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

PUBLIC MEETING MINUTES

Hilton Washington DC North/Gaithersburg
620 Perry Parkway
Gaithersburg, MD 20877
June 5 – 6, 2017

HIGH ENERGY PHYSICS ADVISORY PANEL
SUMMARY OF MEETING

The U.S. Department of Energy (DOE) and National Science Foundation (NSF) High Energy Physics Advisory Panel (HEPAP) was convened at 8:33 a.m. ET on June 5-6, 2017, at the Hilton Washington DC North/Gaithersburg, Gaithersburg, MD, by Panel Chair Andrew Lankford. The meeting was open to the public and conducted in accordance with Federal Advisory Committee Act (FACA) requirements. Attendees can visit http://science.energy.gov/hep/hepap for more information about HEPAP.

Panel members present:

Andrew Lankford, Chair	Joshua Klein	Christopher Stubbs
Marcela Carena	David Larbalestier (online)	Michael Syphers
Kyle Cranmer	Fulvia Pilat	Mark Trodden
Aaron Dominguez	Stefano Profumo	Karl van Bibber
Salman Habib	Laura Reina (online)	Mayda Velasco
Eva Halkiadakis	Thomas Roser	Risa Wechsler
Joseph Incandela	Stefan Soldner-Rembold	James Wells
Kay Kinoshita	Maria Spiropulu	Geralyn Zeller

HEPAP Designated Federal Officer:
John Boger, DOE, Office of Science (SC), Office of High Energy Physics (HEP)

Others present for all or part of the meeting:

David Asner, Pacific Northwest National Laboratory (PNNL)
Tali Bar-Shalom, Office of Management and Budget (OMB)
Bob Bartow, DOE
Lothar Bauerdick, Fermi National Accelerator Laboratory (Fermilab)
Anwar Bhatti, DOE
Gerald Blazey, Northern Illinois University
Greg Bock, Fermilab
Ben Brown, DOE
Joel Butler, Fermilab
Tof Carim, DOE
Marta Cehelsky, NSF
Lali Chatterjee, DOE
Eric Colby, DOE
Tiffani R. Conner, Oak Ridge Institute for Science and Education (ORISE)/ Oak Ridge Associated Universities (ORAU)
Michael Cooke, DOE
Jean Cottam, NSF
Glen Crawford, DOE
Patricia Crumley, DOE
David Dean, Oak Ridge National Laboratory (ORNL)
Patricia Dehmer, (Retired) DOE
Marcel Demarteau, Argonne National Laboratory (ANL)
Robert Diebold, Diebold Consulting
Allison Eckhardt, DOE
Daniel Eisenstein, Harvard University
Jim Ellison, University of New Mexico
Bonnie Fleming, Fermilab
Kevin Flood, DOE
Saul Gonzalez, NSF
Maury Goodman, ANL
Howard Gordon, Brookhaven National Laboratory (BNL)
Rajan Gupta, Los Alamos National Laboratory (LANL)
Nick Hadley, University of Maryland
Karsten Heeger, Yale University
JoAnne Hewett, SLAC National Accelerator Laboratory (SLAC)
Klaus Honscheid, Ohio State University

Bethany Johns, American Institute of Physics
Ben Kallen, Lewis-Burke
Alexei Kanareykin, Euclid Techlabs
William Kilgore, DOE
Jon Kotcher, BNL
John Kogut, DOE
Stefano Lami, Italian Embassy, Diplomatic Sector, Basic Scientific Research
Rick Lansdon, ORISE/ORAU
Ted Lavine, DOE
Tim Ledford, ORISE/ORAU
Wim Leemans, Lawrence Berkeley National Laboratory (LBNL)
Dan Lehman
L.K. Len, DOE
Thomas LeCompte, ANL
Elaine Lessner, DOE
David Lissauer, BNL
Vyacheslav Lukin, NSF
Joe Lykken, Fermilab
Hong Ma, BNL
Ken Marken, DOE
Helmut Marsiske, DOE
Lia Merminga, SLAC
Patricia McBride, Fermilab
Berndt Mueller, BNL
Donna Nevels, ORISE/ORAU
Harvey Newman, California Institute of Technology (CalTech)
Vivian O'Dell, DOE
Mark Palmer, BNL
Abid Patwa, DOE
Leo Piilonen, Virginia Tech
Benjamin Preis, Lewis-Burke
Søren Prestemon, Jefferson Lab (JLab)
Michael Procario, DOE
Rob Roser, Fermilab
Randy Reichardt, NSF
Leonid Rivkin, École Polytechnique Fédérale de Lausanne (EPFL)
Natalie Roe, LBNL
Simona Rolli, DOE
Randal Ruchti, NSF
Anders Ryd, Cornell University
Michael Salamon, DOE
James Shank, NSF
James Siegrist, DOE
William S. Smith, Association of Universities for Research in Astronomy
Anthony Spadafora, LBNL
Bruce Strauss, DOE
Louise Suter, Fermilab
David Sutter, University of Maryland
James Symons, LBNL
Natalia Toro, SLAC
Bob Tschirhart, Fermilab
Kathleen Turner, DOE
George Velev, Fermilab
Harry Weerts, ANL
James Wells, University of Michigan
Jim Whitmore, NSF
Bolek Wyslouch, Massachusetts Institute of Technology (MIT)
Sam Zeller, Fermilab
Kathryn Zurek, LBNL

