

**HIGH ENERGY PHYSICS ADVISORY PANEL
to the
U.S. DEPARTMENT OF ENERGY and NATIONAL SCIENCE FOUNDATION**

PUBLIC MEETING MINUTES

**Gaithersburg Marriott, Washingtonian Center
9751 Washingtonian Boulevard, Gaithersburg, MD 20878**

March 11 - 12, 2013

HIGH ENERGY PHYSICS ADVISORY PANEL SUMMARY OF MEETING

The U.S. Department of Energy (DOE) and National Science Foundation (NSF) High Energy Physics Advisory Panel (HEPAP) was convened at 9:02 a.m. EST on Monday, March 11, 2013, at the Gaithersburg Marriott, Gaithersburg, MD, by Panel Chair Andrew Lankford.

Panel members present:

Andrew Lankford, Chair	Peter Fisher	Paul Steinhardt
Karen Byrum	Murdoch Gilchriese	Hitoshi Yamamoto
Mirjam Cvetič	Klaus Honscheid	
Robin Erbacher	Patricia McBride	

HEPAP members joining by conference call:

Ursula Bassler	John Hobbs	Leslie Rosenberg
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HEPAP members absent:

HEPAP Designated Federal Officer:

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

Others present for all or part of the meeting:

Steve Binkley, DOE
 Gerald Blazey, White House Office of Science and Technology Policy (OSTP), Physical Sciences, Assistant Director
 Greg Bock, Fermi National Accelerator Laboratory, Associate Laboratory Director for Particle Physics
 John Boehnlein, DOE, SC, HEP, Energy Frontier, Physics Research
 Laura Biven, DOE SC Senior Science and Technology Advisor
 John Boger, DOE, SC, HEP, General Accelerator R&D
 William Brinkman, DOE, SC, Director of Science
 Denise Caldwell, National Science Foundation (NSF) Division of Physics (PHY), Acting Division Director
 Marta Cehelsky, Fermi Research Alliance, LLC
 Lali Chatterjee, DOE, SC, HEP, Computational High Energy Physics
 Casey Clark, DOE
 Jim Cochson, Iowa State University
 Jean Cottam, NSF, PHY, Particle Astrophysics, Program Director
 Sally Dawson, Brookhaven National Laboratory (BNL)
 Santiago Dernal, University of Maryland
 Robert Diebold, Diebold Consulting
 Keith Dienes, NSF, Program Director
 Rick Gaitskell, Brown University
 Saul Gonzalez, NSF, Division of Physics, Experimental Elementary Particle Physics
 Howard Gordon, BNL

Josh Frieman, Fermi National Accelerator Laboratory (Fermilab)
 Donna Gilbert, DOE
 Bryan Gynder, Los Alamos National Laboratory
 Mike Harrison, BNL
 Stuart Henderson, Fermilab
 Norbert Holtkamp, Stanford Linear Accelerator Center (SLAC), Associate Director
 Farnaz Khaden, SLAC
 Peter Kim, DOE, SC, HEP, Detector R&D
 John Kogut, DOE, SC, HEP, Facilities Operations
 Richard Kouzes, Pacific Northwest National Laboratory
 Dennis Kover
 Ted Lavine, DOE SC
 Dan Lehman, DOE
 Kevin Leski, Lawrence Berkeley National Laboratory (LBNL)
 Laurence Littenberg, BNL
 David MacFarlane, SLAC, Director of Particle Physics and Astrophysics
 Ken Marken, DOE, SC, HEP, General Accelerator R&D
 Elaine McCluskey, Fermilab
 Carole McGuire, FRA
 Ethan Merrill, DOE, SC
 Tetsuya Nakada, EPFL-LPHE
 Donna Nevels, Oak Ridge Institute for Science Education
 Scot Olivier, Lawrence Livermore National Laboratory
 Ken Olsen, Superconducting Particle Accelerator Forum of the Americas
 Pier Oddone, Fermilab
 Ritchie Patterson, Cornell University, Director of CLASSE, Professor of Physics
 Abid Patwa, DOE, SC, HEP, Energy Frontier, Physics Research
 Sherry Pepper, DOE, SC, HEP
 Eric Prebys, Fermilab
 Ron Ray, Fermilab
 Simona Rolli, DOE, SC, HEP, Theoretical Physics
 Jonathan Rosner, University of Chicago, Physics Department, Professor
 Randy Ruchti, NSF, PHY, Experimental Elementary Particle Physics, Program Director
 Michael Salamon, DOE, SC, HEP, Cosmic Frontier
 James Siegrist, DOE, SC, HEP, Associate Director
 Anthony Spadafora, LBNL, Physics Division, Deputy
 Bruce Straus, DOE, SC, HEP, APUL, Instrumentation and Major Systems
 David Sutter, University of Maryland
 V.L. Teplitz, National Aeronautics and Space Administration
 Bob Tschirhart, Fermilab
 Kathleen Turner, DOE, SC, HEP, Cosmic Frontier
 Michael Tutts, Columbia University, Experimental High-Energy Physics, Professor
 Harry Weerts, Argonne National Laboratory (ANL), High-Energy Physics Division, Director
 Herman White, Fermilab
 Bob Wilson, Colorado State University
 Mark Wise, CalTech

Ray Won, DOE, SC
 John Yates, DOE, SC
 Rik Yoshida, ANL
 Kathleen Yurkewicz, Fermilab, Communication Director

Many others joined by conference call throughout the meeting.

MARCH 11, 2013

OPENING REMARKS

The U.S. Department of Energy (DOE) and National Science Foundation (NSF) High Energy Physics Advisory Panel (HEPAP) was convened at 9:02 a.m. EST on Monday, March 11, 2013, at the Gaithersburg Marriott, Gaithersburg, 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.

Glen Crawford, DOE, Office of Science (SC), Office of High Energy Physics (HEP), Research Technology, Detector R&D, Director, reminded HEPAP members who are affiliated with the Fermi Laboratory to recuse themselves from discussion as it relates to facilities.

PRESENTATION OF EUROPEAN STRATEGY

Tetsuya Nakada provided details on the European strategy for particle physics. More information is available at <https://europeanstrategygroup.web.cern.ch/europeanstrategygroup>.

A draft strategy is being developed by the European Strategy Group and its supporting Preparatory Group. Work started in 2011. Chairs for both groups were elected by the Council.

Community input has informed the proposal. The Strategy Group held an open symposium in September 2011. A scientific briefing book was produced in December based on content from the symposium and written submissions. Since January, the Strategy Group has been drafting the proposal. Later in March, the CERN Council will discuss it and adopt the strategy by May.

The strategy notes that the Large Hadron Collider (LHC) is operating with good performance but not yet at desired energy levels; recognizes the realistic path for the high luminosity upgrade; notes that HERA, PEP-II, KEKB, and Tevatron have stopped operation; and points out that several neutrino experiments are now running or close to operational. These are things that have changed since the prior strategy.

The strategy is also being updated due to new issues. These include the discovery of a new particle at 125 GeV. So far, it looks like the Standard Model (SM) Higgs Boson. There are many direct limits on possible new particles and the parameter space of "simple" supersymmetry (SUSY). There is no clear sign of physics beyond the SM in precision physics. And, in the neutrino sector, $\sin^2\theta_{13}\neq 0$ with more than 5σ and ≈ 0.1 . This forms the preamble for the strategy.

LHC's success proved the effectiveness of the European strategy model. This model should be kept. In addition, the scale of particle physics facilities has led to globalization of the field.

Funds are limited hence not all large-scale activities can be done in Europe and done simultaneously. The community has to assess the current economic situation, the exploitation of current large investments in Europe, and the global landscape. The strategy balances these with a variety of ideas.

The strategy proposes four high-priority large-scale scientific activities.

High Energy Physics Advisory Panel – March 11 - 12, 2013 - Meeting Minutes

One is to exploit the potential of the LHC, including a high-luminosity upgrade of the machine and detectors to collect 10 times more data by around 2030.

A second is to pursue the next post-LHC machine. The decision must be guided by physics results from the LHC running at 14 TeV. A decision cannot be made now, but should be ready when results are available. It also rests upon when a new machine is needed.

The next strategy is for an electron-positron collider, complementary to the LHC, to study properties of the Higgs boson and other particles with precision and with an energy that can be upgraded. Japan is proposing to host the ILC and the European community would be interested if this were available. The ILC is an opportunity for the community and could advance particle physics, but concrete participation requires a proposal from Japan.

The neutrino program is a high priority. The strategy sees a long-baseline neutrino program to export CP violation and the mass hierarchy. Europe has a strong case for developing a detector suite for long-baseline neutrinos and large-scale experiments. The strategy is positioned to take advantage of this opportunity and Europe is positioned to do so. CERN can develop a strategy to pave the way for a neutrino program to be explored by Europe, but could also explore major participation in leading a project in the U.S. and Japan.

Smaller scale priorities include European support for theory with opportunities in the U.S. and Japan. Theory is essential. Comments at the symposium noted that theory requires resources and coordination. Progress can come from unexpected directions and a diverse field. It proposes supporting quark flavor physics, dipole moments, searching for charged-lepton flavor violation, and precision measurements at lower energies.

Particle physics experiments that need high-luminosity LHC rely on innovative instruments, infrastructure, and large-scale data-intensive computing. This is reminiscent of the importance of computing as crucial for analyzing data and for infrastructure.

Non-accelerator experiments present a unique situation in Europe. CERN should seek closer collaboration with the Astroparticle Physics European Coordination (ApPEC) on detector R&D to maintain community capabilities. This research should be part of non-accelerator particle physics experiments under astroparticle physics.

CERN should continue to work with Nuclear Physics European Collaboration Committee (NuPECC) to keep its ability to lead unique experiments.

Along with proposing scientific aims, the strategy looks at organizational issues. CERN should form a framework for a global particle physics accelerator project in Europe, and be the leading European partner in a global particle physics accelerator project elsewhere. CERN's member states conducting particle physics accelerator projects should coordinate these with CERN. Europe is ready to join-particle physics work in other places.

CERN is not a part of the European Commission but can play a bigger role in research and the relationship with the EU. This includes being open to funding opportunities, and participating in Horizons 2020 and Structural Funds.

The strategy looks at the wider impact of particle physics. There is a social responsibility to continue outreach in Europe and with the international outreach group International Particle Physics Outreach Group (IPPOG) and communication group European Particle Physics Communication Network (EPPCN). This should facilitate a network of international organizations to help coordinate and drive coordination in different countries. Another social responsibility is building on the role of networking and coordinating knowledge transfer by member states and other states. The organization can play an important and more advanced role

in nurturing younger engineers. It can help stimulate contributions to the particle physics field, and should be driven by collaboration with industry and others.

This was the first European strategy update. It will be updated about every five years, as needed. The gathering of community input is a good model and should be kept. At the same time, work with the European Commission and communication can be strengthened. Some approaches have worked, but there are needed improvements. This is an opportunity to review those structures.

Roundtable discussion

Erbacher wondered what CERN will host versus join, and if the question of hosting will be informed by a write-up the 14 TeV collision. It does not seem as though those conclusions can come out in May.

Erbacher noted two statements about Europe's creation of programs and global participation. She asked if there will be a decision for CERN to join in global programs already planned.

Nakada shared that the European Commission needs to exploit its resources and know what it can do in the next 20 years. The strategy recommends a facilities upgrade. Any machine that is a large-scale high-energy physics frontier machine cannot yet be considered. Europe will have to wait for 14 TeV data and this could be part of the next update. No decision can be made now.

Nakada noted that no one has said that CERN should be the long baseline facility. It can participate in experiments but the strategy does not say that CERN should build the facilities. If Europe does want to participate elsewhere, it should learn where the facilities will be built. The strategy encourages participation in the U.S., Japan or other places.

Lankford noted that Europe and the U.S. need to do their own respective planning, but asked if there is a path for coordinated global planning or regional planning in a global context. Nakada shared that this was discussed but there was nothing definite. He thinks that the strategy requires one body to connect community input. It can give a global view with some authority that leads to strategies. This does not exist on an international scale. He does not know if the European Committee for Future Accelerators is the right body. It could be the starting point.

PRESENTATION OF THE HL-LHC ACCELERATOR UPGRADES

Eric Prebys of Fermilab gave an update on upgrades to the High-Luminosity Large Hadron Collider (HL-LHC). There has been a rich physics program moving upward in integrated luminosity for more than 50 years. The context for this is the upgrade path of the LHC. In recent years, there have been serious upgrade plans in Europe. Things have been delayed somewhat to get better luminosity for the Higgs signal. The LS (Long Shutdown)1, LS2 and LS3 dismantling are scheduled for 2013-2014, 2017, and around 2022, respectively. In LS2, the LINAC 4 will give bigger luminosity. LS3 calls for various things over the years that will have a smaller focal range and to reach $5 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ leveled luminosity based on pilot work.

The LHC Accelerator Research Program (LARP) started with inputs in 2003 and initial work by Fermilab, Brookhaven National Laboratory (BNL), Lawrence Berkeley National Laboratory (LBNL), and universities. LARP contributed to the initial LHC operation, but work is really focused on future upgrades.

LARP is an R&D organization and has had made significant scientific contributions. It supports two types of personnel at CERN. One is a two-week fellowship, and the other is a long-term visitor program supporting more senior personnel. The former investment funded fellows' travel and living expenses. LARP-funded people have made great contributions to CERN.

There are two components to the upgrade. One is to make the focal point smaller by reducing the beta function of the lattice. This requires powerful lenses beyond NbTi. In addition, beams must cross. This effect draws on the Piwinski Angle. For existing optics, luminosity depends very little on crossing. If something is not done about the crossing angle, then there is no benefit.

LARP has been the primary organization to do something about crossing. The program is driven in the U.S. and CERN relies on it. Research in Europe uses materials from LARP.

Changes over the last few months have been big. Recently, CERN formalized a planning upgrade and LARP is part of it. In June 2012, CERN chose a 150mm aperture for final focus quads. LARP will gather all of the U.S. contributions to the luminosity upgrade of the LHC but will do so with flat-flat funding through FY16. Some amount of General Accelerator Development funds will be invested in support of this program.

Four candidate projects were considered and were fairly traditional. There are also some new things coming from bilateral discussions between laboratories and CERN. Fermilab and CERN are the first project and will work on 11 T Nb₃Sn dipoles. The second is between BNL and CERN and will focus on large aperture NbTi D2 separator magnets. The direct mandate from DOE is that anything that goes into LHC upgrade must come under LARP.

A committee was formed of representatives from LARP, laboratories, DOE and CERN. It reached a consensus to focus on Nb₃Sn quads and recognized that only about half of the masses could be built with the current budget. Backup options are 11 T dipoles and hollow electron beams for halo removal.

Prebys described LARP magnet development. This started in the 1960s and when it was clear that bores would get larger than 90 mm. Now this has moved to higher yokes and bleeds to support high demonstration magnets. When LARP started, it was believed that 90 mm was the largest size possible but it is now working at 150 mm. CERN tests work well with LARP tests.

The proposed magnet contribution was to work closely with CERN to develop a 150 mm prototype. Prebys anticipates that CERN will build a large cold mass, and then build a total of 20 half-length cold masses, including two pre-series units, 16 production units, and two spares.

Prebys described crab cavity development and the ability of a laterally deflected cavity that bends the beam. Luminosity has no compensation and crab cavities get one up to no crossing at all. There were two dozen designs considered. LARP is now down to about three. Prototypes will be built, and will leverage U.S. technology built by NioWave in the U.S.

The proposed project for crab cavities came from within LARP. It will continue to do R&D and do a down-select to test one design to see what effects the crab cavity will have on beams that are not predicted. CERN will provide power couplers and all required infrastructure.

Another project is a high bandwidth feedback system that will leverage LARP experience with the LHC Low-Lever Radio Frequency (LLRF) system.

The budget is divided into R&D. Funding will ramp-up from around \$15M in FY13 to a peak of more than \$50M in FY18. This is mostly due to the cost of the magnet.

Total project costs are around \$236M. Sources are LARP funding, project funding, and general accelerator project funding. Prebys briefed the DOE a few weeks ago, and they were supportive. He is working to determine how much general funding and project funds will be used, and believes that project funds can be released before FY17. There is an internal review scheduled to scrub the budgets for projects.

