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

PUBLIC MEETING MINUTES

Doubletree Bethesda Hotel
8120 Wisconsin Avenue, Northwest – Bethesda, MD 20814

March 13 and 14, 2014

HIGH ENERGY PHYSICS ADVISORY PANEL
SUMMARY OF MEETING

The U.S. Department of Energy (DOE) High Energy Physics Advisory Panel (HEPAP) was convened at 8:30 a.m. EDT on Thursday, March 13, 2014, at the Doubletree Bethesda Hotel, Bethesda, MD, by Panel Chair Andrew Lankford.

<u>Members present:</u>

Ilan Ben-Zvi	Mirjam Cvetic	Thomas Shutt
Klaus Honscheid	Patricia McBride	Tao Han
Mary Bishai	Robin Erbacher	Paul Steinhardt
A. Hassan Jawahery	Lia Merminga	John Hobbs
Karen Byrum	Cecilia Gerber	Robert Tschirhart
Zoltan Ligeti	Jonathan Rosner	Hitoshi Yamamoto

<u>Members absent:</u>

Ursula Bassler	Georg Hoffstaetter
Murdoch Gilchriese	Leslie Rosenberg

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

<u>Others present for all or part of the meeting:</u>
David Asner, Pacific Northwest National Laboratory
Paul Avery, University of Florida
Chris Bee, Stony Brook University
Anwar Bhatti, DOE-SC
Laura Biven, DOE-SC
Gerald Blazey, White House Office of Science and Technology Policy (OSTP)
Greg Bock, Fermilab
John Boger, DOE HEP
Tim Bolton, DOE-SC
Chip Brock, Professor of Physics, Michigan State University
Raymond Brock, Michigan State University
Denise Caldwell, Director, Physics Division at the National Science Foundation (NSF)
Curtis Callan, James S. McDonnell Distinguished University Professor of Physics, Princeton University
Lali Chatterjee, Program Manager, DOE HEP
Claire Cramer, White House Office of Management and Budget (OMB)
Glen Crawford, DOE
Jim Cochran, Iowa State
Eric Colby, DOE HEP
Jean Cottam, NSF
Patricia M. Dehmer, Acting Director, DOE-SC
Marcel Demarteau, Argonne National Laboratory

Dmitri Denisov, Fermilab
Keith Dienes, DOE-SC
Milind Diwan, Brookhaven National Laboratory
Saul Gonzalez, NSF
Howard Gordon, Brookhaven National Laboratory
Rajan Gupta, Los Alamos National Laboratory
Nick Hadley, University of Maryland
Salman Habib, Argonne National Laboratory
Karsten Heeger, Yale University
Barbara Helland, DOE-SC, Advanced Scientific Computing Research (ASCR)
John Hobbs, Stony Brook University
Amber Johnson, Fermilab
Shamit Kachru, Professor of Physics, Stanford University and at Stanford Linear Accelerator Center
Brad Keelor, British Embassy
Peter Kim, DOE HEP
John Kogut, DOE-SC
Stefano Lami, Embassy of Italy
Ted Lavine, DOE HEP
Michael Ledford, Lewis-Burke Associates LLC
Dan Lehman, DOE Basic Energy Sciences (BES)
L.K. Len, DOE-SC
Michael Levi, Lawrence Berkeley National Laboratory
David Lissauer, Brookhaven National Laboratory
Laurence Littenberg, Brookhaven National Laboratory
David MacFarlane, SLAC
Ken Marken, DOE-SC
Helmut Marsiske, DOE-SC
Donna Nevels, Oak Ridge Associated Universities
Harvey B. Newman, Professor of Physics, California Institute of Technology
Scot Olivier, Lawrence Livermore National Laboratory
Ken Olsen, Superconducting Particle Accelerator Forum of the Americas (SPAFOA)
Abid Patwa, DOE-SC
Leo Piilonen, Virginia Tech
Michael Procario, DOE-SC
Srinivasan Rajagopalan, Brookhaven National Laboratory
Ron Ray, Fermilab
Randal C. Ruchti, Director, NSF Experimental Elementary Particle Physics (EPP) program
Simona Rolli, DOE-SC
Rob Roser, Fermilab
Jonathan Rosner, University of Chicago
Michael Salamon, DOE-SC
John Sarrao, Los Alamos National Laboratory
Phil Schwartz, Aerospace Corporation
Gabriella Sciolla, Brandeis University

Linda Severs, Oak Ridge Associated Universities (ORAU)
Jim Siegrist, DOE HEP
Jim Shank, NSF
Marc Sher, NSF
Ian Shipsey, Professor, University of Oxford Department of Physics and Purdue University
Anthony Spadafora, Lawrence Berkeley National Laboratory
Alan Stone, DOE HEP
James Stone, DOE-SC
James B. Strait, Fermilab
Bruce Strauss, DOE-SC
Ceren Susut, DOE-SC ASCR
Vigdor L. "Vic" Teplitz, Southern Methodist University and NASA's Goddard Space Flight Center
Kathy Turner, DOE HEP
Mike Tuts, Professor of Physics, Columbia University
Bruce Warford, Oak Ridge Associated Universities
Hendrik "Harry" Weerts, Argonne National Laboratory
Jim Whitman, NSF
Robert J. Wilson, Colorado State University
Rikutaro "Rik" Yoshida, Argonne National Laboratory
Kathleen Yurkewicz, Fermilab

MARCH 13, 2014

OPENING REMARKS

The High Energy Physics Advisory Panel (HEPAP) was convened on Thursday, March 13, 2014, at the Doubletree Hotel, in Bethesda, Maryland, by Panel Chair Andrew Lankford. A federal-employees-only ethics training session was held from 8-8:30, and the HEPAP meeting began at 8:30 a.m.. The meeting was open to the public, was being recorded, and was conducted in accordance with the requirements of the Federal Advisory Committee Act. Professor Lankford gave an agenda overview. Ms. Donna Nevels of the Oak Ridge Institute for Science and Education (ORISE) provided conference center safety information.

REPORT FROM THE DOE OFFICE OF HIGH ENERGY PHYSICS: RESPONSE TO THE COMMITTEE OF VISITORS REPORT

Glen Crawford, Director of the Research and Technology Division at the DOE Office of High Energy Physics (HEP) within the Office of Science (SC), presented the response to the Committee of Visitors (CoV) report. He gave an overview of the CoV report: the CoV conducted an external review of HEP operations, process and procedures. It was the fourth in a series of triennial reviews; others were conducted in 2004, 2007, and 2010. The CoV report was presented to the HEPAP in December of 2013 and contained 34 recommendations. HEPAP discussion in December was helpful in articulating requested revisions to this report prior to its final approval as well as in developing responses to the report.

A new section II.B, regarding Management of the HEP Program, had been added. The new text read, "Advice on the priorities for the HEP program was given by the 2008 P5 subpanel. The main recommendations – (1) maintaining the priority of the Large Hadron Collider (LHC) program and conducting R&D on the ILC at the energy frontier, (2) working toward a world class neutrino program based on an underground experiment in South Dakota using a high power beam from Fermilab, (3) pursuing $\mu 2e$ and $0\nu\beta\beta$ experiments at the intensity frontier, and (4) continuing experiments on dark matter and dark energy at the cosmic frontier – were heeded and made central components of the HEP program. The P5 subpanel was reconvened in 2010 to examine the limited question of extended Tevatron operations, but at this time the panel was not charged to provide a broader review.

"With six years elapsed since the main P5 recommendations, much has changed both scientifically and with the budgets. The DOE scope in the underground neutrino experiment was enlarged. When JDEM did not go forward, the LSST program emerged as the major new initiative for studies of dark energy, and various other new thrusts were proposed. As the situation changed, OHEP made decisions somewhat incrementally, sometimes with focused panels convened to provide advice within limited sectors of the program. All of these developments are natural in a healthy, dynamic program, but the roadmap laid out in 2008 became less useful as time went on.

"On balance, OHEP has done well in managing the program in the face of the changing circumstances. We are pleased that the P5 evaluation of program priorities has begun again this year, but feel that a full review of program priorities at more frequent intervals would have been beneficial. The primary responsibility for the strategic oversight of the program should be retained by HEPAP." The HEPAP provided no new recommendation to Section II.B.

Section II.L had been updated to add comments regarding laboratory/ university balance. The CoV noted that it had neither the documentation nor time to assess the balance between university and laboratory research programs, and that the new comparative reviews in both sectors were not yet fully in place during the period reviewed. The HEPAP recommended adding, "Although the roles of laboratories and universities differ and the programs are managed quite differently, there are often similarities in the roles played by individuals both in experiment and theory." The CoV found "anecdotal evidence that the balance, at least in funding, varied among the frontiers." HEPAP-revised language followed: "Senior scientists at universities often perform similar activities to laboratory staff scientists but are evaluated differently. We comment elsewhere on differences in Early Career Awards made to laboratory and university physicists."

As a result of HEPAP feedback, other CoV recommendations were reworded: recommendations 10, 19, and 26. CoV recommendation 10 was to "refrain from using university startup funds as a consideration in establishing grant funding levels." The HEPAP response was "we disagree," explaining that scientists' other funding sources, such as university startup funds or pending federal or private support, are valid programmatic factors in determining grant funding levels.

Another CoV recommendation was to make "previous proposals and levels of support available to reviewers." The HEPAP disagreed, responding that the information could bias the discussion and ranking of proposals. Recommendation 19 was then softened to, "Provide summary information on previous proposals, principal investigators (PIs), full-time equivalent staff (FTEs), experiments, and funding allocations to reviewers." The HEPAP responded that it would "consider providing appropriate summary information as needed and relevant," but it noted that "explaining the historical roles and responsibilities of a given HEP group is the job of the principal investigator. Current and pending sources of support must be provided in the application, and this information also gives some context to reviewers." The context: scientists have complained that they are getting less funding than before. The HEPAP then reiterated that, "historical levels of support are not relevant to current proposals under review."

Recommendation 22 was to consider a mechanism for seeking factual clarification of proposal issues from the PIs during the grant review process. The HEPAP disagreed, stating that once proposals were under review, PIs were not contacted for any reason, to avoid giving anyone an unfair advantage. The CoV subsequently removed the recommendation.

Another recommendation was regarding project-style reviews for programs that have significant budgets and extend over multiple years. Fermilab was mentioned as an example. The HEPAP agreed, and the recommendation was reworded to clarify the review of such programs.

A last recommendation was to create a new theory postdoctoral fellowship program. The HEPAP recommended rewording to provide more flexibility. It stated that "education programs are generally not considered part of the DOE mission and therefore we can no longer support any "fellowship" or "scholarship" programs, or those which have a purely educational mission. However, we also note that advanced training and workforce development *are* considered part of the DOE mission, and we are exploring ways of incorporating advanced training in HEP Theory as part of future DOE programs."

Overall, the HEPAP agreed with most of the CoV recommendations and stated that it would work to implement them in a timely fashion. For the two recommendations with which the HEPAP disagreed, one was removed and the other softened.

Crawford concluded his presentation and invited comments and questions.

Discussion of "Response to Committee of Visitors Report"

Professor Robin Erbacher raised the topic of the CoV recommendation concerning grant seekers' disclosure of other funding sources in grant applications. She commented that current support of grad students and postdocs *is* relevant information, although historical funding is not. Is there a way to understand the funding profile of grant-seekers?

Crawford agreed that having some understanding of the historical success of the applicant and having some sort of qualitative, general idea of 'what they took on, and did or didn't do' would be helpful.

Dr. Zoltan Ligeti commented on the early career award, which is a $150K award. Other funding sources don't matter unless you're 'double-dipping,' or receiving multiple funding sources, unbeknownst to the grantors, for the same research projects.

Crawford said we have to consider the other sources of support to understand the total funding profile for a standard comparative review proposal.

Dr. Mary Bishai made a comment regarding the workforce development charge.

REPORT FROM OHEP: 2014 COMPARATIVE REVIEWS

Crawford then discussed the 2014 comparative review process. For the 2014 cycle of grant applications, there were 141 proposals requesting a total of $196.138M that were received by the September 9, 2013, deadline. Some were withdrawn because they were duplicate transmissions, others were outside the scope of high energy physics, and others were declined due to exceeding page limits (but those could re-apply, and some did). Over a two-week period in November 2013, 124 proposals were reviewed by panels of experts.

He provided details such as how many research funding proposals were received, declined without review, reviewed, funded, and declined, including success rates, for the various HEP subprograms (Intensity Frontier, HEP Theory, Accelerator Science and Technology Research and Development (R&D), Energy Frontier, and Cosmic Frontier). The Energy subprogram had the highest success rate, at 80%; success rate was defined as the number funded divided by the number reviewed. The Accelerator R&D subprogram had the lowest success rate, at 38%.

Proposals were declined primarily because (a) proposals and/or senior investigators received poor merit reviews; and/or reviewers noted that the proposed research would not have high impact when compared to others in the same subprogram; (b) proposals were seeking support for research currently not within the DOE/HEP program; (c) budgetary constraints; or (d) proposals were from senior investigators reviewed poorly in the FY13 comparative review and hence, not supported in a FY13 grant.

FY14 review data by-senior-investigator, and by-junior-faculty-and-research-scientists were discussed. There were more "new to DOE PIs" relative to last year, so a larger applicant pool led to a lower funding success rate. Often these new applicants were affiliated with a more senior PI. For Cosmic Frontier applications by junior faculty, of which one in nine applicants received funding: several junior PIs did not review well due to not having an established track record and/or were not fully engaged in the collaboration model of the proposed experiment.

Proposals for FY14 were compared to efforts funded in FY13. For efforts funded in FY13, most program funding went up, except in the Theory physics category.

Crawford discussed proposal "tiers," of merit versus funding, where review panels considered scientific merit and reasonableness of funding request. The most attractive proposals were reasonable, requiring minimal budget adjustment; and were of outstanding merit. The exercise was useful in making funding decisions.

"Full forward funding" of smaller grants was discussed. On January 17, 2014, the President signed the 2014 Consolidated Appropriations Act. Section 310(D) required full funding of multi-year grants and/or cooperative agreements received from academic institutions that had a total cost of less than $1M. "Full funding" meant funds for the *entire* award for the proposal's project period is provided at the time the award is made, instead of incrementally funding the relatively smaller grants spread out over three years (in the case of a $1M, 3-year grant: $0.333M per year for three years). The law applies to comparative review, SciDAC, and early career grants. There is no change in the grant application or review process; the only change is that all of the money is given the first year of the reward for awards less than $1M. The money may be obligated the first year but is not released until the progress report is submitted.

Generally, only one or two out 15 funded proposals for each subprogram were affected by the new "full forward funding" provision. The Cosmic Frontier grants were an exception: 9 out of the 19 funded proposals for FY14 will be subject to full forward funding. He outlined grants (23) affected by that change in law. Similarly, Accelerator R&D grants (7 out of 11) will be full forward funded. This was mainly because they were smaller grants to a single PI. The total amount needed was $7.098M outlay for first year for the grants. It should take the DOE three to five years to fully implement the provision due to grant funding cycles.

In the "lessons learned," portion of the talk, Crawford noted that he and the reviewers considered the 2014 comparative peer review process to be successful in identifying proposals of high merit and impact, noting the pool of proposals was strong. The 2014 review was the first, large-scale funding online application process within DOE/SC that was managed using the Portfolio Analysis and Management System (PAMS). HEP used PAMS and provided input to DOE/SC on debugging and long-term system improvements. To continue to improve the process, reviewers implemented lessons learned from the previous year, such as providing guidance to PIs on the online application process and on drafting stronger proposal narratives, particularly in summarizing personnel distribution and budgets for proposals with multi-thrust research tasks. For next year, the CoV recommended adding pages for research scientists to describe scope of work. And in PAMS, the CoV suggested adding a way to smoothly input reviewers' ranking of proposals/PIs for comparative evaluations. In the area of communications, a meeting is being considered for summer 2014 to help scientists learn how to write better proposals. In 2015, HEP will continue to involve reviewers with experience from either the 2012, 2013, or 2014 process.

In closing remarks, Crawford said the HEP had completed its third round of the annual university comparative review process, and it would be interesting to see how quality of proposals had evolved. FY14 had fewer total proposals and PIs, but probably because of historic renewal patterns for its three-year renewal cycle. The overall average proposal success rates were somewhat lower in FY14, and success rates varied for various subprograms. The Energy Frontier success rate was higher due to PIs indicating proper FTE levels in proposals between research- and Large Hadron Collider (LHC) operations and or projects.

FY14 HEP research budgets continue to be under pressure, and with uncertain appropriations, proposals 'on the fence,' (approximately 10) were quickly funded in the University Research budget once the FY14 appropriations bill was signed into law. Moving the proposal consideration process to later in the fiscal year was helpful, as it aligned better with the timing of congressional appropriations approval, to avoid funding delays.

Discussion of "2014 Comparative Reviews"

Bishai asked why Accelerator R&D programs had the lowest rate of success (38%). Crawford said HEP had received 31 proposals and reviewed 29 of them; for these, the mode of operation is different. They may get funding from DoD and/or other sources. Also, there tends to be more turnover: more groups and more proposals, more "churn," in that program.

