed discussions of conference attendance sharing that new guidance is expected soon. SC is working to support collaboration meetings and ensure that they are not misconstrued as conferences. She can advise attendees on the categories that meetings would fall into based on the agenda and description of the meeting. It is recognized that some meetings have lock-out dates for attendance. However, for a package to receive DOE concurrence on travel expenditures, paperwork needs to be provided 45 days before tickets are purchased and funds are spent. Laboratories have had to deal with a 60-day lead time for travel

and yet many conferences do not have invitations for presenters prior to 60 days. Talamini has started collecting data on conferences over $100,000 that were approved since May 11, 2012. She asked that laboratories have POCs provide this for it to be published on January 31, 2013.

Byrum asked if travel rules are from DOE or from OMB, as OMB guidelines are limited. She is worried that this will harm collaboration in the long-run. Talamini shared that DOE received the OMB memo. She has not heard from many scientific organizations if this restriction causes hardships. DOE has looked at how the Departments of Defense and Interior, and the National Institutes of Health are handling this. She is not aware of a lock-out date for Snowmass. The HEPAP discussed the University of Minnesota's development of a proposal to support ATP work in February 2013. There are plans to have more details about Snowmass in January.

An attendee mentioned concern about foreign travel restrictions and OMB guidance. Talamini shared that this was not in the OMB memo on conferences but that travel guidance is expected. Siegrist expects that SC will work with the laboratories on travel. There is no guidance yet but laboratory directors will have to ensure that their facility is in compliance. Some organizations such as the American Physical Society are advocating to OMB the need for conference participation to support collaboration.

Lankford asked about the two percent reduction in research and about construction. Siegrist shared that research funds mostly went into projects, and that the total construction budget has decreased. Some activities simply were completed.

Lankford asked about the intensity frontier and getting the community to (*could not hear rest of question*). Pier Oddone, Director, Fermilab, responded that work with India is growing. There is an effort in Europe to create neutrino program standards and feelings that the U.S. will not get going. A baseline neutrino experiment with Europe would be beneficial rather than duplicating this work. There is interest in this and starting the process on a small scale. The perception that the U.S. has difficulty obtaining funding and that projects will be cancelled is a barrier. Oddone believes that definitive actions by the DOE would signal stabilization and help to build trust.

Comment [WTW1]: Dr. Lankford – Please see italicized portion

Lankford agreed that the U.S. might be perceived as unreliable. He asked how U.S. plans fall into the strategy being developed in Europe. Siegrist sees that the perception is that the U.S. had plans until NSF backed out. The DOE is trying implement the community's desire and NSF's backing out did not kill efforts. Europe needs to be convinced that the U.S. is not unreliable.

Lankford perceives that the community is confused about the LBNE program. Siegrist responded that decreasing research support too rapidly will do damage. LBNE's current project line gives foreign participants time to get involved in the project. DOE has unusual flexibility within the project and can adjust the scope so that when a target is presented, DOE can leverage what others do and maximize the experiment's potential. Oddone called this a short-term strategy, urging the need to project a long-term direction. Having a first phase with equipment and detectors underground provides a stronger beam compared with others' facilities. The reach is extraordinary but the first phase is compromised. Oddone believes that DOE needs to claim a direction in order to convince the world to participate.

PRESENTATION OF NSF NEWS

Denise Caldwell, Acting Division Director, Division of Physics, NSF, described NSF's leadership structure and where the seven science directorates reside. Physics is under the Director of Mathematics and Physical Sciences (MPS). Astronomy at NSF is being worked out. Caldwell is serving in her role after the departure of Joe Dehmer in September 2012.

Science directorates make connections across multiple scientific areas in NSF, and invest in one another. They have interactions with divisions that directly report to the NSF Director.

Some offices are being moved into other directorates. Fleming Clem from the University of Wisconsin is the newly appointed Director of MPS.

NSF's budget is separated into four lines: operations, education, major construction, and research and related activities (R&RA). This fourth area supports all research investments. The R&RA FY13 funding request is $5.98B representing an increase of $294M or 5.2 percent. The funding of this broad and flexible portfolio highlights the Administration's priorities for science and innovation. There are many focus areas and the budget reflects emphasis areas when NSF assembles its budget requests. One area is the Cyberinfrastructure Framework for 21st Century.

MPS' major investments have done well. One highlight is INSPIRE that accepts proposals and are not reviewed. Caldwell noted that priority funds are not allocated to big projects but are embedded in core programs. This allows NSF to control programs' spending. Priority funds represent 13.5 percent of the total budget. The remainder is invested in open "discovery" projects. Most funding recommendations for associated proposals result from careful reviews.

The FY14 request for the Division of Physics budget will total $280M.About two percent is for administration including Intergovernmental Personnel Act (IPA) Assignments from academia. Twenty-six percent of the request would cover operations and maintenance at NSF facilities, seven percent would go to the NSF's 10 Physics Frontier Centers, and three percent would support education and broadening participation at Research Experiences for Undergraduates (REU) sites, the LIGO education center, and QuarkNet. The remaining 62 percent ($173.6M) would cover six major areas of physics and include educational investments. Spending in the Division is on experimentation, theory, and cross-cutting areas.

In HEP, awards in all three areas are made with no pre-determined preference for any one of the three frontiers. Elementary particle physics is the primary experimental activity and includes work in particle astrophysics. Theoretical investments are in elementary particles, astrophysics and cosmology. Facilities supported are CMS, ATLAS, and Ice Cube. The Division also invests in forming connections such as Physics at the Information Frontier and the Physics Frontiers Centers. Funding for these is approximately one-third of the division budget in FY12. In 2012, the Division got an additional $30M through leveraging of other sources.

Caldwell views the Division in FY12 as a strong and vibrant program, and is excited about the contributions made to other initiatives and agencies. The Division also received a positive review from its Committee of Visitors (COV) in February 2012.

The Division's priority in FY13 remains funding for core investigator programs with awards to individuals and small groups. Caldwell believes that this is where fundamental investments need to be made. Funding for this will never be less than 50 percent of the overall budget.

In 2013, NSF will closely follow Snowmass, look at issues such as CERN-US partnership, and LHC upgrades. Big data and usage are emerging and there has been a lot of talk about it. NSF will have some connecting to do after the White House roll-out on big data in March 2013.

Roundtable discussion

In response to Ramond's question about Joseph Dehmer's replacement, Caldwell shared that she does not know the search committee members. An announcement was posted in September 2012 as "Dear Colleague" letter on the NSF website. The search could take six to nine months. She expects a selection to be made next summer with June being the earliest possibility.

PRESENTATION ON TEVATRON PHYSICS PROGRAM: STATUS AND PLANS

Gregorio Bernardi of the Fermi National Accelerator Laboratory gave an update on the Tevatron physics program. Data and computing resources are well-matched to the analysis effort. There is currently no special request.

Data preservation is a goal for the two collaborations. The most important aspect is the publication of results obtained in the physics, algorithms, and detectors groups. The idea is to keep data for five years after collection and other elements of the accumulated information. An agenda server stores talks and local web pages. A plan for data preservation is being developed.

Tevatron is maintaining its collaborations status with CDF and DZero. Both will accomplish a remaining list of results. Around 50 Ph.D. students are completing theses at CDF and DZero.

Physics work is going strong. With the Higgs discovery, Tevatron does well with analysis. Tevatron provides a great dataset and with high data-taking efficiency of about 90 percent.

A data run stopped on September 30, 2011, and by July 2, 2012, Tevatron confirmed full statistics of 3σ excess around 120 - 130GeV and the 2.4 σ. This was published in March 2012. This rate is compatible with SM Higgs in all subchannels. The most significant is in H→bb. Clear evidence was shown for Fermionic decay of the Higgs particle. This paper was submitted in July 2012. As of November 2012, a difficult challenge has emerged. It is 2.2σ and more than half of the statistics had already been analyzed at LHC. Bernardi shared that the Tevatron gives important complimentary information. The facility also deals with indirect SM Higgs constraints. It achieved a boson mass measure of 15 MeV and 0.9 GeV. At the moment, Tevatron will also have the opportunity to check if this is more indirect.

In looking at top mass and cross sections, there is remarkable consistency of 0.56± .75 GeV. There is an error at LHC that is about 40 percent higher and that will be worked on in 2013.

Forward-backward top asymmetry was an important accomplishment. In the SM effect, this only happens in the initial state. In this case, the observation and achievement was significant at about 20 percent. The combination of asymmetries was about 6.6 percent or a ~3.3σ effect.

Top quark highlights in 2012 include the combination of top-quark mass measurements through CDF-DO combining, and a combining of CDF and DO measurement of the W boson helicity in top quark decays. Other highlights include measuring the leptonic asymmetries and top-quark mass to product very interesting results. Previously, the Tevatron was able to observe a single top-quark product and measure of |Vtb| by CDF and DZero.

In electroweak physics, Tevatron will work on a full data set and target total uncertainty. The LHC will take a long time to improve on this. There are nice results with W and Z asymmetry, and the provision of quark and electron EW couplings. Due to ppbar collisions, the physics from W and Z asymmetries at Tevatron will remain competitive for a long time. Highlights include the precise measurement of the W-boson mass and the measurement of ZZ production with DZero.

QCD work has generated different types of results. Bernardi shared alpha_s findings performed with three different approaches. The measurements were all compatible. Highlights include the observation of exclusive γγ production, the study of substructure of high transverse momentum jets, the measurement of Differential Cross Section in dσ/dt in Elastic pp Scattering at $\sqrt{s}$ = 1.96 TeV, and the measurement of photon + b-Jet Production in Differential Cross Section in pp Collisions.

There were many heavy flavor highlights. Important results included the observation of the Dimuon CP asymmetry at around the 4σ level. This can be interpreted as a violation of CP in the

system. Tevatron has tried to separate this and take advantage of it but now there are ways to keep the separation effect so that there can be new performance measurements. HCD work brought more results but more precision is needed to see what is going on here. CPV in Charm also brought impressive results.

In round two, there are more publications with about 365 from CDF and 295 from DZero.

Tevatron offers a unique dataset. Different collision energy and ppbar collision means that forward-backward asymmetries behave differently in Tevatron and LHC. The well-understood detectors and experts' work means that the facility can provide competitive CP invariance tests.

Bernardi shared that searches for new phenomena is near completion. This work has been dominated by the LHC resulting in a very rich program with more than 150 new phenomena published in Run 2 by CDF and DZero. There are still some open questions and most future phenomena work will be performed through other physics groups.

Searches for the Tevatron and difficulty at LHC have lead to the pursuit of efforts to close gaps. There are specific things to look at but this is not the main part of the program.

Within Higgs, research is nearing an end. The CDF and DZero both have many things in preparation. Efforts are turning toward analysis, more couplings in H→bb, and spin-parity discrimination.

For Higgs, there are efforts to finalize measurements and combinations. One study will look at SM Higgs couplings. The results from a recent conference showed constraints from coupling and two solutions. There is the ability to measure symmetry and Tevatron is preparing to share competitive sensitivity results in Spring 2013. It will show that good discrimination between SM Higgs can be achieved.