JUNE 5, 2016

OPENING REMARKS

Andrew Lankford welcomed the new HEPAP members and thanked the outgoing members for their service. The next HEPAP meeting will be November 30 - December 1, 2017 and an interim teleconference will be held in September 2017. Lankford reminded HEPAP of the great challenge put before the agencies with the current budget scenario for Fiscal Year (FY) 2018.

DOE REPORTS

OFFICE OF HIGH ENERGY PHYSICS BUDGET PLANNING, Jim Siegrist, Associate Director, DOE SC HEP

The FY17 appropriation for the SC is $845M. SC priorities in FY18: 1) cutting edge, early stage R&D and achieve 40% funding for research, 2) continue operations at the national laboratories, and 3) maintain all on-going projects and start two new construction projects. In the FY18 President's Budget Request (PBR), SC's overall budget will be down by 17% (~$900M). HEP's budget in the FY18 is reduced by 18% (~$150M), which means decreased support for current, ongoing science in favor of mid-term and long-term elements of the program. HEP FY18 focus areas are 1) Large Hadron Collider (LHC) and High-Luminosity Large Hadron Collider (HL-LHC), 2) neutrino program, and 3) dark matter (DM) and dark energy. Adjustments to projects and initiatives were made based on the P5 strategy and project maturity. Three projects are fully supported in FY18 and eight projects are adjusted. Two new initiatives include the HL-LHC Accelerator Upgrade Project (AUP) and Quantum Information Science (QIS). Research and Facility operations were adjusted to maintain project support.

Discussion

Dominguez asked about operations in a government shutdown. **Siegrist** indicated operations will continue for a period of time at laboratories with carry-over money; universities in a mid-grant year would see no effect. **Klein** inquired about Congress's support of P5. **Siegrist** said they remain extremely supportive.

Stubbs asked about a new round of evaluation should the FY18 appropriation be similar to the PBR. **Siegrist** noted that stability between Congress and the Administration is needed prior to considering a new plan.

van Bibber inquired if there was money in the HEP budget for QIS. **Siegrist** said $15M for QIS was added after the HEP budget response was completed. QIS may be built into the HEP program if the technical progress moves the HEP mission forward. **Pilat** asked how projects were chosen for full funding in FY18. **Siegrist** stated projects deep into execution were chosen. **Roser** asked about the plan for HEPAP's input on QIS. **Siegrist** said SC is still working on it.

Cranmer was curious about DOE political appointments. **Siegrist** indicated that political appointees provide formal approvals for projects, lacking such appointments means the process works slower. **Soldner-Rembold** asked about international partnerships. **Siegrist** indicated SC is in close contact with all of the international partners.

Lankford inquired about the different percentage decreases quoted in Siegrist's presentation and the Congressional timeline. **Siegrist** explained that the percentage changes varied depending upon whether the FY18 comparison was with FY16 or FY17, said that illustrated why continuing resolutions (CR) cause disruption. SC hopes to see Congressional marks by early summer.

HIGH ENERGY PHYSICS PROGRAM PROGRESS AND STATUS, Glen Crawford, Director, Research Technology, Detector R&D, DOE SC HEP

HEP will move forward with the FY17 budget appropriations. Crawford shared information on the current and upcoming Funding Opportunity Announcements (FOA). HEP will continue to implement P5 which has broad support in the community, the Administration, and Congress. The U.S. strategy for particle physics will need to be reevaluated and HEP is

projecting a new P5 strategy report in 2022. The National Academies of Science (NAS) are determining when to conduct the next decadal survey for HEP.

Discussion

Dominguez wondered if monies in computational physics could provide relief to operations programs. **Crawford** indicated the QIS initiative is driving the ramp-up, it is not possible to use this source of money to support the LHC programs.

Carena was curious about the interlacing of the computational physics research budget with HEP. **Crawford** mentioned that HEP imagines multiple workshops, interactions with the community and HEPAP, and a FOA and lab calls for QIS. HEP needs more information about its role in QIS, and vice versa.

Trodden asked about priorities in Theory. **Crawford** noted that historically priorities in Theory have not been set; given the FY18 PBR that approach may be reevaluated. **Klein** asked if a reevaluation of proposed plans would occur should the FY18 enacted budget be higher than the PBR. **Crawford** stated a re-evaluation would utilize the P5 plan.