Bishai asked, regarding the success rate for the Energy Frontier subprogram (80%): was there a negative bias for high-risk, high-reward projects. Crawford answered that many were funded but not nearly at the level they requested. There are trade-offs between current or continuing R&D and future/ new ideas. Reviewers had to make value judgments. Bishai said there is a tension between funding long-shot, good ideas and determining appropriate FTE levels for those efforts. Crawford said that review panels have to make judgment calls on whether a proposal is too high risk and whether it is appropriately scoped.

Erbacher commented that umbrella grant proposal numbers were large last year. Crawford noted that last year was a peak year for number of proposals received overall, and that HEP tried to adjust with the terms for the grants. The long-term goal is to reduce ups-and-downs in grant support to scientist.

Erbacher said that the award statistics did not include the career process. Crawford answered that HEP had a meeting earlier in the week to select nominees for career process. Those will be announced in June. We had a panel and excellent proposals.

Professor Paul Steinhardt asked Crawford whether he thought that junior faculty were discouraged from undergoing this review until they have exhausted their career path. Crawford answered that, "We encourage people to apply to early career program and get feedback from that, but there is a distribution of junior people. Over two-thirds of them were funded. Many were new to DOE, and overall funding success was pretty strong." Steinhardt then asked whether there could be a separate class of these PIs. Crawford answered that the review panel understands that junior faculty have less experience writing proposals than seasoned PIs and that reviewers respond favorably to good ideas. Cosmic frontier proposals didn't do well, and that low success rate skewed the overall stats lower.

Professor Hobbs said that 10 additional proposals were funded because of the congressional appropriation. The review panel made the decision to give money to additional PIs instead of increasing funding for already-approved grants. This means money was not given to proposals that were successfully but partially funded from earlier. Now, reviewers are going back and looking at whether supplements may be given to existing awards – but there will be fewer of those adjustments. The expected total is about $800k out of $3M.

Professor Klaus Honscheid recommended a second look at the primary and secondary review strategy. Then he asked whether the full-forward funding budget strain level out over the 3-year grant cycle period. Crawford answered: yes, it is more financially stressful in year 1, but over time the strategy buys flexibility to fund new proposals. It is an extra burden during this transition period.

Dr. Robert Tschirhart asked how HEP compared to the National Science Foundation (NSF), regarding grant award success rates. Crawford deferred comment on NSF, but Lankford said that generally, DOE-HEP grant success rates were higher than those of NSF Nuclear Physics (NP), where the overall success rate was 33%. The two agencies and their programs are different, but at NSF, NP was most similar to DOE-HEP. Lankford said that grant success rates depend on funding levels, numbers of awards made, and other factors. But typically, HEP success rates are around 40%.

REPORT FROM OHEP – THEORY PROGRAM

Next was Dr. Simona Rolli, Program Manager for the DOE HEP Theory subprogram. In her overview, she said she would explain and summarize the program, discuss budget trends from 2009-2014, and talk about the university and DOE national laboratory comparative reviews.

The Theory subprogram budget is about 6-7% of a larger, overall program budget that sustains the entire HEP infrastructure in the US (Energy, Cosmic and Intensity frontier experiments, accelerator R&D, and detector R&D). Most of the money is for the experimental program, rather than Theory. From 2009-2012, university funding increased: out of 16 awards, 14 early career awards went to university scientists. In 2012, a large percentage of award funds went to the universities rather than to labs. FY12 was an anomaly, as the lab budget had a surplus due to sabbaticals, carry-over funds, personnel redirection, etc.. It was a one-time opportunity to shift ~$1M to universities. After FY12, lab and university profiles resumed their traditional balance, and both began experiencing cuts. Although lab budgets have been cut since 2011, the July 2014 grant review will reset lab budgets.

Total DOE and Theory budgets declined from FY12-14, from an overall $53M to an estimated $48.6M in FY14. The total decline in the Theory budget has been 9.2%. Other subprogram budgets, such as Frontier, have declined as well. Early career award funds are helping to support the total university base budget, but they are reserved for early career grant winners. Early career funds are protected from future budget cuts.

Rolli discussed lab versus university allocations. Universities are funded through grants awarded via the comparative review process; and the grants typically have three-year cycles. The university program funds about 80 groups, including about 220 PIs, 100 post doctorate fellows (postdocs), and 120 graduate students. In contrast, laboratories are DOE facilities, managed and funded through contracts. Lab management has the authority to hire and fire research personnel, and the lab budget pays 100% of the lab personnel salaries. Laboratory Theory groups with HEP personnel include Argonne, Brookhaven, Fermilab, Lawrence Berkeley Lab (LBNL), Lawrence Livermore Lab, Los Alamos, and SLAC National Accelerator Laboratory. The total workforce is approximately 50 PIs and 25 postdocs.

The total Theory subprogram budget is not determined by any individual program manager but at the level of the entire Office of High Energy Physics (OHEP), following a plan proposed and endorsed by the HEP community through their representatives on the 2008 Particle Physics Project Prioritization Panel (P5). Whether or not that plan continues to make sense is a discussion topic for advisory panels such as the HEPAP.

Given an annual Theory subprogram budget, the program manager is ultimately responsible for recommending the relative allocations across the entire program. Program managers' decisions are not made in isolation, but in consultation with external reviewers. NSF follows a similar pattern.

From the program manager's (PM) perspective, the annual budget process is as follows. The PM receives a total allocation DOE-HEP leadership. She first makes payments for 2nd-year continuations on grants made in the previous year (16%). Second, she makes payments for 3rd-year continuations on grants made two years earlier (16%). Third, she pays previous commitments for labs (50%). Residual funds, about 16%, are then available for new grants. Therefore, the Comparative Review only helps to determine how remaining funding is divided. This is why commitments from previous years can greatly affect the amount of available funds for a given year.

Regarding fiscal-year timeline and postdoc hiring, the HEP budget operates according to a given fiscal year. For FY12, proposals were submitted in November of 2011, and funding decisions were announced in March of 2012. Postdocs were then hired from this money starting in the fall of 2013. For FY13, proposals were submitted in September of 2012, the panel met in November of 2012, and funding decisions were announced in February of 2013, with postdocs starting in the fall of 2013. For FY14 funds, proposals were submitted in September of 2013, the review panel met in November of 2013, and FY14 funding decisions were announced in January of 2014. FY14-funded postdocs start in the fall of 2015.

The decline in the total Theory subprogram budget began one year after the comparative review was implemented. However, these are independent events. The comparative review happened to start as the Theory budget was decreased. To make matters worse, another independent factor: the need to synchronize grants to the same start date (April 1) across the entire program, affected all programs within DOE-HEP, not just Theory. This was done in order to provide long term stability to the HEP program, given that final congressional budget appropriations are not always available prior to this date. This change had a significant effect on FY12-14 grants, and extra months of funding had to be provided to "bridge" each group to the new start date. This extra bridge funding had to come out of the same fiscal year allocation as all other grant actions, further reducing the effective size of the total

Theory budget. This is a temporary situation, as all Theory grant recipients have now been synchronized.

Ultimately in FY14, a method was used, similar to that at NSF, which determines grant sizes according to the ranking of the individual PIs involved, regardless of the PIs' previous award history. The strategy makes sense for the Theory program, given that there are not fixed equipment costs, and only salaries are involved. During the review process, PIs are ranked, put into tiers, and depending on tier, they get a set amount of money; the top tier receives the most money, and the lowest tier gets the least money. And every three years, everyone re-competes for grant funds, starting from zero. There were allowances made in cases of large funding fluctuations, where grad students or postdocs might otherwise be stranded, but this was only to soften a strong derivative or provide a "soft landing." Funding levels are now 'thermalized' to merit. Top tier PIs generally saw their funding increase. Tier 2 and 3 PIs tended to get reduced funding levels. Those at Tiers 4 and 5 were defunded completely. Reductions of funding levels in lower tiers reflect the cut in the total funding level for the entire Theory program. Effort was made to shield the top-ranked PIs from program cuts.

All DOE national laboratory research groups: experimental frontiers, Theory, and Detector R&D, have been undergoing comparative review since 2008. Theory grants were evaluated in 2008 and 2011, and the next review is scheduled for the summer of 2014. Panels evaluate all lab Theory groups at once and make recommendations on how to best allocate resources to labs, indicating areas of weakness and strength. Recommendations of the lab comparative review panel are forwarded to lab management for implementation, and the DOE-HEP budget line is adjusted accordingly. The labs' budgets may then be cut, which has been the case for some labs, just as universities have experienced. For example, at one prominent lab there has been a 30% reduction in postdocs between FY12 and FY14, a 9.5% reduction in permanent personnel, and a 20% reduction in student support.

Rolli concluded by noting that the Theory subprogram is a small portion of a much larger portfolio. The DOE HEP research budget has been declining in the last three years, due to priority shifting of resources to projects (larger laboratory investments). Considering whether the research program cuts have had a disproportionate impact on Theory: traditional HEP funding per PI in Theory is less than Experimental HEP by 30-40% and previously supported on average PI + ½ postdoc + 1 grad student. Inflation has eroded this purchasing power over the years, and PIs rely more heavily on teaching assistants and other sources of funding. Experimental HEP groups, particularly Energy Frontier, have taken similar cuts in FY12-14 but have on average managed better, likely due to a combination of having more "cushion" and PIs' discretion on how to allocate resources.

Discussion of "Theory Program" Presentation

Professor Mirjam Cvetic commented that keeping Theory support healthy is important, noting that the university cut was especially dramatic.

There was discussion on lab versus university cut impacts. Rolli pointed out a 30% decline in postdoc hiring at the labs. Cvetic said Theory university personnel are relatively cheap, relative to large lab infrastructure projects or other investments, and dramatic cuts to university PIs will impact future leadership in this area.

Professor Tao Han asked to be able to access the presentation after the meeting. Rolli replied that it would be posted on the HEPAP website.

Han then asked now that the funding changes have occurred, will funding stability return?

Rolli said the full-forward funding will have an impact, not as dramatic as one might expect, but in some areas such as Cosmic R&D, there will be greater effects. Han then asked if Theory could be protected, somehow, from future, dramatic funding shifts.

Glen Crawford replied that all of the budgets had endured funding cuts. If P5 and HEPAP believe that the current strategy needs adjustment, they can recommend it, but they must be ready to advise on where the funding cut should go. The FY15 budget does not appear to be favorable, and these issues will not go away any time soon.

Ligeti said that computational HEP is a basket of programs, like Scientific Discovery through Advanced Computing (SciDAC)(coming up for re-competition next year), not reviewed or in the funding opportunity announcement (FOA), like the Theory and Energy Frontier programs are. Computational HEP programs are a collection of special programs, rather than a call for proposals.

Ligeti asked about funding differences for the computational HEP programs. Rolli answered: in the budget formulation phase, HEP is given a funding target by DOE-SC. Following budget deliberations, DOE sends its draft budget to the Office of Management and Budget (OMB), which may make an adjustment to HEP budget, which comes out in the President's budget. Congress appropriates the final amount, and HEP may need to make adjustments based on that amount. HEP usually has flexibility on how to make those adjustments unless Congress prohibits it. However, because of previously committed grant funding amounts, the funding available is limited.

Erbacher commented, "When you try to be fair in spreading money for projects, there is a limit on how far you can go. The Theory university community is already operating at the bare bone. They need students, postdocs, and travel funds to attend conferences. Cutting them the same amount [in the near future] may hurt more because they've [already] been cut so far.

Bishai said collecting funding data and stories from PIs could be used to more effectively advocate for stronger Theory funding in the future. Rolli agreed.

Dr. Karen Bynum and Professor Cvetic expressed agreement. Cvetic added that in her field, before 2012, funding was much better. She indicated concern about the sizable cut and that cutting postdocs will jeopardize the field.

Crawford said HEP needs to quantify the cut and how out programs will be specifically worse off than a few years ago.

Professor Klaus Honscheid asked who determines the DOE national laboratory versus university funding top lines. Rolli answered that in 2011, a review of the labs set lab funding for next three years. University funds were different. Honscheid asked: if there is a bad year, do funds for labs and universities all go down? Who decides? Rolli answered: DOE-SC.

Ligeti asked what is the fraction of Theory lab versus university research. Rolli answered: 20 percent. Ligeti then asked how Theory funding had changed over the years. Crawford answered that the program office would need to investigate further to track those trends.

Professor Jonathan Rosner said that he saw a much greater concern, down the road, looking at the President's budget. The HEP community needs to convince OMB and the Office of Science and Technology Policy (OSTP) that HEP is as worthwhile as other areas of the DOE Office of Science that received more favorable treatment in last year's budget.

Professor Cecelia Gerber said that, considering the long-term funding view, there are good years and bad years. Is there a way to protect, in a bad year, groups applying for continuations of funding? Rolli replied that was how she prioritized funding decisions for this year. Crawford concurred that this is a hard problem, that if one program is protected, "something else has to give," in terms of cuts, and there is no easy answer.

The audience was invited to add comments or questions, and there were none.

COMPUTING WORKSHOP REPORT

The Report of the Topical Panel on Computing in High Energy Physics was given by Paul Avery, of the University of Florida, and Salman Habib, of Argonne National Laboratory. The Topical Panel Meeting was held from December 9-11, 2013. The eight-member Steering Committee was comprised of Avery (co-Chair), Habib (co-Chair), Amber Boehnlein, Robert Roser, Stephen Sharpe, Heidi Schellman, Craig Tull, and Torre Wenaus. Thirty panel members participated in five topic areas: cosmic frontier, energy frontier, technology, intensity frontier, and accelerators. The panels operated on a timeline that ranged from initial discussions and a charge letter in July of 2013 to a report to the P5 committee in December 2013, report drafting in the winter of 2014, and the report to the HEPAP in March of 2014. The effort was a "2000-email project." The panel was charged to:

- Identify cross-cuts across the HEP computing program that can benefit from common solutions;
- Identify opportunities for R&D with high programmatic impact, including international leadership;
- Survey HEP software and identify actions related to maintenance/ updating, gaps, non-HEP partnerships, and lifecycle management;
- Survey current computing and data management practice across HEP: Can an improved structure accelerate progress?
- Survey the use of hardware, identify opportunities for increased efficiency, cost effectiveness, & application of the best technologies; and
- Identify opportunities presented by establishing a (virtual/ distributed) Center for HEP Computing Excellence.

Computing plays a fundamental role in HEP. HEP computing is highly diverse across the field and has been influential outside the field. For example, major variations exist between the HEP areas of cosmic, intensity, energy, accelerators, lattice quantum chromodynamics (LQCD). Variations exist for high performance versus high throughput computing; and the use of storage, networks, etc. HEP computing has been influential outside the field, supporting leaders and innovation in scale, data handling, global operations, networking, and grid/ distributed computing.

The topical panel was aware that HEP computing drives large investments, both in people and in infrastructure, both at DOE and NSF. Other panel "drivers" included a desire to increase the effectiveness of computing investments, a need for increased responsiveness to near-future drivers such as science focus changes and constrained budgets; and positioning HEP computing in the wider computing world. The panel gathered and organized information, such as dozens of one-page summaries of various scientific areas. It used the web-based "Basecamp" project software to organize documents and communications such as discussions and daily summaries. It worked to suggest possible ways to move this science area forward and improve the overall effectiveness of computing-based activities. The panel intends to create and maintain a website with documents, links, etc..

Resources that served to inform the panel included the 2013 Snowmass community study; its three-page "Conclusion" section will be included as Appendix three of the panel's final report. Other sources included: SC/Advanced Scientific Computing Research (ASCR) Data Crosscutting Requirements Review (Apr. 2013); HEP-ASCR Data Summit (Apr. 2013); HEP-Nuclear Physics (NP) Network Requirements (Aug. 2013); Fabric for Frontier Experiments (FIFE) Workshop (Jun. 2013); HEP's influence on Energy Sciences Network (ESnet) Development (W. Johnston, 2013); and LQCD influence on computing technology (S. Sharpe, Jan. 2014).

The three-day meeting began with an opening sessions outlining expectations and guidelines. A large part of the meeting included discussions, which was a good thing. Panelists explored mostly "offline computing" topics. Excluded were online data processing and data acquisition: "detector technologies." They covered three frontiers: Cosmic, Intensity, and Energy frontiers. The following are highlights from primary discussion areas. Cosmic cross-cuts with Intensity for dark matter experiments. The Intensity topic includes a very diverse set of experiments. The Energy group concluded that our world is changing, and we must develop commodity computing. The area of LQCD presents a collaboration model that may be attractive to emulate, as the area has facility-, SciDAC funding, and competitive subgrant activities. For Accelerators, researchers working on lots of different problems; there is a need to integrate diverse accelerator simulation codes. For Technology, panelists discussed opportunities for future collaborations with advanced scientific computing (ASCR) facilities and adoption of cloud technologies.

The panel explored how to develop common tools while still respecting each field's experimental timelines. There is a need to better integrate with activities outside HEP; and the training of students and staff is important to this integration.

The report is about 20 pages long, with a 2-page executive summary, 3.5 pages of findings and comments, and 2 pages of "future opportunities." There were 14 findings in 5 areas. In the area of hardware evolution: the panel believes that emerging computing architectures pose a major across-the-board challenge to HEP computing. The community needs programming models. The evolution of data-archiving, data-intensive computing, and storage will drive new computational strategies. The field will need a new balance of central processing unit- (CPUs), storage-, networking-, and advanced analysis strategies. High performance computing (HPC) platforms are important resources for HEP science; some HEP groups, such as Accelerator, Cosmic Frontier, and LQCD already exploit these platforms. HPC sites provide early access to new architectures.

