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

May 22-23, 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 9:30 a.m. EDT on Thursday, May 22, 2014, at the Doubletree Bethesda Hotel, Bethesda, MD, by Panel Chair Andrew Lankford.

Members present:

Ursula Bassler
James Buckley
Ilan Ben-Zvi
Klaus Honscheid
Mary Bishai
A. Hassan Jawahery
Karsten Heeger
Bruce Carlsten
John E. Carlstrom
Mirjam Cvetic
Patricia McBride
Robin Erbacher
Lia Merminga
Cecilia Gerber
Murdoch Gilchriese
John Kogut
Zoltan Ligeti
Leslie Rosenberg
Jonathan Rosner
Gabriela Sciolla
Ian Shipsey
Thomas Shutt
Tao Han
Gabriella Sciolla
James Siegrist
Paul Steinhardt
John Hobbs
Robert Tschirhart
Hitoshi Murayama *via webcast*

Members absent:
Georg Hoffstaetter

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

Others present for all or part of the meeting:
John Boger, DOE HEP
Tim Bolton, DOE-SC
Denise Caldwell, Director, Physics Division at the National Science Foundation (NSF)
Lali Chatterjee, Program Manager, DOE HEP
Mary Anne Cummings, Adjunct Professor, Northern Illinois University
Patricia M. Dehmer, Acting Director, DOE-SC
Saul Gonzalez, NSF
John Kogut, DOE-SC
Donna Nevels, Oak Ridge Associated Universities
Harvey B. Newman, Professor of Physics, California Institute of Technology
Nigel Lockyer, Director of Fermilab
Mark A. Palmer, Director, US Muon Accelerator Program at Fermi National Accelerator Laboratory
Ritchie Patterson, Professor of Physics, Cornell University
Steve Ritz, University of California at Santa Cruz
Vigdor L. "Vic" Teplitz, Southern Methodist University and NASA's Goddard Space Flight Center
Bruce Warford, Oak Ridge Associated Universities
Robert J. Wilson, Colorado State University

MAY 22, 2014

OPENING REMARKS

The High Energy Physics Advisory Panel (HEPAP) was convened on Thursday, May 22, 2014, at the Doubletree Hotel, in Bethesda, Maryland, by **Panel Chair Andrew Lankford**. New panel members were sworn in during an initial, closed-session meeting. The open meeting was convened at 10:01 a.m.. The meeting was open to the public, was webcast with real-time feedback from remote participants, and was conducted in accordance with the requirements of the Federal Advisory Committee Act. Professor Lankford gave an agenda overview. He stated the names of new HEPAP members: Buckley, Carlsten, Carlstrom, Heeger, Murayama, Sciolla, and Shipsey. **Ms. Donna Nevels** of the Oak Ridge Institute for Science and Education provided conference center safety information.

PRESENTATION OF THE P5 REPORT

Lankford said that **Professor Steve Ritz of the Santa Cruz Institute for Particle Physics** would deliver the Particle Physics Project Prioritization Panel (P5) presentation in its entirety and reserve questions and answers for afterward. He noted that people were also participating in the meeting, remotely.

Lankford said that P5 was the culmination of a long process that included a community study last year called, "Snowmass;" 23 days of face-to-face meetings; plus weekly phone meetings. He thanked Ritz, for his tireless work to put together the report. He said that he thought the P5 had put together a coherent plan. He asked the HEPAP to review the plan as a complete program and described it as a plan to address exciting, profound science and to move particle physics forward.

Ritz noted that it was his fourth discussion with the HEPAP, regarding P5 activities, starting from September of 2013. This is the HEPAP's report to transmit to the agency. He thanked the panel members for their hard work. Panel members from other regions of the world made unique contributions. The community's passion, dedication, and entrepreneurial spirit were inspirational. The scientific community provided thoughtful and timely responses, even for large requests on tight schedules.

Ritz went over the main topics of the presentation. He noted that the words were written with great care and said he would have to read a lot, directly, from the PowerPoint presentation. Recommendations were grouped, logically, by science categories, followed by budget scenarios, enabling research and development (R&D), and changes in direction. He gave the HEPAP a few minutes to look over the report.

Summarizing the P5 deliberative process, **Ritz** noted that all information was available on the P5 website. International views were particularly valuable. Multiple subgroups ran in parallel, and the work had been continuous. The panel wanted to ensure uniformity of data, e.g., cost profiles for research and development

(R&D), construction, and operations, in information received from the scientific community. There was an effort to maximize community engagement, including outreach to younger people. The panel hosted in-person and virtual town hall style meetings as well as a public submissions Internet portal. A peer review occurred of the draft report from May 5-10, 2014. The panel worked by consensus: meaning, if any one had a concern, it was in the collective interest to stop and mitigate that concern. People were not "voted down" when they raised concerns or disagreements. Reaching consensus was not easy; there was a lot of give-and-take. No topic or option was off the table.

In the March HEPAP meeting, Ritz said that the group had talked about the five science drivers. The wording of them is largely unchanged in the final report. The global vision is mostly the same. The prioritization criteria are also the same from in March. There were challenges in considering the various budget scenarios. The panel considered three budget scenarios with 10-year profiles:

A. FY2013 budget baseline: flat for 3 years, then +2% per year.
B. FY2014 President's budget request baseline: flat for 3 years, then +3% per year.
C. An unconstrained budget including projects "…needed to mount a leadership program addressing the scientific opportunities…"

Two scenarios, A and B, were constrained: Scenario A was austere, and Scenario B featured funding increases at slightly-more-than-inflation. The "unconstrained" profile was Scenario C. **Ritz** noted that P5 "is not the program office" and doesn't ultimately make funding decisions. Agencies asked for P5 recommendations related to priorities, not simply a list of "wants" and their associated costs. There are intrinsic uncertainties with planning, as some projects are in initial stages – with cost and schedule ramifications.

Ritz described the report structure. After a preface and executive summary, the report contains a brief introduction. The 'recommendations' section begins around page eight and contains more details about projects. The sections are designed to move readers quickly to the recommendations, followed by more details as needed. Then there are sections on the five science drivers; and 'benefits' and 'broader impacts.' Appendices contain major questions from Snowmass; a collation of all recommendations; and lists of the panel and other contributors.

Ritz read points directly from the report's executive summary, which can be found on slide eight of his presentation. The report asserts that particle physics is global and highlights significant developments in the field since the last P5 report, in 2008. **Ritz** said he was grateful to have a Nobel Prize winner on the P5. Snowmass was a yearlong, community-wide study preceding the P5. The P5 distilled the 11 groups of physics questions collected from Snowmass into 5 compelling lines of inquiry that show great promise for discovery over the next 10 to 20 years. These are called the Science Drivers:

- Use the Higgs boson as a new tool for discovery
- Pursue the physics associated with neutrino mass
- Identify the new physics of dark matter

– Understand cosmic acceleration: dark energy and inflation
– Explore the unknown: new particles, interactions, and physical principles

The Science Drivers are deliberately not prioritized because they are intertwined, probably more deeply than is currently understood. A selected set of different experimental approaches that reinforce each other is required. The projects are prioritized. The vision for addressing each of the drivers using a selected set of experiments is given in the report, including approximate timescales and how the experiments fit together.

Ritz went into more detail on each of the five science drivers, reading report language directly from slides 13-17. He then discussed enabling R&D: that advances in accelerators, instrumentation, and computing are necessary to enable the pursuit of the science drivers. Greater demands are being placed on performance in all three areas, at reduced cost, necessitating continued investments in R&D. Program optimization criteria include science, international context, and the potential for sustained productivity, which was part of the charge. Individual project criteria are science, timing, cost versus value, history and dependencies, feasibility, and roles. He then discussed a section making the case that multidisciplinary connections are of great importance to particle physics.

Ritz then discussed program-wide recommendations on slide 21. The recommendations dealt with alignment to the science drivers, costs, and scales. Recommendation 5 specified that a budget target of 20 to 25 percent of the total budget be spent on construction of projects, an increase relative to the current proportion. Research should be about 40 percent of the HEP topline in budget planning exercises. The presentation covered the essential roles of research and theory – calling out Theory, especially here, as part of the research program. The research program should be flexible enough to support new ideas and developments. Since there will be flat budgets in the future, program leadership should carefully assess cuts, including operations budget, given science driver priorities. Further, U.S. participation in international work should continue to be supported.

The next section of the report focuses on near-term and mid-term high-energy colliders. The Large Hadron Collider (LHC) allows for the study of three drivers: the Higgs boson, new particles, and dark matter. Large project construction was time-ordered by the P5 so that peak construction does not all occur concomitantly. The U.S. should complete the LHC phase-one upgrades: the P5's highest-priority, near-term large project. After that, the International Linear Collider (ILC) in Japan should receive modest levels of support for ILC accelerator and detector design in areas where the U.S. can contribute critical expertise. Also, in collaboration with international partners, the U.S. should develop a short- and long-baseline neutrino program, hosted at Fermilab. The P5 recommended, on slide 37, to upgrade the Fermilab proton accelerator complex to produce higher intensity beams. R&D for the Proton Improvement Plan II (PIP- II) should proceed immediately, followed by construction, to provide proton beams of >1 MW by the time of first operation of the new long-baseline neutrino facility. Finally, the P5 recommended selecting and performing, in the short term, a set of small-scale, short-baseline experiments that can explore the physics beyond the three-neutrino

paradigm. Some of the experiments should use liquid argon to advance the technology and build international support for the Long-Baseline Neutrino Experiment (LBNF) at Fermilab.

The P5 listed a number of alternative approaches to address neutrino oscillation physics, such as RADAR, CHIPS, DAEdALUS, IsoDAR, LAr1, PINGU, and NuSTORM, and it recommended that they cannot go forward as major projects at this time, due to concept maturity and/ or cost considerations. The P5 suggested that the program could support R&D in a small projects portfolio.

On cosmic surveys (optical): the Dark Energy Spectroscopic Instrument (DESI [pronounced "Daisy"]) project is technically ready to proceed, and international partnerships are advanced. The P5 recommended building DESI as a major step forward in dark energy science, if funding permits. **Ritz** said he would provide more detail further into the presentation. The panel also recommended completing Large Synoptic Survey Telescope (LSST) and supporting cosmic microwave background (CMB) surveys as part of the core particle physics program.

The P5 specified priorities in the areas of direct- and indirect detection of dark matter; **Ritz** presented that material in slides 42-44; and it specified the completion of Mu2e and muon G-2 projects. It also recommended not moving ahead with ORKA at this time, due to resource constraints and anticipated conflicts with the highest priority items in the Fermilab program.