Bernardi shared QCD prospects. There is a nice program of measurements and papers in preparation including W+light flavor cross section. In the laboratory, research is looking at underlying event studies with 3 collision energy and there are many results being prepared that describe this analysis. Another example is work in inclusive jets and showing that Tevatron jets are the main source of constraint in gluon PDF. Work shows that LHC needs high luminosity.

There are many prospects for work in heavy flavor and papers being prepared for publication in a few months. This will run through 2013 and include a final Dimuon asymmetry paper. There are also prospects for top-quark. More work will be done in 2013 with forward and backward asymmetry. Work in expected top mass precision is a CDF project. With improvements achieved or planned at CDF there is a ~30 percent achievement improvement in b-tagged dilepton channels, 20 and 27 percent in lepton and MET+jet channels, and 10 percent in all jets. With DZero improvements, Bernardi expects a 20 percent improvement in the Tevatron combination.

Projections on forward and backward asymmetry point to measurement dominated by statistics. It is anticipated that results will move down to 4.5 percent to 1.8 percent. There is potential for a 5σ deviation from NLO QCD. This deviation will be challenging to explain.

Bernardi shared that s-channel top significance is important to understand but the significance is difficult to anticipate as it depends on the measured result.

Electroweak prospects will involve less measurement but these are high-precision measurements. In 2013, one prospect is to finish analysis and complete measurements such as the ZZ production cross section with a full sample.

With expected W mass precision, Bernardi shared a graph that shows the most recent measurement for CDF and Run 2. It was less precise. The theoretical line will go down if work is at 4 MeV. This is the plan for the future.

Bernardi shared W mass systematic uncertainties. Work could entail reducing the electron energy scale. At CDF, tracking is used so assuming a reduction, one can divide by error, and if one is able to reduce systematic errors, there can be movement from 19 to 10 MeV. At DZero, a move on the electron energy scale from 16 to 10 MeV and a further reduction can lead to a total below 15. Together that can produce really good measurements. The Tevatron is looking at W-mass and far it can go. When looking at predictions based on known mass, this is slightly different. If the scale is lowered to below 10 MeV, then this would provide consistency.

CDF will produce 69 papers between 2013 and 2014. Some will show a combination of activities as experiments are being done together. DZero will produce around 70 papers. Together, CDF and DZero are meeting milestones at a high rate and physics results are being produced. The work is exploiting unique proton-antiproton data. Some of the results are the best in the world, even with a small subset of data available. There are anomalies being studied that require final results for a complete dataset. Bernardi is looking forward to several important achievements including the collaborations, publishing of papers, and theses.

Roundtable discussion

Lankford asked about the number of papers, plans, and evolution of collaborations. Bernardi shared that the collaboration status profile shows that the number of FTEs is decreasing but is still producing papers and postdocs. The environment at the Tevatron has been very efficient.

Lankford pointed out the comparison of data with the standard model estimator, and asked about collaboration and if challenges are on the experimental or the data side. Bernardi shared that challenges exist on the data side. Tevatron is now completing the second half of measurements and there are some explanations needs including symmetry for measurement.

PRESENTATION OF THE STATUS OF LHCB: RECENT PHYSICS RESULTS AND UPGRADE PLANS

Hassan Jawahery of the University of Maryland provided an update on the LHCb describing the detector, highlights of recent physics results, and future plans.

A primary goal of flavor physics in the LHC era is to determine the flavor structure of any new physics found at the LHC including new CPV phases, right-handed current, and lepton flavor violation. If no new physics is found at TeV, then flavor physics gives a window for physics at higher scales. There are some key experimental handles such as the FCNC process, making precise CKM parameters, and the lepton flavor violation.

The LHCb detector is a single-arm spectrometer. It has coverage at a forward direction. Its acceptance is from $2 < n < 5$. The cross section for flavor physics is large and the ratio for this is very favorable. If you have a forward spectrometer, roughly 25 percent fits into the detector.

The experiment involves 61 institutions and around 500 physicists. They have published 74 papers and are publishing about one paper per week. Since 2005, Syracuse University has been leading this effort that includes Cincinnati, Maryland, and MIT.

Collision occurs in the spectrometer in the early part of the detector. There are two tracking diffusors upstream and downstream of each magnet. The ecal, hcal, and Muon are the primary devices for the hardware trigger. The key to experimental success is reliance on high Pt in the Muon system. The threshold is set by the energy deposited in the trigger and limits the maximum rate to about 1 MHz. This is a major issue for the future of the LHC and is the maximum that can

currently be achieved. The high level (software) trigger brings a total rate down to 5 KHz for permanent storage and about 25 percent for the input event.

As are as operations, they have been running at a luminosity of about ~$4x10^{32}$. Another factor is to run at an average number of visible collisions per crossing; the average is ~1.8 which is higher than expected. The luminosity is constant and maintained by separating the beams.

The current plan is to move from LS1 (Long shot 1) to restart at 13 TeV with 25 ns bunch spacing to reach a total of 7/fb in 2018 above the early goal of 5/fb.

Detector performance is at about the design level in essentially all important aspects. The detection has worked well at π/μ mis-d ~ 1 percent. This translates to high achievement and good separation with very good resolution.

Flavor physics is the primary program but EW, QCD, and pA have also been impacted. Results and data show that many milestones have been met to support flavor physics. B/S oscillation in particular is remarkable and shows 40 femtosecond time resolution. Most data has been published.

Jawahery shared some examples and results where experimentation has had the most impact. In the 1960s and 1980s there was reliance on mixing. Now there is a new milestone in flavor physics with the achievement of $B\rightarrow\pi\mu\mu$. B° was missing as piece of new physics but has a companion in new physics. The two should be compared. Mass matrices can describe the interaction and parameters demonstrated in the mass differences. These are the basic two parameters that define the system. If you know the systems, then you can obtain extra information for new physics. Observations look at a process that shows both mixing and decay and the relationship between mixing and decay amplitude can be understood. Semileptonic asymmetry can also be understood. Both parameters are small and have well-defined SM predictions, leading to highly-sensitive probes of NP.

Φs measurement requires angular analysis to extract CPV information. It is now possible to measure symmetry in $Bs\rightarrow J\Psi\Phi$. This allows for a measure of the Φs and the parameters of the mixing system. The results show that there are no ambiguities.

There is work to measure the semileptonic asymmetry via an exclusive channel, by looking at asymmetry, and accounting for oscillations. This is one of most complicated measurements to do. The LCH has not tried to do this measurement yet. LHCb measurement of semileptonic asymmetry shows good consistency and if you take average of two there is some discrepancy.

There are implications for new physics in mixing. Many people have looked at the data to see what this means in terms of new physics. It allows a complex component and the measure of amplitude, and looks for a standard model in B Factories and Tevatron, and in the Tevatron and LHCb. Jawahery shared that both are consistent with the standard model and there is plenty of room for new physics, as well. There are implications in mixing as shown by the Utfit group. The data before LCHb resulted in a different scale and discrepancy in Summer 2011. Now, the arrows are much smaller and there has been a huge impact on this aspect of new flavor physics.

LHCb measurements of FCNC processes give observable factors that can be tested and are susceptible to different effects. This shows sensitivity to scale factors of new physics channels.

In the case of the $B\rightarrow K(*)\mu+\mu-$, an annual analysis is needed. It is very clean and observable with angular analysis. It gives constraints on coefficients and the results show a level of accuracy that exceeded past experiments. This has been the most precise look at these channels so far.

In forward-backward asymmetry, data favors the standard model, Furthermore, at the zero crossing point the measurement are still large. This is compared with a measure of zero crossing point with average.

The most important lesson so far is the $Bs \rightarrow \mu^+\mu^-$. The important part is that there is only one coefficient that is relevant to SM. Evidence of this was found by looking at events triggered by Dimuon. This is the cleanest of all channels. There are a lot of events in the $B \rightarrow h^+h^-$ pair. These are used for multivariate analysis. To do branching measurements, this has to be normalized and then the branch is measured to understand the branching ratio. Evidence for this comes from examining the signal and looking at a mass plot for $\mu^+\mu^-$ (as shown on Jawahery's slide 31). The branching ratio is completely consistent with the branching model. As shown by a compilation of past measurements at ATLAS, CDF, CMS, and LCH, this is rapidly decreasing. The implication for the $Bs \rightarrow \mu^+\mu^-$ constraints suggests that there was movement from 2010 to 2011, and that this is extremely powerful for the tanβ region. Another plot of this demonstrates that it is difficult to have a model that does not reduce $Bs \rightarrow \mu^+\mu^-$.

Jawahery shared PreLCH and LCH data that offers strong proof for new physics.

There are other promising channels for flavor physics, such as the measurement of the CKM phase γ, probing right-handed currents with $B \rightarrow K^* \gamma$, and direct CP violation in B decays.

The future of the program includes looking at sensitivity to key flavor channels. By 2018, LHCb can be expected to reach 0.2×10^{-3} for B mixing. A goal for the LCHb upgrade is that precision flavor physics will remain a major component of work at LHC. Another goal is to reach 50 fb-1 by running at a higher luminosity. Jawahery believes that there is no question that the LCH program will dominate in this area. The LCHb can compete in exclusive channels and this is their domain. To keep luminosity, the LCHb will have to remove the current LO trigger limit of 1 MHz. The plan is to achieve a 40 MHZ clock rate and implement software triggers to achieve significant flexibility and achieve a gain of x10 for hadronic channels at $2x10^{33} cm^{-2} s^{-1}$.

Overcoming the 1 MHz limit requires all front electronics to be removed, rebuilt, and chips embedded to transfer the data. There are other components that have to be removed. Almost all of the tracking system will be upgraded. Calibration on the new system will be minimal. Most of the system will survive and there will be no major issues leading up to 2018.

The upgrade in 2018 means that operations will begin at 14 TeV in 2019. Logical choices are being made now regarding replacement and technologies. Other decisions have to be made in a similar time scale. Funding procurement will take place in 2014. The framework development has been published and there is approval from the European strategy group.

Jawahery concluded by sharing that the LHCb has been running successfully and in many cases has exceeded its physics goals. The parameters being set for new physics are significant and progress is being made on the right time scale.

Discussion

Gilchriese asked about the proposal. Jawahery described the task of the device as tracing and using the trigger and magnet. This gives a quick status report on the trigger. One problem is the ghost tracks. The tracing system redesign could improve resolution and reduce ghost tracks.

Lankford asked about DOE support. Jawahery clarified that Syracuse and Cincinnati have DOE support, Maryland relies on NSF, and MIT is represented by one PI with a postdoc who has joined with NSF and the DOE.

Erbacher asked about the asymmetry for KSd and a plot for LHCb that show DZero being below the threshold, and Jawahery's take on the difference between the two. Gregorio responded that basically everything would remain compatible, noting that if LCHb reduced the error bar

there would be some exclusion. Erbacher expressed that there is no reason to expect a difference and that DZero has certain controls such as reducing magnets.

PRESENTATION OF IMPLICATIONS OF HIGGS-LIKE BOSON DISCOVERY

Tao Han of the University of Pittsburgh shared an update on the implications of the SM-like Higgs-boson discovery announced on July 4th, 2012. ATLAS showed 5.9σ and CMS showed 5.0 σ results. The Higgs results recently shared at a conference showed a small local p-value with small compatibility. With this data, it can be determined that the expected signal strength of 7.8 was actually 6.9. This conveys that there is room for thinking about the prediction but that the observation is consistent with the SM-like Higgs boson and within the experimental accuracy.