LARP is fighting to keep some R&D component, and energy deposition studies are an example. LARP also does general beam physics, and has successful personnel programs.

Prebys shared a visual on Hollow Electron Beam R&D. The premise behind this is to drive the beam to become unstable and drive the halo to polimeters. This shows that when the beams are turned on, the intensity drops rapidly but the luminosity does not. This was successfully tested in the Tevatron.

Roundtable discussion

Erbacher asked about the success of keeping personnel such as Fellows in the U.S. Prebys shared the record for this is not great. Helene Fileche is one who has stayed, but Prebys noted that having jobs in the U.S. would be helpful. People go to where the jobs are.

PRESENTATION ON PLANS TO HOST THE ILC IN JAPAN

Hitoshi Yamamoto shared an update on planning for hosting the ILC in Japan and the political situation. There are two candidate sites and there will be an evaluation of non-political issues by July 2013. One site will be chosen by the end of this year and inter-governmental negotiations will follow. Around 2015, input from the LHC at 14 TeV will form a solid case for the ILC to proceed. Construction will begin around 2015 and will last about nine years.

On an academic side, the KEK (High Energy Accelerator Research Organization) roadmap was started around 2007. The ILC was endorsed by the Japan Association of High Energy Physicists (JAHEP). It was updated in 2013 by the KEK and pushed for starting an international preparatory organization to engage in detail designs and construction.

JAHEP issued a report on large projects in 2012. For the ILC, it stated, "Should a new particle such as a Higgs boson with a mass below approximately 1~TeV be confirmed at LHC, Japan should take the leadership role in an early realization of an e^+e^- linear collider. In particular, if the particle is light, experiments at low collision energy should be started at the earliest possible time." JAHEP announced that work should begin with a technical baseline. It proposed that the host country cover more than 50 percent of expenses of the overall project for the 500 GeV machine.

One component is the MEXT Program (International Innovation Science Centers). It consists of 15 programs at about \$100M each. MEXT will use super-conducting accelerator and quantum beam technology. KEK is a proponent with support from industry partners interested in super-conducting accelerator technology.

On the political side, the Liberal Democratic Party won the lower house election and took power in December 2012. The ILC appears twice in their documentation and urges that Japan take a central role, including forming the ILC. Prime Minister Abe cited the ILC in his policy speech in February. He sees the ILC as part of innovation through accelerator technologies that are at the global state-of-the-art. He wants international collaboration to succeed through agreements. Other Diet ministers have addressed this in the past.

Prefectural and vice governors have included the ILC as part of the earthquake reconstruction program. There was a call for negotiations with the U.S. and other governments. On January 18, 2013, MEXT minister Shinomura pushed for international discussions and exploring legal frameworks. The promotion of the ILC was started by a federation of Diet members in 2008. This group has been strengthened since the Higgs discovery and includes many former ministers.

A meeting in February brought in many new members and attendees. An ILC planning group will meet with U.S. House leaders from April 29 – May 1, and are planning an industry engagement seminar.

Dr. Brinkman, DOE SC Director, has been asked by former ministers to closely collaborate. DOE responded that SC will consider participation but has to look at priorities. At the middle of the committee planning process and after next summer, DOE will be in a better position to give direction on the HEP program.

There is an industry and private sector alliance, the Advanced Accelerator Association for promoting science and technology. Many industry CEOs meet and work on issues to promote the ILC. They give critical input to civil engineering studies and studies of large projects. They also supported a KEK and JAHEP ceremony in Tokyo to draft the completion of the ILC TDR.

The Japan Policy Council is a think tank led by Hiroya Masuda of the University of Tokyo. He is the former governor of Iwate Prefecture. The Council says that Japan should be a role model for the creation of a global city by supporting the ILC.

There are two candidate sites for the ILC in Kyushu and Tohoku. One site will be chosen this summer. Geology, technical and economic criteria, and political input will inform decisions. In Kyushu, there is a private-public sector partnership formed in 2007 that examines and promotes the ILC. In Tohoku, there is a similar collaboration and cities near the sites have joined. The prefectures near the site have a federation of assembly members to promote the ILC. There have been 200 newspaper articles in the Tohoku region in past years describing the ILC.

Both sites are doing geological surveys, studying the economic ripple effects of forming an international academic city. They have engaged the public reaching more than 10,000 students and hosting 50 public lectures since 2010. They are also producing public relations DVDs.

The major television network NHK and its flagship news program has featured the ILC.

The European strategy includes input on the Japan hosting of the ILC, and is part of the draft that is to be approved by the CERN Council.

An editorial in Nature magazine on December 20, 2012, urged U.S. and European scientists to support the ILC, suggesting that “an early show of support could give the collider the push it needs to get under way. That would be a great victory for Japan, and the world.”

Roundtable discussion

McBride asked about the timeline for the decision and dependency on input from the LHC. Yamamoto suggested that a lack of input should not stop the process, even if something comes out with no results.

Cvetic asked if the proposal will interfere with the building of Belle II and the Super KEKB. Yamamoto clarified that those will come out first, then phase out, and the ILC will come up.

Yamamoto responded to Lankford’s question about the interplay between the initiative and neutrino program development, sharing his belief that the ILC is more expensive and involves greater international commitment even more.

Diebold asked if the construction schedule is set by a timeline or anticipated funding. Yamamoto shared that this is determined by achieving optimal technical construction. The planners are deciding how fast they can dig and how long things will take. A detector takes a similar length of time and to build and assemble. Construction is estimated at about nine years.

Boehnlein asked how much the U.S. neutrino program would need to slow down and Yamamoto was not sure.

UPDATE ON SNOWMASS

Jon Rosner of the University of Chicago gave an update on the status of the community planning project. The Higgs discovery has given impetus for future planning and getting the community together. The website www.snowmass2013.org shares the seven frontiers.

Conveners of each frontier have been active. Meetings have been held for each frontier and each has several subgroups. An initial meeting was held at Fermilab in October 2012. Rosner reviewed the pre-meeting schedule leading up to “Snowmass on the Mississippi” in Minneapolis from July 29 - August 6, 2013, as well as dates, topics and locations for preliminary meetings of each of the frontiers. OMB strictures restrict the overall costs of meetings and a three-week meeting at Snowmass would have vastly exceeded that limit.

Summaries of the meetings will be available at the American Physical Society Division of Particles and Fields (DPF) meeting in October 2013.

Each frontier subgroup will deliver a 30-page write-up and executive summary of their field. Conveners and groups will provide summaries and write-ups. A five-member reading committee will vet language and terminology, and produce a report that will be published at about the same time at that of the European Strategy group.

An e-conference report will include links to white papers submitted to each group and can be submitted to <https://www-public.slac.stanford.edu/snowmass2013>.

A special edition of Symmetry magazine is being produced for public understanding.

The goal is not to prioritize but to lay out leading physics issues and questions to be explored.

The DOE SC will evaluate near-term projects with costs of more than \$100M. The Snowmass effort will focus on longer-term projects.

Rosner gave an update from the Cosmic Frontier workshop on March 6 – 8, 2013, and the topics addressed. It followed each frontier creating write-ups in advance of Snowmass.

Roundtable discussion

Lankford asked about connections between the frontiers, and Rosner shared, as an example, the publication of a complementary document that talked about connections such as dark matter (DM) research and search matter.

Byrum added that the Cosmic Frontier workshop was very exciting with excellent talks.

Cvetic asked how the theory panel will fit with the rest of the activities, and Rosner reflected on the role of theory in the European strategy document. This is expected in the Snowmass proceedings, too, but that is not a limitation. The theory panel is a standing group examining some issues that are sensitive. The organizers do not want to mix the two. There are structural issues that the theory panel will address that are of a separate concern.

Rosner shared with Erbacher that the write-ups available for community input by July are subgroup write-ups. The overall group write-ups will not be done by then. The Cosmic Frontier group said that their group would have a write-up.

Byrum pointed out that the middle of the Snowmass event has not been planned out yet. She asked about focusing on a crossing of frontiers and how they overlap and are complementary. The Cosmic and Neutrino frontiers met at the same time at the Stanford Linear Accelerator (SLAC) meeting but were independent. Rosner shared that the Neutrino meeting included explanations of work in the Cosmic Frontier, but he is not sure if that was true in the Cosmic session. Computing has distributed itself through other meetings. And there have been interactions with the Instrumentation Frontier. Snowmass organizers will take a census of available rooms and try to accommodate requests for interactive sessions and the possibility of end-of-day plenary sessions to share impressions. Some will need video links between the large

lecture halls. This was done at a community planning meeting in October and was successful as Fermilab people were effective in making matches. In a prior Snowmass, the best activity was the working meetings. At this Snowmass, there are six days in which to accommodate overlap sessions. The expanded program is being developed and should be available soon. Those who want interactive sessions should contact the organizers.

Steinhardt asked about any discussion between the Higgs researchers and the Cosmic Frontier. Byrum did not recall this happening. Steinhardt sees this as an evolving issue. If one assumes an SM, then there could be profound implications that bear discussion. Honscheid shared that there was a talk about this and attempts to invite leading alternative theorists to participate but they could not. He agrees that this is part of the discussion.

Rosner added that questions about dark energy (DE) are intimately related to the discussion of Higgs physics. He sees more bias toward experimental physics in the present program and that there could be more theoretical focus. There are email addresses for all frontier organizers and subgroup organizers, so everyone should express their interests.

Cvetic expressed interest in seeing how theory is related rather than policy issues. Rosner shared that Constantine Machev could share how theoretical tools can be used to anticipate signals at LHC. There are down-to-earth kinematic developments and things people have not thought of before. He anticipates hearing more of this at the Energy Frontier workshop.

PRESENTATION OF THE FACILITIES CHARGE

James Siegrist, DOE, SC, Office of High Energy Physics, Associate Director, shared the charge given to HEPAP. DOE SC Director Brinkman charged a subpanel to prioritize scientific facilities to ensure optimal benefit based on 1) the ability of the facility to contribute to world-leading science, 2) the readiness of the facility for construction, and 3) an estimated construction and operations cost of the facility. This is a better government initiative and is a directive from the White House. To meet the submission deadline of September 30, 2013, the subpanel report has to be at the DOC SC by March 22.

Assistant Directors will make a list of proposed new user facilities or major upgrades to current scientific user facilities that could contribute to world-leading science in their respective programs from 2014 – 2024. If there is one large project, this should be on the list. This goes back the 2003 exercise lead by former Director Orbach to understand the full portfolio.

The second component of the charge is for HEPAP and other advisory committees to evaluate the current and new facilities. The third exercise has no cost constraints but is just a list. Brinkman will gather cost data to identify choices.

The explicit charge to the HEPAP is to send a short letter report that assigns each facility, with a grade and a short justification. Siegrist commented on how this correlates with planning in high-energy physics. A “dear colleague” letter expressed SC’s request, noting that this will be due at the end of September. The letter noted that Snowmass will be an opportunity for input, and urged participation to gather the full input from the entire U.S. community to develop a future vision for the U.S.

SC expects that HEPAP will have a subpanel around the end of Snowmass to use input and other budgetary and other input from DOE/NSF to recommend a new strategic plan for U.S. high-energy physics in various scenarios.

Agencies are concerned that the scope of P5’s work is very large, given budget uncertainties. When the original 2008 P5 met, a vision document supported that discussion. There are two

things separable from the P5 mission which is to do prioritization: determining the value of research and exploring questions in the quantum universe.

A meeting on March 13 will discuss the development of some aspects of the P5 report and how to get the attention of decision-makers and convey the value of HEP for society. Siegrist is unclear if there needs to be a subpanel or how to do this. This will be discussed on March 13.

The output of this panel and Snowmass will go into the P5. It is possible that some giant new project will emerge from Snowmass, but it is unclear where this will fit.

Roundtable discussion

Siegrist shared that there is no certainty on how Brinkman will decide and there has been no discussion in SC of the process. Director Orbach kept this process to himself.

Siegrist responded to Byrum's question about NSF's role. SC will prioritize projects across SC. The Administration's concerns include building facilities but not having enough funding. In particle physics, facilities have been shut down. In other parts of SC, this is an issue.

Honscheid asked about the timeline for P5 to produce a report. Siegrist called P5 an official advisory panel hence they cannot meet for too long. He hopes that there is a report by Spring 2014. He wants to conclude the process and avoid sending the wrong messages to the wrong people. SC is still laboring under the P5 plan and has hardly implemented all of it. He asked that, given there are nice results, a lot has been learned from it.

Siegrist responded to Erbacher's interest in the facilities ranking process by encouraging the HEPAP to ask him during his talk tomorrow.

Erbacher noted that public relations value in producing a report that shows the benefits of science for society, and the value of physics as a foundation for all of science. She wondered about including an introductory paragraph from the National Academy of Sciences members as the facilities prioritization will have impacts across science. Siegrist commented that there could eventually be an Academy panel on this issue but that depends on the community's view of its biggest impact. He thinks that physics enables chemistry and biology through accelerators and physics personnel. That gets into broader impacts. Erbacher clarified that she was thinking about actual statements on physics and its importance. Siegrist was considering the next P5 report.

Rosner shared that there will be a special issue of Symmetry magazine at the end of 2013, and HEPAP should work with them to ensure a common message.

Rosner mentioned that the report has implications for other fields. NbTi is a materials and physics problem, and high-energy physicists provide support. Siegrist responded that there may be additional development around that idea.

Cvetic commented that scientific judgment is important. Siegrist agreed with her comment that the theory community needs to be a major part of making a case for high-energy physics.

Siegrist confirmed for Fisher that the National Nuclear Security Administration is not engaged in this exercise – just the SC.

PRESENTATION ON HEPAP FACILITIES SUBPANEL REPORT

Andrew Lankford reported on the Facilities Subpanel report, facilities' ability to contribute to "world-leading science" in the next decade, and the readiness of facilities for construction. The SC has not requested a prioritization of facilities.

The Facilities Subpanel found that understanding each facility required looking at the importance of the questions that they are addressing and their ability to answer these questions. This can be a function of time and generations of abilities. The assessment was also guided by

facilities' uniqueness in addressing issues, their individual breadth of contribution to many or few areas of research, its breadth of users, user demand, and synergies in interacting with others.

The Subpanel met five times by phone and in-person between January 31 and February 14, 2013. The Subpanel was unable to present a report at today's meeting.

Lankford is the Subpanel Chair with 13 others from academia and laboratories.

DOE HEP provided a list of 14 facilities in the U.S. and other countries. Facilities were separated into the Energy, Intensity and Cosmic Frontiers. The Subpanel could add or subtract facilities but had to stay above the \$100M threshold and identify if a facility would be ready for CD-1 by 2024. The Subpanel removed the Higgs factory from the list. It also grouped the LHC and ILC facilities into the Energy Frontier.

The Subpanel discussed the neutrino-less double beta decay (NLDBD) experiment. This is under the Nuclear Science Advisory Committee (NSAC) as the SC Office of Nuclear Physics is the steward. That Subpanel looked at six other projects. The content it used for discussion is available on the Open Meeting agenda page.

At the Subpanel Meeting on February 13, short summaries addressed scientific impacts and readiness. Subpanel members reviewed supporting notes and met with facility representatives.

Decisions were guided by prior documents including the 2008 P5 report that proposed a balanced program across the frontiers. The report was designed to address the most important scientific questions. Other reports included the 2003 HEP facilities report that accounted for all of the facilities currently under the Subpanel's consideration and that have been under consideration for some time.

One recommendation from the P5 report was to sustain U.S. particle frontier leadership.

In the Energy Frontier, there was recommendation to continue support for the Tevatron Collider for one to two years, and the collider has since been shut down. There was also a recommendation to advance the LHC program to include U.S. involvement in the planned detector and accelerator upgrades. The ILC is also on the list. A broad accelerator and detector R&D program for lepton colliders is needed to include continued R&D on ILC at roughly the proposed FY09 level in support of the international effort. This will allow a significant role for the U.S. in the ILC. The report also recommended R&D for alternative accelerator technologies, to allow an informed choice when the lepton collider energy is established.