A discussion of the three funding scenarios followed, with Scenario B referred to as "flat-flat" funding because the scenario budget featured near-term as well as longer-term flat funding. Scenario A was much more challenging, as it represented an even more austere outlook than Scenario B. Scenario A would mean $30M less, per year, until FY18, followed by modest, two percent out-year growth. Caveating that the choices were very hard, the P5 specified the following recommendations, if Scenario A, the most austere budget scenario, became reality:

- DESI would not be possible
- Accelerator R&D and advanced detector R&D would be reduced substantially
- Extension of a flat-flat research program funding would result in further personnel reductions and loss of research capability
- Ramp-up of funding for LBNF would be delayed relative to Scenario B (preliminary work would proceed immediately in both scenarios)
- Third-generation direct detection dark matter capabilities would be reduced or delayed
- A small change in the funding profile of Mu2e would be required

The panel regarded the $96M investment, the difference between Scenarios A to B, as providing excellent "bang for the buck." **Ritz** showed a table indicating large, medium, and small projects that should be supported (or not) for Scenarios A through C, with check-marks indicating which of the five science drivers were fulfilled by the projects. He pointed out that there was a distinction between the 'research frontiers' and 'science drivers' categories. Acknowledging that the scientific community disliked the research frontier labels, he said they are experimental techniques. The five science drivers, or lines of inquiry, are topics.

Figure 1, presented on slide 49, provided a rough outline of recommended project construction timelines, along with expected periods of returns on investments in the form of physics data. The projects, in aggregate, taper off in the early 2020 timeframe. The panel recommended careful planning of construction schedules to avoid cost escalations due to simultaneous, major project construction.

The P5 referred to Scenario A as "precarious," noting that the U.S. will unlikely be able to host a large, $1B-scale project. That situation would mean that the U.S. would lose its position as a global leader in the field. In Scenario C, however, the panel focused on three high-priority opportunities: to boldly move forward to development of transformational accelerator R&D; to play a world-leading role in the Japanese detector program; and to host a large water Cherenkov neutrino detector to complement the LBNF liquid argon detector. Even under Scenario C, a primary goal should be to build future accelerators at "dramatically lower cost."

'Enabling R&D' was discussed beginning on slide 53. The P5 recommended supporting the discipline of accelerator science through advanced accelerator facilities and through funding for university programs. The U.S. should strengthen national laboratory-university R&D partnerships, leveraging their diverse expertise and facilities. Other enabling R&D recommendations focused on future-generation accelerators and included "reassessing" the Muon Accelerator Program (MAP) by incorporating MAP activities of general importance into the GARD program; and the early termination of the Muon Ionization Cooling Experiment (MICE), at the Rutherford Appleton Laboratory.

Further, the P5 recommended pursuit of accelerator R&D with high priority, at levels consistent with budget constraints and aligned with the P5 priorities. A HEPAP subcommittee on accelerator R&D will provide detailed guidance on the implementation of accelerator R&D aligned with P5 priorities. Additional 'enabling R&D' recommendations focused on the topics of instrumentation (slide 57) and computing (slide 58).

The P5 recommended several significant changes in direction. One of which was to devote 20-25 percent of the budget to construction projects and >40 percent to the research program. It recommended changing the approach for the long-baseline neutrino program, reformulating it as an internationally coordinated and funded program, with Fermilab as the host. The Fermilab proton accelerator complex should be upgraded to product higher intensity beams, offset by Project-X and existing accelerator R&D. R&D for PIP-II should proceed immediately. A second-generation dark matter direct detection program should also proceed immediately, and increase support of CMB research and projects while continuing multiagency partnerships. Re-align MAP and terminate MICE; and focus on improving cost-effectiveness for mid- and far-term accelerators.

Benefits and broader impacts were articulated later in the P5 report.

Ritz noted that the scientific community had been a core part of the P5 deliberative process from the start. The panel wanted to build on everything that happened at Snowmass. Looking ahead, there will be a June 2 community presentation hosted by the American Physical Society's Division of Particles and Fields (DPF). There will be discussion of the report in many venues. We want to keep a list of known events to maximize the sharing of information in the report.

There was a 1-pager summarizing the report that was out for the HEPAP to review as a draft. The discussion piece features abstract artwork for each of the five scientific drivers.

Ritz summarized the report in slides 63-67 and offered a set of "panel perspective" statements. The panel acknowledges that this is a challenging time for particle physics, because the science is exciting and successful yet funding is declining. The panel had the responsibility to make "tough choices" under each of the budget scenarios specified in the charge. Historic opportunities are ahead, and the field is ready to move forward.

Ritz then concluded his presentation, and **Lankford** called a break from 12:13 to 2 p.m..

Discussion of P5 Presentation and Report

Lankford gave a brief introduction to indicate how the discussion would be structured. The HEPAP would consider and discuss the P5 report in sections, with any member having a conflict of interest recused from voting on any particular section. For each section, the HEPAP would be allowed to comment first, then members of the audience, then anyone else listening remotely.

Lankford presented the list of sections. First was the introduction of the report (excluding the executive summary), the drivers, and broader impacts. The other sections would follow; and finally, the HEPAP would consider report as a whole and may or may not require a vote.

Moving to the "Introduction, Drivers, and Broader Impacts" section, **Lankford** invited questions from HEPAP members.

Gabriella Sciolla noted that the P5 had been able to pick most promising scientific drivers and articulate a coherent plan. She offered the comment regarding the statement, "particle physics is a global science." Political leaders need to understand that one does not need to put all the money down to take on a leading role in a science. Agency representatives need to be able to communicate that; maybe they will have the toughest job.

Robin Erbacher said her question was similar. In the second paragraph, Ritz pointed out that part of the idea is that for each area, you want to be the host of a major worldwide facility – that was a clever way to solve the LSBN problem; it gets us where we want to go a lot faster. The idea of international partnerships requires international buyers – in the case of Japan: dropping one of their priorities and joining us. Did the P5 discuss how to move these discussions forward with DOE or NSF? There is no mechanism to formally conduct these negotiations.

Ritz remarked that the overall plan is to have large capability for the long-baseline neutrino facility. It would be two-thirds funded by U.S. and one-third externally funded. That was the game plan presented to P5. Although there was a cost cap for this program, there was a strong desire by the community to do something greater. The neutrino community would really have to come together to get this to work. The P5 recommendation is based on that: to make the science happen, the worldwide neutrino community will have to come together and make it happen. P5 created a pathway to make that happen. The words in the report are

written in the strongest way we know how, to foster making this happen. We don't think we should be very prescriptive on who or where, or on the actual mechanisms. There are great scientists that want to make great science happen and to work with the agencies to make that happen. P5 does not in its report say, for example, that the Fermilab director should do this, or the agencies should do that – panel members felt that was not a correct thing to do.

Erbacher said we are still not looking at the agencies.

DOE representative **James Siegrist** said we could look at agency roles. The audience laughed.

Professor Mary Bishai complimented and thanked the P5. She asked if **Ritz** could elaborate how international relationships would be impacted by the lack of a large U.S. facility hosting an experiment.

Ritz said it was about a scientific tradition of people moving from distant places to study and work at world-class institutions and facilities. When a nation no longer has a facility where people from other places come to use that facility – seemed to him that changes the relationship. That consideration was new territory for the panel. The primary motivation is to get the science out. First part is that the world moves its particle physics science forward, best, in this mode. The word cooperation is key. "Coordination" is a word we did not choose over "cooperation." The way nations cooperate was something we did not want to prescribe. For the panel to say there should be coordination… the P5 report seemed not quite the right venue to do that. Cooperation is the word the panel chose.

Robert Tschirhart named the three overarching criteria: science, overarching context, and steady stream of results. Are those ideas prioritized?

Ritz replied that the panel didn't have a score sheet. It was more judgment based. These things were very hard to quantify. Panel members would look at the program and at the projects, and throw the sequence of standard questions to them. Each panel member could come to different conclusions. Thus, there was no uniform metric for each of these things. What matters is do we think that's the right decision.

Ritz then said he had just received an email from people in the cyber audience asking if this discussion was posted.

Lankford replied that the slides were listed under his name on the agenda, in the discussion section, on the HEPAP MEETING site.

Professor Paul Steinhardt warned to be careful in discussing the scientific term inflation, because it can be disputed, as well as what inflation predicts. As a scientific document that mentions "acceleration" and "inflation:" it should not indicate we are equally sure of both phenomena.

Lankford asked for more comments or question from the HEPAP or others on the first section. There were none.

Lankford moved on to Recommendations 1 and 2. There was no discussion from the panel or audience concerning the recommendations.

Lankford moved to Recommendations 3-9: the project-specific recommendations. They concerned reassessing project priorities, small scale projects, the 25 percent construction item, flexibility, further reductions planned with care, operations budgets evaluated, etc..

Karsten Heeger asked how does this relate to the current project process.

Ritz responded that putting a metric on science is very hard to do; yet it matters. A project that answers a science question on a certain cost scale might have a different priority if it were on a different cost scale. Plus, one must consider project maturity levels and the relationship to cost uncertainty. There have been concerns in the community on cost growth. A project's baseline is set in the CD-2 stage. We start to wonder what sort of contingency is there, but it is not like we can do a full-up Lehman review. Built into the CD-2 process, there should be a process to reassess cost. We discussed different mechanisms but didn't feel it was right to prescribe a specific mechanism.

Tao Han said the P5 did an impressive job. Theoretical research is truly important and should be highlighted more.

Ritz asked whether Han was asking why there was not an explicit recommendation about Theory in the set of recommendations. This was discussed extensively. There were discussions at P5 meetings. The panel decided it was better to take research as a group, because it was going to be a similar recommendation for all of research. The P5 felt it was more effective to link arms; to make a strong statement about Theory. It placed Theory near the research program; it seemed the most fair.

Han said Recommendations 6-8 regarding research programs were properly stated.

Ritz said he thinks he made it clear that Theory is research – it is included particularly due to the paragraph about Theory.

Han countered that Theory is different. Take, for example, recommendation #5 regarding the 25 percent of budget topline devoted to construction projects. Theory would have a lot to do to with guiding the new projects and the construction. I would have thought that the Theory effort should be coming in hand-in-hand with the construction. It is broader in that regard. If the construction budget will be increasing to 25 percent, it seems like that would be guided by developments in Theory.

Ritz commented that he strongly agreed with **Han's** main point: Theory is foundational for giving meaning to the data. We say that Theory cuts across, defines, and connects the drivers. A healthy theory program is important for every stage of an experimental program. The science analysis has to have a Theory component. And once you have the data, Theory informs as to the next steps. That is what we tried to capture in the report text. So from a budgeting perspective, we consider Theory to be part of the research program, not part of the construction program. The research program gives meaning to the data. The intellectual effort to get meaning from the data involves Theory. Theory is part of the research program; it is not part of the construction program.

Professor Mirjam Cvetic added to Han's concerns, specifically, to the way Theory is emphasized, with the U.S. leading in this field. It is sort of offered with these other recommendations, instead of highlighting the number one priority within Theory. Theory is without dispute the leading one in this country.

Ritz: said to the panel, it was a more effective way to put this all in as a piece in the research topic area.

Ian Shipsey complimented the P5. There was clearly stated methodology and multidisciplinary recommendations. On Recommendation three: what mechanism would be used to reassess project priority at critical decision stages if costs and/or capabilities change substantively? What mechanism did Ritz have in mind: a program advisory committee?

Ritz answered yes.

