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

PUBLIC MEETING MINUTES

Gaithersburg Marriott Washingtonian
9751 Washingtonian Boulevard
Gaithersburg, Maryland 20878
November 29-30, 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 on November 29-30, 2018, at the Gaithersburg Marriott Washingtonian Center, Gaithersburg, MD, by Chair JoAnne Hewett. 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	Joseph Incandela	Christopher Stubbs
Janet Conrad	Kent Irwin	Michael Syphers
Kyle Cranmer	Kay Kinoshita	Mark Trodden
Rohini Godbole (Remote)	Donatella Lucchesi	James Wells
Jordan Goodman	Thomas Roser	Geralyn Zeller
Salman Habib	Maria Spiropulu	

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

Others present for all or part of the meeting:

Mitch Ambrose, American Institute of Physics
David Asner, Brookhaven National Laboratory (BNL)
Lothar Bauerdick, Fermi National Accelerator Laboratory (Fermilab)
Frazier Benya, National Academies of Sciences, Engineering, and Medicine (NASEM)
Robert Blair, Argonne National Laboratory (ANL)
Greg Bock, Fermilab
Tim Bolton, Kansas State University
Karen Byrum, DOE
C. Denise Caldwell, NSF
Gianpaolo Carosi, Lawrence Livermore National Laboratory (LLNL)
Marta Cehelsky, Sandia National Laboratory (SNL)
Lali Chatterjee, DOE
Adrian Cho, American Association for the Advancement of Science (AAAS)
Eric Colby, DOE
T. Reneau Conner, Oak Ridge Institute for Science and Education (ORISE)
Michael Cooke, DOE
Jean Cottam, NSF
Claire Cramer, DOE
Glen Crawford, DOE
Alex Cronin, NSF
Patricia Crumley, DOE
Keith Dienes, NSF
Bruce Dunham, SLAC
James Fast, Pacific Northwest National Laboratory (PNNL)
Maurice Garcia-Sciveres, Lawrence Berkeley National Laboratory (LBNL)
John Gillaspy, NSF
Sunil Golwala, California Institute of Technology (CalTech)
Saul Gonzalez, NSF
Howard Gordon, BNL
Paul Grannis, Stonybrook University
Supratik Guha, ANL
Rajan Gupta, Los Alamos National Laboratory
David Jaffe, BNL
Ben Kallen, Lewis-Burke
Lewis Keller, SLAC
William Kilgore, DOE
Rocky Kolb, University of Chicago
Richard Kriske, University of Minnesota

Andrew Lankford, University of California, Irvine
Ted Lavine, DOE
L.K. Len, DOE
Thomas LeCompte, ANL
Sonia Létant, LLNL
Eric Linder, DOE
David Lissauer, BNL
Ken Markin, DOE
Helmut Marsiske, DOE
Yannick Meurice, University of Iowa
Bogdan Mihaila, NSF
Lindsay Milliken, Lewis-Burke
Donna Nevels, ORISE
Harvey Newman, CalTech
Allena Opper, NSF
Abid Patwa, DOE
Kelly Perry, ORNL
Leo Piiolonen, Virginia Tech
Michael Procario, DOE
Claudette Rosado-Reges, DOE
Rob Roser, Fermilab
Martha Rubenstein, Universities Research Association
Randal Ruchti, NSF
Steve Schnetzer, Rutgers University
Andy Schwartz, DOE
Kate Scholberg, Duke University
James Sowinski, Indiana University
Anthony Spadafora, LBNL
Paul Stankus, Oak Ridge National Laboratory (ORNL)
Alan Stone, DOE
Bruce Strauss, DOE
Jan Strube, PNNL
Ceren Susut, DOE
Dave Sutter, University of Maryland
Jacob Taylor, Office of Science and Technology Policy (OSTP)
William Thomas, American Institute of Physics
Patricia Vahle, College of William & Mary
Rick Von Kosten, Indiana University
Bruce Warford, ORISE
Tristram West, DOE
Ashlee Wilkins, AAS
Liang Yang, University of Illinois
Lynn Wood, PNNL

THURSDAY, NOVEMBER 29, 2018

INTRODUCTION

JoAnne Hewett, Chair, called the meeting to order at 8:48 a.m. Eastern Time (ET) and welcomed attendees.

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

Siegrist discussed the HEP budget, provided science highlights, discussed facilities improvements, mentioned fostering the future and Early Career Awards (ECA), and emphasized the seriousness of sexual harassment. The FY19 HEP enacted budget was $380M, including a $21M increase to research.