Considering the software environment, the panel found that code maintenance and distribution still lacks well-defined guidelines. This is a real problem, given the fact of architecture evolution. Common tools and coding standards are insufficient, due to stove piping. Code diversity is a strategic issue, as there is a large diversity of codes with significant overlaps in capability. Leaders in the field need to consider evolutionary paths these codes will take to avoid future difficulty implementing common strategies.

In the area of resource management: the scale of computational needs of smaller-scale projects is significant. An ensemble of smaller projects in IF and CF require large aggregate computing support. A coordinated strategy (with enough expertise and manpower) will be difficult to implement without defined inter-project mechanisms. Further, the role of simulations will continue to grow in importance, driven by complexity of experiments and increases in computing capability. Sufficient investment in data preservation and the formulation of an associated data policy is lacking.

The panel found that computation R&D programs are needed, and it recommended two classes of programs: (1) evolutionary developments, specified by clear needs from experiments; and (2) revolutionary approaches targeting large gains in science impact and productivity. More uniform interactions with external organizations are desirable, with a single coordinating entity serving as a coherent point of contact for computation-related matters between the communities of HEP, ASCR, other DOE offices, NSF and industry. This would be a natural role for the Center for Computational Excellence. Training in computational science, such as in programming paradigms, algorithms, software tools, is lacking. The panel cited a shortage of computationally well-trained students and junior researchers.

The panel recommended the formation of a distributed Center for Computational Excellence (CCE) to address several of the concerns and opportunities identified in its findings. A CCE would enable quick and effective responses to a number of identified gaps and well-defined tasks and could initiate collaborations and mechanisms for cross-frontier activities and interactions with external entities such as ASCR, NSF.

Avery said that as a word of caution: the Topical Panel cannot give "advice" or make "recommendations." However, a fundamental observation deals with higher visibility for major computing-related activities. The CCE mentioned would be a powerful element of such an effort. The panel identified eight areas of opportunity.

1. Code modernization, maintenance, and dissemination.
2. Common tools and coding standards, reduced software footprint.
3. Resource support models for smaller-scale projects. Specifically, a model that cross-cuts the Frontiers.
4. Data preservation policy for the HEP community, with broader DOE-SC data management requirements, would promote long-term value of HEP science.
5. Creation of a distributed Center for Computational Excellence will help encourage and capitalize on new ideas, foster better engagement with the ASCR community, and enhance industry partnerships.
6. Training: need a multi-level computer and computational science training program.
7. Creation of a community-based expert group for HEP computing that meets on regular basis could provide program visibility. This needs to be done on a wider scale than HEPAP or a CCE.
8. Expansion of current interactions with researchers in external disciplines, particularly in the DOE-ASCR community and especially in data-intensive science.

Discussion of "Computing Workshop Report"

Tschirhart suggested support for a fellowship or trainee program to attract computational students. Steinhardt said that HEP students are not well trained in computing and computational skills. Physics brings a collaborative, problem-solving aspect to the table; we need to bring in computing students to help us. Increasing the overall visibility of HEP can help. HEPAP members were disappointed to see students coming into the HEP field without much training in computers at all.

Professor Jonathan Rosner asked for clarification on what was meant by a "distributed" CCE. Avery answered that it meant that the components would be at different sites, or the physical footprint would be in several locations. The workshop participants made the suggestion with an awareness of the political ramifications. Rosner said that individual flexibility is important. Avery said that while having common frameworks is important, you need people to be unconstrained by what they're doing. Too many small projects can lead to inflexibility. There is so much overlap in so many areas, we need an overview of what's going on and need to work cross-culturally, even within the Intensity experiments, and with Energy. Cosmic is vastly different, but interesting to us. We need some way to get people together to talk about their experiments to try to form more collaborations.

Dr. Karen Byrum noted that new, peta-scale computers require code written in a completely different way than current and older code used for HEP computing. Habib said this is an important point: HEP software has not changed over recent years. One can solve this problem by buying an enormous amount of hardware, but we don't have the money to do that. Efficiency of code must be improved. Habib also said that software is evolving in different ways, rather than in one direction. Trying to push or support only one advanced code language may be a bad decision; as another language may emerge as the prominent software language.

Tschirhart commented that the panel chose Basecamp for its proceedings. We might gain efficiencies by investing in common scientific information technology tools to improve our conferencing. Avery answered that yes, we discussed Basecamp and its advantages and disadvantages, but you have to dig deeply to more fully understand them. We've used Google Drive as well. But it is true: we didn't thoroughly consider this area. Our field is way ahead of other fields, though, in keeping track of our meetings. But yes, we would benefit from some common approaches. Such a site would have a community board for discussion.

Bishai commented that tools such as ReadyTalk disappear as soon as you get used to them, and they are services provided by DOE that are used by the scientific community. Is this an issue this group should address? Avery said, yes, this is an important issue. Dropping these services is of concern for the community to be able to more effectively communicate.

"TECHNOLOGY CONNECTIONS" PRESENTATION

The group then moved onto the next topic, by Marcel Demarteau and Katie Yurkewicz, entitled, "Tools, Techniques, and Technology Connections of High-Energy Physics." There is a web of connections between particle physics and the rest of the world, but no one has mapped out that web. HEP has entered a new field of scientific discovery and should move toward collaborations.

The charge from SC-OHEP was to articulate key connections and synergies between the tools, techniques, and technologies developed for particle physics and other disciplines. The process followed included contacts with field and outside-of-field experts. SC-OHEP asked the group to identify (a) impacts of particle physics on other scientific fields and on society; (b) benefits to particle physics from exchanges with other sciences and industry; (c) the potential for HEP facilities to serve communities outside particle physics; and (d) most importantly, opportunities to expand and strengthen these connections to better contribute to science and technology (S&T) while advancing HEP research goals. Demarteau and Yurkewicz reviewed existing documentation on the effects of tools, techniques, technologies, and skills; and they interviewed experts within and outside the particle physics community on bi-directional impacts.

Particle physics has the highest impacts on the following key areas: detector technology; computing, software, and data management; accelerators; and particle physics facilities. Detector technology is a major area of connections for HEP. An example is silicon technology – the semiconductor industry enabled development of the silicon detector and readout technology. Particle physics, making detectors radiation-hard, has taken the technology to an unprecedented scale. Around 1999, a nuclear physics experiment at CERN developed a readout chip for the ALICE (A Large Ion Collider Experiment – heavy ion detector) experiment at the Large Hadron Collider (LHC). The chip was useful for imaging, which led to the development of the Medipix chip, even for low-contrast objects. It is a perfect match for LHCb (Large Ion Collider beauty) experiments planned for 2014. It saved two years in the development cycle for LHCb. Another example of silicon technology synergy is Monolithic Active Pixel Technology (MAPS) that contains sensing medium and front-end electronics integrated in the pixel. MAPS was originally conceived by the particle physics community; the technology is being matured by the nuclear physics community.

Another example: the development of BGO (Bismuth Germanate oxide) crystals. Previously, they were never grown on a large scale. The L3 experiment at the Large Electron-Positron collider (LEP) built the first BGO crystal calorimeter, consisting of 11,400 BGO crystals of 1.5 m^3, which were grown at Shanghai Institute of Ceramics (SIC). Although growing BGO crystals was a "one-shot" HEP market for the Shanghai Institute of Ceramics (SIC) in the early 1980s, it led to the multi-crucible growth technology allowing growth of up to 36 crystal ingots per oven. Growing the crystals from one-at-a-time to 36 crystal ingots per oven opened the medical market dramatically: more than 1,500 PET scanners have been built with SIC BGO by GE Healthcare.

The CMS (Compact Muon Solenoid) experiment is another example. Radiation-hardening is always an important challenge. Development of LYSO (cerium doped Lutetium Yttrium Orthosilicate) was based on making lead tungstate crystals radiation-hardened.

X-ray detectors are another example of HEP synergies. The x-ray community has teamed up with particle physics community to develop a 2D imaging x-ray detector for XFEL (a research facility currently under construction in the Hamburg area of Germany), with corresponding DAQ (data acquisition and control) systems.

The particle physics community should take advantage of opportunities to advance other fields as well. Joint workshops to bring scientists together and constant support of dialogue between communities will be beneficial.

In the areas of "Computing, Software, and Data Management," HEP has been at the forefront of big data and the need for advanced networking. As the invention of the World-Wide Web was a response to a new need for scientific collaboration, grid computing is the response to the need for increased data analysis power that can be made available by accessing remote computer installations in widely dispersed institutes. These need (a) reliable high-bandwidth networks to move the data, and (b) access to high computational power systems.

The Energy Sciences Network (ESnet) is a communications infrastructure to support scientific research that is managed and operated by the Advanced Scientific Computing Research (ASCR) program within the Office of Science. The interplay between the particle physics community and ESnet has been fruitful.

Other examples of HEP technology connections include the worldwide LHC computing grid that powers LHC computing and data analysis. The grid was developed beginning in 2002 and deployed in 2008. It is widely used in Europe and in the United States. The lattice quantum chromodynamics (LQCD) community has, from the beginning, been a joint community between nuclear physics and particle physics. In the 1970s, a leading lattice theorist programmed array processors in assembly language to address critical phenomena problems and later wrote the Fortran compiler for the FPS array processor. In the 1980s the same theorist contributed strongly to the Lax Report, which led to the establishment of the NSF supercomputing centers and NSFNET, the forerunner of the Internet. Also in the 1980s, lattice gauge theorists worked to design highly parallel machines aimed at lattice QCD. These efforts helped establish the parallel paradigm for large-scale supercomputing that has been the industry model for the last twenty years. IBM's Blue Gene supercomputers, for example, grew out of the Columbia QCD machines, and the team won the Gordon Bell prize for price and performance in 1998 for the QCDSP, a machine purpose-built for lattice QCD.

GEANT4: the GEometry ANd Tracking Toolkit for HEP detector simulation is another example of synergy with the HEP field. Its use goes well beyond particle physics and is employed by the medical and space communities. Example applications of GEANT include: the effect of Compton scattering on Gamma-ray spectrum in solar flares; X-ray mineralogical survey of mercury by Beppi-Colombo; cosmic rays in planetary atmo-magnetospheres; single event upset (SEE) in SRAM; neutron radiation in proton therapy; and DNA modeling and effects of ionizing radiation.

Many opportunities exist to develop partnerships in particle physics, from lattice algorithm techniques in partnership with condensed matter physics to high-performance computing and particle physics simulation techniques in partnership with other basic sciences like computer science and applied mathematics. Maintaining and further developing GEANT is a specific opportunity to further such partnerships with other sciences.

The web of accelerator connections is broad. Though the first particle accelerators were invented in early 20th century, multi-disciplinary expertise continually drives the technology forward. Accelerators now are critical for research needing high-energy, high-intensity particle beams. For example, nitrogen ion implantation of titanium and cobalt-chrome alloys has improved surgically implantable artificial joints. Superconducting radio-frequency R&D is a major emphasis for the next generation of discovery science particle accelerators and is driven by collaborators in accelerator science, particle physics, nuclear physics, materials science, chemistry, advanced computing, and more. In the area of laser-driven acceleration, major innovations in compactness and cost of accelerator technology may be required to enable future generations of particle colliders. More than 30,000 accelerators are used by industry for a broad spectrum of applications, from electron beam cross-linked polymers (wire insulation, heat-shrinkable films, foam, tires) to sterilization of medical equipment, to disinfection of food and water. Progress has already been made to foster synergistic opportunities through joint workshops. The workshops serve to survey accelerator connections, identify the most critical accelerator R&D needs that benefit all fields of science and industry, and chart the best paths forward. The Long-term Accelerator R&D Stewardship program is now being developed by DOE. Its aim is to lower the threshold for people to move between disciplines. The program will seek the perspective of teams of experts from multiple disciplines with a clear vision of where the future should be.

Many scientific fields benefit from the use of HEP facilities. For example, HEP facilities can be used by other sciences. CERN, the European Organization for

Nuclear Research, hosted the CLOUD experiment (cosmics leaving outdoor droplets). The experiment uses a cloud chamber to study the possible link between galactic cosmic rays and cloud formation; the work was published in Nature on October 17, 2013. The fields of HEP and nuclear physics have both operated accelerators to mutually support each discipline's experiments. Key examples include the heavy photon experiment in Hall B at Jefferson Laboratory; and the SeaQuest nuclear physics experiment at Fermilab. DECAM, a camera for the survey of dark energy, is important in particle astrophysics and of interest to the wider astronomy community. Light sources are creating new lives for machines. For example, SLAC linac now drives the Linac Coherent Light Source (LCLS), creating x-ray pulses of unprecedented brilliance. PETRA, where the gluon was discovered, now forms the heart of the PETRA III X-ray radiation source. Detectors for GeoNeutrinos are used to study the inner core of the earth. Another example is the area of stopped muon beams. Muons are a sensitive probe in many systems, with potential theoretical interest in parity violation experiments, vacuum polarization, and muon induced fission. Los Alamos shut down only system available in the U.S, so condensed matter physics experiments must be conducted at muon facilities at international particle physics labs.

Considering opportunities: some particle physics facilities are a resource for the broader science community. There is an opportunity to evaluate the scientific potential and possible effect these facilities can have on advancing connected fields of science and on the particle physics mission itself. Specific possibilities may include muon beams, neutrino detectors, and the field of atmospheric science. There also exists an opportunity to explore whether the joint construction model that has proved successful for sky surveys might be applicable to other joint facilities. Particle physics has contributed expertise in the construction of large, complex, multinational projects to that effort – there is an opportunity to explore how that model might aid other sciences.

In summary, the connections of HEP reach far and wide, but they have often been established serendipitously. The value of connections that helped create the Internet, ion/ hadron therapy, and the PET scan is substantial. There are many opportunities for particle physics and associated fields of science to explore areas of interdisciplinary partnerships that hold promise for further development. Detector technology invites partnerships with materials science. In the fields of computing, data management, and software: partnerships exist with condensed matter physics. For accelerators, scientists should continue holding joint workshops to identify critical R&D needs. For facilities: investigate use of joint facility construction model beyond particle physics and astronomy. Generally, the HEP community should work to formulate joint strategies with other fields to address technological challenges shared by other fields to further its science. Along with that goes the creation of multi-disciplinary, multi-institutional research projects aimed to address grand science challenges.

Discussion of "Technology Connections"

Tschirhart asked whether we have a credible case that HEP is a significant contributor to advanced technologies for the country. Yurkewicz said that she and Demarteau received a lot of input about the workforce, with anecdotes about HEP scientists transitioning to other fields. The HEP community is part of that story but is not unique in that respect. It is not beneficial to message that the HEP field is the only highly-trained scientific discipline with people who can transition outside the field and still make an impact. Demarteau noted that the notion was not quantifiable.

Professor A. Hassan Jawahery commented that we lack the infrastructure to foster collaboration with the scientific community. One would expect that the DOE labs would take advancements from diverse fields and build more on them. Is it done at the DOE national labs, or is this only/ mainly done at CERN? Demarteau said that the HEP community must articulate what it has accomplished and must also project what it hopes to accomplish in the future. The field has had great impact on other sciences, but funding has not followed for more collaborations. Why? Maybe HEP hasn't done a good enough job [in communications], but how does the field move forward to encourage greater multidisciplinary collaborations? Establishing partnerships with other sciences can help to educate people how HEP contributes to other fields. Jawahery asked whether there existed an infrastructure problem, saying that HEP scientists design experiments but don't have infrastructure…universities no longer have technical capabilities, and has the field moved to increased reliance on the DOE labs for technical infrastructure? Demarteau said that the first step is to start to enable collaborations by lowering the thresholds for people to spend some time in other areas of science and see how HE physicists contribute to other areas of science. The second step is infrastructure.

Bishai said she thought that the first step is a decent patent office: if HEP creates a patentable product, someone in industry will pick up that patent and industrialize it. We don't have, especially at the DOE national labs, a patenting office to bring good ideas forward. Demarteau answered that he and Yurkewicz had not studied the patent issue, but it was probably a double-edged sword. The field has always been open: the World Wide Web is an example. FinePix has always been open, with tremendous positive impacts on the field. Licensing some of these technologies would be good, because through licensing, the HEP community would receive funding to continue base projects. Bishai countered that the issue was not about money, but it is more about preserving the intellectual property. Yes, the issue of patenting and licensing has the potential to bring in external funds to help the field move forward. It is a way for people to start up companies and commercialize products. Demarteau replied that yes, this issue deserves more study. Professor Chip Brock added that developers will admit: if not for royalties from licensing, some projects would have come to a halt.

Gerber noted that the summary was important. She asked whether the objective was to bring the importance of HEP to society to increase funding for HEP? Is there a way for people to recognize how important this is? Demarteau answered that it is a two-fold goal. The aim is not just to educate other sciences and society about HEP, but it is a two-way street [have them inform HEP]: for HEP to learn what other sciences have done from which particle physics can benefit and consider how to increase funding for particle physics, overall. The HEP community should identify shared technological problems as opportunities to tap multiple funding sources. Yurkewicz added that there are far more examples of connections than shown in the presentation. She is trying to find a way to communicate those so our scientists can share that with other fields.

Hobbs asked was there a way to demonstrate a quantitative impact. Demarteau said, yes, but that it takes time, and one has to identify the metric. Yurkewicz acknowledged a strong HEP community interest in showing more than anecdotal information, but doing so takes time and money. She said they were not able to do that in their few months of work.