Jim Buckley complimented the panel, saying he was impressed at how it had taken broad community input and distilled it, and had made effort to ensure it was based on broad community input and planning. Without budget details, he wondered if it could actually be pulled off: 25 percent construction, then research at 40 percent, and hints such as Recommendation 8, with facility operations evaluated…what is really being said here? How do we make it balanced?

Ritz acknowledged that yes, there were three legs: research, construction, and operations; plans for them should be in alignment with the P5 priorities. Regarding the National Research Council (NRC) study: there is a lot to learn and use from the NRC-type approach. The subcommittee approach had some different features. The NRC approach is desirable because of the level of independence from the agencies. An advantage of the P5 process is the agencies have a connection to what it was doing. Most discussions occurred with someone from the agency in the room. As discussions occurred, the panel could ask the agency: is this executable? What is missing from an execution point of view? Ritz said he understood that it was hard not to see the numbers, but the panel was able to iterate as it developed these approaches, and that was a good thing.

Erbacher complimented the P5 for noting that the research program was already being strained: protecting that is important. She also voiced a concern about the project fraction. Why didn't the P5 just recommend cutting more projects? Then, the only thing left to cut is the operations budget. She said she worried about the lab infrastructure and asked whether the panel had consulted with the agencies on that part of the plan.

Ritz explained that the panel had an incomplete understanding of all those budgets. For the projects, they asked the labs about the project budgets – such as for the Intensity Frontier: there is an operations budget at Fermilab. Understanding the details of that, for a panel like P5, was hard to do. Why didn't the panel cut the construction fraction? The field needs instruments that require construction. The panel determined that having a smaller construction fraction was really going to be detrimental. The breadth of the program to address urgent science questions was just too narrow. The word "health" appears on the chart. One must have a functioning research program as well. Agencies have been working very hard to figure out how to do that. The portion of the overall budget dedicated to research has been high, lately, as you can see from **Glen Crawford's** slide. There is an amount the panel felt the budget should not go below, and that was represented by 40 percent. Ritz emphasized that it was a "spreadsheet exercise," looking at the first-order numerical consequences. Was the 25 percent going to make the research budget drop to less than 40 percent? There was not precision in working the numbers. In a flat-flat budget era, either one maintains a constant level of effort in research, and all other investments mush decrease, or research must go down. That

is what the term, "flat-flat" implies. That is intrinsic to a planning exercise like this. Cost escalation for our researchers is faster than that 2 percent. The panel was concerned about that erosion. It didn't additionally cut numerically in the later years. The level of insight it had was not precise.

Erbacher asked what was left, then, in terms of operations investments.

Ritz answered that the agency staff understand the programs and balances much better than the panel did.

Bishai said one of the key features was the physics science drivers, based on the Snowmass process, and most of the field was very happy with that. Her question focused on Recommendation 3, to reassess project priority. Did Ritz envision that reassessment to take into account the drivers? Or, if the physics evolved, would recommendations be revisited because the physics in a specific area is promising?

Ritz said the panel didn't explicitly say it, but in the next 10 years, it didn't expect science would progress so rapidly that a re-prioritization would be needed. But one can open up a can of worms if one continually reassesses the physics priorities. If cost and capabilities didn't change; then one must ask, "Do I really want to do this " for every one. Re-opening, constantly, the physics priority-setting process, if these other things don't change, would not be very helpful.

Dr. Robert Tschirhart said it would be nice to retain the historic strength our nation has in particle physics. Did the panel decide that, by lumping Theory in with the research program, that was the best strategy for maintaining that strength? Was there discussion about that issue?

Ritz countered that the community had raised concerns about the Theory program. The P5 had decided this was the best way to do it.

Tschirhart asserted that Theory was a special category.

Ritz said we are not taking about construction, but we are talking about the research program

Tschirhart said yes: an area where we have historic, world-leading strength: is this the best way to give it special attention?

Ritz clarified by asking whether Tschirhart was advocating that the P5 treat Theory special from the rest of the research program.

Tschirhart said when the panel divided the investments as "Theory plus the rest," did it lump them back together, or did the panel decide not to decide?

Ritz said if one looks at the Theory program, there is this flavor of Theory, that kind of Theory, modeling, each of the Frontiers, and their pieces of research, and cross-boundary topics. Any recommendation that the P5 would want to make about Theory was well covered by all the other things it would say about the rest of the research program. The panel did feel that Theory did merit special attention, as it is world leading, which is why there is a paragraph focused specifically on Theory.

Jawahery said he thought it was a fantastic report. Very strong statements put into protecting the research portfolio. Was consideration given to whether university-based research warranted its own mention?

Ritz answered that it goes to this issue of does one want to tease apart these separate entities, or does one want to make, once, a strong statement about the research.

Lankford said there would be a follow-up discussion on how, under constrained budgets, to execute a science program while considering competing priorities.

Dr. Zoltan Ligeti thanked the P5 for the report; he described it as fantastic. He made a comment regarding international competition.

Ritz said that the point was similar to Bishai's question: how do you want to evaluate the overall scientific value of the project. If there is a protracted process, things could change, and hopefully these processes aren't protracted. If the science goes through a prioritization like this, it must be fantastic science. As long as the overall cost and capabilities don't change, then one goes forward. **Ritz** asked **Ligeti** whether there was something specific that he had in mind? Once one decides to do something, then just go do it and get it done.

Lankford invited the webcast community to comment. No one offered a comment. He asked if anyone wanted him to break apart the recommendations for reconsideration? The HEPAP then accepted Recommendations 3-9.

Recommendations 10-11 were the project-specific recommendations. **Bishai** said she understood that U.S. role for the International Linear Collider (ILC) in Japan was small, so how does that play out what we would do it in a very constrained budget environment?

Crawford noted that investment was $0 for this year. A small contribution could go to the common fund global design effort.

Ritz said it would not be a large program.

Lankford invited the webcast community to comment on recommendations 10-11. Then he asked if the HEPAP agreed with the LHC recommendation. Then, the HEPAP accepted the ILC recommendation.

Recommendations 12-15 dealt with the neutrino program.

Professor Gabriela Sciolla asked about the LBNF: the success of the experiment is dependent on the international community. There are two components: the long and short baseline, and they have overlap. The short baseline findings could be considered as R&D for the long baseline.

Ritz said that Recommendations 12 and 15 should be both coherent, as Sciolla said. The recommendations already complied with her suggestion.

Sciolla added that her issue with the European LBNF is that the name sounds too much like LBNE of Fermilab. A new, international effort needs to be coordinated.

Ritz replied that Recommendation 12 heads off such concerns – it was not just the long baseline. And explicitly in the short baseline recommendation ties it in. Calling it long baseline, as in, "LBL," was also not preferred.

Jawahery said the recommendation for the LBNF had implications for the timing, not only in the U.S., but also in Europe, and Japan. Did the P5 consider that?

Ritz responded that international scientists were interested in the P5 thought process, but the panel did not discuss with them the direction it was heading. The panel was clear that it was gathering information. This is a developing story in all places. One fortunate detail is that there is an international meeting in Paris in June where this will be discussed further. There will be a P5 discussion on the global neutrino program. The global community was not apprised of the P5

internal deliberations. However, the panel did listen to their expectations of what would be important in the neutrino program.

Jawahery commented that neutrino science was developing.

Gilchriese made a comment about the last sentence in Recommendation 15, regarding liquid argon, and LBNF at Fermilab.

Ritz said that there was a set of short baseline experiments to be done, but the P5 didn't want to overly prescribe. That short baseline program should have components that include liquid argon. Physics and also technology need to be taken into account. The panel saw those as intrinsically connected as far as the interest goes, to conduct that experiment. The scientific community was divided about this topic, and that is healthy.

Bob Wilson from the audience thanked the P5 did a great job and fully endorsed the report. Regarding internationalization and the LBNE, after CD-1, a year and a half ago, he said that Fermilab spent efforts pursuing and engaging international partners. Since CD-1, the LBNE collaboration has grown to over 500 members; and 25 percent of the collaborators are international partners. The report from the P5 will open the path for the worldwide community to quickly develop an international facility in the next five years. When Snowmass endorsed the science goals, the number of international partners that joined the collaboration increased. There is no barrier, now, to moving forward; it is just a matter of execution of the program.

Lankford recognized **Gary Sullivan** at Harvard via webcast. Sullivan asked about Recommendation #13 and the Long-Baseline Neutrino Facility (LBNF). In the report, there were hints of a facility at the CERN-EU high-energy reference field (CERF) and that it be an argon detector, but the P5 did not specify further.

Ritz said that the P5 defined the minimum criteria to proceed. Maybe it is in the text – scientific capabilities should be defined by the international collaboration. Providing latitude in the P5 recommendations will be beneficial in establishing an international collaboration.

Lankford then asked if the HEPAP was ready to accept Recommendations 12-15. There was no dissent.

Next, **Lankford** moved to recommendations 16, 17, 18, and 21. He said he would split them up to be separately considered due to specific members' recusals.

Bishai asked, concerning Recommendation 16, whether DESI was the largest factor in the difference between funding Scenarios A & B.

Ritz answered that DESI is about $10M per year, and the total difference between Scenarios A & B is about $30M. He acknowledged that for relatively little money, the community could see big dividends from support. The P5 had attempted to "squeeze every last drop out of the taxpayer dollar to get the science to move forward. We had to be careful not to 'over-stuff the suitcase.'"

Erbacher asked whether the HEPAP would come back to a discussion about the scenarios.

Lankford said that the panel would have a separate discussion on the scenarios.

Lankford then moved to accept, separately, Recommendations 16, 17, 18, and 21, due to specific HEPAP member interests.

Erbacher commented, on Recommendation 18, that cosmic microwave background (CMB) experiments are fantastic, and scientists can learn a lot about the universe from them. Traditionally they are funded from a different purse. She expressed concern that we are supporting the Large Synoptic Survey Telescope (LSST) at a certain level. Opening OHEP, going down this road further is diluting our ability to do particle physics. Should the funds come from OHEP? Following discussion, the P5 reported that for particle physicists with techniques that go into these experiments: that OHEP supports them at that level. She said she wanted to ensure that OHEP participates at a small level.

Ritz responded that he thought the words about the continued multidisciplinary nature of the science covered that. One can see in the construction-phasing diagram that the CMD would ramp up after LSSD ramps down. The portion of HEP of funding should follow the portion of the science, roughly. Multidisciplinary projects can only happen when they have multidisciplinary support. The report does not say particle physics should be the sole funder of this enterprise.

Tschirhart added that a strength of the P5 report was that it directs the field – not by a static definition of labs or techniques. The report urges greater investment in promising science. He said the HEPAP should enthusiastically support the recommendations.

Ligeti said that he supported the recommendations but wondered if it was explicit or implicit that HEP funding for other things would be limited.

Ritz replied that when one gets results, one pursues what's next as hard as one can.

Lankford moved to accept Recommendation 18: "Support CMB experiments as part of the core particle physics program. The multidisciplinary nature of the science warrants continued multiagency support."