Within the Intensity Frontier, the P5 report recommended support for the neutrino program with Project X. It recommended a world-class neutrino program as a core component of the U.S. program, with the long-term vision of a large detector in the proposed DUSEL and a high-intensity neutrino source at Fermilab. An R&D program was recommended in the immediate future to design a multi-megawatt proton source at Fermilab and a neutrino beamline to DUSEL. It also recommended carrying out R&D on the technologies for a large multi-purpose neutrino and proton decay detector. Within the frontier, there is a need for a deep underground laboratory to particle physics and NSF should make this facility a reality as rapidly as possible. The report recommended that DOE and NSF work together to realize the experimental particle physics program at DUSEL. Precision measurements are another important component of the frontier.

In the Cosmic Frontier, there was support for the study of DM and DE as an integral part of the U.S. particle physics program. Recommendations included support for the Joint Dark Energy Mission, which later stalled, and the Large Synoptic Survey Telescope, which has been initiated. The P5 recommended joint NSF and DOE support for direct DM search experiments, limited R&D funding for other particle astrophysics projects, and recommends establishing a Particle Astrophysics Science Advisory Group.

Lankford shared the vision for each of the frontiers.

The vision for the Cosmic Frontier consists of the discovery of the particles that make up DM, advancing the understanding of DE, and conducting broad programs for particle astrophysics. DM is being initiated (generation 2) and generation 3 will follow later in the 10-year period. It is covered in Subpanel report. Lankford noted that the LSST process is progressing and that there could be next generation DE facilities.

The vision for the Energy Frontier is to explore the terascale. The LHC is now being exploited and there are preparations for the LHC accelerator and experiments. From a facilities standpoint, the Subpanel is only including the HL-LHC as it is in R&D with installation to occur around 2022. Included within lepton colliders is the ILC to be hosted in Japan.

The Intensity Frontier vision includes a comprehensive program to understand neutrino mixing and deliver greater limits of charged lepton mixing and hidden sector phenomena. Work will also explore the neutrino properties of mass and nature. There is a diverse program of experiments and an ongoing world-class facility at Fermilab, as well as emerging programs. The Subpanel looked at the facilities projection based on the type of physics. Neutrino physics has looked at LBNE with CD-1 approval for stage one. This could be enhanced by international partners and with further stages. In a short baseline, the facilities review includes nuSTORM. The flavor physics facilities closed. In muon physics, Mu2e has CD-1 approval. Project X consists of accelerators and an experimental program.

Each frontier has a program that is reaching further and probing deeper. Facilities are required to address the question in the near and long-term. This will lead to critical experiments. HEP planning is done in a global context to include facilities in the U.S. and global participation.

While there are exciting recent results in each frontier and scientific and technological opportunities, the biggest challenge is attaining the budget to meet significant goals.

Roundtable discussion

Bryum commented that there are some programs not included but that are near \$100M. Lankford responded that those not on the list should not be shut out. They can be supported in different ways, specifically, if the lead agency is not the DOE SC or through injecting new ideas after Snowmass. Bryum was thinking of the CMB program that was at the cost threshold and tied to neutrino research and DE. Lankford shared that that was discussed. The cost estimates were \$50M to \$100M. It is a telescope-based project hence DOE may not be the lead agency and another agency could support it. He commented that the P5 report covered the three frontiers and that the CMB reflects the neutrino world but not entirely. It can be classified here but not entirely and there is overlap between the frontiers.

Gilchriese noted the scientific impact of the CMB. SC HEP is also the steward of advanced accelerator R&D. An integration of these projects under one category would exceed \$100M. He shared the perception that not including this or other projects on the list means that they will fall-off from any consideration. Siegrist responded that SC interpreted the \$100M threshold to mean what it will take to achieve a first stage. Most projects can be broken into smaller pieces. You likely cannot solve a \$100M project in one bite. Siegrist felt that things such as a neutron collider will exceed \$100M but did not feel that this report would constrain SC on building other things. Some of the projects can be built through R&D money and there will be R&D money.

Gilchriese commented that some things that should be included in the report may be important but do not necessarily fit in the SC criteria. Siegrist suggested that these be included in the foreword of the report. Lankford noted that interpreting the criteria narrowly avoided mixed

perceptions. The examination was focused on facilities. There was extra incentive to do it this way as Snowmass will follow. This made the Subpanel work more achievable.

Siegrist added that CMB and other projects are not off of the table. SC will have a list of prioritized facilities. OMB will use this in its own list of DOE projects. OMB may be sympathetic to keeping projects on the table as other agencies want the DOE to work with them.

Lankford will incorporate all of these details in the written report. It will be a letter report that includes reference material. There is a one-page summary of each facility and one paragraph per facility that will summarize the assessment of each. It will use the categorization proposed by the SC. In both categories, the characterization is rather coarse. The Subpanel will try to structure this such that the paragraphs help justify the decisions versus just providing grades for each facility. The paragraphs are in good shape. There is front material to be drafted. The report will then be circulated to HEPAP for feedback.

Steinhardt asked Lankford to clarify the term balance, asking if the goal is to weigh the impact on science generally or in three categories. The Subpanel approached this as impact on science, and balance does not mean balance with regard to funding levels. The Subpanel ratings were based on what is essential to high-energy physics. However, when discussing a given scientific question, it must be approached both ways. This can vary case-by-case. The last P5 established DM in the portfolio. Some things in the portfolio are specific while other science questions are more complex and framed outside of the SC.

PRESENTATION OF THE ENERGY FRONTIER FACILITY SUBPANEL

Sally Dawson reported on the Energy Frontier Facilities Subpanel. The starting point was to deal with the science questions and issues that facilities will address, their ability to address the questions, and if they are unique. The list of proposed Energy Frontier facilities is short, as the Subpanel also judged facilities' potential for construction by 2024.

The LHC was discussed. There are things known about Higgs but there are also things to be found beyond the SM and fundamental questions yet to be explored.

The Subpanel dealt with several questions. The first is determining what the Higgs is and what should be done with it. Observing rare decays and rare production modes can enable measuring its properties. There is also opportunity to think about physics beyond the SM and look at high-energy SUSY. This could generate many findings, and there are many possibilities here for new physics that are motivated by understanding the TeV scale.

Another question is how to determine the measurement limits from the Tevatron. Precision measurements of masses have profound implications. These precise measurements are important.

The Subpanel considered possibilities for upgrades such as LHC. This work might consider very high energy pp. Hence, LHC luminosity and detector upgrades are on the list. LHC has rapidly achieved high luminosity. Goals of HL-LHC after 2022 (physics at the end of timeframe) would have max of 140 interactions / crossing, $L=5 \times 10^{34}/\text{cm}^2/\text{sec}$, 250 fb⁻¹/year, and 3000 fb⁻¹ total. Dawson reviewed the schedule and plans for the LHC through 2036.

Physics goals for the LHC include testing at 300 - 3000 fb⁻¹ at $\sqrt{s}=14$ TeV LHC and exploring Higgs properties with increasing precision to test SM. Dawson shared some ATLAS predictions for how well the signal strength and CMS couplings could be measured. It shows the effect of improving systematic errors and theory.

Research would continue to explore Higgs to see if it is a scalar. HLC can measure Higgs self-couplings from 15 percent to 20 percent and explore new physics opportunities. This is hard

to quantify as one would want to explore anything that is found in 14 TeV running. This helps form a well-defined physics menu for HL-LHC.

The Subpanel noted that upgrades are part of core U.S. competencies and will require core R&D and engineering. HL poses detector challenges and there would be a high data rate. The Subpanel heard from both detector collaborations and both had proposals for what they might do for HL-LHC. ATLAS proposed three things they would do but was also judged that R&D will need to be ongoing to resolve significant scientific and engineering challenges before initiating construction. Similarly, CMS shared a proposal for Phase II upgrades and wanted to keep the detector as effective as it is now. It proposed upgrades and also found that R&D would need to be ongoing to solve challenges before construction.

Science questions drive the need for luminosity and detector upgrades. The Subpanel found that accelerator and upgrades are absolutely central to world-wide goals of particle physics.

There are many possibilities for high energy lepton colliders. Snowmass has possibilities on its webpage and things to be discussed. The only lepton collider conceivable for construction is the 500 GeV ILC in Japan and it is on the facilities list. The ILC physics goals are well-known and can start at 250 GeV but increase to 500 GeV and observe rare decay and measure total Higgs width. Goals include searching for new physics and making standard precision SM measurements. Top quark physics is also an important goal along the way as it gets to a top mass up to 100 MeV and top width of 30 MeV.

ILC detectors could feature many technology advances and there are now two vetted designs for detectors. The Subpanel judged that these detectors need R&D to resolve scientific and engineering challenges before initiating construction.

There has been progress in planning for accelerator. Dawson shared that the ILC Gradient R&D has made progress up to a 90% yield.

The technical design TDR is complete for the 500 GeV ILC. There could still be nine years from ground-breaking to commissioning hence this falls within the Subpanel's timeframe.

The takeaway for the ILC is that science will drive the need. It would address absolutely central physics question and could be constructed by 2024. The parameters for U.S. contribution to the ILC are not yet known.

The Subpanel used the P5 report which listed the full exploitation of the LHC as the higher priority in the U.S. high energy physics program. The Subpanels conclusions are consistent with findings from 2008:

- Measuring Higgs properties and searching for effects beyond the SM are of primary scientific significance
- The LHC accelerator and detector upgrades, and the 500 GeV ILC in Japan can address these questions in complementary fashion and are absolutely central to progress in HEP

Roundtable discussion

Cvetic asked how the new machines compare to the worst case of only doing precision and diagnostics of SM. Dawson noted that this is a Snowmass question. There could be other questions, too. ILC will precisely measure Higgs mass in a way that the HLC could not.

Steinhardt shared that the Higgs mass is metastable with a small barrier. This has profound implications beyond Higgs that undermine any or most technology. This gives an extreme landscape and looking into the future, it was learned that DE is not stable. Saying that it is unstable is something else. He proposed leveraging the current findings to make a case with something much more vivid for audiences and showing profound implications. Dawson agreed

that these can be measured and would be flashy. Steinhardt added that this makes a case for the Cosmic Frontier and has deep implications. He urged resolving these issues.

Erbacher noted that the high luminosity upgrades were given a 'b' grade, and Dawson pointed out that these were the conclusions of the experiments themselves. Erbacher agreed with the assessment but asked about the potential reaction of readers who do not work in this field. She is concerned that if the project is not slotted in SC's overall scheme then it would not ever be funded and perceived as having another decade to go. Dawson noted that text would support the importance of the ranking, but it was determined that the upgrades are not ready for construction and do not fit the timeline. The Subpanel did not see these as letter grades and noted a gap between grades. The Subpanel will explain the grades and not with a table so that readers will have to read the document to understand the rankings.

Erbacher suggested that a circular e^+e^- Higgs factory could be a cheaper option and that there does not seem to be major technological challenges. Dawson responded that this is not yet known or sufficiently clear to support a conclusion. Going to 500 GeV buys more physics and different physics. Dawson shared that it could be at the end of the time period and come back in.

Fisher commented that the 250 GeV machine is pretty challenging. Lankford shared that there are groups proposing different things. The Subpanel discussed the technical challenge to achieving problems and the political challenges in putting challenges on different scales. It judged that these concepts were not always ready for assessment in this exercise. A criterion is construction-ready in this timeframe. Lankford added that some people did not provide information as they considered their projects too early to be reviewed and considered.

Honscheid commented that when there was news about the collider coming back, some thought that the LHC can do some similar things and be more successful than anticipated. He noted that uniqueness is one aspect of the Subpanel's study. Dawson responded that Snowmass will be a chance to make the physics case and show where ILC can probe higher masses. The comparison will be shown at Snowmass and different areas of strength for the different machines. Lankford added that the Subpanel illuminated some of the most important questions, and that looking at other information about the ILC shows a comparison in each general range.

Steinhardt added that it is useful to point out variances in the frontiers, resolving what is going on with Higgs, and perhaps looking at cosmic tools to directly detect new physics at an energy scale at high energy accelerator physics. Dawson added that we already know that there needs to be new physics. It is important to point out there are tight connections between frontiers.

Cvetic commented that the right detection with HL-LHC of things beyond Higgs will bring about tremendous change. Dawson remarked that this is an aim of the HL-LHC.

PRESENTATION OF THE ENERGY FRONTIER FACILITIES SUBPANEL

Norbert Holtkamp shared discussion from the Intensity Frontier Facilities Subpanel and specifically accelerator technology and Project X. It consists of a series of accelerators working at a total of more than six megawatts of available proton beam power.

The Subpanel foresees that Project X will compete at or exceed the next generation spallation source intensities. It will give intensities across a broad range of beam energies beyond the capability of any other proton facility complex planned or in operation world-wide. It builds on the SNS construction recently completed at Oak Ridge.

Mark Wise shared the main goals of the frontier. A full understanding of the neutrino sector is needed, and this is already beyond the SM. This raises questions such as how many and how massive. There is a desire to search for SM physics using high intensity beams to gain high

precision and / or reach for rare processes. The frontier is complementary to other frontiers and seeks to answer the laws of nature, and specifically is often involved in indirect searches. The energy reach for new physics is often much higher than the Energy Frontier.

The Subpanel looked at LBNE. It takes beams from Fermilab to Homestake and looks for ν_e and $\bar{\nu}_e$. It is known that there is splitting and there is mass hierarchy, but more needs to be known through the long baseline. Stage one of LBNE would have a 700kW beam to a 10kt detector at the surface with no near detector. With international collaboration, LBNE could reach 2.3 MW beam power from Project X to a 35kt underground detector, near detector. Beyond the neutrino program, one could study nucleon decay, supernova neutrinos, and search for physics beyond standard three flavor neutrino mixing.

At 10kt and 700 kW, LBNE is represented in two plots. One shows a mass hierarchy greater than 3 sigma CL for 75 percent of the allowed value of δ . The analogous question is to determine how confident one can be that delta is not zero. Dips in the plot show no CP violation. Every plot will have these dips.

The full vision for LBNE is to reach dramatically improved resolution for mass hierarchy, sensitivity to kaon final state in proton decay, capabilities for new physics beyond the standard three flavor neutrino mixing, a significant ability to detect supernova neutrinos, and meeting this vision earlier than planned due to international support. LBNE is an absolutely essential facility with compelling physics. It is ready for construction to start in 2016.

Mu2e supports studying charged lepton flavor violation with a 10^4 improvement in sensitivity. This is an order of magnitude of a massive scale. Mu2e occurs in extensions of the SM, and has impressive reach in a mass scale. This assumes a particular type of interaction responsible for Mu2e conversion.

Competition for the Mu2e experiment is JPARC. Its first phase has been approved and it will reach a sensitivity about one order of magnitude less than Mu2e. There is a factor of 100 increase in sensitivity possible for Mu2e with Project X. Mu2e is strongly endorsed by the P5 report, is ready for construction starting in 2014, and is considered to be an absolutely essential facility.

Project X is the most complicated of the projects and quite broad, hence all of the pieces need to be put together to support understanding. It is a high intensity proton source at multiple energies for a suite of frontier experiments that range from important to absolutely central. It is planned in three stages and has diverse science goals. These goals tie back to work involving LBNE, electric dipole moments, BSM physics and Mu2e, finding new sterile neutrinos, the search for new baryon number violation, and working beyond the SM physics including CP non conservation in the quark sector. Project X can help improve the reach of current activities.

Stage one of Project X increases physics reach as power is increased. It includes electric dipole moments at $10^{-29} ecm$ which is smaller than is possible now. The stage will more than double the power to the charged kaon mode, and at stage two, power will increase by a factor of 10. It will be possible to study this in great detail stage two is achieved. Project X dramatically increases the reach of LBNE, and helps achieve much higher precision throughout the range.

There is a limit on the neutron anti neutron oscillation transition time, and Project X can increase this limit by a factor of 50. This is a limit on oscillation time.

Beyond additional power going to Mu2e, the use of different targets offers learning about the effect of Lagrangian. If this is discovered, one would want to know the physics in full detail.

Project X is envisioned as a unique world-leading facility at Fermilab that would deliver high beam power at multiple energies simultaneously to multiple users. It has applications relevant to

materials science and to nuclear energy. The Subpanel concluded that Project X is an absolutely central facility. Although it is in pre-CD0, it is ready for construction.