The completion of the SM model is a triumph. Quarks and elements are being identified and now there is understanding of similar structures for leptons, qluons, and Higgs. This is not the end of the discovering but a call for new physics beyond Higgs itself. Direct and indirect research in Higgs will also lead to a new state of understanding.

The discovery has sharpened profound questions. Within parameters, one can determine that there may be a new force but it is not a number. This is not controlled by gauge interaction but by light, weakly coupled boson and is a very small number. This may signal the uncovering of deeper theory and reaching a new level of description. Within parameters, evolution has been observed. In considering variations, the parameter is not well known. The parameters go up with energy and when they go up, the Landau pole goes up to reach an upper bound. This signals movement from zero to triviality. Some new physics may be available but it will not affect new physics. However, a meta-stable vacuum may be a concern.

A second aspect is the Higgs mass. Wilson (1970) noted that scalar particles are the only kind of free particle with a mass term that does not break either an internal or a gauge symmetry. The second part of Wilson's statement is still true. The quantum corrections to the Higgs mass indicate that there is an unnaturally large cancellation that must occur. If it is a centimeter wide and finely-tuned, then this is unacceptable – some other new physics must appear.

Theories behind this include SUSY (symmetry between different spin-states). Fine-tuning in is not bad but is on a weak scale. SUSY will not solve this problem. In Higgs, there are relevant states. A Composite Higgs for this is a pseudo–Goldstone boson. This introduces additional global symmetry. More partners are needed to solve this fine-tuning problem. The statement M_h=126 GeV has already provided a non-trivial test for some models. SM up to M_P is already measured. From the composite Higgs, the scale is heavier and it is very hard to put it down. You can predict Higgs activity on the low end. The particular values here predict where to work. Both suffer from some degree of fine-tuning. The naturalness argument suggests the existence of TeV scale new physics. Giving up this belief means subscribing to the anthropic principle.

A third aspect is the Fermion mass and flavors. Higgs may be the pivot for the seesaw and be a probe to the heavy neutrino sector. Fermion masses are generated by particle masses. There is a measurement problem in that all are proportional to eV and are 15 above (eV). There is still as question as to what controls the mixing structure and if it is minimal flavor violation.

A fourth aspect is viewing Higgs as a portal to dark matter. So far, there is no clear picture but Higgs can couple to new physics and it may help when attached to other types. It is likely that Higgs can decay. There is an indication from direct searches on WIMP dark matter that on the electric scale, Z mediation has changed. A direct search has to reach to H mediation and it is possible that these will help one another. There are other potential consequences, as well. The

existence of a fundamental scale encourages the consideration of a scale field in cosmological applications. The discovery of the Higgs-like boson is the beginning of a long physics journey.

Han discussed examining the Higgs sector at LHC. The search for super symmetry has been carried on but the first particle has loose bonds. This shows that the missing particle has a significant mass. Some missing kinetic energy is needed and there is a pretty large window to accommodate. LHC may also be limited in its coverage of gauginos and Higgsinos.

A second approach is looking at composite Higgs where the current ATLAS limit is MT > 480 GeV, for MA < 100 GeV. The future projection is that at 14 TeV, 100 fb-1 could reach to MT ~ 1.1 TeV at 5σ. A third approach is that there are other particles associated with Higgs, and fourth, it is associated with electroweak gauginos and Higgsinos.

Finally, measuring the Higgs couplings will be difficult but is needed to make connections with flavor physics. Currently, the accuracies are defined by physicists. Assuming that there is particle life, then typically there could be a 20 or 30 percent level for couplings. This is getting into an interesting region already.

There is a not-so natural Higgs sector. It is unnatural as there is some tendency to push forward as we have not seen the topic space. If they are not directly observed at the LHC, the probe to the high scale new physics associated with the EWSB relies on detecting the deviations from the SM-like Higgs couplings. Generic argument shows that there is a heavy-scale. For each model, there is a need to aim at the mass scale M which is not easily accessible.

To go beyond Higgs and extend the Higgs sector, one approach is an MSSM: Two Higgs-Doublet Model. Current LHC bounds allow for connection. This allows for calculating other tree-level masses. It is easy to accommodate an additional Higgs and there are different points and different color to show different bounds. This situation rests in the decoupling and decoupling limit in MSSM. It is possible to estimate the size of the decoupling limit.

Han shared three other approaches from the not-so natural Higgs sector -- the top quark partner, the Higgs boson as a pseudo-Goldstone boson, and the missing MSSM at LHC. He pointed out that precision measurement may be surprisingly rewarding, and if it looks at form factors, it may be possible to test Higgs spin-parity properties and search for CP violation.

Han shared that research needs to go beyond the LHC direct search and study Higgs physics as much as possible. Composite Higgs will give new decoupling and new particles for color / charge loops. Reaching 10 percent accuracy will be important for making H→invisible. Finally, total weight is very important and can provide a lot of detail about individual pieces.

Han described Higgs as a new class and different from other fields. It serves as a pivot point for energy and for other frontiers of energy. Higgs cannot be studied by itself but must be combined with an "interactive friend circle" and partners. If interactions at the LCH are not seen, then Higgs methods should be examined to achieve more understanding and to understand coupling deviations from the EM values at small percentage levels.

Discussion

Glenzinski asked about probing for the existence of particles. Han shared that for Higgs particles, this is new and different, and better understanding is required. This can provide for searching for new physics from the flavor sector which may be a strong indication to use new physics. They may not have opportunity for interaction.

Lankford asked about the role for the study of the cellular complexity of Higgs self. Han commented that in the Higgs sector overall there is a reason for (*couldn't hear complete*

Comment [WTW2]: See italics

response). Three Higgs bosons when measured will show that decouplings are very good. Precision measurement will partially answer this, but formally measuring the interactions will give slightly more information.

Lankford asked what studies should be done, especially in advance of Snowmass. Han shared that this is important and is independent of other particular programs. Understanding will contribute more than just knowledge about computations. There need to be partners. The reason for Han's examples is to look at modification designs and building new scenarios.

PRESENTATION ON THE OPEN SYMPOSIUM OF EUROPEAN STRATEGY PREPARATORY GROUP

Patricia McBride gave an update on the European strategy for particle physics and an overview of the open symposium held on September 10 – 12, 2012. The mandate for the strategy is to look at the medium and long-term strategy as it applies to CERN and other programs. The outcome is an update of the strategy document developed in July 2006.

It has been more than one year since the CERN Council met to discuss the strategy. The preparatory group produced scientific input for the strategy update and is developing a summary. There are no conclusions to share at this time. There is a strategy group using the preparatory group report and nonscientific input from its own working group to prioritize strategy updates.

The preparatory group consists of members nominated from SPC, ECFA, CERN, the Americas and Asia, and members of the Scientific Secretariat for the Council. The strategy group includes delegates from each CERN member country.

At the open symposium, nearly 500 participants reviewed written input to the process and summarized the current status and future options. Discussion sessions helped formulate main points. Areas specific to the science strategy were the high energy frontier, flavor and symmetries, strong interactions, astroparticle physics, and neutrino science. Topics relevant to auxiliary aspects of the strategy were theoretical physics; accelerator science; and instrumentation, computing, and infrastructure.

McBride summarized discussions from the symposium. In the energy frontier, there was a push forward in the flavor and high energy frontiers. This included discussion of the Higgs-boson discovery. The LHC is a major part of the European program and will dictate the nature of proposals through 2020. There was also discussion of whether Higgs boson understanding is enough, and if a new low-energy machine would be justifiable.

The group discussed the future of the LHC and how it can be a wide platform and forum for discussing open questions. People discussed the scientific scope for LHC upgrades. For instance, upgrading the luminosity requires upgrading detectors and other components. There have also been proposals about the LHeC that adds an electron beam to the collider. This is being actively debated in the field. Input from the LHC run at 13~14 TeV is needed.

Attendees discussed the interaction of astroparticle projects, in particular, proton decays. In Europe, there is a process and a roadmap for this discussion which led to discussion about overlap. A consideration is the roadmap for a long baseline neutrino detector facility. There was consideration of challenges in neutrino physics and mass hierarchy, among other things.

The European community made proposals and presentations as part of this process to look at the future in Europe. One approach is a CERN SPS long baseline neutrino beam to Finland. There was interest and debate about Muon storage. Attendees also looked at having a long baseline neutrino beam in Europe but coming from other places in CERN, including Russia.

The symposium included the U.S. vision for the astroparticle program and a multi-megawatt proton driver.

Contributors from Japan talked about a linear collider as a priority project in Japan.

Heavy ions were discussed as was a timeline for work into the 2020s. There are interesting things emerging in the field. Discussants debated how many facilities of this type will be needed.

Coming up next is a reduction in the drafted briefing book and Jim Seigrist will talk to the strategy group on Tuesday to discuss the U.S.' plans, particularly in the neutrino area.

On January 21 – 26, 2013, the strategy group will continue their discussions.

The current strategy proposes that the LHC should be exploited. It has evolved since 2006, and now it is running well. One issue going forward is determining the R&D that will be needed in future and any upgrades.

Accelerator R&D is a major discussion point for future particle physics. There is discussion about the need for the next machines and what they will be at CERN, as well as how the EU community will contribute to the next things at CERN.

There is a window of opportunity for Japan to host the ILC. The Europeans will have to come up with a strategy that describes how they will participate and to what extent.

In the area of neutrinos, a major issue is whether Europe should build its own facility or participate in other nation's efforts.

The European strategy group will meet in January 2013 in Erice. This will drive the presentation of an updated strategy to the CERN Council at its March 2013 meeting. Final adoption of the strategy by the Council is expected during its special meeting on May 23, 2013, in Brussels, coinciding with a meeting of the EU Council of Ministers for Competitiveness.

McBride expects that the publicly available documents that will be coming out are the briefing book of scientific cases and inputs to the strategy. Compilations are available online. There will be a draft compilation statement, longer deliberation document, and framework for strategy implementation. There is a general brochure that presents the opportunity.

Discussion

Hartill asked if there was a discussion of accelerator science. McBride shared that there will be a whole section on accelerator R&D across a wide variety of topics that include advanced accelerators, positive wave fields, and things that are part of the neutrino factory.

Fleming asked if there was discussion of European work and Japan's projects. McBride shared that discussants considered both to be a priority but that IOC is higher, with a desire to effectively set-up IOC.

Gilchriese asked about the U.S.' statement. McBride shared that contributions were made from individuals but that there was no overall U.S. contribution.

Blucher asked about the discussion of budget information. McBride shared that CERN is well-known but there was no specific part of the discussion in the preparatory group. She assumes that this will come-up in the strategy discussions with the Council.

Erbacher asked if the European strategy group will meet to hash out answers, or if that has been done and they will write the report. McBride confirmed that the conclusions do not exist and that the strategy group will meet every few months. A decision about finalization will be discussed in January.

Byrum asked where dark matter and astrophysics fit in. McBride sees this as part of the strategy in different ways. It overlaps other areas and is mentioned in the preparatory

information. There are discussions about CERN as an organization and involvement in a large project that is not on their campus. The group sees pros and cons in this involvement.