Then the HEPAP considered Recommendation 21, concerning the indirect detection of dark matter: to invest in the Cherenkov Telescope Array (CTA) as part of the small projects portfolio if the critical NSF Astronomy funding can be obtained. The group concurred.

Lankford moved to take a break at 3:39; the HEPAP reconvened at 4:20.

Next, the group considered Recommendations 19-20, regarding investments in second- and third-generation dark matter direct detection experiments.

Bishai expressed a concern regarding Recommendation 20 (third generation direct detection experiments), but Lankford noted that they had already approved it.

Someone asked what was the process for the DOE and NSF down select.

Crawford said NSF and DOE were developing a U.S. portfolio for the dark matter program so it would be one, integrated program. It is very much defined by the P5 report.

Dr. Denise Caldwell of NSF, when asked, said **Crawford** articulated the point very well.

Lankford asked for a show of hands in favor of Recommendations 19 and 20. There was a unanimous show of hands, with no opposition or abstentions.

Lankford moved onto Recommendation 22: to complete the Mu2e and muon G-2 projects at Fermilab.

Heeger asked, for redirecting programs under budget Scenario A – was there something specific Ritz had in mind?

Ritz answered that it would have to be a small change. There was no change in scope, but a small change in profile.

As there was no additional discussion on the topic, the HEPAP approved Recommendation 22.

Lankford next moved to the "Scenarios" section, focusing on Scenarios B & A first: the budget-constrained priorities.

Buckley said he was concerned that the current budget looked worse than A. Did the P5 consider that?

Lankford said that topic is for Friday morning. Then he asked how did the HEPAP generally feel about the scenarios.

Professor Thomas Shutt commented that for Scenario A, funds were very constrained. He was trying to figure out what things must have gotten cut. But in considering the 'program,' versus the 'project,' what was being squeezed?

Ritz clarified that for the first three years, the difference between A and B is about $30M out of a budget of about $720M.

Shutt said he did not see a difference between B and A, but the notion of "blue sky," in Scenario C, was different.

Ritz asked what Shutt meant by, "squeeze."

Shutt asked for programmatic differences between Scenarios C and B.

Ritz replied that answering for C is harder. C is an increment on top of B, and the P5 offered three increments. Those increments are things yet to be defined in detail. He said he could answer going from B to A, but he could not recite a list of "blue sky" projects, but that the main projects were in the table.

Shutt said we seem to be hearing a stark scenario from the agencies in terms of next year's budget, but scenario B looks pretty good to me.

Ritz said the discussion from the last two meetings is that it was untenable to concomitantly do the LHC experiment and DESI, and the P5 plan de-conflicts it. There is real difference between Scenarios B and A; it is listed in the table. The report discusses the things you don't get in A that you get in B. The bang for the buck is the incremental difference between A and B, and it is huge. The funding resolutions say nothing about B or A. SC had to choose representative touch point numbers and have the P5 do the planning exercise. From that, one must pick a group of programs and articulate a vision. Ritz thought, going forward, the community could forget about A and B, and look at a continuum of great things it can do.

Bishai commented that the table did not show, in Scenario A, what is reduced. Is it going to cut into the U.S. being able to host a dark matter experiment? Also, also in Scenario A, what is the impact on the research program if operations change?

Ritz answered that it means a few more years of "flat-flat" budgets for the research line, and because of inflation, that's erosion in real dollars. For dark matter: support for G3 experiments is less certain. It is further away, and the

support will be based on what we know from the G2 experiments. The total difference, by 2024, was $96M, and that program will be living out those years. The things far into the future are either going to have to be pushed a little later on, or reduced.

Bishai asked if accelerator R&D would be reduced should an ILC opportunity arise.

Ritz answered that should an ILC opportunity arise, that is a game-changing development. That is a factor outside the scope of the P5: an essential uncertainty. Should an ILC proceed, that is a government-to-government discussion of political value to the nations cooperating. One starts to break the Scenario A, B, and C paradigms at that point. It means that in A, we continue to contribute R&D as described in the report to help an ILC go ahead and fund nothing more. For B: it represents a U.S. hardware contribution that could involve additional international agreements. If the Japanese participate in LBNF, that could spur greater US participation in an ILC.

Bishai pressed that she was trying to understand how the field would preserve core expertise, plus have the ability to ramp up, if an ILC or a collider came on board. How would the field fund existing projects?

Ritz replied that the ILC-specific R&D activities are written into all of the budget scenarios. Some accelerator R&D might be temporarily redirected to PIP-II, which means other R&D would not happen. Or, there might be reductions in A relative to B. The accelerator R&D panel will look at the details of that program in a way the P5 could not. P5 looked at the overall scope, butP5 purposefully did not make decisions on allocations within that area.

Dr. Patricia McBride asked if **Ritz** could programmatically compare where we are now, and then going to scenario B, and then to scenario A.

Ritz explained that the difference between Scenarios B and A in the budget exercise was that Scenario B allowed the panel to increase research to compensate for erosion due to cost escalation. There weren't additional cuts in then-year dollars for research programs.

McBride asked if he would comment on funding plans for operations.

Ritz said that the panel had to estimate operations dollars to the extent that it could. For new projects, they got input from the projects for their operations, knowing the numbers were estimates. For Fermilab, it was more complicated. It was also complicated because of various aspects of redirection and ways things can get done. Going from Scenarios B to A, the operations part of the budget needed careful scrutiny – it had to be considered against all the other things one wants to do. Plus, personnel are involved in the operations budget. The panel asked the agencies whether the plans were executable.

Erbacher said the big shame was the relatively small funding difference but large science impact between Scenarios A and B. The way to move forward in the energy frontier is to do things more cheaply and get to higher gradients with new techniques. Since it has such large societal impacts, this generic accelerator R&D, we can sell that behind the baseline HEP budget. It is pure technology for society. For such a minor incremental investment, to lose those opportunities would be a

real shame. The operations budget affects personnel; the field would be losing students and postdocs. Both are investments in our future.

Ritz concurred with Erbacher's remark about accelerator R&D.

Cvetic asked why the LHC was an unqualified "yes" in all three scenarios, and that the time scale is right now.

Ritz answered that the highest priority in the near term is high luminosity LHC. The baseline is about $12M per year for the LHC. Phase 1 is happening now. Phase 2 will occur pretty soon. Those schedules are not in conflict with other plans, in terms of schedule and cost. They are phased in such a way they don't break the bank and can keep a schedule necessary to complete. That was the priority.

Steinhardt asked, in Scenario A, for the ILC: is that R&D funding?

Ritz said yes.

Steinhardt asked if the U.S. could get global partners.

Ritz said yes. The U.S. is investing heavily in the LHC. CERN is interested in working on PIP-II. The Europeans are interested in the long-baseline LHC detector. Japan is interested, but that is a more complex situation. There is interest in ILC. It is true for Japan and for U.S. that moving ahead with the ILC involves robust funding. He hoped there could be a way of globalizing cooperation in the long-baseline neutrino program as well.

Siegrist said to think about what happens within SC. Even a small contribution to the international program matters. What the field learns from LCLS-II at SLAC will be of interest to international partners, especially if a little R&D is leveraged off of that.

Someone in the audience commented that Fermilab is building an accelerator that, to a non-expert, looks like the ILC. R&D pushes performance in the direction we want to go. In four years, we will be ready to go. We are preparing ourselves for the ILC.

Siegrist said that Fermilab and Jefferson Lab could split the cost.

Professor Harvey Newman, in the audience, said that in March, members of the HEP community had visited 350 offices of Congress regarding the enacted FY14 budget. They will go back and ask for the same or higher budget in FY14. Everyone should be asking for the same thing.

Lankford moved to the "Changes in Direction" section.

Ritz said it was meant as a summary of other pieces of the report.

No one from the audience or webcast had a comment.

Lankford then moved to consider the "Enabling R&D" section: recommendations 23-24 and 26-29, on accelerator R&D.

Bishai said there was a lot of overlap in accelerator R&D that is helpful both to HEP and BES. Was this taken into account as the P5 was deliberating?

Ritz said the idea was considered, but the P5 didn't use it as a strategy for "offloading costs."

Lankford then moved to Recommendations 27-29 on instrumentation, briefly summarizing each recommendation.

Buckley commented that Recommendation 27 represented a major shift. It used to be support for generic, long-term research, and specifically of how detector research is done. He said that in his last operating proposal, that was the position.

Lankford acknowledged that it was somewhat of a shift. High luminosity LHC and other projects will require some directed R&D and will be a focus for a while, then the normal paradigm will return.

Tschirhart asked about one of the changes in direction statements.

Bishai commented that Recommendation 28, on university-laboratory partnerships, was laudable. She said it implied that growth would be needed in the research program. Funding for researchers was quite constrained.

Ritz said that would be harder in Scenario A, but that the research base could be evaluated in comparative reviews as well.

Bishai pointed out that this aspect of the research program has had a large benefit to society. Graduates of instrumentation program are flexible physicists. It is a disproportionately large benefit. In current scenarios, was difficult to see how to grow existing programs without the trainee base.

Lankford said the group would discuss that topic more on Friday.

Dr. Ursula Bassler commented, regarding Recommendation 29 on computing, that data volumes have increased over the years. New computing models are needed. She felt that the computing section was a little short.

Ritz said the P5 had leveraged a recent report and cited it.

Bassler counted that the panel did not mention that in U.S., we like to leverage the software.

Ritz replied that he would review that piece. The main thing was to acknowledge and cite the report.

Newman, in the audience, made a comment on high luminosity LHC. There was a need for better materials, especially for nanotechnology-based communications at very low energies. That idea didn't appear in the report; did the P5 discuss it? Meta-materials technology is crucial in the modern world.

Ritz answered that the P5 did not discuss it.

Someone in the audience asked if RADAR was in the report.

Ritz confirmed that RADAR was in the report.

Lankford added that high power accelerator R&D was in the report. Some things didn't fit in the report structure; the HEPAP will need to decide how to address that.

Rick Williams from the audience commented that funding sources for Recommendations 27 and 28 (enabling R&D – instrumentation) were a mix of R&D and advanced detector R&D. It would be useful to learn how one can support the R&D mentioned in Recommendations 27 and 28.

A summer intern at OHEP commented favorably on Recommendation 28: to invest in instrumentation at universities. He said his undergraduate degree was in in physics; his master's degree was in mechanical engineering because there was not as much focus on instrumentation at universities. On the idea of supporting more global G3 experiments: would they be focused on university and/ or facilities already in place, or located in new areas?

Ritz answered that goal was so far away; he didn't know. He had a sense that we would build on existing infrastructure.

Tschirhart asked about the small project portfolio.

Ritz said it included efforts up to the midscale project type range: $120K. The P5 did not explicitly recommend that the agency should have a small project line out of which small projects should be funded. It did say that small projects were important, and the panel had to cordon off some budgetary space to support and account for them.

Lankford then suggested that the HEPAP consider the enabling R&D topics together: accelerators, instrumentation, and computing. The HEPAP unanimously accepted the recommendations via a show of hands; none were opposed or abstained from voting.