Another facility is nuSTORM. It provides neutrino beams with well-defined flavor composition and energy structure. It is motivated by anomalies from LSND and others that go beyond the PMNS scheme. nuSTORM is not unique in its detection of oscillations at the LSND level but if the oscillations were confirmed, then it would be a unique facility. nuSTORM can detect neutrino nucleon cross sections. This is valuable science but not essential right now.

The performance requirements for nuSTORM are not fully defined. While it has enormous potential, not enough is known to understand how it can impact world-leading science.

Roundtable discussion

Erbacher asked about the kinds of experiments possible with Project X, with increased sensitivity. Wise explained that with Project X, stage one would increase by a factor of 10, stage two would grow by another 10, and this would go beyond the sensitivity for Mu2e.

Erbacher pointed to Project X and asked if EDM will have international competition. Wise shared that EDM has international and domestic competition, expressing that there are things that would be difficult to do outside of Fermilab, as an example. For proton EDM, Project X would be unique, as would radio isotopes.

Erbacher asked what ready for construction means for Project X. Wise shared that the Subpanel was told that it is ready for construction around 2016 or 2017 and does not need significant R&D. Lankford added that it is ready for CD1. Erbacher asked if it would be ready for more R&D at the CD1 level, if comparing luminosity upgrades and if two projects are being compared that way. She noted that in using the same scale, there are few technological barriers. Lankford agreed that using the same scale, it could be ready for CD1 review. The Subpanel heard that relative to LHC upgrades, things are not ready for the construction approval process.

Wise confirmed for Honscheid that Project X is a facility that will enable experiments rather than a set of experiments. Lankford added that an assessment of Project X and the research program with its range of concepts are both needed. There are proposals out there but not a complete research program description. The type of research program that could be enabled needs to be clarified. Gilchriese asked if Project X is a multi-collection stages and all are within the boundaries of CD1-ready before 2024. Lankford suggested that the question is if all three stages will be ready. He confirmed that they will. Project X is not being looked at stage by stage.

Rosner commented that the distinction between absolutely central and a 'b' grade can involve attracting international collaboration. He brought up LBNE and hopes for collaboration. Wise asked how a project can get to a full stage. The Subpanel report will mention this and he is hopeful for international collaboration. Lankford added that this piece was difficult for the Subpanel. There is a defined first stage for LBNE and there is also a stage one. The Subpanel decided to do an assessment of both. This is complicated by the prospect of collaboration and that is not clear at this time. Several options for LBNE could be improved by international collaboration. That was undefined and the Subpanel simply chose the end points. The options will be presented in the report.

PRESENTATION OF THE COSMIC FRONTIER FACILITIES SUBPANEL

Josh Frieman shared discussion from the Cosmic Frontier Facilities Subpanel and reviewed science goals as defined broadly in the frontier and not just within the Subpanel requirements expressed by the DOE.

The Subpanel developed a strategic triad of DM searches to guide discussion. The focus for this study is on direct DM detection, and it covers first-generation experiments now operating or commissioned, and second generation DM experiments.

Third generation DM detection experiments were also considered. Detection by different means would inform the choice made for third generation experimentation. If nothing is detected, then the focus is on sensitivity. At least two G3 detectors will be required, based on input from the community, and would be ready for construction in the early 2020s.

The Subpanel decided that the question of the composition of the matter in the Universe makes the science addressed by these detectors absolutely central. Third generation detectors using G2 technology will require resolving significant S&E challenges before construction.

With regard to DM and cosmic acceleration, the Subpanel asked if acceleration is due to DE or a modification of general relativity. A combination of two different probes will address this question. In the U.S., HEP has developed a program for DE research that includes operating experiments with experiments currently in operation and with more planned. This follows stages laid out by the DM Task Force.

The Large Synoptic Survey Telescope (LSST) is the second large facility for the Subpanel. It is the highest-range large, ground-based project in Astro2010. Over 10 years, it will conduct wide, fast and deep surveys of the southern sky. It is the central next-generation facility for the HEP DE program, and central to NSF's U.S. optical / near-infrared astronomy system for public and private near and infrared telescopes for the U.S. The user community is broad. The current project timeline is to reach "first light" by 2019.

Compared with current capabilities, LSST will make significant gains. It is considered absolutely central to world-leading particle physics. LSST has received DOE's CD-1 approval and is ready for construction. NSF's Director is authorized to request construction funds.

The Subpanel considered the Next Generation DE Experiment. At stage three, this would consist of BOSS and DES. At stage four, this would consist of MS-DESI and LSST. There will be exploratory discussions at places such as Snowmass, and these will have to tie to discussions in the astronomy community. Concepts under discussion include a space-based DE experiment and a team to carry out the WFIRST study with a telescope from the National Reconnaissance Office. There is also interest in improved supernova experiments.

The Subpanel's assessment is that the full resolution of the physics origin of accelerated expansion and the nature of DE expected will require complementary experimentation at LSST. The facility would be absolutely central, yet mission and technical requirements are not yet fully understood.

Roundtable discussion

Steinhardt found that the language about resolving DE is a peculiar. Frieman commented that there is little good measurement of that space. Steinhardt also commented that missing are other ways to look at time variance. There is a gap between the programs in DOE and NSF. Frieman noted that there are novel techniques that probe DE. His understanding is that generally these cases are not about facilities at that scale.

Rosner asked about the aspect of systematics that still be needed to be solved for supernovae. Frieman confirmed that supernovae cosmology is entering into systematic cosmology. In addition to probes, there is also an effort to fight reduced systematics. This supports the need for a multiplicity of probes, and is likely why one would need multiple projects and approaches.

Fisher asked if there is some capacity with LSST to say that DE density is the same in both ways. Frieman responded that this has been looked at to some extent and it covers a large area of space. Fisher asked if there is a need for one on both hemispheres. Frieman finds it hard to argue for building two LSSTs. There is an effort to look at supernovae hull diagrams, and in different segments of the sky it is set by endoscopy. Steinhardt added that it is integrated through the ISW.

OPEN DISCUSSION PERIOD FOR HEPAP MEMBERS AND ATTENDEES

Lankford confirmed for Byrum that the HEP will provide cost data to SC, although this is complex as projects involve U.S. funding and possible international participation. The report will not include funding figures. The P5 exercise gave a roadmap with varying budget scenarios.

Honscheid suggested that the Subpanel provide Siegrist with arguments for physics problems and work to compete for HEP's share of funding once it is divided up. Lankford noted that Siegrist and Crawford have benefitted from Subpanel meetings. Conveying the context and appreciation for the prior reports that were cited was discussed. The Subpanel did not discuss providing a separate transmittal letter to HEP and SC on this timescale. Lankford shared that this could come from the HEPAP. Siegrist noted it could be an extended cover letter for the report. Lankford shared that the underlying effect with this exercise is to show the need for more resources. Honscheid added concern that people would read through and pick a few things, whereas this is an exciting program overall with many opportunities for exploration.

Lankford commented that other programmatic considerations might drive SC's choice-making and how it performs its rankings. HEPAP wants to advance its programs, and there may additional positive arguments from those outside that would help communicate important points.

Byrum noted that there are multiple things being asked for in each frontier but did not feel that there are too many things. Another office might see this list as too long. Fisher commented that the items on the list are planned and have been budgeted. This is input for SC's desire to build its portfolio. He added that these items are budgeted at some level and this is not a request.

To Byrum's concern about not being articulate and conservative in a tight budget environment, Lankford commented that the report will try to convey that these projects have been planned for a long time, not many are new, and these go across the frontiers. He wants to get that across in the report. Lankford added that Snowmass should elaborate on expectations for the field and that the number of facilities on the docket ranges quite a bit. In DOE Nuclear Science, there is a small number of facilities but they also have funding struggles. Basic Energy Science (BES) has four new facilities but the total number is about the same (as HEP).

Siegrist described the report as providing input to SC's prioritization process and helping the Office define its portfolio. He urged being clear that there are three interconnected frontiers.

Byrum noted that it would be good to include that in the introduction.

Gilchriese asked how SC will prioritize without cost data. It seems as though there will be another phase where cost data will be addressed. Adding up the projects' costs exceeds what is on the HEPAP list. Siegrist answered that SC always knows the cost. One variable is collaboration with Japan. This could be along a wide range. SC will discuss examples like this.

Siegrist commented that the foreword can describe HEP as a global enterprise. The U.S. cannot presently invest as much as other countries that can invest \$10B in the ILC. HEP can develop a way to continue pairing with other regions. Siegrist does not see that DOE's BES has suffered from large foreign contributions. He thinks that HEP is in a unique situation and that is understood by SC management.

Lankford confirmed for Rosner that the feedback from Snowmass conveners should go to him, and that the Subpanel report slides are public.

Lankford confirmed for Erbacher that the draft report will be put together for HEPAP before March 22, and that HEPAP's official sign-off is needed before the report is submitted.

Steinhardt asked about the origin of the term "absolutely central," and if this has the same meaning in each frontier. Lankford shared that the Subpanel looked at the most important questions to be addressed by each facility and the scientific significance of each question. The Subpanel put aside the question of whether or not the facility can answer the questions. It found that for every facility, there was little range along the course scale that the Subpanel used. This was used in determining if a facility was absolutely central. The description is supposed to define a facility's ability to accomplish "world-leading" science, which is pretty fuzzy. The Subpanel determined the importance of the scientific question(s), the facilities ability to answer it, its uniqueness, and some other programmatic things such as the number of users and a facility's impact on other fields. There was nearly complete consensus on the importance of the scientific questions, and very little range on facilities' abilities to address the questions. Lankford commented that how this calibrates across different offices in SC is a different puzzle.

McBride commented that evaluations also looked at international collaboration. How that is calibrated across the SC should be put forth in the description. He added that some facilities are not traditional user facilities and are more experimental, and this should be well-articulated. The questions posed for the Subpanel exercise did not necessarily fit the projects that were discussed. Lankford added that the report can also describe experiments. For instance, CMS has a large number of collaborators and users, represents a broad range of science, and has produced many papers. An activity that shows the field's cross-collaborative nature is Project X.

Cvetic urged clarifying that the Energy and Cosmic Frontiers will advance to next stages. The Intensity Frontier is the most diverse with experiment and facilities, and seems to be the most complex and present controversial things. She suggested that the narrative present this mix, along with comparisons with other facilities in the world. Lankford noted the complexity of the frontier. He shared that Project X is a user facility with the potential for multiple experiments, and that describing a suite of undefined research can lead to a set of complicated things.

Steinhardt shared that his struggle with the terminology and the word "centrality." He thinks of this as "if we did not do (this), what bad things would happen in our field?" Wise responded that what we do not know is the answer. Higgs was discovered but perhaps the next set of experiments will not lead to something new yet will involve doing great physics. This exercise involves assigning probabilities and that is influenced by prejudices.

Lankford commented the prior report reflected collecting and combining results to form knowledge that can change things. He wondered about developing an Intensity Frontier argument that proposes combining things and results from other frontiers to produce a more complete change in the SM or picture of the universe.

Hendrik Weerts prefers not to group be frontiers as the experiments themselves seek to explore particle physics. The physics is advanced by the facilities. Today's discussion was started by imagining that there are frontiers and that that is science, but Weert believes that it is not. Lankford responded that the message from NSF and DOE is that use of the frontiers has helped communication to OMB, Congress and others.

Crawford added that the frontiers framework has educated those outside of HEP and that the report would need to guide readers unfamiliar with particle physics. Weerts suggested that putting tools into the frontiers is fine but the science should not be in buckets. He does not want

to change the framework but is concerned about theorists fitting in. There were struggles when the Intensity Frontier was discussed in 2011. He urged selling this based on science, and hence the question about which frontier to put things into becomes less important.

Lankford commented that leading with science questions would produce a long list of questions. The Subpanel wondered how to organize these without confusing those outside of the field. Categorizations can be confusing and the questions are intertwined. Weerts responded that the physics is not at a point where researchers can say that they measured many things. There may be new physics out there, and new experiments are seeking to discover this. He urged leading the report with science and not with the frontiers. Erbacher and Bryum agreed, and Byrum add that starting this way will provide a three-pronged approach. The remaining challenge is the list of questions. Crawford added that the report does not need to have a full list of questions and discuss those as things that are being investigated. Lankford clarified the discussion, confirming that the report should describe the status of current knowledge and the science questions, then propose how to address the questions.

Boehnlein noted that at some level, the report has to define the context of a program, then the organization, and reflect what has been presented to the public and describe what high-energy physics does. He urged some level of categorization as just claiming to work on science is extremely broad. As soon as the report starts talking about high-energy physics, then the work is already categorized.

Steinhardt reflected on two questions from the discussion. One is if there are too many things labeled as absolutely central, and if things are combined would they then be ranked as absolutely central and result in the same list? He shared that if things are not ranked by frontier, then the report would still list the same things. Lankford commented that the Subpanel only categorized things by frontier once it got into programmatic things.

Steinhardt asked if the list would be arbitrary if only 80 percent of the things could be done, and if absolutely central means that HEP cannot afford to not do any of these things. Lankford shared that the Subpanel made a list of science questions and determined the importance of each. It felt that these questions have to be addressed but did not specific the order or a prioritization. The task would have been different if the criteria were to pick only addressing 80 percent of the questions. The Subpanel chose these questions as things to address over the fullness of time. Fisher added that the Subpanel did not talk about bolstering a field or making certain things more essential. The categorization came from the P5 report and it recognizes the great way that the high-energy physics field has changed. To not acknowledge the fields (and frontiers) and how physics has been organized would not acknowledge how the fields is now.

McBride commented that this misinterprets the concern. Prior exercises selected some things as priorities. The concern is that if everything is ranked equally, then the prioritization will be done by someone else. Those making the decision should have enough information to recognize things that are a priority. Lankford described this as “absolutely essential” or “equally absolutely essential.” Steinhardt commented that everything labeled as absolutely essential is currently equal. Dawson commented that the Subpanel thought that there should be more gradation, but the science questions did not make clear which things should be lower priority. All facilities were seen as absolutely essential.

Gilchriese wants to structure the report so that no items are taken off due to SC’s prioritization. He noted that doing this across many sciences might allow for some things to be removed from the list but also sees a challenge in getting things back on the table. Siegrist is concerned that the P5 will have to deal with a lower budget scenario or can consider some higher

budget scenarios. He believes that things should not be removed from the list prematurely in order to take advantage of windows of opportunity.

Rosner reflected on Fisher's earlier comments. He shared that LBNE is the only facility labeled as important but not absolutely essential. He is concerned that this will be crossed off the list. He feels that this is a good risk to take but is concerned about this in terms of European collaboration. Lankford recalled that Brinkman asked for Fermilab to reformulate this project into stages. He believes that Brinkman will not forget about his request, and the Subpanel saw this as important but had differing opinions on its value. The issue of international participation is very delicate, especially as it related to advancing things and achieving the full vision sooner. The Subpanel wants HEP to see the benefits that this project can provide.

CLOSING REMARKS AND ADJOURNMENT

HEPAP Chair Lankford adjourned the meeting for day one at 5:38 p.m. EST.

MARCH 12, 2013

The High Energy Physics Advisory Panel (HEPAP) was convened at 9:02 a.m. EST on Tuesday, March 12, 2013, by Murdoch Gilchriese filling-in for Panel Chair Andrew Lankford.

PRESENTATION OF THE DOE OFFICE OF SCIENCE PERSPECTIVE

William Brinkman, DOE SC Director, provided an update on DOE news. He recognized Pier Oddone for his years of service as the Fermilab Director.

Sequestration will reduce the SC budget by \$215M. There will be furloughs but little else is known. The outcome for FY14 is not yet known. A budget announcement from OMB is expected in April 2013. Congress will be on holiday until April. SC has had to back-off of some priorities that it had set earlier.

Brinkman and Secretary Chu came to Washington D.C. due to concerns about global warming and felt that that was a priority. That meant strongly supporting the Energy Frontier Research Centers, Innovation Hubs, and Biofuel Centers, and trying to enhance the ability to deal with CO2 problems. There has been progress, and the Secretary and others have done a lot of work in redesigning the DOE and other organizations to be more effective. This campaign has caught industry and the world's interest. Chu should be credited for the things he has done.