Spiropulu sought input on possible CRs and the CR numbers. **Crawford** said a CR is always possible and Congress determines the numbers. **Lankford** inquired about new starts in the critical decision (CD) process. **Crawford** responded that new things for which HEP asked in the FY18 request would not happen under a CR. For example, the HL-LHC AUP, a new Major Items of Equipment (MIE) requested in FY18, would not be able to start. **Michael Procario** added that MIE's are flexible thus the CD process can continue moving forward.

Velasco asked about incorporating new ideas such as DM low-energy neutrino projects. **Crawford** noted that if FY18 appropriations are similar to FY17 there is the possibility for small, new efforts. **Lankford** recalled that P5 has a small projects portfolio. **Carena** asked about the 2017 termination of equipment support for Lattice Quantum Chromodynamics (LQCD). **Crawford** said LCQD is a casualty of the FY18 PBR.

Lankford pointed out the paradox between the take away messages (short term goals) and priorities of the budget (medium and long-term goals). **Crawford** indicated the message was it is important to maintain momentum even with uncertainties.

Pilat asked about the role of the NAS. **Crawford** explained that the NAS is an independent body chartered by Congress to give advice on science and technology. NAS is an outside entity looking at HEP and giving their perspective on what is exciting in science.

Lankford requested details on the neutrino program's international commitments and the impact of the FY18 budget on the Proton Improvement Plan-II (PIP-II). **Crawford** said the protocols specify the U.S. contributions to LHC and CERN contributions to the U.S. neutrino program. PIP-II requires more discussion and detailed understanding before a clear statement on the impact is made.

Trodden wondered if the Dark Energy Spectroscopic Instruments (DESI) would be moved ahead more quickly and if DESI priorities would change with a more normal budget. **Crawford** said in a more favorable budget situation HEP would follow the P5 strategy, but he did not foresee major changes to the priorities.

Daniel Eisenstein, Harvard University, co-spokesperson of DESI, remarked that the work on the project is proceeding well. He noted that the allocation for DESI in the PBR was very low, would be damaging for the project, and would potentially open it to direct competition from the European Space Agency's Euclid mission. He questioned whether the priorities of the P5 report should guide management of the construction portfolio. He noted the need to limit the

damage to projects should there be a CR at the outset of FY18. He urged that DOE seek to preserve its full portfolio during a CR.

NSF REPORTS

DIRECTORATE OF MATHEMATICAL & PHYSICAL SCIENCES (MPS), Jean Cottam, NSF

The Federal Government Reform guidance from the OMB requires agencies to submit a plan for reform by the end of June; Division of Physics (PHY) is fully staffed and will not experience an adverse effect. The American Innovation Competitiveness Act (AICA) was passed in January 2017; it does not have any specific funding targets and it supports NSF principles and merit review. FY17 budget allocations were passed in May 2017, but NSF will not know programmatic allocations for ~60 days. NSF is moving from Arlington, VA to Alexandria, VA over the next few months. The FY17 budget appropriation for NSF Research and Related Activities is flat relative to the enacted value for FY16. The NSF FY18 budget request is $6.65B, a reduction of ~10%.

Discussion

Klein asked about the explicit instructions for high energy physics relative to the AICA. **Gonzalez** explained the Mathematical and Physical Sciences Advisory Committee should continue to be a forum for coordination on high energy physics and to look at strategic plans.

DIVISION OF PHYSICS, Saul Gonzalez, Senior Advisor, NSF

Particle Physics at the NSF is centered on Elementary Particle experiments, Particle Astrophysics experiments, and their theoretical counterpart programs. It also includes the LHC and IceCube facilities and other allied programs within PHY. It represents roughly one-third of the total Division funding. For FY17, the NSF PHY program is expected to receive approximately "flat-flat" funding with respect to FY16 Actual. The FY18 PBR for PHY is minus 8.5% from FY16 Actual, while the NSF-wide request is minus 11.2%. Funding, program trends, and highlights were presented for all PHY particle physics programs. Status reports on HL-LHC planning and Computing were also presented. In addition, various mechanisms available for funding instrumentation within PHY were summarized. Finally, the FY18 PBR will require a re-baselining of research programs. The resources needed for HL-LHC planning will further increase the pressure on the Elementary Particle Physics program beyond the FY18 budget.

Discussion

Profumo inquired as to the new procedures for evaluating overlapping sources of funding in the proposal review process and about the funding projection and outlook for the Theory program. **Gonzalez** directed Profumo to the solicitation for details and said NSF does not expect the Theory budget will go down in FY17. **Lankford** asked about the budget dollars for Major Research Equipment & Facilities Construction (MREFC), IceCube and the Center for Bright Beams (CBB). **Gonzalez** said MREFC was expected to be $200M. **Jim Whitmore** explained that in 2016 NSF advanced money ahead of 2017 creating an artificial decrease for IceCube, and that the CBB will be supported in FY18.