Next, the HEPAP moved to consider Recommendation 25 on the General Accelerator R&D (GARD) program.

Ritz commented that given what we know about physics, a muon collider, from a physics point of view, doesn't stand apart from the other programs. The P5 looked at the overall, long-term vision. It wouldn't say one type of machine was higher or lower priority. The highest power 100GeV scale proton machine, if feasible and buildable, is something in which the community is interested. People aren't saying that muon R&D is not valuable, but should the physics evolve, that would also help to set the direction.

Someone in audience remarked that he thought ionization cooling didn't get the priority it should have. It was an expensive thing and required a facility.

Ritz said that given the cost of it relative to other things, our current understanding of physics, and the need for a neutrino factory and muon collider: it didn't stand out as something needed at this time more than any other. Opportunity cost was a key consideration.

Mark Palmer, director of the muon program at Fermilab, made a comment. On opportunity cost: for something we need to be spending on next year, that's one thing. However, with the ionization cooling effort: we made an investment in two facilities that are on the cusp of paying major dividends: the test area at Fermilab, and MICE; and you can't do the calculation without looking at the investment. A second investment that is critical is the team: the investment in people. The accelerator team must have knowledge on how to design, build, and operate a facility. On these recommendations, we have a stellar young team of accelerator physicists with a real grasp of where we need to go. If we cut them off in this context, it will be a serious loss to the HEP community, as they represent one of the few teams able to deploy capabilities for HEP program.

Ritz said he appreciated the feedback.

Lankford invited those participating remotely to comment.

Mary Anne Cummings of Northern Illinois University said that since near-term discoveries are uncertain, there needed to be an array of options. The HEP program is a unique combination of experimentalists and theorists. It concerns people that the breadth of efforts is being reduced, and if we cut things, we can't get them back. It seems to be a minimal amount of money for large dividends. We at least need to keep a very bright pilot light on, particularly for the muon collider at Fermilab. To see it dissolve into a general accelerator is bad for Fermilab.

Ritz acknowledged that it wasn't easy. The P5 had to set priorities. He was at the first muon collider workshop. The panel understood that the implementation of strategic advice had to be handled with great care.

The HEPAP unanimously voted, by a show of hands, to support Recommendation 25 regarding the muon accelerator program and MICE. **Gilchriese** abstained.

Lankford noted that Recommendation 25 was not an assessment of poor performance of the muon program.

Next, **Lankford** invited discussion of the report as a whole.

Jawahery said it was a wonderful report, and it represented reality. There are many elements that depend on how nature behaves and the rest of the international community behaves. The P5 must have discussed when this might need revision.

Ritz acknowledged that "having a significant number of 'what ifs'" weakened the report. Everything identified as a priority direction can move forward right away, so that part is strong. Setting a direction and planning for success is the right message. Regarding the comment on it "depends on how the rest of globe behaves,'" the neutrino world community came to the P5 expressing interest to move it forward. The near-term steps are to get going, and to do the R&D on essential improvements at infrastructure at Fermilab, on a high power beam for neutrino work. The P5 articulated a direction in which one could take all the steps right away, and all the steps would be valuable. The P5 doesn't give advice to the world; the P5 gives a report for HEPAP to advise the agencies. The panel tried to write it to maximize the chances for all these things to happen.

Buckley said his biggest concern from the onset was that the HEP community would be told the P5 plan could not be realized, due to an even more austere budget. Then, it would be back to the drawing board, budget-wise. He said he would hate to see that happen again, after the 2010 experience.

Ritz replied that if the budgets are worse than Scenario A: the P5 did a planning exercise, and not programming. For that reason, they "did not stuff Scenario A to the gills," in order to prepare for perturbations in the budget and potential cost escalation. The planning had some measure of robustness to those sorts of upsets. The P5 was given a charge: state the priorities, rather than what to cut. **Ritz** said he hoped that the advice would be robust enough to still be relevant as funding levels become clearer.

Buckley said since we don't know the exact budget numbers, there was some room.

Ritz said it is like ordering coffee: one leaves room at the top of the cup. The panel made a strong case for why funding should be stronger. It did state that Scenario A was precarious: the U.S. would no longer be able to host a large project, and it would fundamentally alter the character of the U.S. particle physics program.

Erbacher said the panel did a fantastic job, and the HEPAP was about to vote on a large body of work, including work done at Snowmass. Her overall impression was that the report was robust and positive for the field's future. One feature of it that was probably necessary was that accelerator R&D got short shrift, but there was a subpanel that could continue to discuss it. With the muon accelerator

program and all the efforts that are suffering from strained funding: maybe the community could extol the benefits beyond OHEP. The P5 articulated exciting things about that program in Scenario C.

Lankford said he would report on Friday, in the HEPAP activities section, on good things in the muon program.

Heeger asked, regarding Scenario C, if Ritz could comment on plans for communication of the report to the international community.

Ritz said on June 2, there would be a community presentation. It would not be possible for it to be real-time interactive, but planners asked for advance questions and also asked what the community wanted **Ritz** to cover, so he could adapt the presentation. The panel would move quickly to explain and discuss with international partners. This was also something the HEPAP could do: help in gathering and communicating feedback in response to the P5 report.

Shipsey commented that the P5 had involved the broader particle physics community. In nine months, it had laid out priorities, and it brought the community together. International scientists found the P5 to be extremely responsive. Within the community, there was eager participation and optimism. The report had embraced extensive community input. The report articulated a compelling and achievable vision. When the scientific community had read through the report, **Shipsey** said he hoped it would be as enthusiastic as he was and would work to implement the vision. On the three scenarios: particle physics has been able to make great advances in gravity waves, dark energy, and neutrinos. He made an analogy to the discovery of the Americas. Once they were discovered, there was an enthusiasm to spread out, over the continent. Now we are poised to discover areas articulated by the P5. **Shipsey** agreed that Scenario A is precarious and dangerously close to a tipping point: no capability to host a large project. He likened it, instead of exploring America, to only colonizing only the east coast and wondering where the rivers originated and what was over the mountains. Scenario B is better and would be like developing the east coast into more highly developed cities but not going further and deeper into the interior of the continent. The P5 wisely did not choose to add every project into Scenario C. It recommended building a world leading ILC program and hosting a neutrino detector: LBNF. In the discovery America analogy: this represents discovery from sea to shining sea. These are difficult economic times. The sciences are increasingly intertwined. Particle physics is compelling. All fields must compete for limited resources. We have no entitlement for it; it is a privilege to wisely spend taxpayer dollars. Congress must see HEP as compelling. The P5 had articulated a clear and compelling report. **Shipsey** expressed personal and very strong support.

Ritz said nothing was a higher compliment than to say the report expressed the aspirations and inputs of the community.

A physicist from MIT in the audience quipped, regarding the discovery of America: don't forget the gentlemen who designed and built the ships.

The HEPAP unanimously approved the report by a show of hands. There were none opposing or abstaining.

Siegrist said he would give remarks in the morning.

Caldwell echoed the compliments on the report and thanked **Ritz** for his leadership and the P5 for its effort. The acceptance of the report was a reflection of the community's approval.

Nigel Lockyer, in the audience, said the P5 report was a right first step in communicating with NSF and DOE. The P5 made choices. The choices are clear. We have a plan, and now we take the report to the next step. It must have been an exhausting effort; he said he felt tired just listening to it.

Lankford thanked the HEPAP for considering and accepting the report. **Shipsey** articulated it well. This was a process of considering the glass half-full rather than half empty. The future is full of S&T opportunities for the U.S. particle physics community. It was not a winners-and-losers exercise, but a setting of priorities. He adjourned the meeting at 6:04p.m..

MAY 23, 2014

Lankford called the meeting to order at 9:05 a.m..

REPORT TO HEPAP FROM THE DEPARTMENT OF ENERGY

Jim Siegrist, Associate Director of the Office of High Energy Physics, at SC, reported on the HEP program. He presented on recent staff changes in the program office. They would welcome more help from the community to help work on the P5 plan.

For the early career awards: there has been a two-step merit review process. Stage 1 has had some flexibility. It is now a more unified review. He compared application data to last year's lab and university proposals and showed demographics by research focus area. The early career program has become even more competitive. Full forward funding impacts these awards. They are becoming extremely prestigious. Although he was not involved in the awards selection of awards, he said that the candidates were outstanding.

There are several funding opportunities in the coming year. During FY15, DOE/ HEP will continue with large-scale support. Components need to decide whether their research is predominantly HEP-related, or related to another program.

Erbacher asked about the success rate for the early career awards, which was about 10 percent. She asked if we would be able to support that area better.

Crawford said this is the level of effort that was intended, and unless the program dollars are increased, which we don't expect, then the number of awards is not expected to increase. The size of the awards is fixed at 70 to 80 per year.

Erbacher said that was painful.

Crawford said the awards were very competitive, and the proposals were outstanding.

Siegrist said nominations for the Lawrence awards were due in the middle of July – it is not only about young people. We also need to recognize mid-career people for the Lawrence awards. Those nominations are reviewed, personally, by

the Secretary of Energy. **Siegrist** urged the community to get some letters of recommendation together and nominate candidates.

Siegrist said there were no words superlative enough to praise Steve Ritz and his panel's work. The community should also be proud of the huge amount of work captured at Snowmass, at the town hall meetings, and in other forums. The HEP community needs to get projects more mature, more rapidly, so it won't have to deal with the uncertainty that the P5 had to deal with.

There is a need to develop an "elevator speech" or short summary of the P5 report. Pertinent points include:

- "This report represents views of the scientific community." DOE and NSF did not direct discussions during the process. Program officers may have offered technical information upon request but did not advocate for programs or priorities.
- The panel made tough decisions. Project schedules were arranged so they don't pile up on top of each other, generating unsustainable costs, was an important aspect of what the committee did. This is important for talking to decision-makers. Congress directly controls when we do our construction projects.
- "The promise/ potential of HEP:" **Siegrist** said that he still hears, from time to time, that HEP is a dead field. A big breakthrough at Snowmass is that there is consensus that the dark sector is broader than just one particle. HEP did a great job studying visible matter. Physicists must now focus on the dark sector, and it will be challenging. The focus on neutrinos seems to be just right. Hopefully the P5 plan will give some hints about dark matter in the next decade.
- Given the funding challenges, much can be done if good choices are made as a community. The HEP community must not be overly concerned about opportunities left behind, but we may be able to come back around to them, particularly if we can figure out how to do them at lower cost.
- "This is a time of excitement." There are many lifetimes worth of work, here. The real breakthroughs have just started.

The labs must help DOE align around the P5 plan. The plan has been created under a flat budget scenario, so where does the money come from to pursue things like dark matter? We have to redirect some current programs, and that takes time. The agency will try to move things along as quickly as it can. Dark matter and accelerator R&D meetings are on the horizon to provide clarity in the shorter term. There will be a Fermilab user meeting June 11-12, and also a HEP principal investigator (PI) meeting in the short term. Then, the labs will get attention from the agency later on the in summer. There will be discussions of operations to realign on the higher priority projects. Everyone should come, especially junior investigators. We will give an overview of where we are in the P5 plan; and the implementation steps. And the G2 dark matter announcement will have been made by then. In the short term, there are opportunities for one-on-one and small group meetings with DOE/ SC program managers.