Blucher asked about the outcome of this process and development of a baseline program. McBride pointed out that there is no strategy statement yet. She does not know if they will state that they cannot afford to do it here and it should be done globally.

McBride confirmed for Lankford that a briefing book is planned for May 2013, and that there will be a printed version for the strategy group in January 2013.

PRESENTATION ON PREPARATIONS FOR COMMUNITY SUMMER STUDY

Pierre Ramond of the University of Florida shared an update on the Snowmass 2013 meeting to occur July 29 – Aug 6, 2013, at the University of Minnesota. It is planned as a summer study meeting "CSS2013: Community Summer Study Meeting." It was established by the American Physical Society (APS) and Chair-elect Jonathan Rosner of the University of Chicago.

Ramond discussed the process and direction with HEPAP in early 2012. Snowmass will be a long-term planning exercise for the high-energy physics community and lead to the community's long-term physics aspirations. It will communicate opportunities for discovery to the broader scientific community and the government. An initial meeting, "CPM2012: Community Planning Meeting", was held on October 11 -13, 2012, at Fermilab, with more than 450 attendees. Federal government restrictions on meetings have forced the Snowmass 2013 process to be broken into smaller interim meetings ending with CSS2013. The process will give opportunity for discussion and analysis, and develop conclusions, and is intended to initiate action. Planners of the meeting "anticipate that this long-term planning process will trigger an independent process of review and prioritization solicited by the funding agencies." More information can be found at www.snowmass2013.org.

Ramond described eight focus areas that have each divided into working groups and will hold pre-meetings. The areas are: Energy, intensity, cosmic, instrumentation, capabilities - accelerators, capabilities - non-accelerators, computing, and education and outreach. The computing frontier group has separated into two groups: user-needs subgroups, and infrastructure subgroups, respectively.

DOE's Siegrist provided a perspective to the organizers, encouraging exploring of scientific options and emerging opportunities. DOE will initiate a P5 subpanel at the conclusion of Snowmass2013. A few weeks later, the APS meeting at the University of Santa Cruz will share conclusions of Snowmass.

Ramond shared that the community is energized by the epochal discover of a spin zero elementary particle. Particle physicists strive to unravel nature's mysteries for the good of mankind and to benefit society.

Discussion

Fleming noted that some meeting dates overlap and if dates can be re-set. Ramond responded that there are bound to be overlaps.

Fleming shared concern about the process for participants getting along, and reflected the need to "not shoot inward" at one another. Ramond believes that there was not much shooting at the last town hall meeting, and hopes the process and focus are on physics and the realities of funding priorities that are ahead. When reality sets in and the P5 convenes, all need to come

together as a physics community. He observed that many countries in Europe disagree but that they work together for the common good. Fleming urged that that message be relayed throughout the process. Ramond responded that there are issues that all will share in common and different ways of finding the answers. Decisions will be made that may not satisfy all.

Glenzinski asked about the organization of the committee. Ramond shared that some groups started work in December 2011 and are coming together to establish the group as a global leader.

Glenzinski asked if there will be additional meetings for the intensity frontier. There is a planning meeting in April 2013 and a neutrino meeting at the Stanford Linear Accelerator Center (SLAC), according to Harry Weerts of Argonne National Laboratory. Others may have meetings in conjunction with workshops. Harry feels that there is a charge for flavor physics and weakly-coupled particles. A lot of work has been done and needs to be updated.

Comment [tww3]: Could not confirm that this was the "Harry" that responded. He is only one listed on the sign-in sheet and works in high-energy physics at Argonne.

Glenzinski asked if the intensity workshop tasks have been accomplished. Weerts shared that the goal of the meeting in April is to define a direction for Snowmass, discuss a timeframe, and define a strategy for educating other frontiers about high-energy. Drafts will come out of the April meeting and become available in July 2013. Ramond shared that many meetings will occur prior to Snowmass and give a snapshot of the current status.

Lankford asked about the types of questions being addressed by the frontier groups. Ramond is unsure but this is being handled by the conveners. The details are on the Snowmass website.

Lankford asked how supercomputers were being organized in the frontiers. Gilchriese shared that there was agreement in the non-accelerator group to focus with input on underground capabilities and he believes that others will eventually, too. This group has a narrow scope.

Lankford shared that agencies positively view describing the program in three frontiers but asked if there is concern about the use of "frontiers." Ramond responded that this can be discussed if Lankford feels that it is inappropriate for others' areas. Lankford suggested discussing with agencies if this will complicate their messaging, with concern that the word "frontier" will be overextended based on what the community seeks to do. He noted that some focus areas are smaller than others.

Lankford asked for perspective on the relationship with Europe, Japan's plans, and the U.S. community meeting, and how this will potentially influence the European's discussions. Ramond shared that normally there is parallel cross-talk. The European scope has narrowed and there is only one CERN. The U.S. is working more generally, yet the U.S. knows what both sides are doing, said Ramond. Regarding Japan, Ramond sees some new things. He sees that the working groups in the energy frontier can consider physics issues with scrutiny and discuss the benefits of the Higgs boson and other issues. He sees this as cross-talk and sees the need to continue forward as a community with consensus on things that need to be done. Ramond hopes that Snowmass will produce a product that describes a positive direction.

Ramond encouraged early registration. The budget is currently being developed and will be released on December 25, 2012. At this time, early registration has not been discussed.

OPEN DISCUSSION PERIOD FOR HEPAP MEMBERS

Gilchriese asked Siegrist how Snowmass will be impacted by fiscal reality in the Federal government since the budget would have to increase significantly to meet all demands. Siegrist shared that empirically, DOE has to work with its budget and get it through the system, and this is more than just the annual expenditure rate. He suggested that Snowmass participants could develop a budget spreadsheet, if desired.

Gilchriese reiterated his interest in getting guidance from DOE. Mike Procario, DOE HEP Director of Facility Operations, shared that the current plan is to increase the funding increase of $120M to $200M and that funding can be available from base structures. He shared that there may not be funding to build four $2B things but there could be more money available.

Fleming asked where resources will come from if the plan is to ramp things up. Siegrist shared that HEP's plan is to ramp-up and convince the Administration that HEP cannot do projects if people are being laid off.

Lankford asked about varying interpretations of the HEP story, reflecting on Siegrist's presentation that urged building a strong argument for science and convey opportunities to motivate supporters, while also suggesting that people temper their requests. Siegrist responded that boundary conditions exist. People should discuss possibilities, but may not want to put a lot of effort into things that are uncertain.

Lankford asked for advice on what Snowmass should cover, in light of scenarios such as doing precision measurements that require a huge collider, or to think about a large collider but U.S. participation in small pieces. Siegrist noted that eventually the P5 will have to consider what to offer. Collaboration with Japan depends on figuring out the U.S.' duties and understanding the opportunities at different funding levels.

Cohen asked if HEP expects cost estimates as a product of Snowmass. Siegrist shared that the facilities have dollars associated with them, so he does not expect this type of product.

Fleming asked about the consideration of more difficult examples such as U.S. contributions to international projects. Siegrist believes that DOE wants to invest in more than just programs but that focus is important to avoid being slammed by the system. He urged that the community consider what is unique about U.S. contributions that others want to use such as technology that CERN does not want to invest in. An example is U.S.-made infrared detectors to support space telescopes and work in Japan. There are also foreign science investments that DOE can buy into.

Siegrist was asked about confusion around timescales, suggesting that determining needs around 2020 does not require Snowmass but that the event could help define a vision for 2030. Siegrist noted that the community should envision programs in the era when LCS and other things are operational. DOE needs direction on the physics and technologies that will be needed.

When asked about which frontier to address, Siegrist responded that originally the P5 report helped define the frontiers and diversify the programs. OMB and Congress noted that this diversification avoids condensing things into one future project. Science is needed in each frontier. Siegrist noted that it is hard to argue against Europe leading the energy frontier but that long-terms goals for the U.S. are another issue that may mean getting that frontier back. The intensity frontier is looking at experiments and the U.S. has leadership in the capability frontier. The Rocky III report was the first time for DOE to look at these goals. The Administration and Congress does not see a world leader in the capability frontier. Siegrist shared that HEP must insist on setting-up a Rocky III task force as a way to extend it to the next time period.

Byrum urged the need to pay attention to having global leadership in different frontiers. Crawford urged a discussion of the loss of leadership. The attendees spoke to the need for leadership for 2020 and beyond, and determining the goals for Snowmass and the differing views on its purpose. The groups can discuss opportunities without a focus on funding and the boundary conditions that go along with prioritization. The energy working group is not talking about priorities and funding. The meeting at CERN in January 2013 will discuss priorities.

Siegrist responded that priorities will have to be set soon after Snowmass. The attendees spoke to Siegrist's earlier comments that the community should come up with opportunities

across all frontiers to allow flexibility, and to point out to policy makers where the U.S. needs to be in this field.

Rosner commented on deliverables and that there will be write-ups from some sub-groups and some working groups will have write-ups accompanied by executive summaries. A 30-page document will be assembled for each group by the conveners. The planning group has not yet discussed the composition of an overall unified document and at what level information will be presented. Overall, the document could be several thousand pages.

OPEN DISCUSSION FOR HEPAP MEMBERS AND ATTENDEES

Siegrist asked if there should be a proactive argument that positions the limits on conference participation as a unique challenge for the U.S. The DOE will deal with this issue for some time to come. He wondered if this has impacted associations, acknowledging the impact upon science. He asked if the HEPAP should review its suite of conferences and take-on this issue.

Erbacher asked if laboratory directors and professional societies should unite to address conference participation. She is also concerned about restrictions on international travel, particularly guidelines that limit student and postdoctoral researcher travel to use collaborative research tools. There is potential that DOE's reputation as an attractive employer for young researchers could be harmed. She urged that the community make the case that the U.S. needs to work in a global community and the need for a plan to fight restrictions.

One audience member expressed concern that dwindling conference attendance would make the cost of attendance more expensive to offset hosting costs. A net-win could be a reduction in the overall number of conferences by one-third.

Ramond wondered if various panels in other subfields should petition academia to address conference participation limitations as being detrimental to science.

Oddone is concerned that a community push to Secretary Chu and others may convey an assumed sense of entitlement. The community needs to convey its ability to manage conferences rather than implying that it needs to clean-up its act. He wondered if every conference is useful and if an assessment is needed. The DOE can advise the community on guidelines for reductions to certain levels. Decisions have been elevated such that every decision is made at a high level. Oddone urged reducing the levels in organizations at which these decisions are made.

Kogut suggested caution in the use of anecdotal information to discuss (conference and travel restrictions) as guidelines have only been in place since May 2012. Concrete evidence could include the number of people harmed, the number of trips cancelled, and conference statistics. The attendees added that another data point is the number of people who have been tasked in laboratories and DOE offices to deal with the guidelines.

McBride noted a need to separate out the requirements of getting a new system in place and the potential for even harsher guidelines to come. She urged compliance and looking at a process to approach this in a cautious manner.

Siegrist commented that if a data call is desired, it needs to get started. He asked the HEPAP to ask William Brinkman, DOE SC Director of Science, what is needed when he meets with the Panel on day two. Siegrist commented that SC only has anecdotal impacts as information on the impacts does not come through his office.

Goldberg sees this as a universal problem for all of science and not just the DOE.

Attendees commented that collective efforts in the laboratories have started to combine the arguments into a single-page document.