At the same time, the world does not seem closer to solving these problems. The switch to natural gas from coal and changes in emission levels have not been very rapid.

Brinkman knows the difficulties with fields such as fusion and hydrogen physics. DOE could not seem to generate a needed boost and these have not gotten as far as he would have liked.

Nuclear fusion has been challenged and the Administration has decided that it should not be funded out of its domestic budget. DOE has tried to negotiate and get that back into control. IGERT is being built and is an enormous investment. The EU just let the contract for most of the remaining building to be built. That is equal to \$300M Euros. The U.S. has the most difficult aspect of the problem. Making the magnet for IGERT is a major challenge and the central solenoid has to be recycled every time the plasma is turned on. It has to be recycled 5,000 times. The good news is that Japanese companies would provide wire for the facility and tests for the wire have been positive.

In nuclear physics, SC has three major facilities and is trying to build a third (RHIC, TJNAL and FRIB). These have strained the budget. This is very politicized and gets a lot of attention.

The only machine currently providing data is RHIC. TJNAL is under construction and construction is just beginning at FRIB. The NSAC recommended that if one were to be shut down, it should be RHIC. Brinkman is not inclined to do that as it is producing data. He is trying to figure out ways to support RHIC. Eventually, there will be a time where RHIC is not so useful. The NSAC will have to consider that.

In HEP, SC would like to support the LBNE but has not been able to get this through the Administration. Brinkman would like to pursue this to bring in international partners, and wants to do this before he leaves the DOE. One of the big questions in the field is the CP violation phase. Determining this would be very important. This would give a basis for negotiating with other countries and contributing to something in the U.S.

DOE has supercomputer centers at Oak Ridge and Argonne. Those need to be kept up to date to compete in the race to exascale. Other countries are putting in more money, but the U.S. has a good program with good machines. What to do about power and accuracy is unclear. Someone once said that we are out of money and so now we have to think.

The free electron laser at SLAC is a big success. People thought that it could not be done or get to the point where a laser could be made. Experiments are now being done in multiple phases. The effort narrows the spectrum of the light of x-rays even further to about a factor of 10.

In the field, there are interesting ideas about what kinds of machines to build, and new bending models. The direction of the field is unknown due to the fact that free electron lasers are not supercharged and (more than?) one beam can be used at a time. SC has a committee to look at the field and determine where it is going and what to do next.

A new DOE Secretary is preparing for Senate hearings. Brinkman hopes that this will occur before the Senate takes a break. The new person is getting on board and moving from Stanford, and a whole new set of people will be coming to the DOE.

The DOE and SC are dealing with conference attendance and that takes up time.

Roundtable discussion

Brinkman responded to Fisher's interest in how the facilities report will be used once it is sent to SC. The facilities will not be prioritized by Brinkman but someone else who will decide how to consult others to make the decision. Fisher asked if the HEPAP should view this person as Brinkman or someone else in his job. He responded that that is really the objective and he has spent most of the last four years trying to finish the list of projects that need to be done.

Erbacher noted Brinkman's mention of Orbach's list and his disagreement with it. She asked if the concern was the list or the idea of listing things. Brinkman responded that IGERT was at the top of the list at the time. At the time, there was not much enthusiasm about IGERT and the upgrades that were needed to go with it.

Gilchriese cited HEP's desire for global collaboration at LBNE and the ILC opportunity. He asked what the field should do to position itself for partnering. Brinkman's enthusiasm for the LBNE is not just based on science, but also international collaboration. He does not know how the community should approach the ILC and Japan. Some are pushing for work to be done at the Hanford site, but that may not be very effective. He does not want the DOE to get into a situation where it has to respond within a tight timeframe, and does not know the timeframe.

Bryum shared that at a town hall meeting at Fermilab, some mentioned that Brinkman would announce some news about working with India. Brinkman commented that SC hoped something would be finalized but it did not work out. There is an upcoming ministry meeting where DOE hopes to have a deal completed. DOE needs to make sure that this happens.

Erbacher asked about plans with India. Oddone commented that there are two parts of the agreement. One would be to make a large contribution to Project X, the scale of which is being discussed. It could be support for about half of the technical components in the machines. This would be the largest contribution to a facility in the U.S. but many hurdles and personal concerns have to be resolved before the documents are signed. This will require aligning the DOE, OMB and many organizations. It also brings up the issue of DOE's role as a global partner in the community. Brinkman added that the political process in the U.S. does not lend itself well to international collaboration. There could be long-term agreements with CERN, but this is difficult to arrange in the U.S. He does not know how to get the U.S. government to think about long-term things, and politicians and OMB are hearing more and more short-term arguments and are scared of long-term agreements. The DOE was burned last year due to cuts in the larger budget.

Fisher noted that BES has done well the past two years, and wondered if that is simply due to the nature of its field or if they have an approach that HEP should follow. Brinkman responded that they have not done as well as one might think. In the first part of the Administration, they built up a large budget but have not well in recent years. BES is struggling with facility closures and money spent on the National Synchrotron Light Source II was early money. BES is working hard at Stanford and they looked very relevant to DOE management. BES has the Innovation Hubs and the Frontier Centers, but is struggling like everyone else, especially with sequestration. In response to Fisher, Brinkman shared that the lesson to be learned is that SC does not sell things as well as it could but he does not know how to do that any better than SC already does. The cyclotrons are in place due to community efforts. He believes that the field has a tremendous advantage as HEP is fascinating to the public. He sees positive reactions as venues such as the Carnegie Institute when physics is on the agenda.

McBride asked for input on how to make the approach to conference attendance more efficient as arrangements and restrictions take up time. Brinkman shared that he does not want to prevent meeting attendance but OMB has forced a complex approval process upon the agencies. SC is trying to do its best and has had to push back and insist on allowing some attendance. Some proposals to SC have hugely different registration fees and conference costs. At one time, SC was spending \$2M on booths for a computer science conference but has reduced that expense. The biggest challenge is getting information together and doing so in advance of early registration. He wants to solve this but SC does not always succeed.

McBride shared that a major international conference will be hosted in California this summer and it was just approved yesterday. This is very late for bringing people in. Brinkman commented that any major conference like that is unlikely to be turned down.

PRESENTATION ON NEWS FROM DOE HIGH-ENERGY PHYSICS OFFICE

James Siegrist provided an update from the DOE HEP. The SC FY13 annualized budget with continuing resolution is around \$4.903B. Sequestration will reduce this to around \$4.658B. This will likely go into effect in April as the Defense budget will be announced until around April 8. HEP will drop from \$770M to around \$755M and research support is already being cut.

HEP is trying to trade-off research to support projects. This investment helps continue U.S. leadership but under a constrained budget. Worse is decision-makers' worry about things such as international agreements and making decisions that people might get beat up on later.

One scenario envisions reducing research by 20 percent over five years and increasing project support. This would not be equal across the Frontiers and would lead to scientific staffing shifts. Siegrist appreciates community support and laboratories' efforts to keep personnel.

High Energy Physics Advisory Panel – March 11 - 12, 2013 - Meeting Minutes

As described in the media, sequester reductions in HEP will be around five percent in FY13. Research has already been reduced so most additional cuts would fall on projects and facility operations. Siegrist does not expect further reducing grants that are already in the pipeline. There would likely be no new starts, but DOE is working that aspect.

HEP's three pathways for science are experimental, theory and simulation. There is also a convergence of enabling technologies, and work within each of the three frontiers. Siegrist reviewed the recommendations of the P5 report. The recommendations are still relevant and HEP is sticking with this plan. This has led to a comprehensive program across the frontiers. Within five years, NOvA, Mu2e, and G2 will be running on the Intensity Frontier; the CMS and ATLAS detector upgrades will be installed at CERN; DES will have completed its science program and the mid-scale spectroscopic instrument and DM-G2 should begin operation; and, the two big initiatives, LSST and LBNE, will be well underway.

Coming up, the community will participate in DPF. HEP also aims for having a P5 process established by Snowmass and up and running for prioritization.

The current plan for the Energy Frontier is to continue the U.S.' lead role in LHC physics but not be the driver. There are issues regarding the scale of U.S. involvement and the current agreement with CERN expires in 2017. People should be aware that this is a uni-directional agreement. Previously, CERN could not do work outside of CERN. That has changed and it needs contributions from the U.S. The legal framework has to be re-set and SC HEP is working on this now. A similar process with ILC is expected and HEP is having discussions with Japan. A coordinated program between the two countries would make sense. ILC technology is what is needed and bilateral resolutions have to be carefully examined.

In the Intensity Frontier, the U.S. is ahead of other regions but needs to do upgrades, including a booster upgrade at Fermilab. These could attract new partners to U.S.-lead projects. The portfolio is diverse and HEP has a long story to tell, hence this has been difficult to communicate to lawmakers. The scale of projected investments is also a challenge.

In the Cosmic Frontier, the only question is how far to go in precision and setting limits. Siegrist asked when DOE should admit that DM is too tough of a question to answer. DOE is a technology enabler but not a facilities provider. This is analogous to ILC - its facility goals are different due to the owners. The tension is how much DOE should spill over into other things. DOE supports particle physics goals and HEP-style collaborations. The recent OSTP President's Council of Advisors on Science and Technology report discussed thinking of research along several axes with one being single researchers and the other team science. In astronomy, research is mostly single research, while high-energy has mostly been team science. When proposals come in and do not look like high-energy and speak of collaboration, then they tend to be rejected. There is a distinction between how astronomy works and how high-energy physics works, and HEP brings energy to table.

Siegrist listed the Intensity Frontier projects. The field is large in the U.S. and the program is broad and diverse.

One question asked is if the plan for LBNE with a surface detector followed by Project X is set. LBNE has not yet achieved CD-2/-3, so the plan could change. Collaborators have been developing a well-reviewed plan for LBNE, so changes should have significant scientific justification before thinking of changing.

The timescale for LBNE is not unusual. There is a long timescale from concept to data. The "regular science output" needs to be integrated over the Intensity Frontier program.

The required annual funding level for LBNE could not be supported within the current or projected DOE and SC budgets, so it is hard to commit to it now. This would be decided by a range of SC management, OMB, OSTP, Congress and others who have to hear good arguments.

Agencies and foreign partners are having high-level discussions to get support for LBNE and expand its reach. Discussions are premature but the team is in Europe trying to build interest.

One boundary condition for HEP is that physics always comes first, but there are other considerations. The brute force approach to just build a facility does not work. The LBNE saga proved this. HEP recognizes that single project expenditures must be smaller than \$1B per stage, and that breaking things into steps can be more successful.

HEP sees that projects that build on prior investments either scientifically or through the recycling of infrastructure are generally well-received. It also knows that a plan to produce a steady flow of results is highly desirable. Siegrist shared that an undifferentiated list of projects from Snowmass will not advance far as a P5 process needs to be built on top of that.

Siegrist brought up the agency letter from the NSF and DOE to the community regarding the Facilities Subpanel and Snowmass. These will not provide a prioritization, but will give scientific judgments. The agencies will seek to develop a prioritization by the end of the summer.

Siegrist reviewed the HEP status. In the Energy Frontier, Tevatron at Fermilab is working with DO and CF collaborators to complete key analyses by the end of 2013. In addition, there is a plan being set for the LHC at CERN for phase one upgrades and discussion of longer-term upgrades. Physics work in the Frontier is focused on shifting experiments from a search-based strategy to a measurement-based approach. There is no evidence yet of the physics beyond SM.

Issues within the Energy Frontier include proceeding with follow-on discussions for the LHC agreement. The frontier will also require a high-energy LHC running and that could take a few years to sort out. Snowmass is important in thinking about what to do with European and Japanese strategies. Significant collaborations with other regions on a future collider will require high-level approaches between governments. Once Snowmass and P5 inputs are complete, the DOE will be in a better position to evaluate its priorities in detail.

Siegrist shared a list of Intensity Frontier experiments and highlighted the NOvA Far Detector assembly. It is made up of blocks and the whole thing weighs 14kt. Cosmic rays are already detectable and with whatever beam comes from Fermilab, it will be possible to see neutrinos from the back of the NOvA.

Issues in the Intensity Frontier include establishing long-term goals for precision to measure the neutrino mixing matrix elements. This is important as it will help to explain to stakeholders why the field needs such a wide variety of neutrino experiments and why it is a consistent program. Siegrist noted that many other important areas for investigation were identified in the 2011 Intensity Frontier workshop but a situation analysis of each main area is needed.

The Cosmic Frontier consists of many cosmic and gamma ray experiments, and several DM and DE experiments. The DE Survey commissioning has occurred. There will be a down-select of technologies to determine which one to build. The LSST will make definitive ground-based DE measurements, Mid-scale DE Spectroscopic instrument is planned to complement DES/LSST. The High Altitude Water Cherenkov (HAWC) will start operations in 2014.

One Cosmic Frontier issue is determining the most important science area at which to make significant steps toward HEP mission goals. DM and DE have a path forward but needs must be determined and prioritized. DM has technology choices to make going forward. DE needs to have a ground-based plan to reach stage IV measurements. The question is what other measurement or instrumentation is needed to fully exploit these experiments.

The astronomy community in the U.S. has many budget pressures. It recently did a portfolio review, and one concern mentioned is that LSST will generate a fantastic data set but many astronomy issues will likely need follow-up with other instruments. For PIS, they do complementary analysis. Astronomers are concerned about what the optical infra-red system looks like in the LSST area and how astronomy can continue to move ahead. There is an advisory panel for astronomy and physics. There will likely be a subpanel to look into this issue for astronomy. This may be useful to address at Snowmass. Rocky III looked at DE up to the time of LSST. It may be useful at Snowmass to talk about DM in the LSST era and what other instruments are needed.

For other particle astrophysics areas, the science case and role needs to be better articulated. Some response is also needed from the NSF.

Siegrist talked about communications. HEP is in competition with other SC programs and programs for science funds. HEP needs community buy-in to the process and plan. Siegrist is concerned about the work needed in FY13 to understand options coming out of Snowmass and the P5. When the report is done, the community better buy-in to the report. He knows of concerns in the community as to how funding is set-up. He thought that this was obvious, but learned that it is not. If the community does not support the plan, then it will not go anywhere.

Siegrist added that not everyone in the field enthusiastically supports the current direction. He reminded the HEPAP of that at its last meeting, and he hoped that all would know the community position and plan. He has detected that there is a problem and that some in community are not aware of the key issues and the plan. External stakeholders are getting mixed messages and this lack of agreement is demonstrated in the media.

Siegrist believes that the community can be more unified. He shared a headline from an Internet search that demonstrated a disconnection with the realities of the field and how HEP operates. He is concerned that a young Congressional staffer will find misinformation this way.

Europe and Asia have given large support to particle physics in ways that that U.S. has not matched. Siegrist urged collaboration with international partners but also connecting with the centrality of Fermilab while maintaining a healthy U.S. research ecosystem. The Administration is fascinated with clean and green energy. HEP has had a hard time connecting with that interest but also knows that the work others do in green energy would not occur without the light sources that were established. The P5 report needs to be interesting to decision-makers. They can get excited about science but the report also needs to convey that HEP does something useful, too.

A communication summit on March 13, 2013, will strive to support community buy-in and recognize fiscal realities and the budget landscape. The outside world needs an appreciation and understanding of what the field does. This represents HEP's communication and coordination challenges. The summit will look at strategies to identify and overcome perceived communication and coordination challenges, and address a variety of key questions. The most urgent question is how to develop a P5 process to have people stand behind the results.

To make this work, the community may need to re-evaluate its expectations. One question is the staging of LBNE to keep it moving. A staged approach may be unique for the community. Siegrist is also concerned about getting all on the same page about what things are absolutely central versus just important. There is also a need for joint planning with Japan and Europe. Another approach is to use greater scrutiny in evaluating projects and deliverables. And, HEP needs to show relevance through things such as the accelerator stewardship program.

Siegrist shared that HEP needs three things from the community. One is ideas to revitalize the existing program that do not require large financial investments. He is also looking for

identification of the best areas in which to make strategic and directed R&D investments. And HEP needs implicit recognition of budgets, timeframes, and programmatic priorities. He highlighted worry about U.S. leadership as other regions outspend our Nation.