Byrum said that moving forward requires the involvement of agencies beyond the HEP community. There has to be a mission-driven aspect of us reaching out to other science communities to share our expertise. How do you realize the opportunities? Demarteau answered that one way included holding joint workshops with diverse scientific disciplines will help us identify shared areas of challenges where HEP is able to contribute to those sciences. It is not with just global warming, but there are many overlaps with our expertise. Byrum asked, would they be smaller, targeted workshops? Including just a few, key people is really what you need? Demarteau said, yes, they would be targeted workshops with science goals. Yurkewicz noted that the accelerator workshops happened that way: laser driven, for example.

Tschirhart asked a question regarding young people and the career path, going forward: how is HEP pipeline? Demarteau said it is sad – if you went to Snowmass, most people in the room had gray hair. There is not really a pipeline of junior scientists to step into accelerator R&D. Tschirhart recommended adding that point as a conclusion in the presentation.

Erbacher raised the area of accelerator research in context of the pipeline issue. It is not just that job prospects are uncertain, but university programs don't exist to the extent that they should. Graduate students that want to go into accelerator science have a limited set of options. Demarteau concurred that, yes, there exist limited university options.

PRESENTATION: "HEPAP ACTIVITIES – 1 – ACCELERATOR R&D"

Lankford then recommended, as a smooth segue, moving to discuss the report of the HEPAP Subcommittee for Assessment of Workforce Development. Dr. Patricia Dehmer, Acting SC director, charged the chairs of all federal advisory committees (FACAs) for SC to help identify disciplines in which significantly greater emphasis in workforce training at the graduate student and postdoc level is needed to fill discipline gaps. Advisory committees were to consider disciplines (a) not well represented in academic curricula; (b) in high demand resulting in recruiting and retention difficulties in the U.S.; and (c) for which DOE labs may play a role in workforce development. SC requested a report, in letter format, no later than June 30, 2014, which implies relevant discussions will occur at the May HEPAP meeting.

Proposing that the advisory subcommittee consist of four to six members with relevant workforce training experience and consisting primarily, but not solely, of HEPAP members, Lankford tasked the committee to:

- Consult HEPAP and the HEP community for input on possible disciplines in need of workforce development.
- Consult members of the community with experience and expertise in workforce training for disciplines of interest.
- Consult subcommittees of other SC FACAs regarding disciplines of common concern or interest.
- Make use of existing resources from past studies.

The subcommittee could then present its product for discussion at the May HEPAP meeting. Possible disciplines of interest may include: accelerator science, particle detectors and instrumentation, scientific computing, and specific areas of particle theory. Professor Ritchie Patterson of Cornell University agreed to serve as the chair.

Discussion of "Accelerator R&D" Presentation

Bishai asked, regarding the charge from SC: would the topic of internships be also considered? She noted that it was in the original charge. Lankford answered that the charge is to address acute shortcomings in the workforce, implying a focus on grad students and postdocs. Maybe we need to address pipeline sooner. Rosner advocated for outreach to undergraduates and earlier-stage students to try to attract people to the field. It is not essential to have further discussions now, but the subcommittee can move forward to better understand its charge. We are aware of the scientific computing folks getting together to meet and discuss the charge.

Dr. Ilan Ben-Zvi requested the names and connections of other committees addressing the charge.

Bishai noted that many of the accelerator physicists working in the U.S. did not come from the U.S., originally. Would the subcommittee be able to address internationals, tackling issues such as work visas and the challenging of attracting international scientists? Lankford said that's not what is being asked of the HEPAP.

Tschirhart suggested adding a point of the value in making career paths more visible to early-career people. Lankford affirmed the importance of the idea, and asked Tschirhart if he saw, "a toe-hold?" Tschirhart replied that trainees are not present in academic positions. Lankford said that having programs to address these needs might improve energy science visibility, especially in instrumentation areas, to make it a more enticing career path.

The committee took a break at 12:56pm and resumed at 2:03pm.

PRELIMINARY COMMENTS REGARDING THE PARTICLE PHYSICS PROJECT PRIORITIZATION PANEL (P5)

Professor Steven Ritz, of the University of California Santa Cruz Institute for Particle Physics, presented preliminary comments from the work of the Particle Physics Project Prioritization Panel "P5." The last big particle physics science advisory report was in 2008; there have been lots of changes since then. Key elements of the charge to the P5 included:

- An "updated strategic plan for the U.S. that can be executed over a 10-year timescale, in the context of a 20-year global vision for the field.
- Appropriate balance of small, mid-scale, and large experiments.
- Technical readiness and feasibility. Estimate time and resources needed.
- Maintain healthy and flexible domestic infrastructure...maintain leadership position...a healthy balance that preserves essential roles and contributions for national laboratories and universities and enables opportunities for global coordination of large initiatives.
- Three budget scenarios. Not literal guidance, but an opportunity to identify priorities and make high-level recommendations.
- Articulate opportunities that can and cannot be pursued, and approximate overall level of support needed in core research and advanced technology R&D.
- A detailed perspective on whether and how the pursuit of major international partnerships might fit into the program in each of the scenarios.
- Effective communications about the excitement, impact, and vitality of particle physics for non-scientific audiences.
- Preliminary comments by March 1; final report by May 1, 2014."

The P5 deliberative panel consists of approximately 25 members. No topics have been off the table for the "dedicated, hardworking panel." There is "lots of international participation on the panel," and it is also diverse in terms of newer and more 'seasoned' members.

Summarizing the P5 process, Ritz reported that a website was created to support the discussions; it was actively utilized. Town hall meetings held were at Fermilab, SLAC, and Brookhaven in November and December of 2013. The last meeting will be April 5-8, and there have also been frequent phone calls since September. There were also virtual town halls (capturing younger voices), outreach to newer physicists, plus a public submissions portal. Meetings also included "P5 alone time." There were even a few meetings excluding HEPAP members and without program managers to foster an environment for frank discussions.

There have been several, important changes since the previous P5, and these developments play central roles in most of the current P5 planning. Of the scientific changes: the Higgs was discovered. The neutrino mixing parameter was measured. Three Nobel Prizes were awarded: Cabibbo–Kobayashi–Maskawa matrix, Higgs boson, and dark energy. The field is diverse in both topic and scale.

Programmatically, DUSEL (Deep Underground Science and Engineering Laboratory) did not proceed; but SURF (Sanford Underground Research Facility) continued. JDEM (Joint Dark Energy Mission) did not proceed. Tevatron collider operations ended, and PEP-II/B-factory operations ended. Budgets were lower than expected. International cooperation has been both productive and rewarding in terms of allowing for discoveries and moving the field forward.

Additionally, the year-long Snowmass process was helpful for collecting, assessing, and disseminating the great scientific challenges. A sense of unity emerged. Snowmass resulted in a set of 11 interesting scientific questions that challenge the field. Working from those questions, P5 identified five scientific drivers for physics.

- Use the Higgs as a new tool for discovery.
- Explore the physics associated with neutrino mass.
- Identify the new physics of dark matter.
- Test the nature of dark energy in detail, and probe the physics of the highest energy scales that governed the very early universe.
- Search for new particles and interactions; new physical principles.

Particle physics is global. It is a great field for discovery and exploration that attracts great minds to profound and exciting questions. World-leading countries pursue particle physics. The questions are profound and exciting, and the techniques are beautiful and useful. The field attracts great minds, talent, and dedication to a common purpose. Cooperation and competition are both needed for continued success, as large projects require cooperation for technical know-how and required resources. Global optimization is key to success.

If you took all the ideas presented to P5 and laid them out on spreadsheets, and tabulated the costs, the difference between imagined projects and projected program budgets is about $4B over 10 years. The P5 charge was to balance investments. Investments could include projects, facilities, lab R&D, and university research (including Theory). Investments include hosting large, world-leading facilities. They include small-scale projects, aggregated, "book-kept," and prioritized as groups in a 'small project line' in the budget analysis. The P5 rationalized that if an effort is important to pursue, and many small projects are, then they needed to be captured in the spreadsheets. They also checked on timelines for physics results to avoid long gaps in anticipated deliverables: "you can't have a 10 year desert of physics results." The high costs of hosting large-scale facilities and balancing budgets balance under fiscal pressure challenged the group's decision-making.

The first criterion under consideration by P5 dealt with overall program optimization. The overall program is driven by the science. HEP needs a prioritized portfolio that includes the study of known phenomena as well as space for unknowns/ surprises. We must consider the international nature of HEP and pursue the most important opportunities wherever they are (even if outside the US). Reliable partnerships are key, and duplication should occur only when significant value is added, or if a rigorous competition exists. The health of the field is sustained by supporting a balance of project scales and timeframes. Total expenditures on projects should be 20-25% of the total budget; the research fraction should be greater than~40% of both project data analysis and blue-sky research to explore unplanned new directions.

Criterion II is concerning research projects. Considering individual projects and trying to make good choices in supporting a vigorous field into the future, P5 is evaluating how the science addresses key questions in particle physics: how space for discovery might change the direction of the field, and what is the value of "no results." The panel, in evaluating science areas, asked when results are needed; technical cost versus value, scope, schedule feasibility, prior prioritization rankings, and criticality of U.S. leadership critical in an area.

The current plan is to deliver an internal draft of the report approximately three weeks prior to the May 22, 2014, HEPAP meeting, with a one-week turnaround time for comments by peer reviewers. The goal is a short report, referencing the volume of work that serves as its foundation. Feedback from the HEPAP would be greatly valued, and there would be a public release of particle physics priorities upon acceptance of the report by the HEPAP.

Pending approval, broader communication of the P5 report would occur at the time of the May HEPAP meeting, including a press release and ready-to-go web coverage. The panel will recommend draft versions of a 1-page overview and talking points, as well a press release. These would be quickly followed by virtual town-hall meetings, emails, briefings to decision makers, and other presentations to the public.

Discussion of Preliminary Work of the Particle Physics Project Prioritization Panel (P5)

Directed by the chair, the HEPAP re-walked through sections of the presentations in order to provide targeted comments. Bishai and Dr. Ursula Bassler complimented the town hall process.

Ligeti commented on the drivers. The first four points have to do with searches for new particles; yet the fifth point states, "search for new particles…" so that may be redundant. Ritz said he had done that on purpose but would remove it, if it caused confusion.

Bishai said that she assumed the list was not prioritized and suggested a Venn-diagram approach to presenting the priorities.

Cvetic suggested not a Venn diagram but lines to illustrate the interconnectedness of projects. Ritz said that the P5 wants a narrative to explain the connections, and in addition, to summarize the projects by logical groupings as an exposition of the scenarios.

Rosner asked if the priorities would be organized by timeline. Ritz said yes, to ensure communication of product was executable.

Erbacher said that while it may be hard for a 30-page report, the P5 might add, with incremental funding increases, what opportunities in the field might be missed. Ritz referred to it as the "lamentations section."

Bishai recommended illustrating how the Snowmass questions mapped to the distilled scientific drivers. Ritz indicated that the group had intended to do that.

Byrum said she hoped it would be clear, in the report, that hard decisions had been made, that a vision was articulated, and there was no ambiguity.

Professor Klaus Honscheid recommended that the P5 track budgets to programs when assembling the report. Someone pointed out that was done on slide 10. Honscheid said that the P5 needed to ensure the drivers were executable.

Ritz said the charge was more to assess what are the key drivers and opportunities; the budget realities are what they are. But, the P5 report would need to articulate priorities based on a strategic vision. The drivers are already intertwined; and regarding the choices: we have to explicitly say if it is feasible based on specific reasons.

Professor Harvey B. Newman, from the audience, said the last bullet regarding the search for new particles and interactions was fundamentally different from the others, as it speaks to our long-term motivations. The other drivers have more shape. He then asked how one maintains a big vision, yet do so under budget constraints?

Ritz prompted Ligeti, who agreed that the first four bullets were different. Newman said with the first four bullets addressed physical ideas that may change with time, but the fundamental idea expressed in bullet 5 was limitless. Ritz cited a need to have a certain level of specificity, such as accelerator physics.

On slide 9, “Particle Physics is Global,” the chair asked if there were questions.

Bishai said we should remind people that pursuing particle physics makes one a world-leading country.

Tschirhart said that for CERN, there were 100 countries involved. So, are 100 countries “world-leading?” He expressed concern that the message draws a line you wouldn’t want to draw with some small countries being referred to as “world-leading.”

Ritz encouraged the panel to argue among itself, a self-confessed old graduate school trick. Bishai said that small countries have big dreams.

Tschirhart said small countries may not receive that well, but he did not elaborate.

Professor Hitoshi Yamamoto asked how you accomplish the drivers/ big questions.

Ritz said he didn’t think P5 should be shy about articulating leadership roles, but that it should realize the report will be read all over the world, and also on the Hill. However, it is advantageous to have an international panel to help sensitize the P5 to other viewpoints. But when U.S. workers build machine components, like for CERN, and send it to another place in the world, the part is American made, and we should be proud.

Yamamoto said if a country participates in an international from its beginning, that would be much easier.

Hobbs recommended clarifying statements on international context.

Lankford suggested moving to the “Key Elements of Strategic Planning” section for comments. Tschirhart asked about the dollars on the chart.

Ritz said those are ‘escalated.’

Tschirhart then asked about operating costs of the agencies.

Ritz said there are essential uncertainties in this exercise; everyone on P5 now has a deep appreciation for those who make a budget every year, with hard choices. "We could not scrub everything, for the numbers on the charts, but we did strive for consistency: for example, project operating costs. We cannot understand everything at infinite detail granularity. We are told by someone that the lab will re-direct money into another effort… we try not to double-book savings and try not to double-book costs."

Bishai asked if the effort was deliberately scoped for one decade, "because you're really planning for the next 20 years. It may help to extend it out more than 10 years."

Ritz said there were several fictions on the slide, and that the dollar figures were not added to provoke HEPAP members to start to work the money problem out, in their own minds. He agreed, and noted that budget scenarios would not follow the path on the plot. There is a whole set of issues that determine the annual funding, which looks nothing like the chart shown. But Ritz noted that one has to pick something; one has to put some numbers down to do the exercise.

Bishai said, "Maybe what I'm objecting more to, is the integral."

Ritz agreed and said, "We don't spend a lot of time staring at this plot. We have to rein ourselves in and not assume a giant bow-wave of future funding."

Bishai pressed that the integral may not be helpful.

Erbacher commented that when the HEPAP talked about this before, the chart was for the purpose of demonstrating to our colleagues why some projects might get cut. Erbacher said that Bishai made a good point, but the scientific field needs an idea of the magnitude of the problem.

Ritz said there are projects well beyond the report's time-scope that would be part of the vision, but the task for the budget exercise was to consider a 10-year period. Bishai said she just doubted the integral; adding that the difference between where we are, and where our dreams are, is not a big difference.

Saul Gonzalez, of DOE-HEP, said the P5 was charged to discuss budgets.

Ritz said the blue line (the total, estimated cost of currently-funded projects plus submitted ideas) is not scenario C – which would involve choices as well, though.

Jawahery pointed out that Ritz emphasized the need to generate physics results and asked him to elaborate on that: did he mean short term and support for long term projects? P5 is not doing what some would advocate, "clearing the decks." Ritz said the priority list is meant to show a train of thought. If you want to build something big, like infrastructure, there are some nearer-term things you won't be able to fund, that it's about striking a balance. The group tried to depict an overall timeline of anticipated results. It checked whether the large projects "ate up all the small projects." Jawahery noted that the large projects also help to train students and postdocs.

Professor Thomas Shutt asked whether there was a missed opportunity in how the numbers were reported, not depicting a "tipping point" in terms of critical funding levels for HEP.

Ritz said it is something the panel struggled with.

Dr. Rikutaro (Rik) Yoshida, in the audience, said the internal guideline was to maintain a 25% balance, meaning, total expenditures on projects are around 20-25% of the total budget.

Ritz said if funding for projects goes above 25% of the total budget, "that's not sustainable." Ritz noted that the continuous cuts to projects also are not sustainable.

Yoshida countered that the budget outlined showed the project/ national lab funding going up, and research going down; so we're in that budget consideration process right now. Yoshida asked whether the P5 committee felt that's the right place for the budgets to be.

Chip Brock from the audience said the Higgs and large projects are very people-intensive. He asked Ritz: you counting heads when you're considering the budget balance? Physics results come from large projects, with lots of people working on a problem for a long time.

Ritz answered that someone at DOE did a lot of work to provide the fiscal data – but that the demographic number (people supported per dollars project) was not understood with great precision.

Brock said for certain experimental scenarios, there aren't enough physicists in the country to pull some of them off.

Lankford then asked for comments on the slide, "Criteria (I): Overall Program Optimization." Someone asked if it was time for a coffee break. At 3:47 p.m., the group paused for a break.

Continued P5 Discussion

The meeting re-convened at 4:18 p.m..

Ligeti asked whether the P5 had considered scientific areas most interesting to the international community.

Ritz asked: you don't want to avoid doing a project, just because a group in a different country is doing it, right? Ligeti asked how the P5 was considering trade-offs between short-term, long-term, competitive versus duplicative research, and likelihood of success.

Ritz said, "If it is a nice experiment, and someone [else] is going to get there first…" implying that duplicative work would be avoided in that case.

