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
May 14-15, 2018
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 8:48 a.m. ET on May14-15, 2018, 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:

JoAnne Hewett, Chair	Kent Irwin	Christopher Stubbs
Janet Conrad	Kay Kinoshita	Michael Syphers
Kyle Cranmer	David Larbalestier	Mark Trodden
Rohini Godbole	Donatella Lucchesi	James Wells
Jordan Goodman	Fulvia Pilat	Geralyn Zeller
Salman Habib	Thomas Roser	
Joseph Incandela	Maria Spiropulu	

HEPAP Designated Federal Officer:
John Boger, DOE, Office of Science (SC), Office of High Energy Physics (HEP), Research Technology, Detector Research & Development (R&D), Director

Others present for all or part of the meeting:

David Asner, Brookhaven National Laboratory (BNL)
Tali Bar-Shalom, Office of Management and Budget
Rich Barvainis, NSF
Lothar Bauerdick, Fermi National Accelerator Laboratory (Fermilab)
Doug Benjamin, Duke University
Steve Binkley, DOE
Kevin Black, Boston University
Ken Bloom, University of Nebraska
Greg Bock, Fermilab
Joel Butler, Fermilab
C. Denise Caldwell, NSF
Maria Chamizo, BNL
Lali Chatterjee, DOE
Eric Church, Pacific Northwest National Laboratory (PNNL)
Jim Cochran, Iowa State University
Leland Cogliani, Lewis-Burke
Eric Colby, DOE
T. Reneau Conner, Oak Ridge Institute for Science and Education (ORISE)
Michael Cooke, DOE
Jean Cottam, NSF
Glen Crawford, DOE
Patricia Crumley, DOE
Paul Dabbar, DOE
Kyle Dawson, University of Utah
Marcel Demarteau, Argonne National Laboratory (ANL)
Richard Dubois, National Aeronautics and Space Administration (NASA)
Allison Eckhardt, DOE
James Fast, PNNL
Laura Fields, Fermilab
Kevin Flood, DOE
Josh Frieman, University of Chicago
Saul Gonzalez, NSF
Howard Gordon, BNL
Paul Grannis, Stonybrook University
Rajan Gupta, Los Alamos National Laboratory
Jay Hauser, University of California, Los Angeles
Katrin Heitmann, ANL

Zhirong Huang, Stanford University
Andrew Lankford, University of California, Irvine
Anne L. Kinney, NSF
William Kilgore, DOE
John Kogut, DOE
Harriet Kung, DOE
Stefano Lami, Italian Embassy, Diplomatic Sector, Basic Scientific Research
Rick Lansdon, ORISE
Dan Lehman, DOE (retired)
L.K. Len, DOE
Thomas LeCompte, ANL
David Lissauer, BNL
Vyacheslav Lukin, NSF
Joe Lykken, Fermilab
Rachel Mandelbaum, Carnegie Mellon University
Alysia Marino, University of Colorado
Helmut Marsiske, DOE
Verena Martinez, University of Massachusetts
Patricia McBride, Fermilab
Mark Messier, Indiana University
Julie McEnery, Fermilab
Brian Morsony, DOE
Steve Nahn, Massachusetts Institute of Technology
Donna Nevels, ORISE
Harvey Newman, CalTech
Vivian O'Dell, Fermilab
John Orrell, PNNL
Michael Osinski, DOE
Abid Patwa, DOE
Andrea Peterson, DOE
Michael Procario, DOE
Jimmy Proudfoot, ANL
Bogdan Mihaila, NSF
Srini Rajagopalan, BNL
Lenny Rivkin, Paul Scherrer Institute
Natalie Roe, Lawrence Berkeley National Laboratory
Randal Ruchti, NSF
Peter Shanahan, Fermilab
James Siegrist, DOE
Anže Slosar, BNL
William S. Smith, Association of Universities for Research in Astronomy
Hank Sobel, UCI
Anthony Spadafora, LBNL
Bruce Strauss, DOE
Alan Stone, DOE
Dave Sutter, University of Maryland
James Symons, LBNL
Louis Terminello, PNNL
William Thomas, American Institute of Physics
Mike Tuts, Columbia University
Patricia Vahle, College of William & Mary
Justin Vasel, Indiana University
Vitaly Yakimenko, Stanford University
Joseph Zennamo, Fermilab
Chao Zhang, Australian Institute of Physics

MONDAY, MAY 14, 2018

OPENING REMARKS

John Boger, as Acting Chair, called the meeting to order at 8:48 a.m. Eastern Time (ET), welcomed attendees.