CLOSING REMARKS AND ADJOURNMENT

HEPAP Chair Lankford adjourned the meeting for day one at 5:45 p.m. EST.

DECEMBER 6, 2012

The High Energy Physics Advisory Panel (HEPAP) was convened at 9:00 a.m. EST on Thursday, December 6, 2012, by Panel Chair Andrew Lankford.

PRESENTATION OF DOE PERSPECTIVE

William Brinkman, DOE SC Director of Science, provided an update on DOE news.

DOE is working on the FY14 budget. Current discussion on the Hill is to hold the budget steady for five years, and Brinkman believes that it may remain constant for a long time. Challenges for the SC include maintaining the laboratories, conducting laser work at SLAC, and continuing research work that is leading work and needs to keep going.

Facility work is expensive and DOE is trying to enter a second round of facilities, both of which are big ticket items. One thing going for SLAC is that no one else has a laser of that type. There is also financial stress from supporting the National Synchrotron Light Source II and the ITER facility in France.

Brinkman described ITER as a sociological and scientific experiment due to the engagement of multiple countries. ITER is complex and expensive but in magnetic fusion, the sheets have gotten bigger. It now becomes a volume issue, making bigger material for plasma to support fusion. A bigger machine is needed to break even.

The National Institute of Standards and Technology is busy. While it did not meet its goal for October 1, 2012, there are new physics involved in compression and that is being sorted out.

SC is working out what to do in particle physics, centering on whether or not the U.S. should take the lead. Brinkman sees two viewpoints. One is a fear that the Japanese will build a facility and CERN will be in place, while the U.S. has nothing. He would like to see a major facility in the U.S. and global competitiveness. A second view is uncertainty about CERN's role in neutrino physics. He believes a direction needs to be determined. Community input is needed, and Brinkman seeks a discussion about this and other issues.

Brinkman told the HEPAP that if the community wants to build a new facility, then that needs to be discussed.

Discussion

Glenzinski expressed confusion in that LBNE was highly-reviewed by P5 and noted as a high priority project. Brinkman conveyed that it needs to be staged yet is requesting direction. Brinkman asked if the P5 views still reflect the community's view, also noting that it may not be viable in the current fiscal climate. Brinkman is not concerned about P5 but wants to know community interests and how to move forward. Siegrist shared that international contributions could mitigate any loss of science but that the Europeans are concerned about the U.S.' long-term intentions.

Glenzinski deems the LBNE discussion as circular in that there is no uniform opinion about LBNE and that prevents it from being defined. Simultaneously, the discussion becomes more diffuse due to talk of staging for LBNE. He asked Brinkman who in Washington is having a hard time accepting LBNE. Fleming added that people may think that the community is not behind it and that it represents a large project. Brinkman acknowledged that it is a big project but that it is unclear that LBNE is the right thing to do. He described it as a different concept as particle physics is perceived as a simple field and not requiring the building of the next accelerator. He believes that the concept was conveyed well by the P5 but SC is still trying to make it work.

Siegrist noted that the existence of P5 has been reiterated but that the conditions have changed. Community-based and individual feedback may question the P5 conclusions. He urged that the community know the roadmap before expressing an opinion. He asked if feedback should be gathered on an intensity frontier with LBNE as a first step and stage.

Cohen shared that the case for flavor physics and LBNE has been strengthened by the discovery of Higgs boson but that the feeling has not permeated the community. Opposition to LBNE is mostly driven by concerns about energy frontier leadership.

Brinkman expressed that the U.S. is not likely to be the leader in the energy frontier.

Cohen added that a clear community feeling would emerge if there were acknowledgement that the U.S. would participate in an energy frontier in Europe, that Europe would participate in an intensity frontier in the U.S., and that there would be a facility in Japan. Brinkman answered that the U.S. invested $200M in Europe and cannot provide the same level of funds to Japan.

Cohen shared that Europe is nervous that the U.S. many not follow-through with a commitment in the energy frontier, suggesting that better international discussions could signal a commitment and convey U.S. willingness to lead. Brinkman suggested waiting until the outcome of CD1 next week and then making a clear decision about the U.S. commitment. He believes that community support is needed to gain budget support.

An attendee asked about CD1 and the message from the U.S. to Europe. Brinkman shared that if the U.S. is going to lead, then that message needs to be expressed. Administration support is needed due to a constant budget for the next five years.

An attendee told Brinkman that the community voice is not that significant but that Brinkman's is vital. He conveyed that if Brinkman really wants support to come, then he and Siegrist need to send a clear message to other international partners.

Siegrist brought up concern about conference participation. Brinkman and the Secretary want to minimize the impact of restrictions. SC is striving for a less onerous process. He encourages attendance but wants to avoid extravagant funding, citing a cost of $2,000 on average for conference participation. SC has been delaying action on travel, as it is important for people to attend meetings and join the international communities.

Erbacher shared that the guidelines may prevent students and postdocs from international collaboration and being stationed abroad to use tools. Physics is affected disproportionately and broad measures will have repercussions. Brinkman agreed that DOE does not want to limit this. Making exceptions is tricky and DOE wants to make the right decisions in general.

Erbacher suggested a less micro-manipulative approach, giving people guidance and conveying the spirit of the idea. She cited the 60-day rule for conference arrangements and that most of the important conferences are not in the U.S. Organizers do not always know researchers' programs, attendees do not always know who to send so far in advance, and she is concerned that U.S. participation will diminish. She is concerned that laboratories will struggle to attract the best employees due to tough guidelines and an inability to present at international

conferences. Brinkman conveyed that DOE is not trying to tell what laboratories they can and cannot do. The limits do not dictate who should not attend meetings. He noted a recent conference where 10 laboratories participated in a single exhibit booth and saved $700,000.

Glenzinski noted that all agree on saving money but not the manner in which the rules are implemented. He told Brinkman that SC requires the names of the attendees four or five months in advance. Brinkman agreed to check on changing that requirement.

Byrum shared that multi-purpose laboratory directors have to count up the numbers of potential attendees. The rules do have an impact on Snowmass in that the community must now have mini-meetings. She feels this is less productive and recognizes the value of Snowmass for community planning once every 10 years.

Brinkman asked if SC is holding people back from working on Snowmass. Siegrist responded that the mini-meetings permit working groups to feed into the Snowmass. This process seems to evade the new rules. The prior format allowed more time to get together and HEP will see how this new approach works. It certainly meets the DOE's requirements.

Oddone asked Brinkman if he has an objective for managing meeting participation and travel restrictions. The laboratories have ways to control this and support reporting. Brinkman cited the original OMB guidelines that limited participation in conferences and shared that DOE has to work on an objective. Oddone suggested making a proposal for laboratories to prove that it can accommodate the guidelines and avoid the reporting and overhead work. Siegrist shared that the laboratories have FTEs doing reporting and many were not previously doing this work.

Brinkman argued that SC is saving money due to the restrictions. Oddone commented that this is not actually saving money as researchers cannot participate and save funds with early registration. Brinkman responded that SC is trying to get meeting approvals way in advance.

Oddone noted that SC is operating on its own timescale and that invitations for giving a talk do not always arrive six months before a conference. He shared that the process is onerous and not meeting SC's objectives. The provision of an overall travel budget would permit the laboratories to effectively manage travel in the same way that they manage R&D and science budgets. Brinkman responded that SC needs to look at the whole picture and hopes that the Administration will be ahead of this and develop a Congressional mandate.

Siegrist asked Brinkman what the community could do to help head off any legislative actions. Brinkman asked the community to talk to the Hill.

An attendee pointed out that the travel and conference restrictions were amended and attached to a bill to reform the U.S. Post Office. The bill would have to go forward and be changed on the (House / Senate) floor.

Erbacher brought up comments that European support is needed for LBNE. She noted issues with the U.S.' credibility and uncertainty about staging LBNE above ground. Erbacher asked Brinkman about the CERN renewal and how this might go. Brinkman noted that the contract will be up in 2015. It will have to be renewed in some way but he does not know the right answer. It is expensive. Brinkman is interested in seeing the interest around the renewal.

Erbacher asked about setting a line item for the linear collider due to its importance and in keeping with the ITER project. Brinkman shared that he has only seen special line items occur once or twice, that the idea is unlikely, and the building itself would run as much as $400M.

McBride reiterated the need for a definitive answer about LBNE from the U.S. She sees the need to explore collaboration and a framework for international partnering. Brinkman agreed.

PRESENTATION ON DPF COMMITTEE ON DOE COMPARATIVE REVIEWS

Paul Grannis presented the American Physical Society's Division of Particle Fields (DPF) comparative review on Department of DOE HEP. Grannis was reporting on behalf of review Co-Chair Marj Corcoran.

HEP started doing comparative reviews for university grants awarded in 2011 – 2012. HEP noted that a significant number of prior recipients were unfunded or received less, and that new PIs were added.

The DPF gathered community input on the review process, met with HEP to get details on the process, and then prepared its report. It is available at http://dpfnewsletter.org.

There was no formal review committee and the committee reported to the DPF and not the DOE. The HEP's Alan Stone and Glen Crawford provided responses to a list of review questions developed by the committee. There were five panels for six areas consisting of the three frontiers along with theory, and detectors and accelerator R&D, respectively.

Proposals with more than one area were given separately to each panel. For all of 106 proposals in 2011, 12 were sent to more than one panel and many proposals had multiple PIs. Panels were asked to not develop a consensus on proposals and their relative merit.

The committee found that 70 percent of proposal requests were funded. Of 20 non-faculty senior scientists reviewed, 11 were not being funded. Several co-PIs were terminated, and attempts were made to bridge funding for students and postdocs of a terminated co-PI. The committee recommended that those previously receiving research funds be moved to project operations funds.

Gonzalez asked about committee coming to consensus. Crawford explained that these were FACA panels. By law, the committee cannot form a consensus and consensus recommendations. The panels discussed proposals and drew information from their discussions to learn about the HEP review process.

Grannis shared that community input was treated as confidential and taken into account. Most of the input was from people who had lost funding and included criticism that significant changes to the funding pattern had not been sufficiently communicated. Grannis described this as two-sided, as information was provided and may not have been observed. He also noted that those who did not know beforehand were unaware of the nature of the new approach.

Some committee members worried that proposals with multiple research areas were not appreciated in their totality. Grannis commented that a group is often more than the sum of its parts.

The committee was concerned about the relative expertise of the review panels and the HEP, and in the area of theory. It questioned whether the full range from phenomenology to theory was adequately represented.

The committee recommendations are listed below and the HEP agreed in spirit with these:

1. Changes should not be too precipitous and people need time to adjust to changes.
2. Any program emphases should be captured in a clear statement to the community.
3. If a PI is cut, then efforts should be made to ensure support for graduate students. This may require attention on a case-by-case basis.
4. HEP should get input from experiment managers and spokespersons to help adjust efforts and avoid a loss of effort. There was not a systematic effort on this in the last round but it would be useful to inform the review process.
5. Groups are more than the sum of their parts and individual PIs should be evaluated based on contributions to the totality.