Ligeti said, "If you know someone will get there first, it's relatively easy [not to make it a priority], but if two labs are working in competition, it's not as clear." Ritz said, "We just have to take those uncertainties into account."

Ritz then asked Ligeti if he could make his comment more specific; otherwise, all he could comment is that yes, one would have to take competition versus duplication into account.

Han asked how much the P5 had coordinated with European physicists.

Ritz said Professor Tatsuya Nakada of the EPFL (the Swiss Federal Institute of Technology in Lausanne) was on the panel for that reason. On its first working day, the P5 was charged to build on the work of Snowmass and also to take international progress into account.

Ritz said the P5 was writing a report that it hoped the HEPAP would adopt to give advice to the US government, one that provides a way for cooperation at the federal level.

Han said that when we propose our U.S. planning, we should try to be on the competitive side as well.

Ritz said these are different projects at different scales; there's no reason the U.S. can't operate in both modes for different types of projects. What we haven't done as much of is long-term coordination of money for longer-term international work. It is not the same as collaborating on a project.

Jawahery asked is there a sense that the U.S. is coordinating more, rather than competing?

Ritz said he thought that for the very large projects, that is true.

Jawahery asked if that was in the report.

Gerber asked what the P5 would say about international partnerships.

Ritz said they must be clear, reliable, and actionable – from both directions/ partners.

Gerber asked if the P5 had also considered U.S. standing on prior commitments as well as future directions.

Ritz said yes and provided an example: suppose the U.S. wanted to do a project from a particular country or region, and that country wanted to partner with us. We wouldn't ask to go there and them not participate in the project.

Ritz urged her to keep in mind that, via the P5, the HEPAP is giving advice to the U.S. government, as is the mandate.

Shutt asked whether having programs in the U.S. has a different importance. There is sort of a feedback effect: doing all of the science overseas could lead to an investment decline in the U.S..

Byrum said her question was in the same line as Jawahery's point regarding coordination versus collaboration. She said, "We can't have large projects in every aspect of research that we're doing. I don't know how you'll mention the [international] players in your report."

Ritz said the P5 was charged to identify ways in which international coordination will open opportunities. We don't want to tie people's hands but to simply lay out overall goals, not be too precise, and lay out interests for the U.S. program.

Hobbs commented that Ritz would not say specifically who the international players will be and asked whether the P5 solicited input from them.

Ritz said that they collected information about the overall landscape, and they had taken that information into account. Ritz added that we don't want to be overly prescriptive in saying whom internationally, we should work with and on that timeline. But it has to be actionable with flexibility built into it as well.

Bishai noted that the report's audience might not realize how international our collaboration is. The P5 report should state there is an internationally recognized set of physics tools and the role of the U.S. in providing some of those tools. It makes our efforts more successful when we are recognized for our work, internationally, as well as nationally.

Ritz said there aren't too many U.S.-only projects. Without U.S. leadership, many projects wouldn't happen.

Cvetic, asked where the Theory program stood within the key elements of strategic planning.

Ritz answered that Theory is part of the overall research program. The 'search for new particles and interactions' isn't just a fishing expedition. Theory informs this priority area. It is important to pursue theoretical physics work "because Nature sometimes surprises us." That quest represents Theory's special role in HEP.

Han asked whether Charge Parity (CP) violation is part of it.

Ritz said yes, with neutrino mass, and dark matter. These things are certainly intertwined.

Jawahery asked, in the report, would the P5 spell out the "scientific drivers" more explicitly?

Ritz said, "Yes, we will give specific examples in narratives."

From the audience, Professor Vic Teplitz said that a theorist friend spoke to him, recently, and he was considering pursuing a certain direction in science. He may be interested to know if P5 thinks that area of physics is a priority (implying that it may affect scientists' choices of academic pursuits).

Ritz acknowledged this effect and added, "Our product is the report and nothing else. That's the public thing." Ritz then said there should not be a follow-up or later-release of more information…it's not healthy."

Rosner asked a question on the P5 report rollout: "Once the report is out, there may be reaction from the community on things they weren't expecting. How are you going to handle the rollout to maximize the buy-in?"

Ritz answered that part of it is having an open process and inviting comments now. The panel wants to ensure there are as many ways and modes as possible in consulting and weighing in with the community. Additional suggestions [for providing inputs] are welcome.

Ritz then asked Rosner if he was suggesting specific people weren't going to be happy, and that we should talk with them?

Rosner answered yes.

Ritz said he hoped that the HEPAP would help facilitate communications as well. Ritz said that if there were anyone in the community who may be concerned, the he hoped Rosner and others present would encouraged concerned individuals to contact him or anyone on the committee to talk about it. He said the panel couldn't discuss, in detail, everything, but that it could certainly hear concerns.

Rosner asked whether DPF (the American Physical Society Division of Particles and Fields) was included?

Ritz said yes, that he had talked with the DPF executive committee not long ago. It was an informational event. Remember that this is a report owned by the agencies, and it is good for the community to stand up and say why they support it. More suggestions are welcome.

Tschirhart commented that people want to try to understand the cost and schedule factors that led to identification of the five scientific drivers for the field of HEP. How would the P5 illustrate the interplay between cost and schedule? Would it be a plot where one shows overlapping portions of a program's budget over time – how sub-projects sum together into an aggregate budget (a whale plot)?

Ritz said the panel is working on ways to show that the peaks of projects (e.g., scientific products) don't all line up. There will not be a color scale of expenditure by year. But the campaign aspect of the programs can be shown graphically.

Tschirhart said the P5 would need to provide some tools to communicate in more detail than the plot showed today.

Ritz said the final report would not show a plot like the one in his presentation that day. Then he asked Tschirhart: "But you're saying a level deeper than what? Suggestions?"

Tschirhart said that people make decisions and requirements based on available budget. Communicating that interplay will be helpful to the community. Ritz said, "I wish I had a brilliant answer in terms of a figure to communicate that." He added that it was not appropriate to show all the spreadsheet materials, but it would be helpful to graphically indicate where are the choke points and strains in funding versus program efforts.

Ritz said the P5's task was not to design the budget, but its advice must be robust against changes in the budget. It is possible that the funding level will be below Budget Control Act levels. However, the budget won't be actionable if we don't lay out why the field is worthy of support.

Bishai said that it would be a challenge to communicate to the wider DOE audience how the HEP is worthy of higher funding levels.

Ritz said that in the scenarios, we have to sing the praises of how good the program is. It is hard to say that without laying out specific efforts.

Bishai asked: these scenarios will identify key messages, but given that the panel is mired in budgets, is crafting a message to a wider community possible? Does the panel have public relations people? This report will be read beyond DOE and beyond Congress.

Ritz said that the panel did not have the time, at this point, to revise old reports. This report will not be filled with graphics. There will be a one-pager "you can hand to people. " It is a good idea to follow-up, spurred by the P5 report, but look for opportunities to update this guidance. The messages for what is compelling in our field should be in our report and in the one-pager. A follow-on to *From Quarks to the Cosmos* is beyond the panel's scope.

Gerber asked what was the plan to wrap up the P5 report.

Lankford reported that a federal advisory committee would decide whether to accept the report as provided to them. All HEPAP discussions must be public, so there is no practical way to bring feedback into the report prior to its presentation. A mail-in review is not possible. The steps are as outlined on the slide. The P5 would give the HEPAP the report well in advance to allow for the HEPAP to formulate questions and discuss at the May meeting. We don't want HEPAP to be a rubber stamp, but we have to work within this timeline.

Tschirhart asked Lankford to clarify: should HEPAP members hold any P5-related questions that may have until the May meeting, or should they send them, in advance, to Lankford?

Lankford replied that they were, ''trying to work that out." Lankford added that they "expected this to play out differently than the way it is going to play out, now."

Ligeti asked whether the report's peer review period was three weeks before the anticipated date the HEPAP would concur with the P5 recommendations.

Lankford replied that, no, the peer reviewers would do a mail-in review, with a one-week deadline.

Ligeti asked from how many people [outside the HEPAP] would Lankford solicit opinions. Lankford did not specify a number but did express an interest in obtaining views from people with diverse backgrounds – those with scientific and other backgrounds more reflective of the report's audience.

Ritz invited the group to make suggestions on the peer review specifics.

Rosner noted that from the Snowmass planning exercise, the group produced a tri-fold pamphlet that was effective as a communication tool. He advocated for the panel to consider such an idea for the P5 recommendations.

Ritz replied that the one pager might satisfy that.

Tschirhart said, regarding the peer-review process, that he thought it would be valuable for individuals outside the field of particle physics read the P5 recommendations, including DOE Basic Energy Sciences (BES): offices that have had some success in communication. He also suggested soliciting feedback from experts on international collaboration in high-energy physics.

Lankford asked if the panel had any further thoughts and then invited the audience to comment.

Ritz noted that community buy-in was critical, and rationale for choices must be articulated. He said that the P5 report would be very important for the HEP community. Public disagreements on the general direction of the field could be misunderstood by the broader public, so he hoped the HEPAP would choose to accept the report.

Lankford then thanked Ritz for his presentation and adjourned the meeting at 5:14p.m..

MARCH 14, 2014

REPORT FROM THE DOE OFFICE OF SCIENCE

Dr. Patricia Dehmer gave a report from SC. She said how much she enjoyed the Thursday discussions, describing them as "very interesting," and that they totally changed what she had planned to say on Friday. The SC budget for FY15 was not available, yet, on the SC website. She said she would provide an overview and not details; and then explain what it means to wrap up a budget, to try to answer, "Why not just increase the budget?"

She presented a chart highlighting FY13 current appropriations, FY14 enacted appropriations, and the FY15 President's request for DOE-SC and its components. The HEP budget top line decreased by 6.6% relative to the FY14 enacted appropriation; thus, HEP was cut, but not as dramatically as others.

Advanced Scientific Computing Research increased by 13.2%. Programs with the largest decreases included "Workforce Development for Teachers and Scientists" (-26.4%) and "Science Laboratories Infrastructure" (-19.0%). She noted that in 2014, one of the programs had gotten an extra $10M from Congress. Fusion energy was down due to ITER construction budget.

She explained the process by which one goes about making budget allocations for subprograms, when the overall SC budget is flat. When one does this, one rarely says, 'I'm mad at high energy physics, so I'm going to cut it.' More accurately, there are many drivers: OMB, OSTP, the President's priorities. If there is a construction project that has been supported over the years, you'll see an increase in that line, to support that commitment. Funding decreases might occur in areas that are not performing: fusion energy had a construction project that had some trouble. Or ATP that has not yet developed a community plan: its budget is "paused" until it can articulate a plan.

Dehmer provided highlights of the FY15 SC Research budget: there are two examples of overall funding increases. In high performance computing, "big data," and the movement in computers from petascale to exascale processing is receiving extra support. And for BES, the Basic Energy Sciences program, money is being given for three to five teams to tackle big questions. Every single Research line is flat except the $25M increase in computational sciences. The increase aligns with calls from the community and the department's interest. Material science is important to the President. Tom Kalil is back in the White House and cares about the materials genome initiative, so BES aligns with that.

Facility operations, in most cases, operate at or near optimum levels. Two big computers are at Argonne and Oak Ridge. They have sufficient funding to operate to the max, plus funding to prepare the facilities for future upgrades. The upgrades are well established in community needs. There are Administration initiatives that speak to "big data." In BES, the light sources, neutron scattering sources, and nanoscale science research centers are used by 10,000 or more users per year. Fusion Energy Sciences, NSTX, the National Spherical Torus Experiment operates for an 18-week run following a three-year-long upgrade. In High Energy Physics, the Fermilab Accelerator Complex operates to support experiments such as NOvA, Minerva, MicroBoone, MINOS. In Nuclear Physics, facilities will operate optimally. The supported facilities align with major program priorities.

Reviewing the distribution of users at the approximately 30 SC facilities, Dehmer said 75% of the users go to the BES or ASCR facilities. In 2013, there were about 28,000 facility users total. She further discussed the distribution of users at the SC facilities: most use the light sources and computing facilities, and others use nuclear physics, biological and environmental facilities, and high energy physics facilities. Nearly ten years ago, many of the computing facilities were not in operation, but the high-energy physics facilities represented a much greater portion of the overall facility operation. The trend is toward computational facilities getting more and more users. If one goes back even further in time, the trend gets more pronounced.

Highlighting construction budgeted by SC for FY15: BES just finished National Synchtron Light Source – II. And LCLS, the Linac Coherent Light Source, is in its second year of construction. ITER, the Europe-based experimental fusion reactor, is waiting on management to complete its review. R&D continues for the Long Baseline Neutrino Experiment (LBNE) in High Energy Physics: there is a sense that everyone is waiting for the P5 report.

Congressional staff have asked Dehmer what the P5 will say, e.g., are they going to support LBNE? Dehmer had answered that DOE would come over and brief them once the P5 report is completed, and staffers will have time to make their legislative marks to the programs. Whatever the P5 says will have great influence. She urged the HEPAP to come to consensus on the recommendations.

Last year's appropriations bill will allow construction to begin for the Facility for Rare Isotope Beams, an effort that has been strongly supported by the community for a long time. Program staff got support from the Administration when the building plan changed slightly. In the field of nuclear physics: strategic planning didn't take into account a balance between the research and facility programs, so it is now the most skewed, in terms of infrastructure to projects ratio, and nuclear physics programmers are struggling to balance the budget.

She showed a chart ranging from 1990 to 2015 depicting new facility construction at the top and terminated facilities on the bottom. The Secretary of Energy was so interested in this chart that he asked for a narrative version for the public. It shows that DOE does a lot of construction, especially of light sources, in the 25-year period. DOE built five nanoscale science research centers from 2006-2009. The Spallation Neutron Source was built around 2006. The Supercollider in Texas closed in the 1990s. The ratio of big facilities open to those that closed leans toward the closed.

Next, Dehmer moved on to present the BESAC report on "Future X-Ray Light Sources" and the DOE actions in response to the report. On January 2, 2013, Bill Brinkman, then the Director of the SC, charged the BESAC to report on:

- An assessment of the grand science challenges that could best be explored with current and possible future SC light sources.
- An evaluation of the effectiveness of the present SC light source portfolio to meet these grand science challenges.
- An enumeration of future light source performance specifications that would maximize the impact on grand science challenges.
- Prioritized recommendations on which future light source concepts and the technology behind them are best suited to achieve these performance specifications.
- Identification of prioritized research and development initiatives to accelerate the realization of these future light source facilities in a cost effective manner.

At the time, Brinkman and Dehmer were concerned about the multi-billion-dollar costs of the light sources in the program. The BESAC reported that, "At the present time, the U.S. enjoys a significant leadership role in the x-ray light source community. This is a direct result of the successes of the major facilities managed by BES for the U.S. This leadership position is due to the science successes of the storage ring facilities and the particularly stunning success of the first hard x-ray free electron laser, the Linac Coherent Light Source (LCLS). However, it is abundantly clear that international activity in the construction of new diffraction limited storage rings and new free electron laser facilities will seriously challenge U.S. leadership in the decades to come. "

One BESAC recommendation centered on free electron lasers. In spite of the present competitive environment, a window of opportunity exists for the U.S. to provide a revolutionary advance in x-ray science by developing and constructing an unprecedented x-ray light source. This new light source should provide high repetition rate, ultra-bright, transform limited, femtosecond x-ray pulses over a broad photon energy range with full spatial and temporal coherence. Stability and precision timing will be critical characteristics of the new light source.

A second recommendation concerned storage rings. The present plans for upgrades of U.S. storage rings will leave the U.S. behind the international community in this area of x-ray science. BES should carefully evaluate present upgrade plans so that U.S. facilities remain at the cutting edge of x-ray storage ring science.

In response to the BESAC recommendations, SC directed SLAC to consider incorporating the recommendations into the LCLS-II project. SLAC proposed a modified LCLS-II: to use one kilometer of the existing three-kilometer linac tunnel to add a new 4 GeV superconducting linac; add a new electron injector; and add two new undulators to produce the world leading high rep rate FEL in the 0.2-5 keV photon energy range. No construction or new instruments would be required, and the cost would be approximately $900M.

SC also directed Argonne National Laboratory (ANL) to consider incorporating diffraction limited storage ring technology into APS-U (Advanced Photon Source – Upgrade). ANL proposed a multi-bend achromat lattice in the existing tunnel; a doubling of the ring current; and new insertion devices & beamlines that will boost the ring brightness by 100 to 1,000 to position APS as the world's brightest hard x-ray storage ring. The cost would be approximately $550M.

Regarding the Next Generation Light Source (NGLS), at LBNL: NGLS is a high rep rate, soft x-ray, free electron laser facility based on a superconducting linac and 3 undulators. Its status is CD-0 (Critical Decision Zero). Further CDs have been on hold, pending BESAC recommendations. Following the BESAC report, SC directed the lab to consider whether NGLS could be modified at reasonable cost to include an expanded energy range. After consideration, LBNL terminated the NGLS project. Therefore, the status has changed in BES from three to two projects.

Dehmer asked the labs to phase construction projects so at no time construction be more than 25% of the BES budget. SC wanted to know what BES could do with a flat budget. LCLS and APS-U will phase in time, and these projects will comprise 15-17% of the BES budget annually. Dehmer said that this is how a report changes what a program is doing. She briefed the Administration, OMB, OSTP, and Congress. She emphasized there is time to influence the 2015 budget that's on the Hill and to build community consensus. Programs and projects are budgeted when they are discussed as priorities. There is great interest in P5, and it will have influence.