DOE REPORT: Office of Science, Program Status, Steve Binkley, Deputy Director, DOE SC

DOE's FY19 budget request for SC is $5.4B with a focus on cutting- edge, early- stage scientific research and development (R&D) and state- of-the- art scientific tools and facilities. DOE reorganization shifted the Applied Energy programs to the Under Secretary for Energy.

FY19 budget guidance priorities include operations of the national laboratories, exascale computing research, quantum computing and quantum information science efforts, funding to ensure robust cybersecurity program, cutting edge, early stage research and development, and

interagency and international partnerships. Investments in Quantum Information Systems (QIS) in FY19 total $105M for all of the SC offices, HEP will receive $27.5M.

Discussion

Pilat asked for insight on budget proposals. **Binkley** said the FY19 President's Budget Request (PBR) was equal to the FY17 budget, a reflection of OMB's targets for shrinking the federal budget overall.

Roser questioned if there was a SC-wide initiative for accelerator science and technology. **Binkley** indicated SC is assessing such opportunities.

Incandela asked if SC has multiple budget scenarios. **Binkley** stated that Appropriations dictate SCs annual spending priorities and confirmed SC has multiple budget scenarios.

Wells asked if there is coordination within DOE on QIS. **Binkley** stated that all SC Associate Directors are coordinating efforts for quantum information science.

Trodden inquired if the research budget would increase in any budget scenario. **Binkley** reminded HEPAP that the research budget has gone up in the past 3 years as high as 44%-45%.

Godbole asked about trends in the university portion of the SC research budget. **Binkley** stated that the university research budget has been 40% over the past few years.

DOE REPORT: Office of HEP, Program Status, Jim Siegrist, Associate Director, DOE SC HEP

The U.S. long-term particle physics strategy is the Particle Physics Project Prioritization Panel (P5) report which Congress supports through the language and funding levels in appropriations bills. The HEP budget in 2018 was $908M, funding all HEP projects, supporting facilities and experimental operations at optimal levels, and funding research at 40%.

Siegrist updated HEPAP on progress and shared highlights in the three Frontiers (Energy, Intensity, and Cosmic). In QIS, HEP is focusing on black hole physics, quantum gravity and quantum error correction, and fundamental aspects of entanglement. Three roadmaps have been developed by Advanced Technology R&D and the community. The internal working group on the HEP Computing Resource Management Strategy has begun an initial survey of the computing needs of the three Frontiers.

Discussion

Cranmer asked about university expertise in the Inventory of HEP Computing Needs Roundtable Meeting and R&D plans for data processing. **Siegrist** said there is not an HEP initiative to bring in university expertise and that data analysis is not yet integrated into ECP.

Godbole questioned the fraction of computing needs devoted to theory. **Siegrist** indicated that lattice quantum chromodynamics (LQCD) people attended the meeting; National Energy Research Scientific Computing Center (NERSC) cycles for LQCD are dropping.

Stubbs inquired if SC construction projects factor in anticipated data and computational needs. **Siegrist** stated that HEP has made strides to integrate those needs.

Boger called for a break at 10:15 a.m. to swear in new members and the Chair. The meeting was reconvened at 10:49 a.m. and HEPAP Chair **JoAnne Hewett** presided.

DOE REPORT: Office of HEP, Budget Planning, Glen Crawford, DOE SC HEP

Crawford shared details of HEP budgets and noted its variability. The FY17 program included High Luminosity-Large Hadron Collider (HL-LHC), Long-Base Neutrino Facility/ Deep Underground Neutrino Experiment (LBNF/DUNE), Muon-to-Electron Conversion Experiment (Mu2e), Dark Matter Generation 2 (DM-G2), and Large Synoptic Survey Telescope (LSST), sustained support for facilities, and focused research on efforts critical to implementing P5. The Intensity Frontier FY17 research program increased support and long-term R&D in General Accelerator R&D (GARD), Detector R&D, and Accelerator Stewardship was prioritized.