The take-away message for the HEPAP and the community is not to let others grind down the U.S. simply because they have more money. He noted that the political system is adverse to long-term investments and not strong in planning, and this is a hurdle to overcome. The U.S. needs to out-innovate others and have a long-term vision of where to land in the next 30 or 40 years. He believes that budget woes will eventually end and in anticipation of budget constraints being lifted, there is a need to focus on a vision and make this part of a community discussion.

Siegrist highlighted several changes in staffing in the HEP. He shared with the HEPAP that DOE is working to smooth-out the implementation of guidance around conference attendance.

Upcoming reviews include comparative panels. The reviews were held in November 2012 and grants will start in May 2013. Some comparative laboratory reviews were held last year. A report is now available for Energy, and one will be published soon for detector R&D. More laboratory reviews are coming up this year. The SC Early Career reviews were held in January and up to 10 awards will be announced soon.

Reviews of operating or near-to-operation experiments have been conducted and will continue on a more scheduled basis.

Within project reviews, the well-established CD process will continue.

Roundtable discussion

Erbacher suggested that it would be useful to consider the U.S. leadership role in certain frontiers and statements on leadership or ceding leadership to other countries. The U.S. can join projects overseas but should talk about leading science and design efforts. Siegrist responded that there is great interest in the U.S.' role in CERN. OMB is supporting U.S. efforts in the ILC. He suggested that when the U.S. can play a role, OMB and its staff must understand that and the community must address it. He asked if it is enough to have DP writing letters questioning the value of an investment. They do not want the technology to be redeveloped. He urged thinking about the words that are used when this is discussed. Cvetic agreed, suggesting focus on the ILC and how American scientists' contributions can show how the U.S. is leading the work.

Byrum commented that amidst declining funding, frontiers may work against one another. She encouraged all to work together and that Snowmass is a place to start. The agenda has a section where all can discuss a common message. Siegrist shared that this was implied in his talk. He urged understanding and tolerance of the important work that others are doing. Decision makers may be waiting for chances to reduce funding. Dissonant community voices do not help.

Fisher noted that there are fewer people in the community and it has become harder to diversify. People are committed to one thing and that creates a situation where there is going to be dissonance. He felt that the best thing to do is to acknowledge the situation and live with it. Siegrist recognizes that the nuclear physics community has learned how to unite and come together to support proposals. Fisher shared that nuclear physics uses force and people are told to support certain things, and that those who work in certain places are told to support something or go elsewhere. Supporters are not doing too badly, Fisher commented.

Steinhardt commented on discussion from day one, sharing that the division of frontier is useful for external communication but not helpful on the inside. He also commented that HEP has technologies and thinking that can influence other fields. There was also once broad thinking on things such as what constitutes a theory. He feels that now tolerance has been reduced and is

evident in harsh feedback in evaluations. Steinhardt urged that is HEP can have an impact on other fields. It should not be stove-piping creativity and tampering it. Siegrist commented that joint activities around supercomputers have blossomed; this did not exist a few years ago. Theorists are doing calculations on these machines that can help enable LSD physics. Siegrist suggested that all need to see themselves in a larger physical sciences community and not draw walls but accept chemists and others to help them. This must be more than rhetoric, and must include providing technologies. He is unsure if a six year-old child wants to be a nanoscientist but images from the LSST and science questions might broaden interest. To Steinhardt's comments, Siegrist responded that HEP needs to refine aspects of its review process.

Byrum shared the impression that DOE did not do astronomy and cosmology, but did support astrophysics. There are collaborative experiments that could be considered astrophysics and are in DOE. Crawford shared that his position is that there is particle physics work in the experiments but other types of studies are not supported.

McBride asked about flexibility in funding for new starts or if DOE is just waiting for language from Congress. Siegrist shared that DOE is appealing to get things started and will likely learn about this at the last minute.

Erbacher commented that the list of programs shared by the Facilities Subpanel contrasted with current budget constraints. She expressed the perceived challenge in thinking of new ideas and activities when there is already a stretch to fund things such as the LSST. Siegrist urged continuing to think big. He noted that the LSST has forced the astronomy community to think hard about funding. He suggested that the HEP community join them as something compelling could emerge. Regarding theory, Siegrist suggested finding the right balance and emphasis. The right story needs to be identified along with investment opportunities.

Erbacher commented that everyone wants to know about DE but wondered if it should be funded by the HEP. Siegrist shared that NASA is funding half of the James Webb Space Telescope construction and they have fewer constraints than HEP. The entire government has its eyes on that half of the budget and how they could spend it. HEP needs to help NASA hold onto that budget for astrophysics. DOE's role is being established, but DOE is not seen by OMB and OSTP as program owners. Other agencies do recognize this ownership.

PRESENTATION OF NEWS FROM NSF DIVISION OF PHYSICS

Denise Caldwell, NSF, Division of Physics, Acting Division Director, reported that the Director is leaving to become the President of Carnegie Mellon University. The current Deputy Director will be the interim director. The search may take time as this is a political appointment.

The FY14 Presidential budget has not been released. It will be embargoed until then.

NSF has a high level budget figure and is looking at how to divide that among the four line items in its budget. NSF does not have a large staff and hence will unlikely find much money from furloughs. How the rest of budget cuts impact individual investigator programs is unknown as the number is not yet known. The biggest impact will likely be on support for individual investigators, and this will impact the number of students and postdocs that NSF can fund. There will be an impact on STEM education at the Ph.D. level. Caldwell shared a comment from a colleague that those who will be furloughed are the next generation of scientists.

Snowmass is being discussed in the Division of Physics. Caldwell likes to begin with the science and the real science questions some of which are formulated. She encouraged creativity in developing questions and answers, and expansive thinking from scientific experimentation to needed tools and techniques.

The Division is reaching out to other disciplines and groups such as the National Institute of Standards and Technology (NIST), and is effectively working with the NSF Office of Cyberinfrastructure to leverage tools and techniques from this community that can be expanded upon and used in other groups. The Division has done things with QuarkNet and other things that this Office has pioneered.

NSF and the Division are proud of STEM education efforts. Caldwell reminded the HEPAP that research projects at laboratories also result in more-qualified students as the next generation of scientists. They are the ones who will continue this field. In January 2013, Caldwell attended a national meeting of more than 200 undergraduate female physics majors. There were six locations having a simultaneous meeting around the U.S. The keynote was given by Margaret Murnane from the University of Colorado. Attendees shared that they were excited to be working in physics. Caldwell believes that that interest is probably the most valuable thing that can be sold. The physics community has to capture that inspiration and excitement.

Roundtable discussion

None

PRESENTATION ON NSF THEORETICAL HIGH-ENERGY PHYSICS AND COSMOLOGY

Keith Deines, NSF, Theoretical High-Energy Physics and Cosmology, Program Director, reviewed the NSF mission which reads “to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes...” (NSF Act of Congress, 1950). NSF operates with other agencies and non-agencies to fulfill this mission. NSF funds grant proposals, and uses intrinsic reviews. These are mail reviews that ask for the review of single proposals. Science supported by NSF is driven by proposals themselves and what the community of science finds interesting.

The National Science Board and the NSF Director lead NSF. It has nine directorates and also nine divisions, some of which have been absorbed into other directorates. The Office of Theoretical High-Energy Physics and Cosmology resides in the Division of Physics (PHY). Particle physics resides within seven offices and there is a lot of cross-cutting among offices. Particle physics is important for all of PHY.

The value of the particle physics portion is supported by the SM as an encapsulation of all current knowledge of the fundamental laws of physics. This story is compelling and the 2010’s will be the decade of the LHC. There are two aspects to this. Higgs is a step toward unraveling the mechanisms behind electroweak symmetry breaking and the origins of mass, and there is direct confrontation with the hierarchy problem.

This story is very LHC-centric, but high-energy is not the only way to probe for new physics. Higher intensities can also give an independent window into fundamental physics. Particle physics has strong connections to other fields, and studies of the history of the universe. This will be an exciting field and a story that NSF can sell.

The theory program and PIs funded are developing most of the theoretical possibilities that will soon be tested. Themes are broad and include different Higgs structures, new models of DM, AdS/CFT, AdS/QCD, AdS/CondMat, and others. The themes run the gamut from data-driven collection of physics to philosophical physics.

There are 104 grants including 13 career awards. These fund 186 PIs and Co-PIs, and about 50 postdoctoral students. This ratio of about one-to-three is a problem. The culture of large group

grants has carried over in the theory and funds many university theory groups. These are presumably ones that DOE is not funding but also some that are jointly-funded by DOE.

NSF funding in this program transcends international boundaries with reach to Switzerland, France, Japan, and other experiments. This includes legacy experiments in the U.S. There are 49 regular base grants and 11 CAREER awards. NSF funds 181 senior researchers, 104 postdocs, and 176 graduate students.

In Experimental PA / Cosmos, NSF funds rich programs in the Cosmic and Intensity Frontiers. This is led by Program Directors Jean Cottam Allen and Jim Whitmore. This program works to solve fundamental questions for the Universe such as determining its origin and how it reached its present state. This is a large program with 134 regular base grants that include 35 under-represented PIs and 15 PIs who received a Ph.D. after 2001.

Research activities operate in parallel with education and outreach programs. QuarkNet is one example. It brings LHC data to teachers and students, reaching 450 teachers, 100 student researchers, and 100 physicists per year.

This is all funded through the MPS budget. The NSF FY13 request was \$7.373B. The MPS request was \$906M and MPS received \$1.3B in FY12. The PHY budget in FY12 was \$277M and receives the second largest portion of funding next to Materials Research at \$295M. Funding over time shows a peak jump around FY09 with ARRA money.

Particle physics funding in FY12 was \$94M, to support Experimental EPP, Experimental Particle Astro, and Combined Theory. Additional funding from other allies, projects, MPS support for education and graduate student support, and the Office of Cyberinfrastructure brought in \$30M, for a total of \$124M. There is never enough funding to support all that PHY would like to do. Protecting the core program is a concern.

Severe financial stress is one problem for the High-Energy Theory Program. There is insufficient funding for new faculty start-ups or current faculty, and to support graduate students. Teaching assistant support is challenging as state funding gets cut. Funding support is needed to keep non-U.S. citizen students in the U.S. and support research at U.S. institutions.

There are emerging “systemic” problems. One is the notion that one can write a grant proposal and get funding. When that expires, a researcher may put the research into the next proposal. The concern is double-dipping when funding for work comes from one agency and then CAREER funding for the same work comes from another agency. This is being more heavily scrutinized. In addition, funding levels are not always commensurate across agencies. Someone may get a CAREER award from one agency, but might hold-out until a decision on their funding is made by another agency.

Goals include establishing and deploying “emergency” funding for graduate students and building this into long-term funding support profiles. There could also be a higher minimum funding floor for starting grants and increases for mid-career physicists whose funding levels have been frozen since their early faculty years. There are possible new initiatives working in Underground Science in the Intensity Frontier and International Network collaborations.

Roundtable discussion

Erbacher noted that the CAREER awards used to be bigger in some programs, but is the opposite for theory. Deines responded that funding can be no smaller than \$80K per year for five years. If a new assistant professor normally starts at \$40k, they are in essence getting two grants. A DOE Early Career Award from DOE is \$150k. The hierarchy of funding between agencies is a problem and this should be roughly commensurate.

Erbacher noted that the LHC study was written before the LHC was turned on. That was to help with Monte Carlo efforts and other things. Deines shared that LHC has grown and funding supports people who are doing more than just LHC-funded research. This was not always the most flashy thing and funding was meant to give that more prominence. He hopes that work on Underground Science in the Intensity Frontier will lead to proposals to explore that area.

Erbacher noted that proposals reflect particle physics and gravity, whereas one earlier slide showed gravity differently. Deines confirmed for her that activities and PIs overlap as divisions talk to one another and find ways to fund the best science. String theory and things related to gravitational physics come to his program, whereas gravitational physics takes things that do not include string theory. He is turning to mathematical physics as more research uses superconductors. His budget is limited and if a study looks at how a superconductor works, then it should not be funded out of particle physics.

Cvetic commented that theory is impacting fields in other divisions. Deines shared that the Division of Mathematics and Material Sciences handles condensed theoretical physics. Program directors at NSF are able to co-fund ideas. For example, if there are new techniques to survey the sky and do cosmology but also some analysis, then funding might come from another office. F-Score is an example that funds research in certain states that do not get large amounts of NSF support. If there is funding outside of physics that can fund that, proposals can be nominated.

Gilchriese commented that there are big items coming up and asked about NSF's role and what they will provide. Saul Gonzalez from NSF Experimental HEP responded that NSF is proposal driven. There are different areas of physics that catch many programs. NSF is trying to create funding to recognize multiple disciplines and vehicles that can fund theory out of many programs. Caldwell added that NSF's continued emphasis with resources is on individual investigator programs. This supports universities, postdoctoral students, and graduate students. Those activities will always be protected, and NSF looks at the tools and experiments that are needed. Caldwell and her colleagues look within PHY to support experiments that need to be done and this is essential to the physics instrumentation program. This is not renewable funding but allows for investing at a level that NSF can afford. NSF also has an instrumentation program and PHY has done well in securing funding for detector development. If a researcher has something that needs to be built up to \$4M, then NSF has this avenue. Gonzalez added that it is important to realize that there is more than particle physics. Proposals in that area compete with a lot of other interesting proposals.

PRESENTATION ON DOE SC DATA MANAGEMENT POLICY AND PLANS

Laura Biven, DOE SC Senior Science and Technology Advisor, provided an update on the SC Statement on Digital Data Management. Biven supports Patricia Dehmer in SC. This was last discussed in Summer 2011 wherein HEPAP gave input on data management and access.

The text is not yet final but the components of this are firm. The requirements apply to proposals that come into SC for research dollars but not to SBIR/STTR or proposals for the use of facilities. The statement considers OSTP guidance on "increasing access to the results of federally-funded research."

Data management refers to all aspects of the data lifecycle but the policy really is focused on data sharing and preservation. This policy will affect PIs and the research community.

The approach is that this policy is specific to the SC needs and mission. SC wants to make sure it is consistent with Administration guidance and consider input from the community and the public. The requirements will go into effect on October 1, 2013.

Principles for the policy dictate that data management is an integral part of research planning. A data management plan (DMP) should be part of research planning, that sharing and preserving data allow for replication and broadening other disciplines through access. The costs and benefits of data management should be considered in planning.

All proposals coming into the SC for research funding are required to have a DMP of about two pages. It should show how the results will be shared to enable validation, or how they could be validated if data is not shared or preserved. Data should be made available in a digital format and could be available through a third-party website.

DMPs should indicate how data in publications will be available at the time that the research is published. This is from an SC report in 2011 that requested that all data be in digital format.

Researchers planning to work at an SC user facility should know that facility's data policy and reference it in their DMP. A facility's written approval is needed in instances where the DMP exceeds what is normally provided to approved users.

Not all data needs to be shared or preserved.

There may already be thoughts in the HEP community on how data will be shared and preserved. SC would respect those bylaws already set by HEP organizations.

These requirements apply at an SC level and are for all DMPs coming into SC. There may be additional requirements in HEP or other offices in SC.

Roundtable discussion

Biven shared with Fisher that SC did not want to specify a timeframe for managing data at an SC level. HEP or other programs might have additional guidance and could be specific for a particular field. In the absence of guidance, proposers should propose something that they feel would pass muster with PMs and reviewers.

Biven confirmed for Hendrik Weerts that SC did not want to specify how long data should be preserved. Some communities can define this. Just as important is when data should be retired.

Byrum asked if this pertains to all proposals. Biven shared that a proposal is defined as a response to an FOA. Not all lab funding is done that way. Proposers could consult someone within HEP to get input on this. Some proposals require white papers and other products.

Biven clarified for Honscheid that SC thinks that the two pages for data management are in addition to the rest of the submission. Honscheid asked if there is a plan that can be referenced or guidelines for submissions. Biven responded that this is how SC would like to organize this. Crawford added that the DMP will not count against the proposal length but might very well say that it follows the ATLAS data management policy. This approach is a little fuzzier for laboratories. SC intends that DMP will part of proposals and will have a statement for pertinent organizations' DMPs.