DISCUSSION OF AGENCY REPORTS

Lankford opened the floor to comments on the agency reports. **Pilat** asked about the planning mechanism if the FY18 PBR funding level becomes permanent. **Siegrist** said the President's request planning process sets the baseline; Congress has the ultimate authority over the budget and HEP will respond to Congressional direction. **Roser** suggested an exercise to articulate the losses based on the FY18 budget. **Siegrist** thought the exercise was better for HEPAP. **Lankford** asked HEPAP, what is lost if the FY18 PBR becomes the budget? **Cranmer** pointed out that different scenarios suggest different statements about the losses. **Lankford** said reactions to the FY18 budget can be expressed. **Siegrist** noted that project delays and re-planning have immediate impacts. **Cottam** added NSF is planning to a new baseline and is working with FY18 PBR numbers for award decisions.

Trodden stated that the effects of the FY18 PBR will be seen in delayed projects, in loss of competitiveness, in competition outside the U.S., in projects that do not come to fruition, in workforce lost from the laboratories and universities, and in areas like Theory. **Lankford** asked HEPAP to consider Roser's question and Trodden's comments about the impacts in preparation for further discussion.

PUBLIC COMMENT

None.

Lankford adjourned HEPAP for lunch at 12:11 p.m. and reconvened the meeting at 1:32 p.m.

ACCELERATOR SCIENCE AND R&D

INTRODUCTION TO DOE ACCELERATOR R&D, Glen Crawford, DOE

Crawford explained the general characterization of SC's accelerator science R&D and the Technology Readiness Level (TRL). Near- to mid-term R&D is typically owned in Facility Operations, while mid- to long-term R&D is owned in three HEP subprograms: General Accelerator R&D (GARD), Accelerator Stewardship, and Directed Accelerator R&D. GARD focuses on basic accelerator R&D with priorities driven by P5.

Discussion

Klein suggested consolidating accelerator R&D into one office and asked if the stewardship role is exclusively HEP. **Crawford** said near- to mid-term accelerator R&D is owned within Facility Operations to maximize the output from facilities. Mid-term R&D and the stewardship program are primarily managed by HEP.

Roser wondered how the mid- and long-term R&D was communicated and implemented. **Crawford** said the HEP-specific parts of stewardship come from P5 and the HEPAP Accelerator R&D Subpanel. **Eric Colby** replied that the stewardship program uses a series of basic research needs workshops, and priority research direction comes from the community, the stakeholders, and the federal agencies; FOAs are based on the priority research areas.

Pilat asked about the HEP-funded program for accelerator R&D for TRL 0-2 and coordination of early phase R&D. **Crawford** stated basic R&D is 95% HEP. Regular interactions with NSF and the other SC units are held to understand how basic research proposals overlap with their programs.

GARD OVERVIEW & STATUS REPORT, L.K. Len, DOE

The HEP GARD program funds medium- and long-term accelerator R&D that is primarily aimed at supporting the HEP mission. Research activities are categorized into five thrust areas: (1) Advanced Accelerator Concepts (AAC), (2) Accelerator and Beam Physics, (3) Particle Sources and Targets, (4) Radio Frequency (RF) Acceleration Technology, and (5) Superconducting Magnets and Materials. GARD is currently implementing recommendations from the HEPAP Accelerator R&D Subpanel. Many of the GARD research efforts are world-leading and continue to push the performance limits in these technological frontiers.

Discussion

None.

AARD & GARD-RF ROADMAP WORKSHOPS, Gerald Blazey, Northern Illinois University

The AAC and RF communities developed comprehensive and detailed roadmaps that are responsive to P5's request for alignment of R&D with physics priorities and for reduced cost and improved operation of future facilities. The GARD-AAC roadmap identifies and addresses five common challenges for laser, particle, and dielectric wakefield acceleration technologies: a higher energy stage, emittance control, two stages, positron acceleration, and maintenance of a collider parameter set. The GARD-RF roadmap addresses performance and cost goals through a focus on improved Superconducting Radio Frequency and Normal Conducting Radio Frequency accelerating structures and RF and auxiliary systems.

Discussion

Pilat asked about funding to move AAC from TRL-3 to TRL-9 in 25 years. **Blazey** said discussions of budgets were outside the workshop scope. **Wim Leemans** pointed out that the lasers used today were only invented in 1985 and in the last decade laser technology has evolved rapidly. **Lankford** added that the Accelerator R&D Subpanel observed a need for future test facilities to develop AAC technologies. **Blazey** stated that the facilities need is included in the documentation.