There are some new reports that are available: one is, "Computing in High Energy Physics," that addresses needs across the fields. Computer architectures are

being built that are going to be more powerful than current software can handle. Although many benefits have come from improvements in transistor size, the effort may be cost-prohibitive. It is time to think whether we have a sustainable model for the future. A second report, with a title beginning, "Tools, Techniques… is also coming out soon.

The HEP website has been updated, with a new front page and design. **Siegrist** urged the HEPAP to provide feedback to OHEP, because they have people actively working on it.

Siegrist said he believed the P5 report was a realistic, coherent, shared plan. The next step was to share the plan more broadly. A timeline for the P5 rollout was in a backup slide. There was a need to work with the labs on phasing in the implementation strategies. So far, the press had been positive. **Siegrist** said the HEP program office staff had some phone meetings, that day, with the House and Senate on P5 and would return to the HEPAP meeting after lunch for individual discussions with attendees. The program office has told the labs it would need responses to the report from them in early June. After that, the program office will talk with Congress and OMB about those plans. There is a large-scale neutrino meeting on June 23-24 in Paris about the international funding agencies. No Indian representatives are expected to be at this meeting, so that may be a limiting factor. The international agencies will want to discuss the P5 advice. Later in July: there will be more discussions with the labs: **Shipsey** will report on those activities.

Lankford asked if remote participation was possible for the Paris meeting.

Crawford said they would try.

Siegrist said the NSF program office and PIs could attend the meeting, but it was mainly for DOE.

Someone in the audience asked about the House Science, Space, and Technology Committee hearing on June 10th. Present would be Steve, Natalie, one other person and himself.

Tschirhart asked about the FY15 budget: would it be increased?

Siegrist said Congress was anxious to read the P5 report. It is up to them to decide what to do, but we understand they will be deciding that in the next couple of weeks. It will have a big influence on the formulation of the FY16 budget.

Steinhardt asked what is the message to young people, when the early career grant program has a 10 percent success rate? What advice should one give them?

Crawford pointed out that the success rate for regular PIs was pretty good. It was not was good as for senior PIs, but it was not bad. We should give new scientists encouragement and mentor them to write good proposals.

Steinhardt said he thought they were supposed to try, first, for these early career awards, and then try for the other kinds of awards.

Crawford said they could apply for both in parallel, and even use the same proposals. There are eligibility rules, like 10-years-since-the-PhD. Except for eligibility rules, all options are open. Applicants should talk to program managers about strategy.

Siegrist said that if the P5 plan was well received, the funding outlook FOR HEP might improve.

Jawahery said that the funding success rate for junior faculty is very good but the situation is different. One issue that came up is whether young investigator grants should be considered separately.

Crawford said that the funding opportunity announcement (FOA) for FY15 would be out soon. They did discuss input from the HEPAP and Committee of Visitors (COV). The FOA refers to the P5 report. The idea is to try to incorporate as much community feedback as possible into the review process.

Sciolla asked about report wording that stated, "…consensus by the physics community," rather than the particle physics community: was that an oversight?

Siegrist said we had some involvement at Snowmass from our nuclear physics colleagues, but this a plan is for particle physics. We have a lot of technology overlaps and are part of a fabric of science.

Bishai wanted to follow up on the early career support issue. The number of proposals is half of what it was in 2010. Is that a reflection of a contraction of the number of researchers, or are people discouraged?

Crawford said that in the area of Theory, there was a lot of pent-up demand, so in 2010, there were a lot of proposals. We've seen this decline across the program, not just in HEP. We do not have hard data on why people apply or don't.

Siegrist added there was pent-up demand that didn't exist before; and, there were 10-year and three-try rules.

Someone from the program office said it was a combination of both.

Siegrist said that one could not underestimate how important universities are for the hiring process. Anecdotally, university faculty positions haven't been opening up as fast as they once did. HE moved to utilize the P5 report to persuade universities that they need to hire HEP faculty.

Bishai said that universities want to know whether that person will be able to win grant funding.

Cvetic noted that in the last few years, there were dramatic cuts to university programs. So that's why universities think the field is dead.

McBride said that the CERN agreement was an example.

Siegrist added that the State Department has become responsive. DOE sent in a request to State to negotiate with CERN, the international experiment in Europe. Time passed. Michael went over and had lunch with State Department colleagues and explained the situation, and suddenly they became a lot more sympathetic. One leader will step down in December, and someone else will act for a year. Changes in our leadership means we need to get this going.

Tschirhart noted that with budget erosion: that might be reversed once the P5 plan is implemented. P5 calls for increasing the project fraction of the budget from 16 to 20 percent. How are we going to do both of those things?

Siegrist said if decision makers in Washington agree with the P5 plan, they will get behind the scenarios. There is concern in Congress about the cuts to OHEP.

Tschirhart pointed out that the report calls for a minimum of 40 percent of the top line dedicated to the research program

Crawford said currently the research program is funded at the high 40s or low 50 percentage of the HEP total budget. Accelerator R&D is much of that.

Siegrist noted that as we turn on PIP-II, it will look like a cut to research to Congress, but to us it is less impactful. The issue of the loss of research capability is something over which the P5 spent a lot of time agonizing. They reached a balance; it is a good plan.

Buckley asked about statistics of career grants. Did the OHEP see interest shifts among cosmic, energy frontier, and other subfields? What was the funding breakout?

Siegrist showed a chart, by frontier subfield. The agency would continue to manage and track efforts by frontier, but it will incorporate the P5 five science drivers into the communications from the department. It is easy to map the P5's five drivers to the frontiers. OHEP won't need to do a major disruption of budgeting to incorporate the P5 vision.

Bishai commented that at Snowmass, people were concerned about those who straddle the frontiers.

Siegrist said that the messages we use, that are aligned along the drivers, will be more acceptable to the community than messages referencing the frontiers. The drivers offer a more nuanced view of how particle physics actually works.

Crawford said the issue would be addressed in the PI meeting.

Erbacher shared that there had been discussion in the scientific community on who got what, etc. She assumed that the awards had gone to the best proposals overall, not necessarily to proposals focused in preferred areas or frontiers. For example, the Energy frontier represents a large number of people in the field, so competition for grant funding on that topic is vigorous.

Siegrist said it seemed that the panel was having a harder time funding energy proposals than they would like.

Crawford commented that there are a few energy frontier proposals that stand out. Many proposals are similar. However, there is no conscious effort o say we are only having two or three energy awards.

Someone from the HEP program office reported that the number of submitted proposals from last year was half of the number from 2010. For the Energy Frontier, there were about a third as many.

Cvetic said the cuts to the Theory subprogram budget had been drastic.

Erbacher said the Theory subprogram had been over represented in previous years.

Lankford said that the scientific community doesn't like the science frontier categories. The frontier designations create "cylinders of excellence/ stovepipes" and are seen by community as too compartmented.

Siegrist indicated that it was impossible to make everyone happy.

Vic Teplitz congratulated OHEP on supporting gender diversity in its early career awards. He asked if there were plans to support efforts in other kinds of diversity.

Siegrist said diversity is always a concern for the whole DOE complex. Cultivating it means mentoring good candidates. It is up to the field to bring minority and women candidates forward with good proposals.

Teplitz added that at some point yesterday, the group discussed getting astronomy to apply to some projects. Based on the year he spent at NSF, he thought that might be unrealistic.

Siegrist said that the National Academy of Sciences (NAS) decadal survey had some prescriptive language about the CTA project, that it should be split between NSF astronomy, NSF particle physics, and DOE particle phys. The P5 advice is consistent with "New Worlds, New Horizons."

Ritz explained that the P5 applied criteria, and one of those was that multidisciplinary science is very important and can only be enabled by disciplines that cooperate.

Siegrist noted that CTA is a program with broader science impacts, only a piece of which is particle physics.

Ritz concurred by saying it is great science, and it crosses boundaries and fields. Its support needs to come from multiple fields.

Newman said the labs had been discussing how to help with the rollout process. The lab facilities' users executive committee will send a support letter soon. It hadn't given up on support reflected in FY15 appropriations. The labs will identify key members of Congress and go see them. Maybe we can discuss the timeline of when to do strategic outreach.

Siegrist replied that the "elevator speech" framed in his slide was one thing to say, but he was open to discuss, later, how to message points relating to the budget.

REPORT OF HEPAP SUBCOMMITTEE FOR WORKFORCE DEVELOPMENT

Professor Ritchie Patterson said the workforce subcommittee was formed after the March 2014 HEPAP meeting to respond to a charge letter from Patricia Dehmer of SC to "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." The charge specifically targeted graduate students and postdocs. Patterson described the subcommittee's process to respond to the charge, which included a questionnaire to the DPF and DPB membership, a request to the DOE lab directors for hiring data, and four phone meetings.

At the March 2014 HEPAP meeting, three areas with gaps were identified. The subcommittee looked at those disciplines one at a time. In accelerator science, the subcommittee recommended to recognize accelerator science as a distinct academic discipline and increase support for university investigators. It also recommended for the agency to support test accelerators and enhance university access to those at national labs. Over time, university accelerators closed down, and accelerators became more the province of the national labs. Accelerator science also became more sophisticated, studying subtle effects such as weak interactions and subatomic particles' behavior. Now it is rare to see accelerator scientists in the universities. Only five U.S. universities have more than two accelerator faculty members. There are difficulties in hiring and retention in the national labs. Searches, by the DOE labs and also by European labs, for accelerator scientists

typically attract two to three applicants, mostly foreign. There is a sizable gap between the number of accelerator scientists we are producing and number we need.

Jawahery asked if this is only true for accelerator scientists, and if so, why is there such a high demand.

Patterson answered that, yes, the deficit spans nuclear physics, light sources, and other areas.

Bishai asked if **Patterson** knew in other fields, like medical accelerators, where they get their students and experts. Do they hire from particle physics programs?

Patterson answered: they hire from abroad.

Heeger asked why so many more are trained in Europe. He guessed that funding for accelerator science is not as stark as it is here.

Patterson said the subcommittee felt this required major attention.

The second recommendation for accelerator science was to support test accelerators and enhance university access to those at national labs. The subcommittee felt that test accelerators are important for graduate education, so students can get their hands on equipment. For real equipment, there are demands for time, user days, etc., and no opportunities for training. She called out the example of ATF at BNL.

Tschirhart asked about proposals to use current facilities. There was clearly a need: 100 proposals may come to a university, but were are only 50 slots to use the test facility. The recommendation also says to enhance university physicists' access to national labs. Are there many proposals from universities that are turned away from test facilities?

Patterson said that a rising tide lifts all boats. The problem is coupled: there are not enough students, and not enough facilities.

Tschirhart asked: is the message to the host lab that it needs to make more slots for students at test facilities?

Patterson answered, yes, that is the message, but also: more support is needed at universities.