Honscheid noted that there are peers in theory that do not work in ATLAS. Crawford sees that this will depend on what is in the DMP, but this is not yet completely decided. For instance, if there is a figure in a paper, will a policy be needed to deal with that figure? Theorists will have to address this in one way or another. NSF has taken more than one year to try to determine how to do this. Dienes shared that proposals coming to NSF should have a theory management plan or state that they will publish results in archives or post them on a website. Ultimately, proposals will go through a peer review process, so if a panel accepts the proposal then that is enough. Biven commented that this is consistent with academia. In terms of figures used in publications, if the proposal is peer-reviewed then it does not need to give an explanation.

Biven shared that there is a movement from publishers to ensure that the data supporting research findings is available. More recent activity comes back to the 2010 COMPETES Act that established committed calls for public access to research that included publication and data. OSTP provided guidance on February 22 and agencies have to do this.

Caldwell shared that NSF has been dealing with this for two years and is working on a uniform approach. The DMP would be submitted as part of a proposal review process. This is a mechanism for allowing the community to make decisions as to what constitutes data access and preservation in communities. It can be as simple as the bylaws of ATLAS. Some universities are setting up data management approaches and policies. Caldwell has seen proposals that have been turned down and sent back requesting a DMP.

PRESENTATION ON DOE HEP UNIVERSITY COMPARATIVE REVIEWS

Glen Crawford, Director of Detector R&D in DOE SC HEP Research Technology shared an update on HEP university comparative reviews. There are differences between the DOE and NSF and the implications of funding.

DOE is trying to fund new projects but also dealing with the reality of decreasing levels of funding. This is driving the comparative review. DOE HEP received 185 proposals requesting \$335M in one or more of six sub-programs by the September 10, 2012 deadline. An initial cut brought this total to 162 proposals that were evaluated and discussed by experts who met in six panels over two weeks. This included traditional umbrella proposals requesting support of two or more of the six sub-programs. Panels reviewed proposals within their individual subject areas. The areas were the three frontiers, theory, particle detector R&D, and the HEP Advanced Technology S&T R&D sub-program.

Sixty-one proposals were declined, some of which were extending their current proposals or were follow-ups to funding received in 2012. In FY13, there were many new proposals in the Cosmic Frontier and technology R&D areas. HEP funded 101 proposals and declined 61, for an average of about 62 percent. The success rate for new proposals was about one in three and about 78 percent for continuing proposals.

There were 504 HEP senior investigator proposals. About 20 percent of the individuals were new to DOE and had not previously received funding. It is possible to be PI or Co-PI on a proposal if your proposal is not funded. The overall success rate is around 74 percent.

Last year, there were many questions about the success rate for junior faculty and research scientists. Sixty proposals were received from junior faculty and 40 were funded. About half were new to DOE and were not previously funded on a DOE grant. Some are already have stand-alone grants or are part of an umbrella grant. Eighty-one proposals were received from research scientists and 47 were funded. The totals were dominated by the Energy Frontier and accelerator R&D. In the Energy Frontier, this is due to people who are senior researchers but are not faculty and have been on a staff for a long time. In cases where people were not funded, DOE is working actively with ATLAS and CMS to find support for the fraction of research scientists needed for the LHC Ops program. These individuals do not always review well, but DOE wants to hang onto these people and find a way to support them.

Crawford compared FY13 proposals with FY12 decisions. There were 20 new ones that were not previously funded. Declined proposals are new proposals that were not funded. There were big changes in the Energy Frontier as most might have been associated with the Tevatron project and thus did not get funded.

There were more proposals and PIs this year than in FY12. Crawford recognized the ability of the DOE staff and PMs to manage this. DOE also had to deal with umbrella proposals that were broken-up into pieces. The average proposal success rate was somewhat lower, but the total dollar levels requested was similar. University funding was down overall on average, and significantly lower in theory and the Energy Frontier. DOE decided to provide additional funding for these two areas after the review and Crawford suspects that this will be a year-by-year process to adjust funding levels as best as DOE can. The point of the comparative review is not to rely on historical funding figures but to hit reset each year and fund the best groups possible.

Most of the new proposals in FY13 were from new PIs in the Cosmic Frontier, and there were many astronomy proposals when people realized that HEP was funding DE. Crawford also noted a larger turnover in technology R&D. This may account for many new PIs.

Crawford reviewed lessons learned for next year. The process was deemed successful and will be repeated. It was logistically complex, so HEP will start earlier. The FY12 process informed the uniformity of the FY13 process. It was made more uniform across the research thrusts and panel chairs wrote brief summaries of panel deliberations for PIs and proposers.

For FY14, HEP is considering ways to optimize the workload of proposal reviewers, give a proposal template for personnel and budget information, encourage reviewers to add comments to PeerNet prior to adjourning, and ensure a balanced panel of reviewers.

HEP will also seek to improve communications by updating the FAQ section of the HEP website, giving updates at HEPAP and other meetings, and continuing its interactions with the DPF. It will also use reviewers with experience from either the 2012 or 2013 processes. Some had a positive experience. HEP will try next year to have PMs continue to present DOE programmatic priorities, future direction, and the role for the panel to help guide panelists in their reviews, following the end of the review process.

The FOA for next year will come out in the next few months and there will be an email drop-box for questions that come up.

Roundtable discussion

Erbacher shared the impression that funding would not come from research programs to support the proposals, but that it seems like more funding came from some frontiers than others. She believes that funding should follow P5 recommendations and wondered why a PI who ranks in the upper third of a priority area would suffer more cuts than one in a different area. HEP seems to be micromanaging what topics people should research, and that it is unfair to not fund researchers who are doing well and review well but happen to be working areas such as the Energy Frontier. Crawford clarified that proposals that did not do well in the reviews, did not do well because they were compared with peers in same area and deemed to not have the same impact. These individuals are not performing as well compared with peers in their field.

Crawford also commented that the review folds in other factors including the fact that the DOE is a mission agency and has priorities. An equal cut across all areas does not give the HEP its best possible research program. It is not fair to those who are doing well in particular areas to then cut them. A better approach is to create a scale of who is doing well. This decision was made with PMs, Siegrist and Crawford. Overall research budgets are declining but that is not being distributed equally to every program. The Tevatron program is almost competed so it is not funded in same way that it was funded two years ago. The first round of the review showed that HEP could not all that it could in the Energy Frontier, so DOE scraped up extra money to support those who are doing good work.

Crawford added that the office has priorities that it must execute and the evaluations describe how well proposals align with the DOE's Mission.

Erbacher commented that the guidance for the mission is from the P5 and that the Energy Frontier is the highest priority. Crawford asked if that is the highest priority, should DOE fund everyone who wants to do Tevatron analysis.

Erbacher expressed that people are uncomfortable that these decisions are being made without their input. Crawford reminded the HEPAP that this has been posed before. He asked if HEPAP wants to give input on things such as how many people should be working at the LHC. HEP would listen. That kind of estimate has not been provided.

Abid Patwa of the DOE SC shared that the decrease in Energy Frontier funding of eight percent is largely due to a ramp-down of the Tevatron. He also pointed out to Erbacher that there were other proposals that did not review well for ATLAS and CMS. On top of this, there are budgetary constraints. Eleven of the 28 proposals were for the Tevatron. There were 10 in the Energy Frontier that went up and those are proposals that went up.

Erbacher asked how many physicists it takes to measure delta, and Crawford responded that this is a fair question. Lankford added that the P5 evaluates issues. A statement speaking on a project is not directly speaking to a frontier. Erbacher commented that it takes a lot to do LHC work as there are so many topics.

Gilchriese commented that normally the P5 would not address this issue. He thinks that there may be some sensitivity to how a field distributes its personnel, and wondered if this is something for a subcommittee to consider as part of the new P5 process. Lankford commented that this will be discussed later by the HEPAP.

Cvetic commented on the significant cut in funding for university work on theory. She felt that this was considered to be a forefront community, and asked about the decision to reduce funding. Crawford shared that a challenge was that the community had a large share of research questions in both the universities and laboratories. The university theory budget took a larger cut than other budgets but the proposal success rate was comparable. People at the top received higher or flat levels of support. This was dictated by available funding. HEP could have funded fewer groups at higher levels but did not. After a first pass through proposals, the HEP found more money to put in the university theory program.

Crawford responded to David Sutter's question about folding a stewardship program into technology R&D, sharing that this was not explicit in the FOA but was done. Some of the reviewed proposals were relevant to HEP and this intersects accelerator physics.

Steinhardt asked about theory and for clarification on the difference between university and laboratory support. Crawford shared that the theory research budget took a hit just like others. There were cases in several laboratory proposals where existing commitments were made to various places. This tied HEP's hands to some extent for laboratory budgets for FY13. The resulting impact was on the university research budget, but HEP tried to some extent to improve that situation. Steinhardt wondered about comparing one location to another and if commitments can be made to one but not another. Crawford responded that universities and laboratories cannot be reviewed head-to-head as one is a contract and one is a grant. The commitments are different. Universities can write a proposal and they are good or not. Laboratories are evaluated against their peers and this also brings in issues such as people going on sabbatical or retiring, and then HEP has to get involved to determine funding levels.

Simona Rolli of the DOE HEP added that funding comes out of the peer review. There were grounds for some individuals to be dropped. Generally, grants went down due to specific

individual researchers. Many of the highest reviewed grants were maintained at levels comparable with the prior year. In addition, the comparative review could only allow for a comparison of things at the same time. Many grants were starting on different dates but HEP has grouped funding to save funds in the FY13 budget. Some prior grants ran for 18 months, so HEP had to balance between FY12 commitments, FY13 funding, and the length of grants.

Rolli added that laboratories are contractors and HEP cannot run these as grants and take away funds. Generally, HEP can give guidance and determine if a program would review well in certain areas. HEP gives laboratories less money but asks them to find a solution to a specific problem. Most of the laboratories have reduced reserve funds to zero. She does not know why prior managers did that. People returned from sabbatical and the money was not there. This is a contract issue and is a decision made by the contractors.

Crawford commented that laboratories and universities have historically been funded about equally by DOE. He shared that if HEPAP wants to comment on the appropriate levels of funding, DOE would be willing to have that discussion.

Erbacher noted that Crawford's slides showed that three of 40 Energy funded proposals were provided term support (<1 year) for graduate students and post-docs. She wondered if this was a case where a PI did not review well. Crawford confirmed that there were some instances where this was true and that there was funding provided to support post-docs.

Lankford reminded Crawford of Siegrist's comments at the December HEPAP meeting that overall university funding would go down by two percentage points but now it may be down by more. Crawford cautioned comparing different things and that HEP is still sorting out the funding details.

Lankford asked about research funding at universities. Crawford shared that this could be down from one to three percent but that there may also be local variations. He looks forward to wrapping this up when HEP actually has an FY13 budget and looking into maintaining a university and laboratory balance.

Erbacher asked about cutting university funding to fund future facilities, and if the money will go to facilities or where it went. Crawford responded that it can be difficult in the Federal government to track where money has gone. HEP is trying to put more money into facilities and has been less successful than hoped. Siegrist added that in the continuing resolution, HEP is operating at the lowest point of the budget projection and as if the money was gone. He shared that the LHC was taken out of the President's budget, and in the context of operating at the lowest possible budget, HEP is operating as if Congress has not decided on a budget. Crawford added that one approach to sequester is taking money out of the facilities operations and project areas. He hopes that when the budget is normalized, the money can be reinvested next year.

Oddone shared that Fermilab's funding has been dropped, commenting that discussion of two percent cuts have led to a 10 percent cut at Fermilab.

Steinhardt asked Rolli what happened to laboratory theory, and its losses and gains, along with the number of people being funded at the laboratories compared with universities. She commented that laboratories are using post-doctoral students. She will have to look at HEP's records to understand how the two compare. BNL is losing one proposal and another laboratory is losing students. Crawford shared that this is happening at other laboratories. Steinhardt asked to see the actual numbers.

PRESENTATION ON ASTRONOMY AND ASTROPHYSICS ADVISORY COMMITTEE ANNUAL REPORT

High Energy Physics Advisory Panel – March 11 - 12, 2013 - Meeting Minutes

Kathleen Turner of NSF provided details on the Astronomy and Astrophysics Advisory Committee (AAAC) panel. It reports to NASA, NSF and DOE in areas of overlap. The AAAC reported on the progress of National Academies 2010 Decadal Survey, “New Worlds New Horizons (NWNH).”

The AAAC will give an annual report to the agencies and Congress on March 15, 2013. The report was published earlier this year and is available at http://www.nsf.gov/mps/ast/aaac/reports/annual/aaac_2013_130308finalreport.pdf.

Recommendations relevant to the DOE and NSF include continuing support of the LSST. WFIRST is the higher priority space, but is a larger prior large ground-based facility in NWNH.

The AAAC recommends that work should continue on an open skies policy. The definition for open skies varies. The astronomy community holds its idea of an open skies policy, but is starting to realize that not everyone shares this view and their capabilities. The recommendation asks that the agencies work together to provide access to foreign and non-federally-funded facilities and data sets. For example, in the LSST era, many want to use the Gemini telescope to follow-up OOST observations. Gemini access is partially foreign or privately-owned, and cannot be easily accessed. LSST is open to many and is U.S.-owned. Private telescopes are another component, such as those at specific universities. If you work at other universities, then too bad.

AAAC also asks that projects be leveraged when designing the project. An example is LSST and Euclid. LSST is producing large data sets and Euclid needs LSST targets to do data analysis. However, Euclid will only allow 40 U.S. people in on its collaboration. The U.S. wants more and this negotiation is ongoing.

Only NASA is allowed to talk to the European Space Agency (ESA) and the agreements and discussions are not clear.

AAAC recommended that NSF commission the National Research Council Committee on Astronomy and Astrophysics (NRC CAA) to help define a revised national ground-based optical/infrared OIR system to balance out all of the measurements that could be done. That is one thing that Siegrist talked about. Turner suggested that the DOE DE community give input and describe what it would like to do in order to not miss out on this opportunity.

The last recommendation is that the NRC CAA carry out a mid-decade review of progress on NWNH survey gals and keep the program going forward.

Roundtable discussion

None

PRESENTATION ON DOE DARK MATTER SOLICITATION

Mike Salamon from the DOE SC HEP provided a status update on the second generation (G2) DM program and formally announced the selections for the dark matter solicitations.

Generation one (G1) detectors are able to detect Xenon levels. G1 DM detectors defined as those can reach 10^{-45} . The best detectors come from accelerators and not DM.

The PASAG Report (2009) informed G2 opportunities and the ability to reach sensitivity levels better than 10^{-46} cm^2 . This is a factor of 400 better than present-day limits and a factor of ~10 better than expected.

The community is also looking at G3 detectors. G1 was supposed to get down to $^{-45}$. G2 has an order of magnitude sensitivity, as does G3. At G3, one could exclude the SUSY space until Higgs was discovered. One issue is that this does not sufficiently define G2 as there is interest in

low mass regions where the cross section is larger than 10^{-46} . This is completely inapplicable to axion measurements, for example.

For the FOA, a G2 experiment is defined as improving current knowledge of relevant DM particle parameters by roughly one order of magnitude or more. For WIMPS, this parameter could be but is not restricted to the WIMP-nucleon cross section limit. In the case of axions, the parameter could be but is not restricted to a limit on the photon-axion coupling constant. Any viable DM species may be the object of an investigation.

The PASAG report contributed to the funding profile and mission needs statement approved in September 2012. For R&D studies only the total funding is \$7M in FY13. The total DOE DM budget is \$38M. This does not include the cost of research such as support for faculty, post-docs, graduate students, and other research budget costs. The other \$31M is for fabrication.

Salamon described the G1 experiments. The COUPP (Chicagoland Observatory for Underground Particle Physics) at SNOLAB relies on energy disposition that when above a certain threshold develops a bubble. Betas and gammas are too small to detect, but other things can be detected. There is a Large Underground Xenon experiment at the Homestake Mine. DarkSide 50 at LNGS is in the process of commissioning. Cryogenic DM Search at Soudan is operating. And, the Axion DM experiment at the University of Washington will start its science run this summer. There are some smaller scale experiments such as DMPTC and DAMINT that is a low threshold CCB detector at SNOLAB.