Stubbs wondered how to shape intrinsically risk-averse corporate cultures into high-risk, high-value opportunities, such as DARPA. **Crawford** suggested demonstrating the application of projects and investment pay off to other parts of science, such as Basic Energy Sciences (BES).

Velasco sought clarification on the advanced plasma physics modeling. **Leemans** said while the modeling codes are available and full modeling of plasma formation is possible, the biggest issue is that full 3d simulation can take up to 500,000 central processing unit (CPU) hours on a supercomputer. The exascale program (ECP) is focusing on increasing the speed of these simulations. ECP is an important parallel effort to pursue.

U.S. MAGNET DEVELOPMENT PROGRAM, Søren Prestemon, LBNL

The U.S. Magnet Development Program coordinates HEP accelerator magnet research efforts at the national laboratories and other HEP funded magnet programs. The primary goals of the program are to a) explore the performance limits of Nb_3Sn accelerator magnet technology, b) develop and demonstrate High Temperature Superconductor (HTS) accelerator magnet technology, c) investigate fundamental aspects of magnet design that could lead to substantial improvements in cost and performance, and d) pursue Nb_3Sn and HTS conductor R&D to increase performance and reduce cost of accelerator magnets.

Discussion

Lankford requested information on the relationship between the U.S. magnet development program and European efforts. **Prestemon** stated the Europeans are investing money into conductor and magnet technology. They are in design studies of different paradigms (mostly 2d work) and CERN is making progress on block designs.

GARD SUMMARY & PROSPECTS, L.K. Len, DOE

The GARD Program's research community is developing research roadmaps for the five thrust areas. Potential impacts and measures of a negative budget trend were discussed. GARD research roadmaps and HEP program optimization processes are being developed to guide the program to best support the HEP mission.

Discussion

None.

NSF ACCELERATOR SCIENCE PROGRAM, Vyacheslav (Slava) Lukin, NSF

The NSF Accelerator Science program has been in existence since 2014. "A key goal of the program is to seed and develop research efforts in fundamental accelerator science..." There will not be a regular Accelerator Science competition in FY18 due to decreasing rates of well-fitted proposals and the anticipated budget pressures. The program will consider proposals submitted to NSF-wide solicitations and entertain supplement requests for graduate student support from principal investigators (PI) whose current awards expire in FY18.

Discussion

Syphers wondered what Lukin meant by "not an education program". **Lukin** clarified that although education is very important, the key review criterion is the intellectual merit of the research component. **Wells** was curious about the ill-fitted applications. **Lukin** said there has been a downward trend in applications, only 22 in FY17, and PHY will emphasize Early Career.

GENERAL DISCUSSION: ACCELERATOR SCIENCE AND R&D

None.

Lankford recapped the remaining topics for the day and asked for any general comments or questions about accelerator R&D. **Eric Colby** asked HEPAP to respond to a laboratory optimization exercise they received via email.

HEPAP Chair **Lankford** adjourned the meeting at 5:15 p.m. ET.

JUNE 6, 2016

HEPAP was convened at 8:33 a.m. ET on Tuesday, June 6, by Panel Chair **Andrew Lankford**.

ACCELERATOR SCIENCE AND R&D (cont.)

DOE R&D FACILITIES AND FACILITIES DEVELOPMENT, Michael Procario, DOE

HEP supports both directed R&D and construction projects for accelerators. HEP currently supports the Muon Accelerator Program and the LHC Accelerator Research Program (LARP), both of which are coming to completion by 2019. Results from each were shown. The results from the LARP will be used for the HL-LHC AUP, which received CD-0 approval in

2016 and will be reviewed for CD-1 in August 2017. PIP-II will replace the 50-year-old linac at Fermilab and received CD-0 October 2015. Facility for Advanced Accelerator Experimental Tests II (FACET II) is a project to continue the beam-driven plasma wakefield acceleration program at SLAC. The original FACET has been displaced by the construction of the Linear Coherent Light Source II.

Discussion

Roser asked when the community would provide advice on FACET-II and QIS. **Siegrist** stated the community input plan has not been developed, and the discussion is currently internal to SC. **Soldner-Rembold** asked for the status of PIP-II and HL-LHC AUP given the budget situation. **Procario** said HL-LHC AUP will be completed, but there is no solution for PIP-II.

DOE ACCELERATOR STEWARDSHIP, Eric Colby, DOE

The DOE Accelerator Stewardship program was first authorized by Congress in 2014. The program began at $10M per year with the goal of ramping to $20M per year. Approximately half the funding supports R&D aimed at (1) use-inspired R&D and (2) developing fundamental knowledge. The remaining funds provide more than 2,000 hours per year of accelerator, laser, and Ultrafast Electron Diffraction beam time at Brookhaven Accelerator Test Facility (ATF), fund upgrades to the ATF, and facilitate access for non-DOE users to accelerator capabilities across the SC National Laboratory complex. Over ten federal entities coordinate on accelerator R&D objectives to provide maximum synergy and leverage while minimizing duplication. An FY17 call for proposals was issued on June 1 with an accelerated deadline. Stewardship awardees have produced 6 patents, more than 100 publications, 23 PhDs, and provided an average of 20% in cost sharing.