The FY19 PBR reduces near-term science for P5-guided investments and includes actively engaging in a successful LHC program and HL-LHC upgrades (Energy Frontier, EF), establishing a U.S.-hosted neutrino program (Intensity Frontier, IF), and advancing understanding of dark matter and dark energy (Cosmic Frontier, CF). Crawford noted FY19 projects and new initiatives; research and facility operations; and funding by subgroup (Energy Frontier, Intensity Frontier, Cosmic Frontier, Theoretical and Computational Physics, Advanced Technology R&D, Accelerator Stewardship, and Construction).

Discussion

Trodden asked about funding for QIS coming out of Theoretical Physics. **Crawford** said QIS is part of the overall HEP portfolio; it is not intended for theory to provide all the funds.

Godbole stated that the experimental program requires theory. **Crawford** agreed and stated a challenge going forward is to maintain the right balance of the programs.

Trodden asked if the target for research funding remains at 40%. **Crawford** said the goal for research is to keep it ≥ 40%.

Larbalestier inquired about the Congressional markups. **Crawford** stated that the P5 Report, users group, and individuals have been successful in conveying the message to Congress.

DOE REPORT, Paul Dabbar, Under Secretary for Science, DOE

Dabbar expressed his appreciation to HEPAP members for their time and effort. The recent success of the SC program offices has been the user facilities and a coordinated user group and community. The SC FY18 budget increase was 16%, an all-time high. Dabbar discussed international collaborations, supercomputing and quantum, Artificial Intelligence (AI) and Machine Learning (ML), broader scientific applications, and symposiums on select topics.

DOE is focused on increasing international collaborations; HEP has lead SC well especially with LBNF/DUNE. A second request for proposal (RFP) on the exascale machines at Argonne and Oak Ridge has been issued and provides an opportunity for suppliers to propose an upgrade to AURORA. Across SC is a push to utilize potential AI and ML applications. DOE is starting conversations with NSF, National Institute for Science and Technology (NIST), Department of Defense (DOD), and universities on how to integrate more on quantum topics outside of SC; Dabbar is talking with Congress about increased research funding for quantum. The initial areas for symposia are batteries and storage, AI and ML, and additive manufacturing; the first will be held at SLAC National Accelerator Laboratory.

Discussion

Roser asked about support for foreign scientists in the U.S. **Dabbar** said DOE's intent is to accelerate international collaboration. Careful thought must be taken on the collaborative intentions and goals of other countries.

NSF REPORT, DIRECTORATE OF MATHEMATICAL & PHYSICAL SCIENCES (MPS), Anne L. Kinney, Assistant Director, MPS, NSF

Kinney provided a high-level discussion of MPS, scientists telling stories of science, and NSF's sexual harassment policy. MPS is the largest and broadest Directorate in NSF supporting 64% of mathematics, 45% of physical sciences, and 28,400 people, 53% of which are students. MPS invests in 18 facilities and is involved in five of the 10 Big Ideas. NSF is moving towards the second generation of Big Ideas and is reaching out to the broader public.

NSF funding history has remained flat since 2004. The FY19 PBR for NSF is $7.47B and $1.345B for MPS (1.3% below FY17). MPS will emphasize the Big Ideas Quantum Leap and Windows on the Universe and join Harnessing the Data Revolution, Mid-Scale, and Rules of Life. MPS has strategic investments in fundamental research, facilities, workforce, partnerships, and long-term programs. Kinney closed stating the imperative that agencies learn to work together and understand different cultures that exist, and a worry that the funding profile for an average annualized award size is $139,127 (FY17).

NSF REPORT: DIVISION OF PHYSICS (PHY), Denise Caldwell, Director PHY, NSF

Caldwell noted the Laser Interferometer Gravitational-Wave Observatory (LIGO) accomplishments in 2017. Particle physics at NSF is one of a number of sub-areas of physics. The four facilities in PHY include LIGO, National Superconducting Cyclotron Laboratory (NSCL), ATLAS and CMS Detectors at LHC, and IceCube. The Center for the Physics of Biological Function was established in 2017. The Kavli Institute for Theoretical Physics will be funded through the Integrative Activities programs, and the Kavli Institute for Cosmological Physics will be phased out over the next two years.