Discussion of the Report from DOE Office of Science

Bishai asked if the timescale of the P5 decision (May) was known. Dehmer said yes.

McBride noted that when Dehmer showed the LHC chart, she didn't show the users.

Dehmer said all user data is captured; to get it, you have to go back to the user facility with a specific definition, certain responsibilities, put out calls for proposals, track review committees.

McBride said there have been discussion of adding those facilities as user facilities. She asked, "Do we want to include the LHC as a user facility?"

Jawahery asked would user hours, rather than number of users, be the better metric.

Dehmer said they count not only numbers of users, but also hours of operations, noting that she can only get average hours per user. Every year SC must estimate the number of hours each facility will operate. For the light sources, users tend not to use them for days at a time. Dehmer said that for a light source operating at 5,000 hours per year, and three to four users at that facility, one can get the data.

Lankford commented that this metric doesn't serve HEP very well, which is probably why Dehmer showed the HEPAP the chart. What action can we take?

Dehmer said the pie chart with users doesn't matter. The more important question is: what is the P5 going to say? Where is this field going to go? Don't get trapped in minutia.

Tschirhart asked about large funding shifts. For BESAC, when interactions occurred between users and labs, what happened in the community?

Dehmer said that the community was considered in the BESAC report. The HEP community is different. The light source community understood what was happening as soon as the BESAC report came out; they understood the recommendations on the facility modifications and upgrades. Such changes may not be as needed for this community, at this moment, perhaps?

Tschirhart said the scientific community wasn't sniping at the sidelines. Dehmer continued to explain that part of the BESAC was, indeed, nervous and unhappy that one of the light source projects was terminated, and they did reach out to the 4,000 or 5,000 people in the community (3,500 users per year) in a specific outreach strategy. Tschirhart asked whether that outreach strategy was something from which the HEP community could learn.

Dehmer said that the HEPAP's proposed communication strategy for P5 recommendations was good: going to the professional society, a website, briefing groups as it meets with them.

Erbacher expressed concern about Dehmer's statement on the division between facility projects and the research program. The BES research budget is not commensurate with the HEP budget.

Dehmer said yes, yesterday we heard that a ratio we like to see is 40% research, 20%, construction, and 20% facility operations. All of the programs in the SC Nuclear Operations had a low research budget.

Erbacher said that you need students, postdocs, faculty, and infrastructure. Even though we don't have a plan and big facilities, the cuts will affect researchers at big universities as well – there must be some stability. We are not getting the word out that fluctuations in the research budget will affect our ability to do the science.

Lankford asked, what were the indications that a research budget is trending too low?

Dehmer answered that if you project out five, six, and ten years, you can see a trend. You have to provide for personnel cost-of-living increases, and to offset the costs, hours of operation go down, very quickly. The facilities will 'eat your lunch.' With BES, a high percentage of the budget is for facilities, and if you know construction is occurring, plus the cost of operations will be large: those are danger signs. The light and neutron sources are the same way. It's easier to sell a billion dollar facility than a small increase in research.

Bishai said that the HEPAP heard a few million dollars in one of the subprogram research budgets would mean a lot.

Dehmer said it's really hard to 'sell' an initiative in a research budget, explaining that she had spent five to seven years, at workshops, to advocate for the energy frontier workforce centers.

Bishai said that if we create Theory centers, is it easier to get money for their work. Usually, the Administration and Hill don't like Centers because funding them becomes a commitment on their part. They have asked SC for a list of its centers because they are costly.

Erbacher asked if there was a term that would be better to use, as an advocacy tool, than 'center.'

Dehmer shared that the current Administration believes that the term, "initiative" indicates efforts at a higher level, such as at a Presidential level. Examples are: the Materials Genome Initiative; the National Nanomaterials Initiative; the Brain Initiative.

Tschirhart commented that one of the challenges is in communicating with the community to reduce their stress level.

Dehmer said you can't reduce their stress level; P5 needs to just finish its work.

Tschirhart countered by saying the FY15 budget for HEP is lower than that of FY14.

Dehmer said that Congress did provide more money, relative to President's budget. She added: the only way our community is going to have robust growth is if we come forward with a robust plan. That plan will determine whether the program gets increases. Don't talk about a stalled or flat budget. Focus people on what they have to do.

Tschirhart pressed: people in our community note that the FY15 budget went down, and you're advising them to ignore that?

Dehmer said: "I would advise them to do that. No squabbling. I want to hear, 'Here's where we are going.'"

Bishai noted Dehmer's emphasis on the importance of completing the P5 recommendations and asked whether Dehmer could recommend timing on their rollout.

Dehmer answered that the HEPAP will have a May meeting and have seen the P5 report, and the HEPAP would talk about it in May. If you say 'we totally buy into it,' then SC will go ahead with the communication plan. On the other hand, if HEPAP says we have concerns, the consequence is the communication plan will be delayed and the Hill staff won't have much time to respond with appropriations and programmatic decisions based on what they hear.

REPORT FROM DOE OFFICE OF HIGH ENERGY PHYSICS

Next, Jim Siegrist, Associate Director of the Office of High Energy Physics , gave a report from DOE/HEP. The FY15 budget had been handed to Congress but had not been posted yet. Siegrist started by sharing take-away messages: HEP is actively engaged with the community on the P5 new strategic plan. DOE management says the plan must be compelling and executable, with the community behind it. HEP has supporters in Congress. But the budget and appropriations problems have delayed projects. The HEP community has a weak basis to argue for more funding in a constrained fiscal environment. The message from HEP, quoting Steve Ritz: "Bickering scientists get nothing."

Siegrist gave an overview of the budget. Its impacts include workforce reductions at universities and labs and delays of several new efforts. Key areas of the FY15 request include maintaining forward progress on new projects while minimizing the impact of Research reductions to the extent possible. The FY 2015 budget request supports: (a) full operation of existing HEP facilities and experiments; (b) planned construction funding profile for the Mu2e; (c) MIEs for the ATLAS and CMS Detector Upgrades; (d) capital equipment funding for LSST, Muon g-2, and towards Belle II; and (e) Accelerator Stewardship funding for new research activities in high-impact areas.

He reported on the Energy Frontier Physics Program. For the Large Hadron Collider (LHC) at CERN: Run 1 was completed December 2012. At the Fermilab Tevatron, teams are working with DØ and CDF collaborations on completion of legacy analyses as part of its ramp-down research program. Most efforts should be completed in FY13 and FY14, and final papers (e.g., $M_W{}^{Tevatron}$) should come out in FY15.

There is a major upgrade to the LHC planned for 2020 that will enhance the LHC luminosity by a factor of ten. The U.S. LHC Accelerator Research Program (LARP) aims to leverage expertize to serve needs of HEP community. LARP consists of four U.S. laboratories, BNL, FNAL, LBNL, and SLAC; and it aims to realize the full capability of the LHC and maximize the discovery potential of U.S. investments in the LHC.

Several major experiments are ongoing in the Intensity Frontier program. The NOvA experiment sees the first long-distance neutrino. Siegrist showed February 2014 data from Fermilab indicating the signature of one of the first interactions captured at the NOvA detector from a beam of man-made neutrinos generated 500 miles from the detector. The project was completed in November of 2014 and cost $278M. The last of the 28 NOvA blocks of PVC modules was installed on February 25, 2014.

For the Long Baseline Neutrino Experiment (LBNE): the reaction to the CD-1 approval from other countries was positive. The European Strategy Group recommended that CERN seek ways to partner with the U.S. on LBNE. Discussions are now ongoing. We need a new CERN-U.S. agreement that envisions CERN investment in the U.S. as well as U.S. investment at CERN. The U.S. and India will sign an agreement any day now to collaborate in several areas including LBNE. The European collaboration, LBNO, is discussing merging with LBNE. Brazilian, British, Italian, and Indian physicists have joined the LBNE collaboration. The collaboration has grown 30% with two-thirds of the growth from outside the U.S.. The U.S. particle physics community desires to locate LBNE underground to allow proton decay and neutrino astrophysics. HEPAP, through the SC facilities prioritization panel, found an underground detector to be more compelling, and CERN and the Snowmass participants expressed similar views. The P5 will address this issue.

Within the Cosmic Frontier area of SC: the Dark Energy Program operates via the Baryon Oscillation Spectroscopic Survey (BOSS) and the Dark Energy Survey (DES). DOE and NSF are partnering to build the Large Synoptic Survey Telescope, representing a next generation imaging survey. Fabrication was approved to start in FY14, and ten-year operations are slated to begin in 2023. NSF will build the telescope, and DOE will build the camera. For future planning; the dark energy spectroscopic instrument will have a CD-1 review in the summer of 2014, with R&D continuing in FY15.

For the Dark Matter Direct Detection Program: this staged program is currently running experiments to test multiple technologies to determine the most powerful method for future generation. Generation 1 (DM-G1) experiments are currently operating. Examples are SuperCDMS-Soudan, LUX, DarkSide-50, and COUPP-60. In the near future, at least two Generation 2 experiments will be selected to move to the fabrication phase. The goal is to improve sensitivity by one or more orders of magnitude. The CD-0 occurred in September of 2012, and the plan is to announce selected experiments in 2014, after the P5 report. Planning for G3 R&D continues at a low level, but the community is waiting for P5 to give advice on future direction.

In the area of advanced technology R&D, work at SLAC represents new technology for lower accelerator size and cost. The new FACET facility demonstrates first acceleration of a witness bunch a in beam-driven plasma wakefield. The accelerating field of 6 GeV/m is 300 times that of the SLAC linac. The technology represents an important step towards a meter scale high-energy plasma based accelerator.

Record currents have been generated in high temperature superconductors (scientists achieved 500 A/mm^2 at 30T, 4.2K in $Bi_2Sr_2CaCu_2O$). This level of current density could technically enable magnetic field levels that double existing particle collision energies.

SC is formulating a national accelerator stewardship program: In 2012, SC asked for a broad review of the accelerator field. The Holtkamp Accelerator Task Force met in 2012 to identify initial stewardship opportunities and potential impediments. In 2013, the task force held the 'Ion Beam Therapy and 'Laser Technology for Accelerators" workshops; Ion Beam Therapy was held jointly with the National Institutes of Health (NIH). For 2014, a facilities pilot program meeting is planned to discuss potential user community needs and how to make the facilities ore accessible. There is a 2013 Request for Information (RFI) and a 2014 Energy and Environment Workshop aimed to identify key accelerator R&D needed to advance energy and environmental applications of accelerators.

For the Accelerator R&D Stewardship program elements: in its initial year, FY14, the Accelerator Stewardship program begins with redirected funding. About two-thirds of the funding is in existing activities that were identified as having broad impact beyond HEP. About one-third of the funding applies to initiatives starting in FY14, including for Brookhaven-ATF and for opening accelerator test facilities to "non-traditional" users such as OFAs and industry. In 2015 and later, new grant applications will be sought in the areas of laser technology, ion beam technology for medicine, and energy and environmental applications.

Siegrist highlighted the high energy physics budget. In the Energy Frontier: LHC data is taking resumes in 2015. The U.S. will continue to play a leadership role in LHC discoveries and is actively engaged in the initial upgrades to the LHC detectors. In the Intensity Frontier: the Fermilab program continues its evolution as the leading accelerator facility on the intensity frontier: the newly completed NOvA detector begins generating physics data in FY2015. Fermilab scientists are building several new experiments to access new phenomena that cannot be observed at the LHC, such as the Mu2e experiment, the muon g-2 experiment and the MiniBooNE experiment. Work in the Cosmic Frontier aims to advance our understanding of dark matter and dark energy. The recently commissioned Dark Energy Survey continues its five-year mission, looking for the subtle effects of dark energy in shaping the evolution of universe. This search will be significantly extended in the future by the Large Synoptic Survey Telescope, now under construction. The search for dark matter will enter new territory with R&D and design of selected next-generation dark matter detector technologies that can advance this field by an order of magnitude in sensitivity.

For recent funding trends: from about FY2000 to FY2006, Projects experienced a funding dip, from 20% of the budget to nearly zero. We have been trying to get construction budget back up. Many projects that commenced since 2006 are coming to completion. Congressional continuing resolutions (CRs) and other budget uncertainties have been detrimental to the budget; the P5 recommendations may help.

Slide 27 laid out HEP "performance expectations for particle physicists." The P5 report will impact major infrastructure funding. DOE/HEP expects the community to fully support the result of the P5 and Snowmass deliberations
The entire community has put an enormous amount of work and energy into this process. The Secretary has advised HEP (see Snowmass opening letter) to 'get a plan' and 'stand behind our plan.' The budget scenarios P5 had to deal with are extremely tight, so it is very likely that 'favorite projects' did not get the priority some may have hoped. DOE/HEP expects the community to support the prioritization chosen by the committee in any case. Physicists were urged to "suppress any feeling of entitlement that the budget scenarios are too austere for a field as glorious as HEP." Attendees were warned that the science priorities chosen

by P5 might not match individuals' personal preferences, but DOE/HEP expects physicists to respect the P5 science priorities and the P5 process.

He offered some communication "do's and don'ts" as the P5 report comes together. Do provide unvarnished feedback about the P5 report to NSF, DOE, Chair of HEPAP, Chair of P5, Director of FNAL, and/or DPF Chair line. Do familiarize yourself with the P5 supplemental materials that will be provided and will be vetted by communications professionals for clarity and impact. Do take careful note (listen!, don't lecture) of how the folk you talk to react to the P5 story and pass those reactions back to NSF and DOE so they can adjust messages about P5 to have maximum positive impact. Do put yourself in the position of an outside observer of HEP, and ask yourself: (a) Do these strange people look like they know what they are doing? (b) Do they have their act together? (c) Do they have a clear and compelling message? Don't ever speak to someone outside our field and transmit a sense of our entitlement to support due to the glorious nature of Particle Physics research, past Nobel prizes, etc.. Don't ever attack areas of our field in favor of your favored area since 'bickering scientist get nothing.' Don't ever diminish other areas of science as somehow less important than HEP.

Discussion of the Report from the DOE Office of High Energy Physics

Bishai said, regarding the list of "don'ts," that there is a fine line between excitement for what one is doing and transmitting a sense of entitlement. We are excited about what we're doing. Do you have advice on how to show passion about what you're doing yet not inadvertently show entitlement?

Siegrist said don't compare negatively to other fields.

Bishai clarified that what Siegrist meant was saying, "I'm more important than field xyz."

Honscheid asked whether the system was ready to accommodate comparative review, and would shifts be detrimental to the current scientific community.

Siegrist said yes.

Randal Ruchti of NSF added that the new P5 plan will bring the field together, and sub-programs will adjust/ align with that plan.

Honscheid said if there is major change in what a researcher plans to do based on P5 recommendations, then that might be a factor to consider for grant funding.

Ruchti said individual funding decisions are made on a case-by-case basis.

Byrum said having transitioned from CDF to astrophysics, it can be difficult to make a major transition. A lot of people don't fare well in those grant reviews in terms of applying for grant funding. She echoed Honscheid's concern.

Tschirhart said the communication do's and don'ts are mostly geared toward the community, rather than targeted at the HEPAP. Basically, the message is, 'don't complain first to Senator before talking to the agencies.'

Bishai asked for a clarification: regarding the advice on discussing the P5 report to NSF and DOE: while it's ok to discuss with grant monitors, program managers, etc., are you recommending that we not discuss with those at the highest leadership levels at NSF? Going above isn't actually bad, right?

Siegrist said, well, it is better to communicate with mid-level people, so complaints can be attempted to be fixed without elevating.

Lankford called a break at 10:10. The meeting resumed at 10:36.

REPORT FROM NSF MATHEMATICAL AND PHYSICAL SCIENCES

Dr. Denise Caldwell, Division Director of the NSF Division of Physics gave an update on NSF Mathematical and Physical Sciences (MPS), noting that it was important to discuss within the context of NSF, overall. She said there are six research directorates under the office of director, one of which is Mathematical and Physical Sciences, which is fundamental, basic research in MPS. The goals are to advance discovery, create building blocks for innovation, develop and maintain forefront facilities, and educate the next generation. These are goals both for NSF and DOE.

Advancing chemistry is an exciting field; three chemistry Noble laureates and six MacArthur Fellows were funded through MPS. NSF also supports Peter Higgs and contributed to Atlas and CMS to discover the Higgs particle. In 2013, high-energy neutrinos at the Ice Cube facility at the South Pole was partly funded by NSF MPS and the Geosciences Directorate.

In 2011, 24% of federal support for academic research came from NSF. There are 29,000 people estimated to receive support and do MPS activities. About 60% of MPS support goes to graduate and undergraduate students. Another 30% goes to senior researchers (principal investigators, or PIs). NSF also funds engineers and research scientists critical to the operation of a research facility or center.

From 1970-2012, NSF has experienced periods of flat funding and periods of growth. Funding was flat from 1970-84; 1995-99; and from 2004-present. The NSF budget increased from 1985-95 and from 1999-2004. We must think about what we'll do within the constraints of a flat budget.

There are six lines in the FY15 NSF budget request. The Research and Related Activities budget ($5.8B for FY15) funds most of the basic research. It has been essentially flat since 2014. The total NSF budget increased only by 1.2%.

The Sequester affected everyone. At NSF, Physics decreased by almost 10%, all of which came from 2013 funding. That means there was no funding for an estimate of 150 students, postdocs and junior scientists. NSF-MPS budgets are roughly flat in FY14 and FY15. But relative to FY13, Physics increased slightly.