Bishai said she knew instances of particle physics faculty trying to get opportunities for students on the real instruments. They want their students to be on the actual machines, not just the test machines. Do we need to find a way for students to work more at the labs?

Patterson said she would not rule that out. The labs have to figure out how much access to trainees they should provide, while still delivering results.

Patterson moved on the recommendation three: support training grants for graduate students engaged in accelerator research and to give them visibility within the field.

Recommendation four, regarding accelerators, was to sustain support for the U.S Particle Accelerator School. The advantage is that the school teaches advanced topics such as magnet systems and RF technology. No university has a critical mass of students in those advanced topics. DOE laboratory staff also rely on these students.

Tschirhart pointed out that a majority of people who come to these are not physics Ph.D. students. Also, what is the fraction that are U.S. versus not?

Patterson did not know the statistic.

Tschirhart followed up by asking whether the school was this serving people not getting a degree.

Patterson replied that about half the people are not getting a degree.

Bishai asked whether there was trouble in getting instructors.

Carlsten said that when he was teaching there, he had 15 students. Half worked in U.S. labs; half worked in labs outside the U.S..

Patterson said there was a concern that the school would be designated as a conference: that would be bad. She moved on to the topic of instrumentation research. The number of students in this area has been declining. Another issue is the very long time-scale of experiments, in years. There is also a lot of focus on detectors, and then grad students are mostly doing analysis, so people are not working on the instrument consistently and/or long term.

Recommendation one, regarding instrumentation, is to make targeted resources at the national labs, including equipment, services, and expertise, available to members of the university community; and to invest in instrumentation at universities. This is compatible with the P5 recommendations. The PREP (Physics Research Equipment Pool) at Fermilab that provides equipment and some services to university researchers and is a valuable resource. It would be valuable to update equipment and to have a formal process of merit review. It needs to be widely understood in the community how to access resources. SLAC is working through how to do this.

Tschirhart said that for accelerators: we determined that work would be at the DOE national labs. Is most cost effective approach to build that expertise at universities or at the national labs?

Patterson answered of course there is a need for these efforts at national labs, but we need to have a strong program of accelerator science at the universities.

Patterson said that the second recommendation in the area of instrumentation is to support training grants for graduate students engaged in instrumentation research. Recognition is part of the problem. Universities don't value it: there is the perception that conducting instrumentation research at the graduate student or postdoc level is a detriment to career advancement in particle physics.

Bishai asked, given that these skills are of greater interest, is private; industry sponsorship of grants considered?

Patterson replied that the subcommittee charge was to give advice to Dehmer at SC. If we could get industry sponsorship, that would be great.

Bishai: industry typically likes funding partnerships with government.

Buckley said that in the P5 report, there is a challenge for university groups doing this instrumentation. He then disclosed a conflict of interest. Instrumentation costs are part of projects for a while. Ups and downs in funding make it difficult. While student support is great there is some minimum amount of equipment support needed at universities. Maybe NSF is an appropriate place to help meet that challenge because of the emphasis on student training.

Patterson discussed short versus long term R&D. There is a place for both of those. Then she moved to recommendation 3: continue to support national instrumentation schools offering introductory courses and support new courses in advanced topics. There is also a need for more advanced topics that are not currently covered by any schools. They could be hosted by USPAS, at the national labs, or consortia of universities and labs.

In the area of large-scale computing and big data, the subcommittee found that scientists with strong computing skills are essential for HEP, but high demand in industry makes retention difficult. The NSF has a new program: "National Research Traineeships in Data-Enabled Science and Engineering," supporting the development of new university programs in this area. The subcommittee recommended that there be support for national schools and workshops offering advanced training in computing. The CERN School of Computing is valuable and over-subscribed.

HEPAP Discussion of the Workforce Development Report

Heeger asked how long it would be before the report was released and also about compatibility with the P5 recommendations.

Patterson said the subcommittee's findings were more detailed but complemented the P5 report.

Bishai said when you say 'qualified applicants' sometimes you get biology people or others not possessing an appropriate educational background.

Patterson said 'qualified' was a very 'low bar.'

Tschirhart asked for statistics of replies from the community.

Patterson said the subcommittee received "tens of replies," which is why she didn't present any data.

Tschirhart asked whether she encountered any PhDs in detector R&D.

Patterson said that universities don't award PhDs for detector work alone. But often, faculty want to see their students work in hardware somewhere along the line. She recalled no responses of students working in accelerators.

Erbacher said it would be nice to encourage PhDs in accelerators, but they would be pigeonholed. There would need to be a mechanism for a job path. Second: **Alan Stone** from the program office made a good point about the computing: did you talk about Monte Carlo type infrastructure? It seems there is a lack of neutrino simulators.

McBride said the problem was a lack of jobs more than a lack of training. There is an issue with training as well, but maybe we should add something on phenomenology of simulations.

Han said the subcommittee sent a letter asking for input from theoretical community. The feedback was the same as is expressed here. In the U.S., we complain about the lack of training, but really, it's about job opportunities. Second, summer schools are attractive to European and American students as well. We should get input from theoretical community and should comment on that in our report.

Bishai opined that this issue that can only produce PhDs for which we have an academic career path is a little myopic. When she was a graduate student, she was told only five percent were going to make it into academia. Training in accelerators opens up a broader view of where trainees will end up. Students know what their training is going to help them do.

Erbacher agreed but said this is supposed to address deficits in HEP, and the aim of the exercise was to highlight the need to keep trainees in HEP.

Patterson added that the charge was to address deficits in HEP. Other SC subcommittees were asked similarly for their areas of science, and many of the problems were the same.

An LBNL representative in the audience said they have a program where students can come. He said that if Patterson could share who needs training, that information could be helpful to LBNL.

Patterson said instead of trying to target one or two universities, make it open to a broader pool of applicants.

Crawford commented that university departments have Ph.D. programs that are narrowly scoped.

Shutt offered that he had an accelerator degree. The issue is not so binary as we only grow a culture of people who just have an instrumental degree. But let us indulge PIs who want their students to have an expertise in that area. Echoing Jim: make funds available to support R&D in this area. There are students who would be interested in this area.

Tschirhart asked if there were metrics for detector R&D positions that are posted and not filled.

Patterson said she was not aware of that.

Shipsey said, from personal experience, when we advertise for people working on instrumentation, we get applications from people but they are not qualified for these kinds of positions. The national labs have more data than the universities in this case.

Tschirhart said that was another anecdotal story, but it would be nice to have data.

Someone from the program office said it is an aging population. We depend on experts in the field. We always go to the "usual suspects," and it would be nice to bring in new people and replenish the population. An aging population of experts in accelerator science is not sustainable.

Heeger said the comments he had heard concerned accelerator needs from various fields. Detector R&D instrumentation is a broad field. There is value in making connections in the subfields.

Lankford thanked Patterson for finishing the effort on the requested timeline. The report was due in a month; Patterson said she thought she would have it ready in two weeks. He said the subcommittee would need to send a draft report to the HEPAP and then have a teleconference to discuss final approval. He asked the HEPAP on the best place and time for that final meeting to sign off on the report.

Ligeti asked for Lankford to clarify what was needed to sign off on the report.

Lankford said members of the HEPAP could send feedback. There would be one more discussion, then an email sign-off. Instead of people sending Patterson comments, individually, he would prefer that the panel get together by phone and have a discussion.

Patterson agreed but said she thought the panel had a thorough discussion here.

Lankford concurred that it seemed the HEPAP was happy with the subcommittee's work and with the report

Erbacher commented that there was only one accelerator located on the west coast, which seemed to be a bad thing, because people nucleate around where the test facilities are located.

Someone from the audience clarified that there are seven facilities on the west coast, including Vela, and Neptune; they are close to national labs and universities. At Vela, there are 5 Ph.D. students.

Patterson note that there was not an explicit recommendation to build new test facilities; but rather, to sustain and increase access to existing test facilities.

Lankford said the panel would talk later on how to close out the report. He called a break from 11:05 to 11:34 a.m..

Continued HEPAP Discussion of the P5 Report

Lankford said that **Professor Hitoshi Murayama** sent comments: first, that he liked and endorses the report. He liked emphasis on the international aspect. He recognized the challenges in implementing the P5 recommendations and was curious how that would be done. His primary concern was for the Theory budget.

Lankford said those topics would be included in the "further impressions" and "thoughts about HEPAP follow-up" sections, to voice them later. The P5 is handing this report over to HEPAP, and HEPAP would then take ownership of it. The last P5 report that went forward never got beyond the final draft. And it says inside that the report was being submitted for approval; nothing was in the old report that said the HEPAP actually approved it.

Erbacher said that the HEPAP should add their names to the P5 report and message it as the HEPAP's report to the DOE.

Lankford said the report received Thursday in printed fashion was not intended to be the final report. A page could be inserted, if the HEPAP wanted.

Erbacher said it would send a message that it was the HEPAP's report, too.

Tschirhart asked, would that be in addition to the transmittal letter?

Bassler said she wouldn't mind if there was a statement about the HEPAP, but she would like the P5 to get the credit. The P5 made such a tremendous effort, and they should be recognized. The HEPAP contribution is very modest, and it is appropriate that the P5 is well distinguished, so they get credit.

Gilchriese agreed that the P5 should get the credit, that the HEPAP could send a transmittal letter.

Professor Cecelia Gerber said the report was clearly called P5, and it would get the credit. She recommended against including the names of the HEPAP names inside the report; the transmittal letter would be sufficient.

Lankford said on the HEPAP website would be posted the charge, report, and transmittal letter.

Tschirhart said signatures of all HEPAP members could be on transmittal letter.

Lankford asked for the HEPAP's opinion on putting the transmittal letter inside the volume.

Tschirhart said it was fine: put letter within the report.

Lankford said the HEPAP wants to endorse it but not take ownership of it.

Erbacher pointed out that there were other support letters in the back of the report. The HEPAP support letter could go there.

Heeger said the HEPAP should not take ownership of the P5 work.

Lankford said he thought ownership was okay, but that the HEPAP would not want to take credit for the report. He volunteered to draft a transmittal letter for the group and would talk to Steve Ritz about putting it into the report as front or back material.

Ligeti asked whether the P5 was going to refine the one-pager to include support for Theory?

Ritz said he did not support calling out Theory as separate from other research. But there is a half statement about research but not about Theory.

Ritz noted that the one-pager was not a P5 product. It is a communications tool, and there is much more flexibility than the in the report. HEPAP feedback on the one pager was valued.

Lankford said he heard **Ritz** say that is a fair suggestion; he asked **Ritz** to work with **Ligeti** toward a product.

Ligeti said the one-pager already mentions research. He suggested having a sentence or even a few words that discuss the value of Theory.

Lankford said it needed to make clear to the reader what research is.

Paul Steinhardt said he had already seen early news reports on P5. What did people think about that? News reports seem to be emphasizing only one aspect of the report. What should we be doing about that?