Caldwell shared information on Elementary Particle Physics, HL-LHC upgrade, Particle Astrophysics (PA) program, and Theory program. PHY will most likely institute new deadlines for proposal soliciation in the fall because of the budget delays from the recent past. Caldwell mentioned the goals of Windows on the Universe and Quantum Leap and closed by discussing NSF funding activities.

Discussion

Irwin inquired about growth trends with private foundations. **Caldwell** said more discussions are occurring. **Kinney** added that efforts in this area must be extremely well-defined, limited, and competed under NSF merit review.

Incandela asked about calls for mid-scale proposals. **Caldwell** was unsure of the form and timing of such calls.

Stubbs asked about computational implications of a Major Research Equipment and Facilities Construction (MREFC) proposal. **Caldwell** said computational needs have been discussed extensively. CERN is leading solutions to the increase in data from HL-LHC.

Cranmer asked, with regard converging research and Harnessing the Data Revolution, how NSF foresees funding data science positions that extend across several different grants. **Caldwell** mentioned that NSF developed the Computational and Data-Enabled Science and Engineering program to address some of these needs.

Jim Siegrist and Denise Caldwell presented Andy Lankford with an Award of Service from DOE and NSF. Lankford thanked DOE and NSF for the opportunity, as well as HEPAP members and subpanels. Siegrist also welcomed JoAnne Hewett as the new HEPAP Chair.

Hewett adjourned HEPAP for lunch at 12:48 p.m. and reconvened the meeting at 2:09 p.m.

REPORT OF LARGE HADRON COLLIDER SUBPANEL, Hugh Montgomery, Jefferson Lab

Montgomery shared the HEP portfolio review report of the LHC Subpanel. The charge was to assess scientific merits and impact of DOE-supported contributions to the LHC detectors ATLAS and CMS. The Subpanel met February 26-27, 2018 and March 26, 2018. The U.S. component for ATLAS is ~20% and ~30% for CMS. Montgomery presented the findings and comments from the report.

Discussion

Hewett asked about DM in the physics topics for ATLAS and recommended specifying the three science drivers referred to in the text. **Srini Rajagopalan** indicated DM is part of the first goal. **Montgomery** agreed to consider the recommendation.

Cranmer inquired if the Subpanel discussed the tracking of junior researchers. **Montgomery** said there was an explicit discussion about tracking. More than one method must be utilized due to the different career paths; the objective is to benefit society.

Lucchesi asked about a more common computing model to exploit computing resources. **Montgomery** noted for CMS the U.S. contributes a larger share due to the Tier 1center. **Lothar Bauerdick** added that CMS has to make resource choices and has to optimize those resources and deemphasize the source. **Montgomery** said the High Performance Computing (HPC) situation is unique to the U.S. because of the funding support. **Rajagopalan** noted that U.S. ATLAS contributes ~10% and plans to exploit HPCs. He added the science case motivates getting appropriate credit in terms of H4 HPCs.

Cranmer pointed out the large effort to orchestrate computing and R&D needs for ATLAS and CMS, but the report includes little about the large community project reports (https://arxiv.org/pdf/1712.06982v3.pdf). **Montgomery** agreed to add references to those efforts.

Godbole suggested there be synergies between theorists and the experiments. **Montgomery** stated that the theory subpanel discussed such synergies.

Pilat inquired as to the composition of the committee. **Montgomery** said he was involved in committee selection and felt the makeup of the committee was appropriate; he did not seek members outside of the particle physics community.

Cranmer suggested adding a line about synergies between the theoretical and experimental communities in terms of understanding the position in the broader theoretical landscape, making the results more useful and digestible to a broader audience. **Irwin** recommended changing the wording “the programs should seek synergies across the program”.

Paul Grannis asked about evidence that small collaborations of faculty members/ post-docs have been occurring in LHC. **Montgomery** mentioned that a committee member was able to do this and that the Subpanel continues to dream of such a thing.

Harvey Newman noted an omission about the barriers, limitations, and constraints of a new computing system design. **Habib** said that the Subpanel’s main concern was disruption in software and hardware and getting locked into temporary solutions.

Incandela suggested the U.S. mimic the career and mentoring efforts at CMS and CERN. **Lucchesi** noted the issue is worldwide. **Spiropulu** added that the Energy Frontier program has recently gained six women hires during the last academic year.

Hewett asked HEPAP to send changes to Montgomery by the end of the week and called for a vote on approval from HEPAP. There was unanimous acceptance.