6. A separate review by the frontier may not do justice to those working in more than one area or working on group infrastructure. Reviews should be tuned to allow the evaluation of such multiple responsibilities.
7. The process should include an appeals process.
8. Care should be taken when choosing mail reviewers and panelists to ensure that there is necessary expertise. This may be particularly important in the theory area.
9. To the extent possible within DOE regulations, some collective ranking and opinion making process is needed. Individual letters from panelists are valuable but managers could use opinions and rankings to make decisions. There are questions as to whether this advice is prohibited.
10. Reviewer recommendations and program officer actions should be internally documented and reviewed by a Committee of Visitors (COV) to monitor the comparative reviews process and the appropriateness of actions taken, with its full view of the process.

The committee identified broader issues and concerns:

1. Partitioning the program: Reviews follow the HEP organization and budget process, and the three frontier and subject areas. Boundaries between these can become too rigid, divide the field, and remove flexibility and mobility for researchers. Some of the best PIs work in more than one area.
2. Universities and laboratories: There can be tension between the two. The HEP technical infrastructure has mostly transferred to the laboratories, particularly in the area of detector development. Universities can train students and attract students to the field.
3. Research versus operations: Previously, people could contribute to both areas. Rigid boundaries between the two could create two classes of physicists: those who tend toward analysis to learn technical aspects, and those in operations who become partitioned from the analysis side. This is a trend that needs to be monitored.

Discussion

Crawford talked about the recommendations. The consensus issue brings up FACA rules. HEP's approach is the standard across the DOE. HEP felt it could get information without mini-FACA panels like those used by the NSF. HEP uses discussions of individual proposals and brings it together. This seems to work well and this is echoed by those in the process.

Crawford commented that recommendation one was ironic in that people complained about the system then complained when it changed. HEP tried to avoid abrupt changes and realizes that there are people involved. Crawford shared that there is no entitlement to a certain level of funding regardless of the length of a grant and level of funding. There will be some changes and there are limited resources. HEP cannot provide funding to groups that do not review well. HEP will try to be as clear as possible on program emphases. Meetings with the community help but HEP is open to input on other communication vehicles.

Crawford commented on recommendation three and that HEP does not want to strand students and postdocs. It makes every effort to help them complete theses and pursue research interests. Grannis shared that some stranded students were picked up by schools. The committee believed that these instances lead to universities' perception that HEP is not supporting students and energy physics. Crawford reiterated that the point is that there is no entitlement to funding.

Crawford remarked that recommendation four is about processes. HEP discusses programs and reviews with experiment managers without sharing details and HEP knows that this can impact experiments. Doing this in advance could violate review impartiality. HEP does want to consider this aspect once reviews are complete.

Regarding recommendation five, Crawford shared that HEP program managers try to reflect this aim and ask panelists to discuss the synergy of full proposals. HEP asks for comments and evaluates that. This aspect may be more strongly considered in the future. Sometimes HEP cannot see how two groups work together or it does not get these comments from reviewers. Alan Stone from DOE noted that there are case-by-case reviews of proposals where the sum is greater than the parts and that this does work.

On recommendation six, Crawford sees reviewing across areas as being both a disservice and useful. HEP considers this when it combines different panels' work and when this may impact support levels. Some PIs split their efforts and do very well but there are good and bad examples. At times, proposals from PIs working across areas are not appreciated by all reviewers. And often times, PIs simply have not written a good proposal and not explained what they are doing.

Crawford shared that there is no interest in setting up an appeals process, as suggested in recommendation seven. Proposals are discussed at length, reviewed multiple times by many reviewers, and there are many checks and balances. An option is to submit another proposal.

For recommendation eight, Crawford sees this as a constant challenge and difficult as HEP has a set number of reviewers. Stone shared that the last review covered all of the bases.

Regarding recommendation nine, Crawford remarked that this is simply how HEP does it.

Regarding recommendation ten, HEP will conduct a COV in Fall 2013.

Crawford noted that the recommendations were useful and raised many good questions. HEP has done its best to respond and is looking at improvements for next year. He appreciated working with physicists and their interest in raising questions that force a process review.

Crawford confirmed for Erbacher that the recommendations were received as the panels were starting this year. HEP had discussions by phone with the DPF over the summer and prior to the review. This prompted consideration of how to do the review this year.

Honscheid asked for clarification on changes made between year one and two. Crawford shared that all panels were the same this year whereas chairs ran their panels based on their preferences in year one and differing logistics were used. In 2012, things were more regular and HEP determined what worked and did not. Another change was doing comparisons between in-person and mail-in reviews. HEP also changed the weighting between review criteria and received feedback that drove weighting changes. HEP also requested a letter of intent (LOI) to help initiate the process earlier. It also got information out earlier to explain the process.

An LOI may not be required in 2013, Crawford shared. An LOI is typical where there are a significant number of proposals that really do not fit what people are looking for. Only a few in the past have been completely out of the scope.

Blucher asked about ranking, describing it as unpleasant but a means to get comparative information. Crawford shared that HEP does something similar but does not use explicit rankings. Panelists do individual rankings for top proposals and PIs. Discussions inform proposal quality and those that are the best. The panel shares its thoughts but does not explicitly vote.

Honscheid shared that most believe that a consensus ranking is the aim. Information about the (selection) is not really formalized. Grannis shared that the DPF recommendation is to give the panel enough information to make a decision but to not actually make a decision. NSF seeks a consensus but it is not binding.

Siegrist asked if committee members have a conflict with the (consensus-seeking component). Crawford shared that NSF uses public meetings and has a specific office with FTEs that do this full-time. NSF takes a lot of time and resources to put out reports that define rankings. This is useful for program managers. HEP can make decisions without going through a report phase. Dehmer shared that NSF finds the consensus ranking to be valuable and important. NSF follows panel guidance, and deals with programmatic and financial decisions. The funding selections are made by program managers. The process is detailed but serves NSF well.

Crawford shared that this year, panel chairs will write summaries that will go to the PIs.

Gonzalez is affected by DOE and NSF. He sees DOE as more mission-oriented, and NSF as affected by intellectual merit and impacts. DOE program managers need flexibility to implement programmatic priorities. This process allows for input that gets folded into other things, which is different but can be effective.

Akerib asked how site visits are handled. Crawford shared that a grant monitor may have recently visited a group. The monitor can judge the transition around a particular issue. Panelists can explain the details of a particular institution's program and inform the review.

Byrum asked if NSF has site visits. Dehmer shared that that is the program director's prerogative but also depends on the availability of travel funds.

Cohen asked if site visits are more problematic for the DOE and wondered about creative ways to connect amidst budget constraints. The PIs and program managers have found visits to be extremely helpful. Crawford shared that HEP tries to do this but cannot visit every institution. One idea is a PI meeting over three days to hear PI presentations, meet managers, and discuss programmatic priorities. This could be part of funding allotment travel budget.

Cvetic noted the recommendation about comparative reviews between laboratories and universities, and asked if DOE has plans for this, including the area of theory and comparing available research tools. Crawford shared that these reviews are done separately. The structures are different at the two types of organizations, the funding length is different (12 months for laboratories, nine months for universities), personnel at both have different costs, laboratory staff may be contractors and have a contract with DOE to do research, universities get grants and not contracts, and unless the solicitation calls for laboratories and universities then you cannot compare proposals from both. DOE welcomes input on how to conduct this more effectively.

An attendee asked about the cosmic frontier and site visits, sharing that most university proposals explain their activities removing the need for a visit. The panel could also get needed information if it had a consensus approach and viewed all comments and inputs. The cosmic frontier also overlaps with the astronomy community, which necessitated creating a model and articulating why and how the panel would fund certain things. An excellent proposal, in this case, may not fit the model and review well. Siegrist shared that HEP reports back to the Astrophysics and Astronomy Committee, and this committee reports to Congress. This occurs before explaining to astronomers why they may not receive funding for students. HEP explains how things do not fit in the DOE mission. HEP is tries to communicate how it operates outside of the particle physics community. These issues, especially in the cosmic frontier, need communication.

Ramond relayed that comparative review panelists were told that funding for theory submissions should fit a context and knew that funding levels for FY12 would be $12.2M. He noted angst among the theory community that university theorists may face a 40 percent cut next year with a significant increase for laboratory technical activities. Crawford responded that panelists who discuss the review process outside of the panel are in violation of the process and a

signed agreement. He also noted that the funding levels do not reflect current discussion and are being discussed by the HEP. Crawford offered to discuss the outcomes at the next HEPAP and the levels that have been set for specific things. He has asked program managers to ensure consistency across the programs and ensure sensible and justifiable decisions.

Crawford reminded the Panel that past discussions such as limits on salary that were imposed across the program have received approval from attorneys. A final budget decision has not been made. In 2012, HEP supported no more than $14,500 in salary per month for a grantee. This was implemented across the board and HEPAP was told about this. DOE is not dictating what universities can pay their staff. Universities and grantees must determine how to respond. This may be in effect next year but that is not year final.

Crawford confirmed for Cohen that the salary decision will be applied uniformly and is a cost-saving measure.

Cvetic shared the view that people who get financial compensation are senior leaders who make significant contributions to the field, and now are being punished by a unilateral decision to cut salary support. Crawford shared that funding decisions use input from panels and come from a bottom-up construction of budgets. The budget and appropriate funding levels are considered but historical funding levels are not. The intent is that if you review well then you will be well-funded. However, budget constraints have led to setting salary support limits to support more well-reviewed groups and individuals. Money not going to salaries is going to students and postdocs. That decision was made in the best interest of the program.

Siegrist commented that feedback on summer salaries was offered outside of other recommendations. The feedback was that universities received information at a time when it was too late to react. Crawford clarified that this was implemented across the program but that the HEP may adjust its guidance in specific circumstances.

Erbacher reiterated Honscheid's early question about panels coming to consensus, offering that it is not necessary if reviewers have all the information that they need. She shared that written summaries are useful for PIs. She commented that HEP's reasoning about limiting the use of mail-in reviews did not make sense and that having a reasonable number of reviews is important. Crawford clarified that mail-in reviews have not been eliminated although the review is mostly a panel process. Mail-in helps for areas and approaches that are not well-covered by a panel. Reviewers can access information repositories and one panelist is assigned to read the mail-in reviews and share a synopsis with the panel. All information is available to panelists and will not be eliminated. The process itself is a balancing act.

Shipsey noted the value of getting diverse PIs together and how this can also give HEP perspective on the weakest and strongest PIs' thoughts. He asked about the extent to which laboratory proposal reviews examine individual PIs and if it would be valuable for laboratories to strengthen their PIs. Crawford shared that HEP tried to do this with the laboratory reviews last summer. A complication is that Fermilab is larger than the other programs. Doing this for other laboratories is manageable. It was agreed that this can help the HEP program. HEP does not tell laboratory directors who their best people are and who should be promoted, making this a delicate matter. Directors must manage their staff and produce an effective scientific program. HEP hopes to add value by comparing researchers to their peers and showing where people are strong. Cvetic added that this is probably possible in the area of theory.

Cvetic commented that there is a more general concern about annual changes to the criteria. It is a three-year process and a proposal might be in a different position or proposers might have

fear due to changes. She hopes that uniformity and fairness can be set for a whole set of proposals over the cycle.