Major MPS major investments include: Science, Engineering, and Education for Sustainability (SEES); Designing Materials to Engineer and Revolutionize Our Future (DMREF); Biological, Mathematical, and Physical Sciences (BioMaPS); Cognitive Science and Neuroscience (CNS); Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21); and Mid-Scale Research Infrastructure. MPS participation in NSF-wide initiatives make up about 5.8% of the MPS budget, or $75.6M. The budget includes a certain floor that we think we will invest, but we often invest more due to receiving good ideas. And regarding partnerships: CNS:

Cognitive Science and Neuroscience, desperately needs Theory. CIF21 is another area where high-energy physics contributes strongly. This encompasses things other than just doing big calculations on big computers, but it includes developing new models, computational tools, and new ways of handling data. Midscale is another major class of MPS Major Investments and represents a priority area. At least two divisions, astronomy and physics, have a critical need in this area. NSF is interested in developing a platform approach for studying materials that is at the midscale level.

Regarding students: CAREER awards and Research Experiences for Undergraduates (REU) have funding from MPS: $66M and $21M, respectively, for FY15.

Most NSF awards are 'individual investigator awards,' but we also support a number of multi-user facilities: LIGO, IceCube, and the NHFML (National High Field Magnetic Lab) are examples. One must have facilities to do science. But once one build them, one must keep them running. There are costs to operate and also costs to turning them off, as well as the necessity of concomitant support to researchers who will work in those areas. Thirty percent of Physics funding is for facilities. For Astronomical Sciences, facilities are 57% of the funding pie. For Chemistry and Mathematical Sciences, zero of their money is for facilities. There are two different budget lines for facilities: "Research and Related Activities" (R&RA) represents the operations money. "Major Research Equipment and Facilities Construction" are construction costs only, not O&M (operations and maintenance)– which comes out of R&RA.

Caldwell then moved to discuss the MPS Physics budget, which was affected by the Sequester cut, then by small increases in FY14 and FY15. In all, MPS increased by about 2%. The advanced LIGO construction project should wrap soon, but about 32% of the budget is for O&M for facilities. About 8% is for Physics Frontiers Centers. That leaves about 55%, or $145M, to support research projects in the five major areas of physics – experimental and theoretical. It is challenging to balance these five areas: Atomic, Molecular, Optical, and Plasma Physics (AMO); Gravitational Physics; Nuclear Physics; Particle Physics; and the Physics of Living Systems. This community should benefit from Midscale support, but so should Plasma, and AMO.

NSF responds to research proposals. It relies on the community, through submitted proposals, to give us the ideas. There is a vigorous merit review procedure for vetting research proposals. NSF solicits community input via workshops (such as for the Brain Initiative).

NSF is looking forward to the recommendations form P5. This stage of the process is especially important for the P5. P5 is a real opportunity for the field of physics. The panel is extraordinary, in the work they're doing, the deliberations. This is an opportunity to take advantage of having a group get together, struggle with these issues, and come up with a solid recommendation that everyone buys into. If you don't do that, then you get into stove-piped advocacy that doesn't help you as a decision-maker. P5 must also articulate what we give up to pursue those priorities. What you "not" do is just as important as what you will do. When times are tough, and budgets are flat, that is when you're really forced to think, and I really want you to take advantage of it.

Considering connections between HEP and NSF areas, it is better to focus on what is the science question. Multiple fields may be valuable in reaching the answer. The NSF will present five areas in which it will contribute to the President's Brain Initiative. Focusing on the science question helps you to capitalize on multiple areas of expertise. Cross-cutting programs such as Accelerator Science, Computational Physics, and Physics Frontiers Centers leverage diverse science connections. Caldwell concluded her presentation and asked if anyone had questions.

Discussion of the Report from NSF Mathematical and Physical Sciences

Lankford asked Caldwell what potential connections she could see between the P5 report and NSF multi-disciplinary science.

Caldwell said, if the report appropriately prioritizes research of the scientific areas, it would represent and garner proposals that are funded exceedingly well. Strategic, high-level, quality guidance will garner an influx of strong proposals, the number of which should increase over time as people are motivated by fresh, exciting science. For P5, NSF works closely with the DOE. The report will influence NSF's interactions with DOE.

Bishai commented that it was nice for Caldwell to show the cover of Science for 2012 and 2013 in her presentation, that the neutrino was also on the cover.

REPORT FROM NSF PARTICLE PHYSICS

The following program directors from the NSF Physics Division presented reports from their respective divisions: Saul Gonzalez, Randy Ruchti, Jim Shank (NSF Elementary Particle Physics; Jean Cottam, Jim Whitmore (NSF Particle Astrophysics); and Marc Sher (NSF Particle Theory, Astrophysics/Cosmology Theory. Randy Ruchti gave a report on NSF Particle Physics and began with an overview of topics. He showed an organizational chart of the NSF Physics Division. Major subdivisions are called Facilities, Experiment, Theory, and Cross-Cutting. He showed a budget history spanning from FY08 to FY13 actuals. The current, effective total for particle physics is similar to the FY08 actual amount. However, the Recovery Act did provide a big influx of funding in 2009. The frontier centers and LHC operations lines were maintained the same. The Theory number came down. Total particle physics is nearly $90M, and including allied funding, stands at $109M in appropriations in FY13.

There were a total of 138 proposals received by the NSF particle physics base program in FY13. Career awards had an average success rate of ten percent: there were three career awards out of thirty total career proposals submitted. Target dates for proposals are in the fall. For EPP and Particle Physics, it is about October 30, 2013. Accelerator Science picked November 29, Black Friday, to be its deadline, and THY's deadline is Decemer 5. The Merit Review process is underway for proposals submitted last fall.

In the area of accelerator science: NSF is starting an accelerator science program, with the goal of enabling fundamental discoveries and training students and postdocs across disciplinary boundaries. The contact is Saul Gonzalez. Broader impacts are significant: industrial applications, medical applications, homeland security, and light sources. The NSF accelerator program will focus on transformational developments that are likely to come from curiosity-driven research with strong interdisciplinary links. The program will evolve with the community as new challenges are identified. The merit review process is currently underway. A total of 60 proposals were received this fall, requesting ~ $70M in funding.

For MRI, the Major Research Instrumentation (MRI) program at NSF has had a major impact on the community. MRI serves to increase access to shared scientific and engineering instruments for research and research training in our Nation's institutions of higher education, and not-for-profit museums, science centers and scientific/engineering research organizations. This program especially seeks to improve the quality and expand the scope of research and research training in science and engineering, by supporting proposals for shared instrumentation that fosters the integration of research and education in research-intensive learning environments. Two types of funding support from NSF include: Track (1) acquisition of a research instrument; and Track (2) development of a research instrument. Other programs, such as Atlas, are touched by this program. The program contact is Kathleen McCloud.

Mid-scale instrumentation is a critical need among research projects. This is not a separate program to which investigators can apply directly. PIs request funding for specialized equipment as part of a regular proposal to a disciplinary program in the Division. Then, the Program Officer can then request that funds be provided through the Mid-Scale Instrumentation Fund. The support is non-renewable and is intended for off-the-shelf purchase or construction of specialized equipment. Examples of potential mid-scale support are large detector upgrades.

Physics Frontier Centers (PFC) support university-based centers where collective efforts are fostered. Proposals were due in January and are currently under review. The program is designed to foster major breakthroughs at the intellectual frontiers of physics by providing needed resources such as combinations of talents, skills, disciplines, and/or specialized infrastructure, not usually available to individual investigators or small groups, in an environment in which the collective efforts of the large group can be shown to be seminal to promoting significant progress in the science and the education of students. PFCs can be in any subfield of physics within the purview of the Division of Physics, including elementary particle physics, particle astrophysics, theory and accelerator science. The NSF Physics Division issues a new solicitation every three years.

NSF is engaged in a direct detection of dark matter solicitation. The current generation of direct dark matter experiments should all achieve their projected sensitivities and complete operations within the next few years. The more sensitive, "second generation" direct detection experiments will then be required to either search with increased sensitivity or to measure in detail the detected dark matter. These next generation experiments will be selected through a solicitation with funding beginning in FY 2014. NSF and DOE are closely coordinating the review, selection, and funding of the awards and subsequent support for the experiments. The review is in process; and NSF expects to make selections later in the spring. Program contacts include Jean Cottam and Jim Whitmore.

In the area of Broader impacts: NSF supported a documentary on the quest for the Higgs Boson entitled, “Particle Fever,” by David Kaplan and Mark Levinson. And coming soon, in preparation for a planetarium presentation, will be a show on dark matter entitled “Dark Secrets of the Big Bang” lead by Reinhard Schwienhorst, Kaushik De, and Michael Barnett.

NSF Particle Physics program staff are shifting. Mike Sher and Ruchti are leaving at the end of FY14. Jim Shank from Boston University joined NSF as an IPA in January 201 as a program director in EPP.

Ruchti closed by saying that NSF is appreciative of the Snowmass initiatives. The P5 report is highly anticipated. And while funding is challenging, NSF is committed to advancing particle physics research across its many frontiers.

Discussion of the Report from NSF Particle Physics

Jawahery asked whether the accelerator initiative was aimed at universities or national labs.

Ruchti answered: universities.

Jawahery pointed out the value of training opportunities.

Yes, said Ruchti, it is part of the universities. Ruchti said the accelerator initiative is cross-cutting for different disciplines, but it could also support cross-cutting efforts within a lab to enable a PI to develop new things.

Tschirhart asked about the FY13 Base Program Proposal Action Summary, about the low level of success for career grants.

Ruchti said that what makes career proposals so competitive is that they’re looked at separately in the program. For example: the program may receive 70 or 80 proposals and are then reviewed. Determining the pay lines is challenging. New faculty members who haven’t had a lot of experience are encouraged to apply. Emphasis on major education component is not weighed with same strength. It gives young faculty members several opportunities for support.

Erbacher asked whether funding for the career program is protected from year-to-year fluctuations.

Ruchti said there’s no career money and base program money; they are not considered to be separate.

Erbacher pressed to know what happens with grant funding when the NSF research topline changes.

Ruchti said the career awards are made earlier than the project awards. But it wasn’t till the end of June last year that NSF knew what its final funding numbers were.

Someone from the audience pointed out the 30% cut. That kind of fluctuation is devastating and makes it hard to hire post-docs.

Richter said we try to spread the load of the cut. It’s not quite as abrupt as you’d think, but it might be more creative than you’d want to know. It is not necessarily an equal load in one year, because there may be fewer submitted proposals in a year. That is part of the way it works.

Lankford called a break at 11:54. The meeting reconvened at 12:18.

PRESENTATION ON SCIENCE CONNECTIONS

Professor Shamit Kachru gave a presentation on connections between high-energy physics and other sciences with the goal of finding interdisciplinary activities. In doing so, they took stock of the HEP portfolio to see where to go next.

Particle physics enjoys connections with many other fields, such as nuclear condensed matter, astrophysics, climate science, plasma physics, biology, and economics. He assessed how close the other field is to particle physics by asking, if you wander into a talk about one of these other sciences, how mystified are you?

It is a good time to consider these broader connections. The charge by Jim Siegrist was broad, so Kachru decided to discuss the disciplines by contacting scientific experts in different disciplines. The disclaimer was that the answer to the charge was taken from a parochial point of view rather than from an objective one. Kachru showed the list of subject matter experts.

Some of the most spectacular successes in HEP originated in different scientific fields. The "inner circle" of fields near HEP include atomic, nuclear, condensed matter physics; mathematics, and the emerging discipline of quantum information. Discussing these successes with experts in the field, Kachru reported that with atomic physics (AMO), there is a long history of measure EDMs, a key precision indicator of physics beyond the Standard Model. Coming out of AMO are new modes of axion and gravity wave detection to get precise measurements of fields acting on matter. These modes, characterized by high coherence rather than high energy, provide new tools for probing fundamental laws and can enrich the long periods between consecutive accelerators. Finally, coming out of AMO, is the greater ability to quantum control atoms and arrange them in a lattice. So you can create model systems to test new theories of interest to particle physicists.

Condensed matter physics is an "inner circle," related field to HEP because of a shared language of field theory. A. Vishwanath of Berkeley said, "In recent times, we have been confronted with strongly coupled problems ... where non-perturbative techniques are sorely required... [a] promising topic is SUSY as a tool and its realization in condensed matter." S. Sachdev of Harvard said, "Many important correlated electron materials display strange metal regimes where a description based on quasiparticle excitations breaks down. Here, much insight has been gained from ... the AdS/CFT correspondence."

Kachru noted it is not a one-way street in which HE physicists go in and solve other communities' problems, but that other scientists can help HEP by their collaborations. Super-symmetry is interesting, for example, and it is possible that condensed matter ideas will allow us to finally realize some theories long discussed in HEP circles, in condensed matter labs. These control capabilities of creating molecules and arrays allow for advanced study of physics properties.

With nuclear physics, there are some specific connections to be explored in the near future. M. Ramsey-Musolf, of the University of Massachusetts at Amherst, said that, "knowledge of neutrino/ nuclear cross sections is a huge issue for LBNE and other oscillation studies. The nuclear targets are complicated by many-body systems, and the way neutrino cross sections are modeled… is rather simple-minded. Dedicated resources need to be invested…"

There is also strong synergy in the investigation of field theories – starting with lattice QCD and more recently in the investigation of QGP. Said K. Rajagopal of Massachusetts Institute of Technology, "The analysis of dynamics of strongly coupled liquids without quasiparticles poses a great challenge to theoretical physics. Over the past decade, theoretical physicists have gained substantial qualitative insights into these dynamical questions ...by using holography, or AdS/CFT."

With quantum information science, there are linkages in the area of topological field theory "A particularly deep connection involves the emergence of topological quantum field theory, originally developed by particle physicists, as an especially elegant... approach to achieve error- resistant quantum computing. Meanwhile, ideas generated by the QI community are exerting an expanding influence on particle physics and string theory," said J. Preskill of the California Institute of Technology.

Summarizing the discussion of "inner-circle fields," Kachru pointed to a broad theme that seems to unify some of the new, highly interdisciplinary research directions. There seems to be a renaissance using themes modern tools of QFT, together with entanglement, to provide new windows on issues ranging from novel topological states of condensed matter to emergence of space-time. There are fruitful interactions that are pushing science forward due to their synergistic effects.

For the slightly more distant disciplines, the "middle circle" would include astrophysics, plasma physics, and climate research. Astrophysics and particle physics meet at the HEP cosmic frontier. Ground-based cosmic microwave background (CMB) observations are now probing an interesting parameter space in the hunt for primordial gravitational waves. A variety of observations, beyond just optical observations, are relevant to the Cosmic Frontier goal of investigating the nature of dark matter and dark energy. All of these are central to the interests of HEP.

A new, hot topic among young, high-energy physicists is on gravitational waves. And with climate science – one may want to be able to calculate uncertainty, so physics can contribute to the field. Plus climate is of central societal interest. Climate scientists believe that, in addition to brute force computation, conceptual advances will be needed to reach the ambitious goals of these fields (the prediction, with quantifiable uncertainty, of future climate statistics as an example of such a goal). While there is no direct map of HEP resources onto these problems, there are growing, very promising, intellectual overlaps between HEP and these disciplines (field theories of turbulence, lattice simulation of multi-scale QCD physics, AdS/CFT insights into fluid dynamics).

The "outer circle" of more distantly-related fields contains cell biology, neurobiology, and "social sciences." These fields need ways to handle large volumes of information. The HEP community has experience successfully executing large-scale, complicated projects, experience that could be useful in other fields. There is also a theme that the biological sciences can benefit from HEP to explain interactions between molecules.

Several precedents exist to illustrate fruitful theoretical cross-fertilization between HEP and nearby disciplines. The Supernova Cosmology Project is an example; it won a 2011 Nobel Prize. Another example is topological field theory – developed by mathematicians and particle physicists in the 1990s. These theories have provided startling insights into topology and geometry, and these insights have benefited HEP with real world applications in topological insulators and superconductors.

In AMO: high energy colliders are important, but exciting opportunities exist in non-accelerator approaches to fundamental physics, as in multi-lab AMO attacks on EDMs, axion searches, or gravity waves.

There are deep theoretical issues in climate, plasma, condensed matter that require new techniques; coordinated attacks would also benefit HEP theory if progress occurs. Could the "big science" culture of HEP be usefully exported to other fields that are beginning to operate in such a mode?

Discussion of the Science Connections Presentation

Tschirhart mentioned open-source software development and crowdsourcing as examples of possible HEP science connections. He added: business has recognized the value of open-source software, and you can't fire anybody. We have had difficulty communicating the links between HEP and open-source, crowdsourcing to the SC.

Ben-Zvi commented that many accelerators were developed for high-energy physics study, as were light sources.

Bishai said prominent particle physicists are active in the field of climate change science. Having an independent set of eyes look at climate data increases the viability of the science.

Kachru said renewable energy was another area.

Bishai asked about economics.

Kachru said there is an economo-physics. There are big, theoretical problems that many fields are facing at the same time.

Steinhardt said Kachru had found these interesting connections; what do we do about that?

Kachru said a logical conclusion was to provide opportunities for researchers to collaborate, through novel funding streams or breaking down potential barriers that keep scientist from working 'between lines.' Research university departments tend to be divided among parochial lines.