Hewett called a break at 3:17 p.m. and the meeting reconvened at 3:40 p.m.

REPORT OF MAIN SUBPANEL FOR OPERATING EXPERIMENTS, Paul Grannis

DOE General Counsel identified two types of conflicts of interest for the purpose of discussion of this report: 1) personal membership in one or more of the 13 collaborations reviewed in the report, and 2) institutional membership in one of these collaborations. The second conflict of interest pertains to those HEPAP members who are not necessarily a member of a specific collaboration but their home institutions were. All but five HEPAP members were thus conflicted. Of the five non-conflicted HEPAP members, only four were eligible to vote on the report. The HEPAP members eligible to participate were Larbalestier, Pilat, Godbole, Lucchesi, and Incandela. Incandela as an ex officio member could not vote. The following HEPAP members (and their collaborations) had conflicts of the first type: Habib (eBoss), and Conrad and Zeller (both MicroBooNE). HEPAP members with institutional conflicts were: Conrad (MIT), Cranmer (NYU), Habib (ANL), Hewett and Irwin (both SLAC/ Stanford), Kinoshita (UCincinnati), Roser (BNL), Spiropulu (CalTech), Stubbs (Harvard), Wells (UMichigan), and Zeller (Fermilab).

The Subpanel was charged to review and evaluate experiments that have been operating for at least 2 years and are expected to receive DOE support during FY2019–2022. The Subpanel only considered DOE programs in the Intensity and Cosmic Frontiers. Evaluations were based on scientific merit and productivity, impact on P5 Science Drivers, and impact on DOE-supported contributions.

There were 13 experiments examined five in CF and 8 in IF. The Subpanel requested documents outlining science goals from each experiment. The 13 experiments were put into one of four groups: Group I was considered highest priority, Group II could have funding reduced somewhat, Group III experiments could experience reduced funding without causing much harm, and Group IV were considered less effective in advancing the P5 Science Drivers.

Discussion

Boger led the HEPAP discussion.

Incandela asked why the reactor flux anomaly is not interesting for future examination. **Grannis** said while modern data and constraints inform future experiments the anomaly is not transforming physics.

Pilat asked about the outcome of the report. **Grannis** understood it as a report created for HEP to provide guidance on where to begin cutbacks if future budgets decrease. **Crawford** added that HEP has to look closely at the research and operations budget. HEP may take some action to implement the recommendations for the lower tiers.

Lucchesi asked about the recommendation of K0 at TOkai (K0TO) to be assigned to Group IV. **Grannis** said K0TO ran into large backgrounds early in the program and it is unclear if the problems are surmountable once data is analyzed, hence the urging to step back and have a close look.

Lucchesi asked if the delay in the Micro Booster Neutrino Experiment (MicroBooNE) results, expected in the 2020s, are due to the technical problems. **Grannis** said MicroBooNE is successfully collecting data at the rate expected and 2020 will show first results and would have been in Group II if not for the technical issues.

Lucchesi noted there was no comment on data preservation and open data. **Grannis** said the Subpanel highlighted it for Main INjector ExpeRiment for v-A (MINERvA) where data must be maintained to evolve models of neutrino cross-sections in Monte Carlo simulations. SPS Heavy Ion and Neutrino Experiment (NA61/SHINE) is similar to MINERvA in its support of measurements of neutrino cross-sections and of neutrino production; both are needed to reduce systematic uncertainties on future experiments.

Pilat asked for clarification on the statement "while results do not directly address Science Drivers, they strongly support them". **Grannis** stated that P5 did not say measure cross-sections of particles that ultimately produce neutrinos, but the neutrino experiments need them.

Boger noted that Super-Kamiokande (Super-K) has two numerical designations; by itself it is Group III, whereas as part of Tokai to Kamioka (T2K) it is Group I. **Incandela** inquired about the impact of the Group III recommendation. **Grannis** indicated that it would be more palatable to reduce funding for Super-K atmospheric neutrinos and solar neutrinos than losing Super-K as a far detector for T2K.

Godbole agreed that if DOE does not support Super-K then T2K would be affected. **Grannis** gave an example, that the insertion of gadolinium salts is a different question for Super-K than T2K.