Cvetic commented on salary cuts, pointing out that all proposals are funded and subject to the same cut. She sees that this rewards the best people and that the quality of research should be proportional to the rewards. Crawford shared that the panel process seeks to be more uniform in 2013 to address these concerns. HEP is looking at other areas in which to establish uniformity and is reviewing 2012 to ensure that future outcomes are correct. He shared that HEP can probably do a better job of understanding priorities upfront. Proposers need to know that DOE is a mission agency and has to make programmatic decisions. He commented that the communication of priorities will be better and that HEP is working on this.

Audience comments

None

Lankford thanked the DPF for taking on this task and for their report, noting that there are continuing broader issues to be discussed.

PRESENTATION ON THE SEARCH COMMITTEE FOR THE FERMILAB DIRECTOR

Ezra Heitowit of the Fermi Research Alliance, LLC (FRA) gave details on the search for the new Director for the Fermilab and asked HEPAP members to participate in the search process. The 2012 - 2013 FRA Search Committee is chaired by Norm Augustine and Heitowit is the Executive Secretary. The scope of the search is similar to searches conducted in 1998 and 2004. Details on the process are available at www.fnal.gov/pub/directorsearch. The site includes contact information for the committee members, the charge for the committee, news and updates, and the opportunity to confidentially submit comments for committee consideration.

The charge asks that a director demonstrate visionary leadership, scientific achievement, strong credentials, working knowledge of the DOE mission and programs, and the skills needed to communicate directly and effectively with many constituencies, among other things.

Currently, the committee is welcoming input through January 2013. Advertisements are appearing in publications such as Science magazine. The search is being promoted at scientific meetings including the Snowmass meeting. Formal correspondence has been issued to scientific leaders, university presidents, and university vice presidents for research by Chair Augustine.

The committee will meet with the Fermilab community on December 12 and 13, 2012. A town hall session will take place on December 11 and will also be presented live through www.fnal.gov. Questions for the town hall meeting can be submitted in advance.

Committee membership includes representation from high energy and astrophysics, international representation, the FRA Board, Fermilab, *ex officio* representation.

Discussion

Heitowit indicated that there has been good feedback and input to the search.

Byrum asked about the point of a candidate demonstrating a "record of leadership…in a DOE national laboratory or other complex research setting." Stone explained that a spokesperson-at-large would be another example of a candidate that would fit this.

An audience member noted that the Snowmass meeting is in July 2013 and may be too late to be impactful. Heitowit responded that the search will focus on the Snowmass satellite meetings.

HEPAP DISCUSSION OF DOE ACTIVITIES

The HEPAP continued its discussion of the DPF review.

Crawford commented on the DPF Committee discussion of early-career awards. He shared that this is an SC-wide initiative and is dictated by SC management. It may conflict with funding levels from HEP awards.

Crawford shared that the current HEP management structure is not well-matched for consideration of umbrella grants. This limits PIs' flexibility to change research foci and interests. He believes that this is not a bad thing but HEP cannot allow PIs to change research as they want. This would be different from the DOE's fundamental approach of addressing its mission and HEP focus on being a well-integrated R&D program.

Byrum asked Crawford how funding is divided and moved into frontiers. He shared that HEP relies on community input on priorities and emphases. HEP works in the framework everyday but is can be modified with direction from OMB and Congress. The decision is iterative. Siegrist added that a balance between frontiers is a key issue prior to Snowmass. The community does not want P5 to come back with the direction but there is a sense that ideas would emerge from Snowmass and P5 would not start with a blank sheet. Siegrist expects continuity with past ideas and past budgets, but sees that the community view can dictate the emphases.

Procario confirmed with Siegrist that Snowmass is not charged with developing a budget. Siegrist agreed that Snowmass can be used as a reference point for funding direction. Siegrist wants a community sense of what is important and wants emergent topics and issues so that P5 has a starting point. Oddone commented that Snowmass must emphasize science and then priorities in order for a consensus and priorities to emerge. He sees opportunities for inputs but that may not identify the most important topics and allow for prioritization. Siegrist sees going back to the Higgs discovery and using that as a starting point. Hobbs pointed out that the conference rules for Snowmass may not permit the type of discussion that Siegrist wants.

The HEPAP continued its discussion of broader issues and concerns in the DPF review.

Cvetic commented that issue #3 comparing research with operations, asking about concrete plans for making a comparison. Crawford shared that HEP does not have a plan for this review. Last year, HEP had a laboratory review and will have another in two years. HEP will consider the value of a head-to-head comparison and discussion of university and laboratory roles. Crawford shared that DOE may consider whether there is a relationship or divergence.

Akerib commented that Snowmass is a chance to examine issue #3 to determine the balance of roles. Siegrist responded that faculty appointments are a related issue. Historically, many departments do not have many of those and this is a concern for NSF and DOE. Snowmass could be a place to discuss this, yet the university structure could be difficult to change.

Shipsey added that there are ways to connect laboratories and universities, one being instrumentation. CPAC is one example where they work together. This includes international partners. Akerib commented that if there is room for erosion, there are ways to make progress.

Crawford returned to the separation of research and operations, as both help fulfill the DOE mission. Operations have clear metrics and milestones that are similar to DOE fulfilling projects. University groups conduct operations and managers must meet milestones. Research program managers must have budgets to meet goals. It is hard to have an undifferentiated group working in both areas. HEP has to defend its investments to DOE, OMB and Congress and have clear budget lines for both areas. He realizes that programs and individuals share time in these areas.

Siegrist pointed out that stakeholders take issue with building new things. OMB and Congress are concerned about construction and potential runaway operations costs. HEP argues with the system to build things and also has to use different review mechanisms.

Siegrist shared that another issue is managing the program and not spending money managing operations. This important strategic issue has unfortunate consequences but the penalty is less than the benefits that HEP receives. Some things relevant to LSC and collaboration have arisen and HEP has no control on who researchers plan on authors' list for papers. He commented, however, that some LSC experiments have mixed these up and caused consternation.

Crawford responded to Siegrist sharing that mixed authorship has made life complicated. He shared that the bottom line is that HEP pays common fund costs for scientific authors who show-up on papers. With computing costs, HEP pays $50,000 or more per person. This is significant at CERN but is the mechanism that is used. HEP's position is that it funds those who it supports on research programs and who are working in a research program. HEP does not want to pay a "head tax" on someone who comes in as an author and is not supporting the research program. Lankford asked if this includes computing pledges and is not based on WLCGS. Gonzalez confirmed that they are, and Lankford suggested that this be discussed at CERN.

Siegrist added that this creates two classes of experimentalists. That may serve the community but not the DOE, and DOE needs the community to define things. Lankford agreed that this is not just a U.S. position but is also true in Europe. The community needs to define what experimentalists do.

Lankford had the impression that the U.S. policy per head taxes is different for member states. Oddone commented that the operations people should be leading what they are doing as they are tasked to do certain things that drift over to research. Operations people should write a proposal and participate in that way. Operations staff want to do things cheaply to allow optimal funding for research but a permeable membrane between the two is needed to permit flexibility. Grannis commented that a traditional physicist view is to build the instrument, use it, and obtain science from it. This is part of the DOE mission and anything done to compartmentalize this is not in DOE's control. He commented that it is bad to promote this separation.

Lankford asked for comments on other broad issues and heard none.

Lankford invited comments on scientific investments, their status, and plans.

Lankford reflected on Bernardi's presentation on Tevatron. He noted the sharing of plans and analyses for the next few years that would wrap-up the program for the next few years. He asked if there is merit to close-out the effort and if the effort sounds well-matched. Byrum commented it did a good job of accessing the number of FTEs over the near-term and putting an effort into having a lasting legacy and combination of things that work well. The effort is publishing at a high level and deserves congratulations. Lankford agreed.

Stone would like to see a distribution of the FTEs. Bernardi shared that this is evolving. The U.S. is one country that has stopped its contributions. Other countries have continued to support this evolution.

Lankford brought up the LHCb as an important current piece of LHC. This does not have the same degree of U.S. community investment as Tevatron.

Gilchriese asked DOE if it will see increased involvement in LHCb, and Gonzalez added that interest rests in being able to respond to proposals. Crawford shared that HEP is evaluating a proposal and that there are programmatic considerations. HEP is considering a new role where there are no PIs or laboratory involvement.

Gonzalez commented that the data on LHCb was impressive and urged extending this unique effort as much as a decade. Honschied added that leadership in this was field was a question in past decades but appreciates current support for this area. NSF shared that it has been supportive and that a single group is now two groups. The consideration of any proposals cannot be discussed but there is substantial LHC involvement and there may be a slope there. However, budgets are limited and everything is under review.

Lankford commented on Tao's talk on Higgs boson and the underscoring of this particle as a stimulus for new discoveries in physics. Tao emphasized the new physics theme outside of LHCb, thinking about precision instruments, and coupling of direct and indirect. Lankford asked if this could motivate research in all three frontiers and is this message should be promoted.

Ramond commented that the discovery is important as little is known about the Higgs sector. This signals the start of understanding the super-symmetric sector. Low mass Higgs is perturbative as theorists see it and think they can say more. Higgs resuscitated discussion of flavor physics and old ideas, as it conveys that there is strong coupling. Research can determine if this new particle is zero plus which breaks a pattern. This is a different species.

Cvetic agreed with Ramond but offered that one should express concern about how the standard model works now. In addressing ultraviolet completion and other theories, the whole theory becomes an issue. New discoveries of other particles would be tremendous. Starting with the Higgs particle is safe but becomes difficult for theory and experiments.

Lankford asked what should be found that SLAC did not find. Cvetic wanted to know more about how to handle quantum theory. That would boost general and formal theory communities.

Ramond commented that understanding matter and neutrino mass are important issues. There may be some relationship and precision instrumentation in the intensity frontier can identify the effects. He suggested that the credibility for discussing this has changed. Siegrist responded that there are two points of view. In the field, there are serious attempts at propaganda to return to the quantum universe. He hears that this is a portal but does not see anything. Siegrist is unsure if the discovery has been publicly communicated. Cvetic commented that the importance of this discovery should not be undermined, and Ramond commented that there is more symmetry as we look back into the history of the universe. Higgs gives a more credible picture and enables understanding couplings, instability bounds, and ideas developed long ago. There are questions about flavor, and there has been misunderstanding about the three families. Ramond urged that going back to earlier times in the universe will give more understanding.

Lankford asked if any experimentalists had comments. Yamamoto shared that the Higgs discovery impacts experimentalists but that it is basically a theoretical question. Its mass is unstable and the discovery could solve some theoretical problems that experimentation has been

trying to solve. Ramond responded that a collider is not capable of showing how many weakly interacting objects are there, hence Higgs brings new possibilities. It is also the most unprincipled part of the theoretical scheme. He hopes that Snowmass will examine this in detail.

Lankford shared that Tao showed something quantitative, and did not see much in the literature to show what this might mean for theoretical models. Lankford asked if this is a productive topic for Snowmass. Ramond responded that the conveners and others are looking at this and finding possibilities.

Ramond asked what the experimentalists can do now that the collider people have a target. He believes that a few years from now, things will operate at close to design energy. As far as experimentation, this has to be looked at carefully as the mass of the object is known.

Hobbs added that Tao's message shared the effort needed to measure the Higgs, and that a program is needed to nail down what is happening. It is more than measurement and experimentation is still needed for understanding. Ramond said that the purpose of a neuron is still undefined. This is a long discovery process but the picture needs to be complete.