Lankford said the report to us represents a complete program. The Associated Press story that focused only on neutrinos is a real pity, especially to our decision makers. We should talk to our communications people. There are some events coming up: an LECP conference the first week of June in New York. There will be a panel discussion hosted by Dennis Overbye of the *New York Times*, talking about the future of the field. The press may find it to be too much to absorb. We should engage with communications people to receive suggestions on how to message.

Steinhardt said that the five science drivers should be upfront on whatever the panel presented to colleagues. He thought the presentation was clear.

Lankford asked **Steinhardt** what he thought of the one pager, with the five graphics.

Steinhardt said the panel should consult with a communications person and get some feedback.

Shipsey said the first thing we did is realize VPN isn't only in the U.S.. We asked Fermilab, SLAC, and professional users' organizations to help organize and

provide feedback on the P5 report. So far, people are responding extremely well; we want to channel in some formal way, such as via a virtual town hall. The P5 held physical town halls, but it was difficult to get young people to be able to travel and participate. The first and second virtual town halls were successful with young people. Q&A can be challenging, with that format. Or, there could be local Q&As at SLAC and Fermilab with a P5 member locally to field the questions. Prospective participants can go on the online forum right now and submit questions. We can help Steve Ritz prepare responses to the advance questions. The second activity is that Jim will be talking to OMB and OSTP next Tuesday. Users and executives of each of the labs have signed a support letter; and Andy and Jim will present that. It is too soon to say whole community agrees with report. A third way to provide feedback: a letter will be ready in two weeks; people can go to website to sign as individual supporters. Another way to provide feedback is to send letter to Congress that you can fill in online. Fifth: Senators and Members are back home next week. We are organizing visits to Members of Congress' home offices next week to express enthusiasm for the report. Sixth: we are organizing visits to appropriations staff in D.C. during the recess week. The labs are convening panels of experts to discuss how the report was developed. Seventh: the report is being advertised via social media; there is a Facebook page. We allow people to post comments and ask questions; we monitor the page and answer questions. We are also on Twitter. However, there have been unique challenges; 350 people attended a reception last year to celebrate physics when the Higgs boson was discovered. One does not traditionally celebrate the appearance of a report. We plan to wait to autumn for grand-scale event. When members of Congress return home in August, we will ensure that every district where there are particle physicists visit a Member's home office and explain the P5 report. The last outreach activity is to talk to those at the National Academy of Sciences who are not physicists. We will organize colloquia at universities and create a repository of effective styles of talking about P5.

Newman emphasized that the one-pager was an important tool for communicating with Members of Congress. He provided more specific feedback on the back of the one-pager regarding large projects, the first bullet on LHC and an energy upgrade which is about to begin.

Ligeti read a pre-prepared written support statement. He suggested explicitly stating that U.S. research capability be maintained with a thriving Theory program.

McBride said that NOVA had just started a project, and that perhaps near-term operations could be in the one-pager.

Ritz responded that was included in the science drivers section in the P5 report. It was not listed as a P5 decision but is in the report.

Han recommended adding "theoretical and experimental research in particle physics…" instead of just "research." He suggested putting those words on the front page.

Lankford said everyone should email specific suggestions to Michael and he would check with the communications people to vet the language.

Lankford indicated that Ritchie's workforce development report tied into the P5 recommendations. Accelerator R&D is also relevant to P5. He showed overview slide on why it is important.

Lankford then noted that the charge was pretty close to final. Scenario C was a late addition to the charge. He then discussed the requested framework of major report elements. Then he said that the time scale was under discussion. Would the HEPAP meet again in late November or early December? The final report would be due in March.

Tschirhart suggested, regarding the Scenario C section, that the panel might want to include industry. The fact that it is explicitly not mentioned might send the wrong message. Scenario C was meant to be unconstrained.

Lankford responded that industrial applications are the products of the stewardship program.

Tschirhart said except that there was an emphasis on cost.

Lankford said the stewardship program is about applications outside HEP in industry. Industrial partnerships that we use for accelerator technology within HEP could be part of it.

Tschirhart agreed, adding that the P5 report says that cost effectiveness is key. With the high cost of superconductors, the path to that success must include partnership with industry.

Someone in the audience: said that we have challenges getting products from industry. The sooner we bring industry into partnership, the better.

Lankford then moved to discuss the topic of the national scientific program advisory subpanel. Very little work has been done on this between the last meeting and now. It could have a possible role in advising the P5 on the small projects portfolio or short baseline portfolio. There is a strong interplay with Fermilab. There was also a recommendation from the P5 that critical decision points for capability versus cost should be re-examined. This subpanel could evaluate projects that experience changes in cost.

Lankford explained that as the P5 plan is adopted and becomes implemented, there would be tactical components to it. More details would be a considered by this subpanel. For the more strategic direction: the agencies are looking to the HEPAP for that.

Buckley asked would this be the subpanel that looks at major changes.

Lankford said yes.

Bishai asked if it would be a standing subpanel with rotating members. A small project or short baseline portfolio would need different experts.

Lankford said a panel would be convened roughly once a year that would look at proposals that come in with respect to a call or if needed to review candidate proposals for a specific goal. Membership may be constituted according to expertise needed, unlike the HEPAP.

Gilchriese postulated that for very broad program evaluation, the panel would need to be very broad.

Lankford countered that the panel would not evaluate the program as a whole. It would deal with proposed experiments, looking at whether they are

aligned with the P5. It would consider experiments that are not being performed at Fermilab, for which there is no experimental program advisory committee.

Heeger asked would the subcommittee be focused on physics alignment, or on cost and scope.

Lankford said the subcommittee would deliberate on projects at the $20M threshold, rather than give broader R&D direction. The P5 recommended sourcing $2M of such projects.

Heeger repeated: will the subcommittee mainly look at the physics or other details?

Lankford explained that the subcommittee would look at proposals before they enter the CD system. A positive review could result in a CD0. That is the mission need. The concept must be feasible.

Saul Gonzalez offered that we need to think about whether this works for NSF. With procurement issues, there are certain rules. We don't need another FACA panel. Meeting once a year would be insufficient.

Lankford replied the subcommittee could meet once a year and as needed.

Gonzalez asked, is this a subcommittee of the HEPAP, so the HEPAP must vote to accept its recommendations? And then the NSF piece: there might be 100 percent overlap with this subpanel, as there are NSF processes in place for this kind of effort.

Lankford said that he had presented a DOE-centric view. The subcommittee's outputs would need to be meshed with NSF.

Lankford then brought up the formation of a future subcommittee on laboratory and university roles, not detached from the research program. It is conceivable that this panel could provide information to the agency on the research program.

Lankford then asked for input on future topics the HEPAP would like to discuss.

Tschirhart, asked, regarding the P5 report, if SC could report back to the HEPAP on its work to communicate it to Congress.

Lankford agreed.

Erbacher said she would like to hear feedback from the lab directors and a vision statement from Nigel on detailed recommendations for the small project portfolio that the P5 was not charged to handle. What is implementation of that plan?

Lankford asked if she wanted a report from Fermilab. The small projects portfolio won't be a "grand call." There are less than 20 projects.

Ritz clarified that there were small (less than $50M) and medium projects. There was also a whole set of experiments below a threshold of evaluation by the P5: those in the $20M range. The P5 just carved out this concept it internally called the small projects portfolio, but there was no recommendation to create a small projects funding line. However, in its planning exercise, the panel wanted to make sure to leave budgetary space for it. But for **Erbacher**, it might be good for the HEPAP to hear what are those topics of interest.

Gilchriese said he wanted to expand on **Tschirhart's** comment. The HEPAP should evaluate whether the P5 recommendations are being fulfilled as time passes.

Siegrist returned to the subject of small projects. DOE and NSF have different ways of executing on small projects. DOE could not issue a call for them until it could confirm it had the funds to support them. That will probably take some time. **Gilchriese** was right to ask for what progress we are making to implement the plan.

Gilchriese said it is about more than just the agencies. The management should also be in the hot seat.

Siegrist then raised the subject of rotating the location of HEPAP meetings at different locations around the country.

Lankford noted that the P5 had been doing a lot of traveling and had decided to keep the HEPAP planted in Washington, DC. DC is convenient due to proximity to DOE program staff and to Congress. Perhaps there could be one HEPAP meeting outside of DC per year.

Bishai commented that the FACA panels had received some scrutiny about such things.

Crawford said the program office would be open to that possibility.

Lankford wanted to try to schedule the next two meetings for the year. The panel could discuss having one of those two meetings outside DC.

Gonzalez said if it did, to make sure there was a way to connect remotely, because the agency staff's travel budgets were constrained.

Someone commented that people had suggested scheduling the meetings up to a year in advance.

Lankford asked HEPAP members how far in advance they were willing to tie down your schedules.

Bishai advocated for six months in advance, with an agenda ready a month in advance.

Lankford then moved to hold next meetings to discuss planning for two things: (1) the annual report on computing, and (2) a catch-up topic on communications, specifically for the P5 report.

Tschirhart moved to discuss the density of conferences in the field. The LHC community has been talking about consolidating some of the conferences. His impression was that the density was too high.

Siegrist affirmed that advice from the HEPAP on conferences would be most welcome.

Lankford ask Crawford and **Siegrist** for questions on which the HEPAP could deliberate.

Siegrist offered: are enough or too many conferences? Should the field consider retiring any of them?

Lankford said the HEPAP could advise. It would need to examine the purpose of the conferences. They are a venue for young scientists to present their work, not just an opportunity for scientists to jet round several times a year. Should the HEPAP simply discuss, decide, and vote at a future meeting?

Siegrist said he would not leave out accelerator conferences; they tend to be much larger.

Kogut confirmed that some conferences are large.

Siegrist said they are large because they draw upon the broader community.

39

McBride said the APS is evaluating conferences. He asked the HEPAP to forward comments to him on how at a meeting serves or doesn't serve the particle physics community. That report was due in a few days.

Siegrist noticed that the American Astronomical Society chose to have its annual meeting in DC every year. The *Washington Post* covers it. They combine the meeting with Hill visits every time. The cadence of our meetings, and where we choose to do so, should be considered by the HEPAP.

Heeger said that a topic that had been discussed was whether to have it every other year.

Stone said there is the bureaucracy of the conferences. The HEP program office does not want to be heavy-handed about saying people can or can't attend this or that conference. Research grant support will be prioritized above travel and conference support. This is an international problem, not just a U.S. problem. We don't have good data on scientists traveling internationally.

Lankford asked **Crawford** if he could form an ad hoc subcommittee to look more closely at the matter. **Crawford** said yes. **Lankford** asked for volunteers from the HEPAP to frame the questions.

Bishai asked whether a subcommittee was necessary.

Bruce said he was already on a similar subcommittee and he'd be happy to volunteer.

Lankford said would find a few more people to help. Having topic suggestions in advance helps in setting the agenda in advance. He concluded the meeting at 12:58 p.m..

The minutes of the HEPAP meeting, held at the Doubletree Hotel, Bethesda, Maryland, May 22-23, 2014, are certified to be an accurate representation of what occurred.

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

Andrew Lankford
Signature

6/3/14
Date

High Energy Physics Advisory Panel - May 22-23, 2014 - Meeting Minutes