Incandela asked if investigations of the antihelium flux could benefit from a continued run of the Alpha Magnetic Spectrometer (AMS) and stated that proton fluxes are statistically limited samples. **Grannis** said that AMS is in a limited regime for antihelium detection. If the eight events observed by AMS are truly antihelium, that is significant. Statistical uncertainties are smaller than the model uncertainties. DOE spends as much on operations as on research; analysis of the data has more potential for advancing understanding than adding more data at this point.

Lucchesi asked if AMS has a plan to examine the eight events and include improvements in the cosmological model. **Grannis** said the Subpanel was unaware of a plan but did not conduct a technical review. The understanding is that the cosmological models are too far afield. In the astrophysical models it is uncertain how many things found in the detector look like antihelium.

Incandela asked about the funding amount ($4M) for the Dark Energy Survey (DES). **Grannis** clarified that the funding is for analysis and the development and continued improvement of the algorithms. $4M is the 2017 number, and operations costs for DOE will go away at the end of 2018. The impact on $4M was not taken into account.

Incandela asked how five more years of runtime will impact the statistics of the Fermi Large Area Telescope (Fermi/LAT). **Grannis** said five more years would add another 1/3 to the full data set, increasing the statistical power a little. The judgement was that the cost/benefit was unbalanced.

Julie McEnery, Fermi/LAT project scientist, emphasized that the summary table is showing FY17 funding numbers. The Fermi/LAT request is <$1M (1.5 full-time equivalent (FTE)) because most operations have moved away from DOE institutions. The remaining DOE lab expertise is completely essential; it is important to be aware that if the investment of 1.5FTEs goes away it is likely the end of the mission as a whole. It is important to recognize that a small amount of investment is leveraging significant contributions from other agencies. She added that the summary table does not show that Fermi/LAT has done everything possible to reduce costs

to DOE. While the summary table is accurate based on 2017 numbers it does not paint an accurate picture versus cost. **Grannis** asked McEnergy to send her comments in an email.

Natalie Roe, LBNL, stated she had a conflict with Daya Bay. While MicroBooNE has experienced technical difficulties, it is better to build those technologies on a smaller scale than DUNE. The constraints on sterile neutrinos coming from Daya Bay, in combination with Prospect, are similar to the constraints from the short baseline neutrino program. Both MicroBooNE and Daya Bay are growing the next generation of neutrino physicists which will be needed for the $2B investment in DUNE. **Grannis** reiterated that the Subpanel was asked to identify experiments that were going to add relatively less knowledge than others. Daya Bay is close to their ultimate statistical reach and it will become less expensive going forward.

Harvey Newman sought clarification on the AMS science case and path forward proposed in the report. **Grannis** explained that while the situation for data is superb, statistically it will not improve much on either the positron or the heavy antinuclei results. The primary objective is to obtain confirmation with the models; improvements will come primarily from better modeling.

Boger presented two choices, the four non-conflicted HEPAP members vote and the report becomes a HEPAP report to DOE HEP, or the report can simply be passed along to DOE HEP without comment. HEPAP members chose to vote. A unanimous decision (of four voting HEPAP members) was reached to adopt the report.

Hewett adjourned the HEPAP meeting for the day at 4:59 p.m.

TUESDAY, MAY 15, 2018

HEPAP was convened at 8:33 a.m. ET on Tuesday, May 15, by Chair **JoAnne Hewett.**

DOE Office of Advanced Scientific Computing, Barb Helland, DOE, ASCR

Helland discussed computing in the future and focused on exascale. Power limits are driving change. The 2015 National Strategic Computing Initiative (NSCI) is still in effect today. The Exascale Computing Initiative (ECI) is funded from SC and National Nuclear Security Administration (NNSA). The Exascale Computing Project (ECP) has three focus areas: application development, software technology, and hardware & integration (HI). All SC facilities have Performance Evaluation and Measurement Plan (PEMP) goals and a facility engagement plan with ECP. Path Forward initiative is a cost-share investment with vendors. DOE is contributing $258M and vendors share ≤ 40% of the total project costs.

ANL, LLNL, and ORNL are trying to move to solid-state archival storage. Helland mentioned two workshops on Scientific Machine Learning (SciML) and Extreme Heterogeneity. ASCR's quantum efforts are focused on algorithms, applications, and testbeds.