Lankford asked for comment on the European strategy and heard none.

Lankford asked for comment on the CSS2013, if the purpose of Snowmass was clear, and how to convey that to conveners and participants. Fleming sees how Snowmass can support the P5 meeting. This defines Snowmass' purpose. McBride suggested announcing the P5 schedule and its start date to enable focus at Snowmass and the collection of thoughts.

Fleming shared that Brinkman's presentation described difficulty in selling the intensity frontier and the next big machine, and the evolution of other frontiers. She is concerned about overuse of different frontiers and confusion around semantics.

Rameika reflected that Brinkman asked for community consensus on the direction for LBNE, but is unsure how this will happen with a split-up Snowmass process. LBNE is a big near-term decision with big impacts in the next decade. Clarity over the next few months is a concern, as is what Snowmass will look like during this decade. She asked how the community will decide, buy-in, and avoid grumbling over decisions to proceed or not. Crawford urged that HEPAP is the official government advisory committee and can weigh-in on this and provide a statement as community representatives. Rameika reiterated that the success of LBNE depends on European buy-in, especially if Europe builds its own facility. The dialogue needs to stretch beyond the European planning process and occur at a higher level between laboratories and officials.

Akerib cautioned that LBNE efforts will fail if the message is unclear. If discussion leads to unclear and fuzzy answers, then that itself is a decision. Siegrist responded that LBNE is a direction that P5 endorsed long ago and that Snowmass could give strong endorsement. New starts in the next decade will need endorsement from Snowmass and the next P5.

Lankford commented that Snowmass could be for programs beyond LBNE. Incorporating an LBNE reassessment to Snowmass as a prelude to P5 could lead to a long discussion and the potential for a new conclusion.

Lankford heard from Brinkman that there is confusion about community support for LBNE due to widespread dissenting voices. He asked if LBNE needs to be taken into the process or if the DOE is struggling with confusion about the message from the community-at-large.

Cohen sees that the cause of dissension is that the experiment is not underground and not as large as all thought it would be. The argument is that not everyone supports it and that more want

the experiment to be underground. Cohen believes that the combination of phasing and current discussions is creating uncertainty even among those who are excited about physics.

Siegrist offered that the practical issue is how Snowmass should consider LBNE, especially as DOE is slowly and deliberately ramping down research, and there is simultaneous construction on all frontiers. LBNE would require foreign collaborators. He sees that DOE can move this underground with U.S. funding, but that there is maximum flexibility.

Ramond reflected that Snowmass would not define LBNE and scientific goals but rather articulate how internal collaborators can support it.

Hobbs added that there is confusion about the purpose and European role, and that these questions can be answered simultaneously through more international engagement. He asked if an international case can be made to show the value-added science that an international partner would support or the diminished potential returns due to a lack of support.

Shipsey added that the U.S. neutrino physicists at Snowmass need to discuss how scientists, the agency, and community should be engaged. Roles and messages get confused. Siegrist commented that a letter from HEPAP could help in this regard.

Fleming sees that Snowmass can discuss things in conjunction with LBNE. Discussions of LBNE will be unavoidable. If (the DOE/community) want Snowmass to discuss and not question LBNE, then that needs to be addressed. Siegrist responded that the current program needs to be defended and cannot be left for the next decade. Higgs pushes reconsideration of LBNE and the ongoing program needs to be examined. He urged that it is not that LBNE cannot be discussed but that the discussion needs to focus on the next decade.

Fleming added that the Snowmass process needs to be constructive and not gun-pointing.

Byrum sees that getting frontiers to the LBNE message and supportive of the overall program is a problem. Lankford responded that an important point is developing mechanisms to do that. He commented that there are mixed perceptions about LBNE stage one, particularly around international collaboration and when stage two will occur. Another challenge is a focus on the intensity frontier and LBNE. He sees a challenge with skeptics making a case by inserting words (into the message), as well as issues with properly articulating the program purpose and its propagation. Lankford believes that Snowmass can enable discussions on what needs to be measured and how well, in a non-combative and vital way.

Lankford asked about a letter from HEPAP about Snowmass if the Panel would agree to it. There was no discussion.

Lankford asked the Panel about available tools and modes for message delivery. There was no discussion.

McBride suggested that people are confused about there being another decision about LBNE and that (the community) needs to be careful about what it is deciding. Some might sense that a framework is being articulated. She sees that Congress and the European community perceive that there is no clear plan. Snowmass is a time to think about LBNE and what it could achieve.

Byrum commented that the program is broad and cross-frontier, but that there is always one project. (At present,) LBNE is that project.

Harry Weerts is organizing the intensity frontier convening. He has taken from the Higgs discovery that all components need to be measured. LBNE is always coming up and should be considered among strategies for the next decade. He believes that defining a goal for LBNE

would further international collaboration. The question of a timeline for LBNE is challenging. He sees that it would be difficult for Snowmass to evaluate LBNE as there are many questions. Guidance from HEPAP for the intensity frontier would help.

Siegrist is concerned that not stating what LBNE will be like and if it will be underground will cause the European community to go away. He believes that HEPAP needs to comment on this before this opportunity has passed. Procario added that a strong endorsement from HEPAP is vital for the CD1 meeting next week in Europe. He believes that the price for LBNE is $137M from which Europe would get a big return.

Lankford reflected on systematic presentations heard at the HEPAP meeting in July 2012. He has heard that DOE wants to proceed with LBNE but senses that the message is mixed due to the nature of the community. He offered to draft a message for HEPAP to review that supports stage one as it was described as the first stage for neutrino work in the intensity frontier, and with the potential for international collaboration. Fleming suggested adding the comment that a second stage goal could be reached earlier due to funding flexibility and with international collaboration.

Rosenberg commented that he would not sign-on to a statement that would signal HEPAP support for one project out of many other investments and convey the others as lower priorities. Lankford did not see how this prioritizes LBNE, and Fleming commented that there are not many other large programs.

Rosenberg asked if a future Higgs collider would not be considered if HEPAP identified LBNE as a "top priority." Lankford wondered if LBNE should go forward without a complete reprioritization of the field.

Rosenberg believes that the science behind LBNE is good but is unwilling to sign-off on funding this as a priority amidst budget constraints and funding scarcity.

Rameika responded that this does not seem to be an issue of priority but resolving problems with LBNE. It does not need to be reevaluated but needs confirmation on moving forward. Choosing to move forward with phase one and the available dollars means moving on to phase two. Fermilab has developed plans for each phase and how to deal with challenges and projects following phase two. Rameika pointed out that it would be the 2030s before doing the real science that is desired. She asked if this is how the path that dictates the next two decades in neutrino physics should be set, pointing out that, even after completing the project, it could be another ten years of data-taking before even reaching three σ or four σ. She pointed out that there are risks. Lankford asked if this is the right way to move forward.

Blucher believes that the P5 plan is not controversial, and that all support DOE and attracting European investment. He asked about restating the goals of P5 support and getting European contributions to build a world-class facility. Ramond shared that he would approve this as it reaffirms P5 recommendations and does not set priorities. He pointed out that Higgs has given certainty about what to do, and that the Panel is responsible for advising the government on direction. Ramond shared that the groundwork has been done and the physics case is clear.

Akerib asked Rosenberg which aspect of support he is concerned about. Rosenberg shared surprise about HEPAP naively failing to recognize that its support would define LBNE as a priority. He offered that reaffirming the P5 is an option.

Fleming suggested that HEPAP state that is it endorsing the P5 and LBNE, and DOE's ability to move funding around. She believes that helping DOE achieve its goals earlier is great.

Rameika clarified that it would be reaffirming P5, and recommending a world-class experiment and multi-megawatt source. She urged taking the description of phase one and striving for international collaboration.

Hobbs commented that a phased program can take a long time, and urged that if the community believes that this direction is important, then it needs to be committed to staying on this path for decades. He sees reaffirming the P5 as important.

Ramond added that Brinkman stated that the P5 is fine. He wondered about other ways to reaffirm the P5 without saying that NSF has pulled out of DUSL and saying that this is what is being pushed.

Lankford asked for clarification on the message, hearing from the HEPAP that a message should support P5, encourage European collaboration, and recognize the DUSL aspect.

Ramond asked why HEPAP should be recognizing this, noting that the P5 report is two years old. He wondered if the facts and context around international collaboration have changed. Lankford clarified that this is not about supporting international collaboration but rather supporting the agencies that are seeking collaboration. Rameika commented that the community needs to know that international collaboration is a better approach, and that a multi-decade program needs commitment.

Fleming commented on the importance of the language in the HEPAP meeting minutes, and if this is the right time to incorporate something into the minutes when considering that the next HEPAP meeting is in March 2013.

Lankford commented that in January 2013, the international collaborators will provide a statement about their neutrino program. He shared that there is skepticism and questions about reliability and Seigrist will speak in Europe next week. He offered that Europe may look to embrace U.S. leadership when they consider their goals and funding constraints. Lankford found agency and community waivering on LBNE to be eye-opening. He believes that there is a timely opportunity to set an international direction.

Lankford asked Siegrist about doing something before March 2013 and what he needs before meeting in Europe next week. Siegrist needs to know if HEPAP sees LBNE as a high priority and its feelings on welcoming European collaboration on all aspects of the intensity frontier.

Lankford shared concern about Siegrist's use of the word "priority" and if language should reflect reaffirmation of the P5 roadmap. Siegrist responded that Europe is concerned about NSF's pull-out but that DOE kept it going. It needs to be conveyed that the pathway will be kept going and that there is a 10-year view to set facilities for science.

Hobbs noted that HEPAP is to advise the DOE and that he strongly encourages the DOE to realize the full scope of the LBNE project as outlined in the P5 report. Glenzinski added that this includes garnering international support.

Lankford talked about writing possible language, and Fleming suggested writing something now for HEPAP to revisit in March 2013.

Rosenberg commented that previous meetings on this at the Fermilab were contentious and cautioned that shoving this at the Fermilab people would generate a possible outcome. Lankford responded that this does not diminish the fact that there are other good projects to be supported.

Erbacher shared that comments from the Fermilab town hall meeting included skepticism about opportunities for domestic programs. There are opportunities for LBAC but there was thinking that LBNE could be the centerpiece of the energy frontier program.

Fleming also noted concerns from the town hall. There is concern that without successfully increasing support, there are programs that will get pushed off. Different philosophies lead to tensions over pursuing LBNE at the risk of programs that are on the bubble.

Lankford will capture Panel remarks and synthesize a simple statement that will reflect familiar wording and not strive to have other meaning. He will circulate it to the Panel so that

Siegrist has this available before the meeting in Europe. If the timeframe cannot be met, he will consider a different timeframe. He asked the Panel to consider the message first, and then think about word choice.

BOARD BUSINESS

The next HEPAP meeting is in March 2013 and Lankford will poll the Panel on specifics. For reviewers, that will be the last meeting.

CLOSING REMARKS AND ADJOURNMENT

Lankford adjourned the meeting at 2:15 p.m. EST.

The minutes of the High Energy Physics Advisory Panel meeting held at the Double Tree Hotel, Bethesda, MD, on December 5 - 6, 2012, are certified to be an accurate representation of what occurred.

Signed by Andrew Lankford, Chair of the High Energy Physics Advisory Panel on (date).

(Insert electronic signature)