Science highlights covered the Higgs to bb observation, Precision Oscillation and Spectrum Experiment (PROSPECT), Dark Energy Survey, Muon q-2 prediction, and Scientific Discovery through Advanced Computing (SciDAC), and HEP data analytics on high performance computers (HPC). DOE issued a new requirement to fully fund facilities' Accelerator Improvement Projects (AIP) <$5M. AIPs discussed included Berkeley Lab Laser Accelerator (BELLA), Facility for Advanced Accelerator Experimental Tests-II (FACET-II), Neutrinos at the Main Injector (NuMI) accelerator, 8 GeV booster accelerator, and Fermilab Utility Corridor.

The Fermilab Integrated Engineering Research Center (IERC) will support future accelerator operations. The 'Stage-4' ground-based cosmic microwave background (CMB-S4) experiment will pursue CD-0 in FY19. While awaiting the Japanese decision on the International Linear Collider (ILC) and the European Strategy for Particle Physics (European Strategy) update in 2020 on circular colliders, DOE's near-term priorities support Large Hadron Collider (LHC), and research and development (R&D) for high luminosity (HL) LHC. Despite a 50% increase for National Energy Research Scientific Computing Center (NERSC) requests from the HEP community, much of the HEP code is not ready for exascale computing. The Center for Computational Excellence will work with HEP and Advanced Scientific Computing Research (ASCR) to determine the needs HEP codes require for exascale.

In FY18, there were seven university and seven lab ECA's. The 2016 Committee of Visitors (COV) recommended HEP develop a plan to increase diversity in HEP programs. HEP is working with SC management on strategies to increase diversity; the 2015 Government Accounting Office's report on Women in STEM Research and the 2016 COV recommended collecting demographic data. The community was encouraged to provide demographic data in Portfolio Analysis and Management System (PAMS).

Sexual harassment is a serious issue. SC and HEP currently refer to the American Physical Society's (APS) Code of Conduct. HEP expects scientists to behave in a professional manner and SC is working on an official statement. Siegrist closed by sharing staffing changes and potential federal positions.

Discussion

Hewett inquired about an end date for negotiations with Japan in relation to defining success. **Siegrist** said the timeline is likely an early topic of discussion.

Cranmer requested the ITER deadline and inquired about the U.S. strategy. **Siegrist** explained the deadlines shifted out, but there is no information on the U.S. strategy on ITER.

Lucchesi asked about the impact if Japan stops the ILC. **Siegrist** speculated that such a decision would have an effect on Europe's Strategic Plan for Particle Physics.

DOE REPORT: Office of HEP, Glen Crawford, Associate Director, DOE SC HEP

Crawford discussed HEP Review, Reports, and Funding Opportunity Announcements (FOA). Outcomes of comparative reviews showed a smaller number of proposals and Principal Investigators (PI) in FY18. Letters containing DOE guidance, portfolio review findings, and sunset dates were sent to Tier I-IV experiments. Crawford focused on Tier III (Super-K, Daya Bay, Fermi LAT: The Fermi Large Area Telescope (LAT), and Booster Neutrino Experiment-Micro Scale (MicroBooNE)) and Tier IV (K0 at TOkai (K0TO), Alpha Magnetic Spectrometer (AMS)) experiments.

Three Lab comparative reviews were completed in FY18; HEP Theory released their report in November 2018, General Accelerator R&D's (GARD) report will be completed in early December 2018, and the Intensity Frontier report will be available in January 2019. FOA's included the HEP FY19 Comparative reviews, the US-Japan joint call, and a new Ozaki Exchange Program for students. Fourteen ECA's are anticipated for FY19, Accelerator Stewardship and Traineeship FOA's are planned for 2019, and there are possible future FOA's in Dark Matter (DM) Science.

Crawford highlighted the usparticlephysics.org content and materials, and encouraged the HEP community to share science highlights from their university webpages or create short articles for DOE and White House summaries.

Discussion

Conrad asked if the U.S.-Japan program requires a PI to have a DOE grant or research that is aligns with an existing DOE program. **Crawford** explained that an existing DOE grant is unnecessary. The key is to have a U.S. group and a Japanese group doing research or R&D together that broadly advances high energy physics.

Roser asked how closely related the proposal has to be to HEP activities. **Crawford** said the focus is to support a broad spectrum of accelerator technologies as stewards of that portfolio.