Bishai asked would multi-disciplinary labs be places where these scientists could work?

Kachru said Siegrist and SC could decide what is appropriate. He noted that parts of SLAC are funded by BES. The caveat: while two may be collaborating; one funded by one stream, and another funded by another funding stream, both may be worried that the research funding will dry out.

Bishai drew a distinction between agencies and universities, that agencies may have more flexibility to support multidisciplinary efforts.

PRESENTATION OF HEPAP ACTIVITIES: ACCELERATOR R&D

Lankford thanked the HEPAP members rotating off the panel and noted that the next meeting is in May. Then he moved to development of a subcommittee on accelerator R&D. The effort was in response to a charger from Dr. Dehmer of SC: "We are asking the assistance of each of the Office of Science Federal Advisory Committees to help us identify disciplines in which significantly greater emphasis in workforce training at the graduate student or postdoc levels is necessary to address gaps in current and future Office of Science mission needs."

Possible disciplines of interest include accelerator science, particle detectors and instrumentation, scientific computing, or specific areas of particle theory. A small subcommittee was set up to consider the charge. The subcommittee included Patterson, Ben-Zvi, Han, McBride, and Shipsey.

In an overview, Lankford said that accelerator projects are crucial to the short-term and long-term future of particle physics. The field demands a healthy, multi-faceted R&D program focused on accelerator projects in the foreseeable future, such as HL-LHC and the Japanese-hosted ILC. R&D should pursue enabling technologies for new accelerators in the more distant future, such as a muon collider or very high-energy hadron collider. The program should pursue numerous technical subjects: novel concepts for acceleration; superconducting RF; accelerator, beam and computational physics; particle sources; beam instrumentation and control; normal gradient/ high gradient structures & RF sources; superconducting magnets, and others discussed at Snowmass. Accelerator R&D is a major commitment of the HEP program, occupying 15-20% of the HEP budget and representing a new thrust for NSF in basic accelerator science.

The basic issue is to have a well-balanced program, appropriately aligned with the P5 strategic plan. The official charge is still under development, but Lankford presented the outline of a possible initial mandate/ charge. It would follow shortly after the P5 report, in fall/ winter 2014. The scope of the subcommittee's report would include elements of demographics, program, and stewardship. For demographics: the subcommittee would report on the current demographics and capabilities of the HEP community engaged in accelerator R&D. It would articulate lab-university roles, cooperation, and balance.

Regarding what the subcommittee would say about a future program, it might suggest an appropriate mechanism to monitor, review, and update the program. It would assess the manpower and capabilities requirements of program. It would comment on how to match "resources" and "requirements." In the area of stewardship: SC is seeking comment on the interplay of HEP accelerator R&D and accelerator stewardship, e.g., identify R&D that addresses the HEP strategic plan, that is primarily of interest to applications in other fields and in industry, and that is of general interest to HEP and to other fields.

Although the initial charge was still under development, the subcommittee membership was presented. Marty Breidenbach and Don Hartill will serve as chairs, and the subcommittee would include physicists from the HEPAP, the particle physics communities, and the international accelerator community.

Lankford asked if anyone had questions. There were none.

PRESENTATION: NATIONAL SCIENTIFIC PROGRAM ADVISORY SUBPANEL

Lankford next proposed a concept of a National Scientific Program Advisory SubPanel. A concept in development, the subpanel's genesis was in response to CoV concerns for more transparency, for new projects, and for projects that have undergone significant changes. P5 does strategic planning, and this subpanel would address the goal of a more effective and transparent mechanism for the HEPAP to advise on the execution of particle physics projects.

The subpanel would perform scientist and technical reviews and would align with the objectives of the P5 plan. The scope of the scientific review would include usual merit review criteria, such as (a) significance of scientific objectives and (b) capability to achieve scientific objectives. Also within the review's scope would be the quality of the team; the technical approach; a budget review sufficient to set a CD0 range; and an assessment of the potential for impact on the particle physics program.

This subpanel, called the NSPAsP, would be convened as needed and would provide initial review of experiments proposed to join the U.S. particle physics portfolio. The national body (FNAL PAC) would be analogous, with the NSPAsP working in concert. Agencies would collect proposals on a regular basis through solicitation/ FOA; they would perform initial screening for appropriateness to call and of cost. Proponents would provide any prior outside reviews, to see if the proposals were ready for NSPAsP. NSPAsP would then conduct a scientific evaluation, including compatibility with the P5 strategic plan and position within global context, and evaluation of technical readiness. In cases of multiple projects, the NSPAsP would provide prioritization

The next steps would be to refine the subpanel concept in several proposed ways, mostly dealing with interplay and avoiding duplication. Lankford asked for comments and feedback.

Discussion of Forming a National Scientific Program Advisory Subpanel

Byrum asked about a call for proposals. For good ideas that come after P5, or smaller experiments that might be candidates. P5 is looking at all aspects of the HEP – big and small projects.

Jawahery asked about a notional case in which a project is proposed at Fermilab, but does it already have funding?

Lankford said we don't want to have "Double Jeopardy," or duplication in funding. In our world of very tight resources, new undertakings need to fit into the national plan.

Jawahery said are these projects not in the lab?

Lankford said no…. he didn't want to pick on only one kind, that it's important that agencies have advice on how a proposal fits into the national program before they fund it at the lab.

McBride expressed concern that the subpanel could become too powerful, obstructionist, or "shape" too much. She re-stated that she was concerned about the balance. Lankford said it would be organized as a subpanel of HEPAP. There is HEPAP looking over it, and when DOE goes to OMB to make the case of a new project, HEPAP can say it has been reviewed and fits the new plan.

Gerber asked if it started at CD0 and further commented that if the committee evolved as a stamp at each stage, it could be burdensome. Also, she said that there are, at a certain level, certain things one can do without this subpanel. Is this $10M or are you thinking smaller?

Ruchti said at the CD level but they didn't have a firm minimum threshold.

Erbacher asked about the Concept – 1 slide: there are a few different goals. She said that it looked like Lankford was trying to create a mechanism in-between P5, that new experiments could come in at a smaller scale, and judge whether it follows strategically with P5. But what happens if major events happen in our field? Things may happen between P5. Would this subpanel be able to redirect? Or simply consider specific projects coming in?

Lankford answered: specific projects. For significant changes in the field, HEPAP would identify them and possibly recommend an updated P5 report.

Tschirhart made a comment regarding the Fermilab PAC: this process could add value in encouraging the science community to align with the P5 vision… he thought that the PAC aligned with the P5 vision already.

Lankford said he didn't mean to imply Fermi PAC doesn't align.

Tschirhart added a caveat: that the community might see the subpanel as another hurdle they have to get over in trying to win grant funding. However, a benefit is that not all communities know the jargon of the HEP, and this body could help communicate the value to the community - consider that as being part of its function.

Lankford said that's interesting point, which he would like to come back to it as part of the discussion.

Tschirhart asked, do good ideas have to wait for a call from SC? Ruchti said a call annually would be a sufficient opportunity to recommend the formation of such a group.

Ruchti said the idea is to be flexible rather than overly prescriptive.

McBride agreed that it is important to remain flexible. Cost is another concern. Advisory committees don't like to consider costs.

Lankford said yes, at a certain level, cost would be a consideration: size of impact to the field, relative to the investment.

Bishai said this seems to be a solution in need of a problem. Is this yet another committee? What is the problem for which we need another committee?

Ruchti answered with two theoretical examples: there was a project strongly recommended by the 2008 P5. Since 2008, the cost has grown. It would be nice to address that within the context of the P5 plan. In the previous P5 (2008), we got proposals for some of the smaller projects, and we had to put together an ad-hoc committee to review those proposals. Many people felt that the ad-hoc committee was comparing apples to oranges, and that it was not a good model. This subpanel could advise on what we could prioritize.

Bishai said people are going to be unhappy, regardless, if the P5 doesn't pick their projects. She said that she was trying to push back to see why one should convene a subpanel.

Erbacher said she heard what Bishai was saying, but that addresses complaints from the field, as this inserts community decision-making into the process. This subpanel would make us more nimble, more responsive, and more democratic. We're supposed to be advising OHEP, and it's a good idea.

Jawahery echoed what Erbacher said, that it would benefit the national program.

Bishai said it seems, now, that you have to go through yet another review panel just to get your proposal reviewed. This adds hurdles.

Lankford said that's not the case – and LHCC review is not suitable for just the U.S. contribution to the effort.

Bishai read the possible mode of operation regarding when it would call for outside review.

Lankford said the point was not to add to a long list of reviews, but to have this subpanel review some idea because no one else was positioned to do it.

Tschirhart asked what is a cost suitable range for items to be reviewed by the subpanel. Lankford had no answer. Tschirhart and Ruchti discussed how the subpanel might operate for cost thresholds.

Lankford said he hadn't yet thought it through.

Bishai said, this comes pre-CD0? You're proposing something expensive. And Pre-CD0? Sure, cost must be evaluated, so my concern is: what is it that the subpanel is evaluating?

Siegrist said we can invent that cost range. But we need to fix this, because the 2008 P5 had trouble with cost. The P5 reporter confirmed that there were inconsistencies.

Lankford said that he didn't think that applicants had to come to the application process with BA cost levels.

Ruchti said the subpanel could kick back the proposal to recommend it have more cost information.

Shutt said it would be helpful to clarify the scale of where this is… G2? If it is Cosmic Frontier or AMO, the culture with NSF needs to be worked out; people won't have had exposure to DOE labs. There are issues specific to Cosmic Frontier.

Lankford said it's not limited to that. The cost threshold is something we're going to have to figure out. And the NSF piece needs to be worked out.

Regarding advising/ mentoring things going into the application process: Lankford said he wasn't sure that he wanted that panel to do that function.

Shutt clarified, not mentoring…

Tschirhart said the articulation of added value that Bishai is searching for, regarding this subpanel, is not ready. Also to be reviewed are the cost thresholds for work to be considered; the subpanel proposers should report back.

Shutt: there will be a cost threshold on the low side, but would there be a cut-off on the high-cost-side? What is the target here?

Ruchti said yes, there would be an upper threshold. Very expensive proposals would need review of the P5 specific plan.

Siegrist said he was hoping for an approval from the HEPAP, as we are having a ‘backing up of the sewer’ with proposals not getting approved.

Byrum asked: it’s a subpanel of HEPAP. What does that mean?

Lankford recommended very active participation by HEPAP members in the subpanel. For P5, we did that. We wanted the independent review of HEPAP, but in the end we’re not getting that.

Ben-Zvi asked if accelerator projects were the right scale.

Lankford said yes – otherwise, what is the mechanism? You need various perspectives (scientific value, technical feasibility).

Ben-Zvi said at one point, he was an accelerator advisor, and that there was no longer an advisory body like that.

PRESENTATION: ROLES AND RESPONSIBILITIES SUBPANEL

Lankford moved to a last topic: “Roles and responsibilities task force.” Approaching the subject, HEPAP discussed the formation of a subpanel or subcommittee to consider respective roles of laboratory and university groups in the execution of the HEP program. The effort arose from topics such as university infrastructure, senior scientists, the Theory Panel Report, and cost differences. The CoV recommended an examination of the balance between the lab and university research programs.

An approach to the subject of lab and university roles is to start the discussion in the context of lab and agency (DOE and NSF) missions. Agencies have different missions; labs have different missions; and university missions are different. Focus on how best to accomplish science goals in this context. Define respective roles of the various types of institutions in accomplishing the program’s science goals, and in satisfying the missions of the program. Determine how roles and working relationships can be defined or redefined to optimize science accomplishment and to satisfy missions. Bear in mind that DOE and NSF missions differ. Consider how the DOE mission differs for Fermilab and multi-purpose labs, and how missions differ for large and small universities. And determine how roles can be designed such that there are no ‘second class citizens.’

As an update: in the presence of P5 and other HEPAP activities, only modest progress has been made on formulating the concept and charge. The subpanel will pull from diverse member sources (labs, academia, government) to achieve a balanced composition. It needs to conduct its business in a collegial manner, even in the face of difficult and controversial issues. Lankford said to expect to receive a formal charge.

Discussion of Forming a Roles and Responsibilities Subpanel

Han asked what is the time scale for launching a national scientific program advisory panel.

Lankford said 6 months to a year. The subpanel would encounter tense, diverse topics.

Cvetic asked, due to the complexity of topics, would the subpanel be divided into subpanels?

Lankford said they probably would sub-divide into cooperative groups.

Gerber asked if the subpanel would have formal meetings; would Lankford draw recruits. This is an area where it is important to integrate different points of view of the field. Community input prior to deliberations would be important.

Tschirhart thought it was a great idea but said he wasn't well informed.

From the audience, Newman asked what would be one possible outcome of the panel, and it should not be prescriptive.

Lankford said that universities have lost, over the years, technical know-how and don't have mechanisms to properly train their students and postdocs. Maybe a solution would be that they get good training. Another example is the general deterioration of resources in our field. The funding has created a lot of pain in the Theory community. Maybe there is a balancing of roles. The charge perhaps should not list specific outcomes.

Siegrist said Dehmer had described having a hard time getting funding. Some of the issues like Lankford said might just need organizing.

Someone expressed concerns that we're setting ourselves up for two COVs and suggested just wrapping the question up into a CoV review. Lankford said the subpanel would need more people.

Erbacher pointed out that the issues the subpanel would address are unrelated to the most recent CoV review, and that Lankford had noted that this subpanel had been a CoV recommendation.

FINAL DISCUSSION

At 2:12pm, Lankford said he wanted to close by hearing HEPAP comments on things they had heard at the meeting.

Steinhardt said that he liked the "Connections to HEP" talk, but the lingering question is what we do about it: how we encourage young people to intelligently choose areas even if they cross-disciplinary boundaries.

Lankford asked Steinhardt: should we follow up with recommendations on how to specifically pursue these connections?

Steinhardt said there is one set of connections today, and that things could change, and there would be new synergies next year. In High Energy Theory, you see it develop and work in an environment where you are encouraged to explore across disciplines.

Newman from the audience commented: science connections were framed well, but the experimental science/ advanced technologies have tighter connections. There are areas of advanced technology we don't touch, such as graphene and quantum computing. When engaged with advanced technologies, we are currently behind the curve. We brought silicon electronics to a large-scale direction. But it's a severe consideration, because it could dramatically change how we spend our money, favoring high risk or emerging technologies over traditional areas.

Tschirhart said he was excited about the connections presentation, but we are not getting traction at SC. With SC, there is this laser focus on P5, and this sense of wanting HEP to get its connections straight for itself. He expressed concern about the timing and didn't want to demoralize people by the effort possibly not getting the attention it deserves. He was disappointed with the lack of attention by Director of SC.

Byrum said that she wanted to see something more. There are these connections opportunities: we have to come up with a plan to take them further. There has to be a "what's next, in my mind."

Cvetic added that research fields naturally move and evolve.

Han echoed Cvetic's comment: the Theory effort is a lot broader, and you don't see impact immediately. These are long-term investments to support broad development of the workforce.

Lankford turned to Siegrist of the HE program office, regarding the connections information.

Siegrist said we were hoping to put fuel into the P5 report. The SC response would probably be to host some workshops and see what comes out. Then, would Condensed Matter welcome HEP participation at conferences? Where is the funding? This happens routinely at NSF, but DOE lacks a structure to foster interdisciplinary engagement. Buy-in from the other offices would be important.

Someone noted that a workshop at Boston University would be held in May. Siegrist said that some of these efforts are privately-supported and have low federal agency visibility.

Chatterjee noted that there are already workshops that could have a joint activity. She asked: how do you nurture these effects before you get to a point that another office recognizes it? Maybe NSF can nurture this more in the earlier, idea stage. At DOE there is no formal way to support that.

Cvetic commented that the interface of theoretical physics with mathematics have been supported by private foundations.

Ruchti concurred and pointed to the Physics Frontier Center as an example.

Lankford said there is sensitivity within the SC to this issue. We need to make efforts to organize a joint workshop at the earlier, idea stage to encourage interactions, formal or informal, before scientists would worry about where they'd get grant funding for joint initiatives. Lankford added that although, now, it sounds like a case-by-case consideration, we have identified connections.

Lankford moved that the panel identify two or three such multi-disciplinary areas to explore further.

Chatterjee said the panel should product a short report on the subject.

Lankford recommended conducting a "preliminary investigation, and small groups of HEPAP members could look at reports and help design a future workshop.

Chatterjee cautioned: if you look at this area three years later, the fields are different.

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Lankford said the HEPAP looked forward to the reports. Using the reports as a primary guide, the group could identify two to three areas for further investigation. Then, we can work out a way forward from there. There is a lot of consensus on the issue of fostering interdisciplinary work.

Steinhardt offered suggestions on how to get started making connections: I think it's cost free; it's a change of mind. There already is a measured amount of exploration in other areas. The exploration part should be encouraged – that could be no cost.

Lankford invited final comments from the HEPAP and audience. There were none. The meeting concluded at about 2:45pm.

The minutes of the HEPAP meeting, held at the Doubletree Hotel, Bethesda, Maryland, March 13-14, 2014, are certified to be an accurate representation of what occurred.

Signed by Andrew Lankford, Chair of the High Energy Physics Panel.

Andrew J. Lankford   12/8/14

Signature   Date

High Energy Physics Advisory Panel - March 13-14, 2014 - Meeting Minutes