Discussion

Klein asked if the review process was peer reviewed or agency level. **Colby** stated it was strictly at the agency level. **Spiropulu** was curious if the process was similar in other instances. **Colby** said GARD and Stewardship has reciprocal memberships on review panels.

Pilat inquired as to the support and budget distributions of the Stewardship Program. **Colby** said roughly half of the funding is in the research program and half is in the test facilities, and less than $70K is in program planning and the workshops. The goal was to serve a technology transfer role to get to TRL-4. Hovering at $10M per year has had direct impacts.

Roser wondered if the facilities referred to in Track 3 of the FOA include non-HEP facilities. **Colby** confirmed it does include non-HEP facilities and there is very specific language in the FOA. **Roser** mentioned Security and Prosperity Partnership (SPP) agreements. **Colby** indicated that everything under the sun was tried, including SPPs.

REPORT ON DARK MATTER COSMIC VISIONS WORKSHOP, Natalia Toro, SLAC

The March 2017 community workshop "US Cosmic Visions: New Ideas in Dark Matter" focused on opportunities for small projects in DM science. The workshop investigated low-cost opportunities to explore DM science complementary to the next-generation (G2) program, focused largely on the science of hidden-sector DM, charged under a new force, and ultralight DM including Quantum Chromodynamic (QCD) axion DM. The community presented a diverse and innovative set of experimental proposals within four working groups: New Avenues in Direct Detection; Detection of Ultra-Light (sub-milli-eV) DM; DM Production at Fixed Target and Collider Experiments; and New Candidates, Targets, and Complementarity. A

comprehensive exploration of key science targets requires multiple experiments with complementary sensitivity. This drives a portfolio of multiple small experiments in DM.

Discussion

Profumo suggested there are opportunities for future MeV gamma ray detectors such as CTA. **Kathryn Zurek** said that Cosmic Microwave Background already puts very strong constraints on sub-10 GeV s-wave annihilation and the workshop was focused on the sub-GeV scale for DM.

Profumo asked about community involvement for the workshop. **Toro** stated the workshop was advertised and all requests fit the budget constraints for acceptance. A Google forum was established for the white paper discussions.

Spiropulu requested more information on the Visible-Sector New-Force Anomalies experiment, and indicated 6.8 sigma is a big deviation. **Toro** stated the Institute of Nuclear Research of the Hungarian Academy of Sciences (ATOMKI) findings are not widely accepted; the community feels it needs to be confirmed. **Klein** said it seems like weak evidence to base a program on. **Toro** indicated it is not the motivation for the program, but strong evidence on which to base small experiments dedicated to testing that specific anomaly.

Spiropulu sought clarification on a radical generalization of the hidden sectors. **Toro** said the overall hidden sector framework is a modest generalization. However, there are specific models that invoke very particular details of hidden sector dynamics to get DM anomalies making them radical generalizations.

Spiropulu supported stressing the use of new quantum materials for advanced detector R&D. **Toro** added that detector technologies are an important cross-cut for both the ultra-low threshold direct detection efforts and the ultralight DM searches. **Cranmer** inquired as to the phenomenon of quantum materials in terms of individual particle glitches. **Toro** said that people often think the phenomenon is more classical, or it is a different classical limit of DM. The classical field limit rather than the classical particle limit.

van Bibber added that in the case of the Axion, it could be a Bose Einstein Condensate. One of the pathfinder experiments is deploying a squeezed vacuum state receiver and single photon detection techniques.

REPORT ON PROJECT LEADERSHIP INSTITUTE, Ben Brown, ESnet Program Manager and Senior Science and Technology Advisor, DOE

The DOE Project Leadership Institute (PLI) is a new program created to connect and develop project leaders across the DOE complex and is open to all project-focused personnel. The planning team created a prestigious, transformational professional development experience that is simultaneously both a leadership development and project delivery course of study and practice, tailored to the DOE context. PLI is a 12-month, cohort-based program with five week-long in-person instructional events and a small-group capstone project. The first cohort includes four senior professionals with key roles supporting current HEP projects. The application period for the 2018 cohort will open in July 2017.

Discussion

Dominguez suggested that a module on NSF projects would be helpful. **Brown** indicated such things were being considered and explained that the academic content is designed to abstract beyond DOE.