Discussion

Stubbs asked about curation and distribution of data sets post experiments and without operations funding. **Helland** recognized this is a large problem that SC needs to address.

Cranmer suggested developing a system allowing restricted querying of data; something along the lines of Singularity and Docker. **Helland** stated querying is occurring at Advanced Light Source (ALS), NERSC, and ANL; X-ray free-electron laser (XFEL) includes singularities.

Spiropulu asked if there is an interface between HEP and the exascale ecosystem. **Helland** shared that the exascale project working with GEON has started talks in this area.

Helland explained that the ESnet upgrade design review was just completed. ESnet is moving from a static network to a dynamic network. ESnet now has the dark fiber needed for bandwidth and are working with vendors on the application programming interface (API).

COSMIC VISIONS DARK ENERGY REPORT, Katrin Heitmann & Josh Frieman

Heitmann began the presentation by telephone but due to technical difficulties Frieman presented the information to HEPAP. The charge was to look at projects beyond LSST and DESI, determine what can be done to enhance the science outcome for LSST and DESI, develop a near-term small scale project portfolio, and gather community input.

Frieman provided an overview of the process and roadmaps. Two roadmap concepts were 21cm and "Southern" Spectroscopic. Three small-scale ideas were New Technology Development for the Future, New Observational Windows to Enhance LSST and DESI, and Theory, Analysis, and Computing. Frieman shared the motivation and science drivers for the three small-scale ideas. The committee believed that support of the three small-scale components will have a strong impact on dark energy science and that these efforts are extremely timely.

Discussion

Irwin noted advances in sensor technology into the infrared region provide a higher Z but not breakthrough technology. He asked if that is because new sensor capabilities are needed, sensors are just not advancing, or a need for new blue-sky ideas. **Frieman** said detecting and measuring shapes of galaxies was needed. Beyond infrared is a third spatial dimension to get actual red shifts. A different technology, including spectroscopy, is needed to get all the information from galaxies. Charge Coupled Device (CCD) detectors have diminishing marginal gains when quantum efficiencies get close to 100% and Microwave Kinetic Inductance Detectors (MKIDs) are in the early stages of development. Sensor technology is science-driven and the R&D focus is on getting to 3D maps.

Stubbs pointed out that MKID systems do not have enough energy resolution. Getting an r of a few thousand at a 1¢ per pixel with a quantum efficiency of 90% will be transformational.

Natalie Roe stated that the fully completed CCD extended the quantum efficiency ~300nm from 700nm to 1 micron. The germanium CCDs will make another leap from 1 micron to 1.4 micron, doubling the volume of the reachable universe and deeper spectroscopy, a nice compliment to LSST and not a trivial matter. CCDs are a much better technology than others.

Procario noted work on Color Magnitude Diagram (CMD) with microwave. He asked if there is benefit to going in a new area. A radio astronomy community exists and CMD brings something to the table.

Trodden strongly supports integrating theory into the technology. He stated that people with real particle physics skills are needed. A program dedicated to theory would go a long way and would set the tone for research in this area.

A break was called at 10:22 a.m. and reconvened at 11:01 a.m.

COMMUNITY COMMUNICATIONS ACTIVITIES, Joseph Zennamo

Zennamo shared information about the Annual DC Trip which has occurred for 35 years. The 2018 trip included 54 attendees (called Trippers) with special attention to diversity and early career scientists. A new tool, WHIPS, was used for logistical support and was considered one of the keys to a successful trip. The newest community supported material is "How particle physics

builds STEM leaders" focusing on the innovation economy. Zennamo mentioned other communication avenues. The team is looking at the best metrics of success to provide quantitative feedback and wish to continue fostering an atmosphere of community-wide communication.

Discussion

Wells asked for clarification on the statement "the status of research funding". **Zennamo** said in past budgets research has been shrinking. A consistent and cohesive message was crafted about budget cuts, value lost, and research funding.

Boger asked about people the group talked to. **Zennamo** said mostly staffers, some science staffers, but rarely with the Congressperson.

Siegrist complimented the communications team. Stakeholders respond well to anecdotes about particle physicists who have gone into industry. Congressional visits are about people; steadily improving the logistical aspect and taking it seriously benefits SC.

Hewett also thanked Zennamo on the DC trip efforts stating here awareness of the amount of work involved in the DC visits, it really does pay off.