A challenge in moving forward is that the DM community wanted to move forward quickly. Various technologies were and are at different stages of maturity. Some of these early low maturity technologies have great scientific promise but have yet to fully demonstrate their level of performance. If only two or three are chosen, then these need to be the best and the choice needs to be informed. DOE wants to learn as much as it can about these technologies.

The solution is to conduct the selection in two phases. The first occurred in FY13 and selected several proposals for one-year for R&D funding only. The work is solely pre-conceptual experiment design activities. An experiment with a total cost of less than \$5M is exempt from restrictions on fabrication and expected to go through the CD1, 2 and 3 gates.

The second phase will involve a down-selection in FY14 to identify two or three projects from the R&D pool that will move into a project phase. This will be informed by reports from phase one teams using specific criteria. Each experiment will become a project in the G2 DM Program, will have independent project life cycles, and will start at end of FY16. An important point that the final selection of G2 projects will be done in close coordination with NSF to combine agency resources and have a robust DM program.

The G2 DM FOA provides one year of R&D funding in FY13. Salamon reviewed the FOA application requirements. In particular, DOE wanted to know about the experiment as whole and what was to be built in the project phase.

DOE received 13 proposals in July 2012. Ten were more WIMPS and three were for axions. DOE struggled putting together a panel as many experts were on one or more of the proposals. Non-U.S. reviewers were sought and met in September. It was recommended that DOE fund all of the proposals but DOE was only able to pick five due to budget constraints.

The five G2 DM proposals that are to be supported are:

- ADMX-Gen 2 (Axion DM Experiment) where the ADMX-2A is being supported.
- LZ which is a G2 version of LUX and planned at the University of California-Davis
- SuperCDMS at SNOLAB
- DarkSide-G2, planned for LNGS

- COUPP-500 at SNOLAB

There seems to be one-to-one mapping between G1 experiments being supported and G2 funded activities.

Salamon described each funded experiment.

ADMX-G2 is a resident microwave cavity where the axion comes in and produces microwave photons. These are detected in the resident cavity and with a point-one degree SQUID amplifier. This is sensitive to sub-yoctowatts (10^{-24}) of power. In G2 at lower temperatures, the scan rate can be increased and can probe for $1\frac{1}{2}$ orders of magnitude of axion mass. This is below the mass established for general axions. ADMX-G2 will be able to search for over half of the viable parameter space but will also exclude Petchiykun axions.

The LZ experiment will operate at ~ 8 tonnes of Xenon volume. The water tank being used is the same as at LUX that was already funded through the Sanford Laboratory. The LZ reach is down to 10^{-48} cm^2 and it does not make sense to go down much further. Neutrinos look exactly like WIMPS and it is impossible to discriminate between the two. LUX wants to get down to bottom of region.

SuperCDMS SNOLAB will get down to 10^{-46} cm^2 but will also explore a lower threshold to probe lower mass space. This is important due to claims of lower DAMA and CREST-II regions. There is interest in this experiment and the ability to probe this region for WIMPS is a plus.

DarkSide G2 is liquid argon TPC at 5 tonnes of argon. It is TPC surround by a veto system. The TPC and liquid argon TPC is put into existing scintillator and water veto in an existing tank. The experiment will use a lot of existing infrastructure. An important aspect is that 5 tonnes with existing argon results in not having to worry about argon39. The work can trigger TPC where the lifetime is low. A Princeton group got around this and found deep underground argon deposits. All argon39 is decaying away. This is the argon that researchers will liquefy and use in the DarkSide G2 experiment. They expect to reach a sensitivity of 10^{-47} cm^2 .

COUPP-500 is another funded project. It shows a spin independent of 10^{-46} and spin dependent down to 10^{-42} cm^2 . Multiple targeting is a nice feature and this work will merge with PICASSO DM experiment.

Salamons shared cost profiles for all of the selected experiments. In FY13, there will be one year of R&D funds at \$7M. The selections made were dictated by this constraint. The selections were not constrained but based on out-year costs as DOE has low fidelity. The most highly-ranked of the experiments consumes all of budget, and yet it is a superb experiment and should be a contender. If there was more funding then DOE would try to accommodate experiments of this type. DOE sees many lower costs experiments and all of these wanted to come in under the \$5M cost cap. The number of proposals selected was based on cost constraints and not the total estimated cost of the project candidates.

Theoretically, all of the experiments will start fabrication in FY14/Q2 but that may shift assuming that there is no continuing resolution.

Roundtable discussions

Salamon shared with Byrum that most of the experiments received NSF support in the review process. SuperCDMS and ADMX-G2 did not apply to NSF, and he was not sure about COUPP.

He told Bryum that those not selected will be not out of the competition. There are some specific ones that DOE is dealing with but will not be part of the G2. They can get support from the Cosmic Frontier and R&D budget. This can lead to a G3 selection if there is such a program.

Siegrist shared that his expectation is to support coalescing in the community. Salamon added that those selected experiments may expect to build up their number of postdocs and students to support research work but that will not happen. The research support will probably remain a rough constant. Personnel will have to come from expanding collaborations and institutions that may not have been part of the original proposals but were on losing proposals. DOE wants to keep this expertise and drive community coalescence.

Salamon confirmed for Lankford that most of the experiments include international collaborators. LZ, for example, includes partners from the U.K. and Portugal.

Honscheid asked how these experiments compare with others overseas. Salamon shared that there are discussions of a merger of COUPP with PICASSO, and ongoing discussions to form certain U.S. and European collaborations. There are competing activities in China but they will lack the reach of experiments such as LZ. The U.S. will be in a position to compete.

CLOSING DISCUSSION OF HEPAP ISSUES

Lankford invited comments on the Facilities Subpanel report.

Erbacher expressed that it is unclear what will happen with the information and how it will be handled by Dr. Brinkman's successor. Lankford asked if Brinkman seemed to imply that the report would inform decision makers. McBride felt that Brinkman was ambiguous and that this will have a secondary function of informing his successor.

Erbacher shared that people seemed opinionated about the report wording, despite not having a draft on which to comment. McBride lauded the Subpanel for its work in a short time period but commented that a draft is needed to know what will be presented and show the careful thought that was put into it.

Rosner added that he hopes that the rating for LBNE can go beyond letter grades and explain how it is absolutely essential for international collaboration. Lankford responded that this is the intent. He hopes that there is an effective way to do that. Siegrist thanked the Subpanel.

Lankford asked for reflections on agency reports.

Erbacher shared a perception that the number of universities going through the comparative review was larger than in the past. Crawford noted that DOE purposely funded some for four years, and others for three or two. This will reduce the number in this year of the cycle and help in future years.

Honscheid shared that DPF moved to a new type of committee. McBride commented that DPF already turned in a report but it has not been discussed yet. Crawford added that a COV this year will ask questions about the DPF and which activities were funded, why, and if this was done correctly. That will be addressed in Fall 2013.

Lankford asked for comments on the comparative review. Siegrist commented that the COV process is SC-wide and SC takes it very seriously.

Steinhardt commented that the issue of the value of theory studies at universities was brought up and should get some attention. Lankford shared his observation that over a significant number of years, budget pressures have led to changes in the university group. Panel reports have noted a decrease in technical personnel in the overall structure of universities. The first big shock in the comparative review is the number of senior personnel and operational tasks. He shared that with differing sizes of universities and laboratories, there is no clear vision of the respective roles of

these differing institutions on the national scene. Lankford commented that it would be useful to engage agencies and DOE on the current vision and how to develop it. One or two university panels might describe university needs but that could be an unachievable wish list. He asked how the community unites to get things done, and that this is a general problem that should be addressed to sort out what is happening and come up with constructive strategies.

Lankford responded to Byrum's question about forming a group to study this, suggesting that should move from anecdotal information to facts and discuss potential scenarios. Themes could include shrinking technical resources and clear paths for university investigators to collaborate. Theory is an area with research personnel at laboratories and universities. Opportunities for students could also be studied. Lankford would like to see a balanced subpanel that could have frank discussions.

Cvetic is amenable to proposing a subpanel with balanced representation that could form a vision for how things have been changing. Lankford asked if theory would be a separate panel.

Siegrist shared that he is not immediately convinced by HEPAP discussions over the last few meetings that there is a joint vision for laboratories' roles. The community could discuss this and how laboratory and university theory groups interact. He is also concerned about the student pipeline, as so many technical aspects have been removed from universities. A broader look at university and laboratory interactions might help and could include theory. He agreed with Lankford that there has to be a subpanel to talk about results but also have detailed discussions.

Steinhardt sees theory as different. Theorists' roles at universities and laboratories are different as the problems differ. He expressed that discussing both types of problems in one subpanel would not produce a solution as the solutions are different. Lankford added that lumping the environments in one discussion could lengthen the process. McBride responded that they do have different problems but if a subpanel is producing this it could also get at balance. Some way of coupling in the field can also show results. Lankford added that the different types of theorists would have to be considered.

Rosner noted that the subpanel could couple theory and experimentation in similar programs. For instance, Fermilab has a student internship and opportunities for theorists to gain experience and learn experimentation. Or, it can bring in someone from college to work on theory.

McBride shared that another issue is determining how NSF would fit into the subpanels. Crawford responded that subpanels should direct the agencies.

Weerts observed that there are many people missing from today's HEPAP meeting. He suggested that the discussion should wait for greater representation and be discussed on the first meeting day since the issue is critical for the whole field. He would like this to include a charge to a subpanel. Weerts described this as a sensitive and important issue that may lead to doing things better than the community is doing now. Lankford commented that the charge will have to be carefully put together, especially in determining the support and timescale needed.

Weerts also added that the theory discussion is aided by having strong experimentation and theory groups. He would prefer to have inclusive and integrated discussions, and to not treat theory as a separate field.

Rosner added that he is concerned about university physics departments, describing them as being in total peril. These concerns are low for institutions that are normally supported by agencies. He reminded the HEPAP that there are people at universities who can benefit from agency support, and that this is more in the mission of the NSF than the DOE.

Lankford asked for comments on the DM solicitation. Byrum commented that it will be interesting to see the level of integration between those selected and those not selected. Siegrist hopes that this will happen and that OMB is watching. He added that there is a lot of scrutiny and questioning about the pairing of technologies. DOE has been able to counter this but it has been a struggle. Siegrist hopes that the community will respond well to the panel's decision.

Steinhardt commented that it is fascinating to see the projects competing with one another and that it is rare that the technologies will become available at the same time.

Erbacher commented that G3 might not be necessary if the G2 goals are completed and nothing is found. Siegrist responded that this is an excellent point for Snowmass. DOE wants to determine what DM is. There is theoretical speculation and what is known can be extremely useful. However, running below the irreducible floor does not make sense. Salamon asked where would one look if nothing is found in G2. There is an investment of \$100M but if nothing is found, then he does not know where to look.

Rosner asked about G3 at ADMX. Salamon responded that there are pathways in G2 if one sticks to the Petchiykun map. A group at Yale is working on technologies to scan for other regions. This would occur at the 30 micron range.

Rich Gaitskell commented that with G3, one has to look at scenarios with detectors and the intensive plots that one is eliminating. To study WIMPS, those machines are insufficient. He also noted that assuming one listens to what is known about constraints, there is actually room between G2 and G3. If one is theoretically motivated, you can find other masses. He expressed that there should not be a notion that there is no need for G2. Based on theory, there are parameters and research can look into those pockets.

Salamon confirmed for Honscheid that the schedules are about 2 ½ years and are based on what was described in the proposals. These are not major facilities but experiments. Equipment and facility support exists in some.

Honscheid added that the conversion of LUX took more than two years, commenting that the construction of a G2 experiment is not an unreasonable amount of time. Gaitskell responded that LUX had an extended period for R&D. LUX was a prototype of another machine with technology developed for a bigger instrument. Xenon 100 was a different attempt. There is for LUX a relatively modest effort to put things in the water shield that were designed for a much larger instrument. That explains why researchers worked hard on the surface.

Steinhardt asked about CMS detectors, and Salamon responded that there have been discussions about that. He could not answer the question programmatically. Crawford added that there is a schedule of things that are coming. After a down-select, DOE will baseline these projects and it is possible that the schedule will shift.

Lankford asked for input on the digital DMP. Rosner commented that the computing frontier will discuss this at Snowmass. Lali Chaterjee added that there will be an effort to keep this as soft as possible. Community members are already data aware and the policy is very general. It may not ask for more than NSF does already.

Lankford asked for other remarks.

Siegrist asked how the agencies can maximize other communities' buy-in to HEPAP. As a follow-up to the discussion about choosing a subpanel to discuss university and subpanel roles, he wondered if something more transparent or communicative needs to be done. He shared that

the last P5 involved about 15 people, and responded to Honscheid's question about timing noting that the preparatory group would respond to Snowmass.

McBride shared that the EU strategy group started in September 2011. Despite a slow start, it had an open symposium one year later. The group met several times and most of the work was done in one year. Siegrist added that fitting this into budget timeframes makes it complicated.

McBride noted that there are meetings in other countries where people have very formal input and discussions, following discussion in their home countries. He felt that the EU strategy process would be hard to use as a model.

Siegrist cautioned against opening town hall meetings immediately after Snowmass in order to get greater input from the community. Lankford noted that the last P5 took about six months with three town hall meetings across the U.S.

McBride found that a remarkable aspect of the EU process was that people were well-prepared for the week-long process and were able to reach agreement by the end of the week. In addition, there was no draft document at the beginning.

Siegrist wants a process that will lead to conclusions that are agreeable to the whole community. McBride shared that the EU process was closed at first but expanded and produced documentation that was transparent to the community.

Siegrist offered that this could be done as a subpanel instead of at a HEPAP meeting. He offered that two agencies could write a "Dear colleague" letter to inform all of the process.

Siegrist shared that his impression that if things are to proceed like they did for the LHC, then a strong report is needed as justification. Comments about Project X are needed. Confirmation of the strategy for the Intensity Frontier is also needed. He expressed that DOE does not want to constrain that too tightly but could shut out the three frontiers and show how that has been successful.

Siegrist expects that not much can be done about the ILC until a government discussion is initiated. A Japanese delegation will visit Washington in Spring 2013. He shared that there are formal mechanisms for this and the negotiations have started, but that steps cannot be taken until a bilateral agreement is complete.

Siegrist commented that today's discussion showed that the agencies should proceed in discussions with CERN and Japan, and find ways to closely align planning. He is not sure how far this will get by the end of the summer.

Siegrist added that some of the social issues do not have to be loaded onto the P5 agenda. DOE wants to re-do the quantum universe question. This can lead to avoiding operating multiple panels at once. This could be discussed in an email to HEPAP.

Lankford confirmed that the discussion of societal issues is something that Siegrist would want done by the time that the P5 report is done.

Lankford added that the idea of a group email and allowing people to nominate subpanel members is an opportunity to describe the type of person who would be on that panel. If there is a meeting on the Project X science questions, then people would be needed who are willing to provide a vision for the whole program. Cvetic added that the way that HEP summarized the main mission was powerful. That should be listed as one way to communicate to communities.

BOARD BUSINESS

The next HEPAP meeting would occur after the Snowmass process. There may be some consolidation of Snowmass and the DPF meeting in Santa Cruz on August 13 – 17th, 2013.

HEPAP could meet after this time. Crawford shared that NSF could host the next meeting. Gonzalez commented that room availability may be an issue.

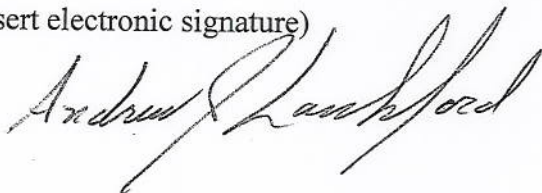
CLOSING REMARKS AND ADJOURNMENT

Lankford adjourned the meeting at 5:17 p.m. EST.

The minutes of the High Energy Physics Advisory Panel meeting held at the Gaithersburg Marriott, Washingtonian Center, Gaithersburg, MD, on March 11 - 12, 2013, 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)

A handwritten signature in cursive script that reads "Andrew Lankford". The signature is written in black ink and is positioned below the text "(Insert electronic signature)".