REPORT ON ASCAC LDRD SUBCOMMITTEE, Karsten Heeger, Yale University

Laboratory Directed Research and Development (LDRD) provides the laboratories with the opportunity to invest in high-risk, potentially high-value R&D. LDRD provides an avenue to recruit strategic new hires, support students, postdoctoral researchers, and retain key scientists. The LDRD program provides a unique combination of high-level laboratory-driven strategic research and "blue sky", investigator driven, fundamental research based upon individual innovation in a framework that has constructive federal, laboratory, and external oversight at multiple levels. LDRD is essential to maintaining the national laboratories' Science Technology and Engineering base both now and in the future. Both the level of funding and the LDRD funding processes are appropriate and necessary for the national laboratories to continue to perform at their present high levels of R&D.

Discussion

Weschler asked if the committee evaluated the most effective range of support. **Heeger** noted the focus of the charge was only on the processes, but every laboratory tries to optimize their LDRD funds.

van Bibber, who spent 5 years as a Deputy Director for LDRD at Lawrence Livermore National Laboratory, pointed out the importance of the LDRD program. At the National Nuclear Security Administration labs LDRD has played a large role in enabling the signature facilities in HEP, such as the B-factory, X-band linear collider, the CMS Muon chambers, and now materials for QIS.

Stubbs was curious if there was an analogous entity in the university research sector. **Dominguez** mentioned that the indirect return from federal grants pays for speculative, high-risk R&D at a very small level compared to LDRD. **Klein** stated LDRDs are set at a different bar when compared to university proposals and thatLDRDs can foster much high-risk R&D..

REPORT ON HEP AND FEDERAL BUDGET PROCESS, Glen Crawford, DOE

Crawford provided an overview of the three phases of the federal budget process and HEP's role in each phase. The federal budget process is long, complex, continuous, and the community continues to play a vital role in the process. P5 and HEPAP are significant to HEP and essential components of the process. P5 provides the long-term view and HEPAP acts as a federal advisory committee.

Discussion

Klein asked who wrote the language in the Congressional budget and where the budget altering information comes from. **Crawford** stated the appropriations staff writes the language and they have a wide variety of backgrounds, including science. The information comes from the users groups, lab directors, and the community.

Pilat mentioned the possibility of 2-year budgets. **Crawford** said the idea had been discussed, but it is up to Congress. **Siegrist** added that the States have experimented with solutions, for instance the California Legislature does not get paid if they do not pass a budget; Nebraska passes biennial budgets. **Dominguez** suggested structuring budgets with a 95% confidence level that there will be a CR. **Crawford** said steps are taken to factor in the reality of a CR. Moving all grant start dates to April 1 was one mitigation technique.

Leo Piilonen asked about funding levels at the start of a CR. **Crawford** replied that the statute says to operate at the lowest Congressional mark. In DOE, the Chief Financial Officer set guidance to operate at the lowest of the Congressional marks and the PBR.

REPORT ON COMMUNITY COMMUNICATIONS ACTIVITIES, Louise Suter, Fermilab

Seventy percent of the House and Senate were contacted during the 2017 annual advocacy trip to Congress. New communication materials were produced through the joint efforts of the HEP community; the materials have been well received and can be found at http://www.usparticlephysics.org. A Community Letter from Fermilab Users' Executive Committee, SLAC User Organization Executive Committee, U.S. LHC Users Association Executive Committee, and American Physical Society Division of Particles and Fields Executive Committee was sent to the Appropriations Subcommittee on Energy and Water Development (EWD), June 2017, urging a budget of $868 million for HEP in the 2018 EWD appropriations bill.

Discussion

Cranmer asked if there was a plan to send a similar letter to the Appropriations Sub-committee on Commerce, Justice, Science and Related Agencies for NSF. **Suter** said there is a plan but the NSF budget does not have a HEP sub-breakdown and MPS does not have numbers.

HEPAP DISCUSSION AND FUTURE TOPICS

Lankford provided follow-up on two topics from the December 2016 HEPAP meeting, the Theory Letter and the Committee of Visitors (COV) Recommendation #8.

Lankford introduced further discussion of the FY18 PBR by noting that HEPAP advises SC and MPS, is not an advocacy group, and should appreciate the challenges of HEP and PHY undertook to craft the FY18 budget plans.

Klein estimated that ~100 graduate students and post-docs would be cut in the FY18 budget plan. **Spiropulu** said that a large impact of training in science and technology (S&T) will be felt. **Lankford** added that ~90% of the students and post-docs trained by HEP do not remain in the field but go on to S&T in other fields. **Klein** emphasized that research is not something you can turn on and off. Taking a year off from research is damaging for a much longer time.