PUBLIC COMMENT PERIOD

No comments.

HEP BASIC RESEARCH NEED (BRN) WORKSHOPS AND TECHNOLOGY ROADMAPS, Glen Crawford, DOE

Crawford discussed the COV recommendation on optimization and covered two of the five steps HEP has taken to optimize program plans and budgets: BRNs and Accelerator Technology Roadmaps. Crawford presented information on the workshops on Laser Technology for Accelerators and Advanced Accelerator Development and roadmaps on Beam-driven Plasma Wakefield Roadmap and Laser-Driven Plasma Wakefield, and the U.S. Magnet Development Program plan. Two HEP BRN workshops, one focused on small dark matter experiments, are planned for late summer 2018 and a third is being considered. Crawford concluded by touching on diversity and inclusion, PAMS, communications tools, staffing changes, and the next P5.

Discussion

Habib asked about the context for BRNs and where dark energy fits. **Crawford** stated that the BRN will help HEP consider areas where more community input is needed and identify new initiatives or calls for proposal in a given area, such as dark energy.

Conrad asked how the wider community will be involved in the dark matter focused BRN and if participation is limited to DOE-funded individuals. **Crawford** replied the Chairs are prominent in the DM community. The focus is bringing in the right people, covering what is necessary, and being inclusive.

Roser asked if the BRN reports will be approved by HEPAP. **Crawford** noted the BRN reports are not HEPAP reports.

HEPAP DISCUSSION AND FUTURE TOPICS

Hewett introduced the HEPAP discussion items, HEPAP's role, the Portfolio Review Process, items for future HEPAP meetings, and reminded everyone the discuss is on the process.

Larbelestier said the purpose of soliciting a report and receiving feedback from HEPAP was not done. **Crawford** was concerned that the committee did not have technical reports available to them. **Godbole** stated that if the fate of experiments was being decided the process was inadequate. **Trodden** was not comfortable that there should be a HEPAP vote.

Stubbs thought the idea of looking at value proposition across SC was healthy. HEPAP must find a way to declare and manage conflicts and be transparent, but allowing people to draw upon their expertise is essential to the process. **Incandela** suggested noting COI's alongside comments and giving the experiments an opportunity to respond to the comments. **Habib** added that a process is needed where HEPAP members can declare a conflict but still make comments.

Cranmer asked if points raised during the discussion were going to be revisited. **Hewett** stated that only factual comments from the audience will be allowed.

Irwin said it is critical to have advanced information on the rules of the conflicts. **Hewett** asked DOE what steps can be taken since HEPAP does not feel there was appropriate validation and approval given the process. **Crawford** explained two scenarios where SC comments and lays out their intentions on the website, or HEP holds a phone call with HEPAP prior to the report being posted to the website. **Siegrist** added that the HEPAP Chair can write a letter to Binkley about decisions from General Counsel.

Wells reminded HEPAP of the unprecedented budget cuts proposed. DOE officials and experts in the field discussed the experiments with insight and passion, with respect and understanding. The categories in no way reflect negatively on the experiments. Addressing complaints and difficulties and making improvements is a healthy process.

Saul Gonzalez commented that for the last P5 conflicts were managed through waivers provided by NSF lawyers. **Siegrist** noted that the P5 report has an appendix identifying conflicts and recusals from particular recommendations. **Lankford** added that the P5 report includes how the discussion was handled in HEPAP. **Hewett** expressed desire for a statement accompanying the report and asked if such a statement required a HEPAP vote. **Crawford** explained the decision was up to Hewett as Chair. **Hewett** offered to draft the letter.

Hewett asked for any topics HEPAP would like to see next time; she suggested communication strategies, technology transfer, economic benefit, and P5 science drivers especially with small experiments. **Roser** suggested office-wide research items, QIS and how it folds into HEPAP's area of discussion. **Lali Chatterjee** stated she can present SC's progress on QIS and small experiments. **Habib** asked for an update on computing and experiments generally.

Hewett adjourned the meeting at 12:32 p.m. ET.

Respectfully Submitted,
T. Reneau Conner, PhD, PMP, AHIP
Oak Ridge Institute for Science and Education
June 13, 2018

Signed by JoAnne Hewett, Chair of the High Energy Physics Advisory Panel.

(insert electronic signature here), (date)