Wechsler said the impact on the research budget is difficult for the future of particle physics, industry, and other areas. A decrease in support of 15% will have an impact larger than 15%. Maintaining balance in the program is important. **Profumo** added that a 30% cut in Theory would translate to a loss of more than half of the post-docs. **Crawford** stated that the HEP budget request estimated that 175 graduate students and post-docs, and 450 total full-time equivalents (FTE) would be lost relative to FY16. **Carena** asked about the translation from the research dollars to FTEs. **Crawford** said this is an attempt to turn budget reductions into FTE using an algorithm developed over a few years. The Scientific Employment tables in the HEP budget have the numbers. **Gonzalez** added that across NSF MPS 10% of the workforce would be lost (600 PIs, 200-post-docs, 200-students, 1,200 undergraduates); PHY is one-fourth of that.

Carena said that the particle physics field relies on global science facilities with international partners and that these partnerships are delicate. **Soldner-Rembold** added that the U.S.'s credibility as a reliable funding partner is routinely discussed. A lot of confidence has been built over the last couple of years; however, the current budget situation is damaging. He also noted that losing 50 PhD students and post-docs instead of 100 is still extremely bad. **Trodden** stated that the position U.S. high energy physics has in the world was not established overnight; however, the U.S. could lose its influence and position instantly with 20% or 30% cuts. **Sypher** said accelerator physics is already hurting to bring people on board and that we could see this problem spiral downward. **Lankford** shared that, given the program being executed, the demand for resources is greater than Scenario A in the P5report, and that funding

less than Scenario A would be a precarious situation. Resources appropriate to the trajectory of P5 are needed and rolling back those resources in any way would upset the delicate balance.

Pilat shifted the discussion to actions that would best affect the appropriations process. **Siegrist** noted that the problem is SC-wide but that HEP is on a trajectory that makes it more vulnerable. He said that advocating through the American Physical Society (APS) Division of Particles & Fields (DPF) is a good approach for personal and community action. HEPAP can write its impressions of the budget to the head of SC. **Carena** shared two options from DPF's standpoint. DPF will provide a template letter for personal action through the APS website, and the DPF Executive Committee could write a letter to the head of SC directly. **Spiropulu** asked if it was time to do more than just write letters. **Lankford** agreed, and he mentioned that at the University of California, Irvine local Congressional representatives were brought to campus to meet with researchers. **Siegrist** stated that as HEPAP action is delicate; a more effective path is to use APS DPF or Division of Physics of Beams (DPB). Congressional support remains very strong for the P5 report and staffers do notice when the community makes contact. **Cranmer** suggested making universities more aware of the full impact of the FY18 PBR. For example, taking the message that 40% of the students are going away will initiate a snowball effect as students tell their parents.

Stubbs stated that the budget issue is science wide. He noted that a lot of the science in SC is based on large facilities. In a facilities heavy budget, the impact on the workforce component of the program is disproportionately large. **Roser** agreed that, by showing budget numbers that stay within the P5 strategy, it is impossible to put in a different strategy. If the FY18 PBR is enacted, that would mean a new normal for HEP and call for a new P5 strategy. **Lankford** agreed but thought a new P5 is premature.

Lankford asked for input from the laboratory members on HEPAP as to the impact on laboratories. **Roser** said the impact would be devastating for BNL. Sharing how devastating the FY18 PBR is will engender support from the Congressional delegations particularly for the laboratories. **Zeller** added the impact on operations is a loss of discovery, it is not capitalizing on investments already made, and it basically means suspended science because those discoveries will not be made. There would be a big impact on the neutrino program.

Lankford summarized what he heard from HEPAP. The balance of Research, Facilities Operations, and Projects is delicate. We are in a precarious situation. Existing international commitments would be at risk, and the international partnerships that are fundamental to particle physics as a global field would be damaged (LBNF/DUNE was cited as an important example). DESI, an important component of the dark energy program was at great risk. In terms of momentum, now is not the time to cut budgets causing delays and cost over-runs in projects. Research activities have already been put under stress by years-long decreases. The workforce is disproportionately affected by the budget. The research at universities would be particularly hard hit, and to curtail operations at existing facilities would shrink research opportunities further, especially in the neutrino experiments. Major reductions in the science and technology workforce, including the graduate student and post-doc levels, disrupt the pipeline that feeds both the field of particle physics and many other professions. The best students and research scientists will leave the U.S. for better opportunities elsewhere. These are lasting consequences for the health of U.S. particle physics, and the recovery will be slow. **Wechsler** emphasized that the cuts come at a time when there are a lot of discoveries to be made. **Lankford** noted this was a good point that ties in to the comments on neutrino operations. He stated with our focus on

projects, we sometimes take for granted the importance of ongoing programs and the science potential there.

Lankford adjourned the meeting at 2:25 p.m. EST.

Respectfully Submitted,
Tiffani R. Conner, PhD, PMP, AHIP
Oak Ridge Institute for Science and Education
June 20, 2017

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

July 13, 2017

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