DOE REPORT: Office of HEP, Budget Planning, Allen Stone, DOE SC HEP

Stone provided a history of the budget process through FY19, lab funding, opportunities and modernization, workforce development, and new R&D initiatives. The current budget process began with the Budgeting and Accounting Act of 1921, which was reorganized in 1933. Nixon formed the Office of Management and Budget (OMB) in 1970. A continuing resolution (CR) impedes the start of new projects, impacts the ramp up of anything less than CD-2, and effects future planning. The Bipartisan Budget Act of 2018 includes a budget Resolution for FY18 and FY19. The FY19 budget has been allocated in three minibus bills passed September 21, September 28, and a third yet to be completed. The first minibus funded DOE; the current CR will effect NSF and National Aeronautics and Space Administration (NASA). $338.4M (34.5%) of the FY19 HEP budget is controlled by language in the bill, and $641M (65.5%) is allocated for research and operations. The White House Executive Order M-18-22 outlined the FY20 R&D Priorities, five of which overlap with HEP areas.

Stone highlighted facilities modernization and improvement projects including the Kautz Road Substation (KRSS) Radial Feed, Fermilab, and the SURF Infrastructure. Stone is in discussions with ORISE to maintain a database concerning the career tracks of HEP-supported PhDs. Stone shared early science results from projects, new R&D initiatives for FY21+, and closed by stating that the federal budget is complex, but there is broad support for HEP's vision, and community support around the Particle Physics Project Prioritization Panel (P5) strategy.

Discussion

Conrad suggested that the number of ECA's be reflective of the applicants' affiliation, whether in labs or universities. **Stone** indicated there is a higher rate of application from labs in the Intensity Frontier and the Energy Frontier, and more university applications in Theory and the Cosmic Frontier. However, many potential applicants choose not to apply.

Wells asked about a threshold level when new money must be requested. **Stone** indicated the threshold number is a grey area. In the aggregate anything with a total cost of >$5M should be put into the budget request, but the total project cost can be covered by adjustments and market fluctuations. **Siegrist** added that there is an increased interest in infrastructure by the new administration and HEP is discussing this with HEPAP because of the Sanford Underground Research Facility (SURF).

Cranmer encouraged infrastructure support for InSPIRE, the High Energy Physics information system. **Stone** explained that InSPIRE at Fermilab is supported by indirect funding and SLAC supports it from the research line. **Cranmer** added that at SLAC the support has been

reduced to almost zero, and discussions with Dark Energy Spectroscopic Instrument (DESI) and CERN personnel indicate there is great concern.

Trodden raised a point about presentation of numbers stating that in a previous HEPAP meeting there was much discussion about separating out the theory numbers from computation and other things. **Stone** referenced the background slides for that detail.

Godbole asked about the distribution of funding between the Frontiers. **Stone** said the distribution is not straightforward because the projects overlap Frontiers.

Hewett called for a break at 11:22 a.m. The meeting was reconvened at 11:34 a.m.

NSF REPORT, DIRECTORATE OF MATHEMATICAL & PHYSICAL SCIENCES (MPS), C. Denise Caldwell, Division of Physics (PHY) Director, NSF

Caldwell shared awards won by MPS PIs, discussed the FY19 budget, underscored the NSF Big Ideas, and emphasized the NSF policy on harassment. NSF is awaiting its FY19 appropriation from Congress and is operating on a CR until December 7, 2018. MPS's FY19 budget is 1.3% below FY17.

Caldwell covered four of NSF's 10 Big Ideas: Windows on the Universe and Quantum Leap (lead by the MPS Directorate); Harnessing the Data Revolution (lead by the Directorate for Computer & Information Science & Engineering (CISE)); and Midscale in PHY. 36% of proposals in PHY are funded across other areas within NSF. There are two PHY Midscale opportunities in Fall 2018 ($6M-$20M and $20M-$70M).

NSF has developed a new set of policies to address sexual harassment. These are found in the Terms and Conditions of the award information. Awardee organizations must notify NSF if they have a finding or a determination that an NSF-funded PI or co-PI committed harassment. Caldwell thanked Hewett for her presentation to the Physical Science Study Committee (PSSC) on behalf of the community and the work that went into P5.

Discussion

Stubbs suggested that the language in the policy be modified to include "awardee" since graduate students at some universities are not PIs.

NSF REPORT: DIVISION OF PHYSICS, Saul Gonzalez, Program Director, PHY, NSF

Gonzalez explained details of the PHY Division showcasing the Elementary Particles Program (EPP), Particle Astrophysics (PA), and Theory (THY) programs and what they support. FY19 opportunities and solicitations discussed included Investigator-Initiated Research Project (PHY) Solicitation (NSF 18-564), Faculty Early Career Development Program (CAREER, NSF-17-537), NSF Graduate Research Fellowship Program (GRFP, NSF 18-573), Alliances for Graduate Education and the Professoriate (AGEP, NSF 16-522), and Non-Academic Research Internships for Graduate Students (INTERN, NSF 18-102).

Major Research Infrastructure (MRI) projects range from $0-$4M with two tracks, Track 1 for design and Track 2 for implementation. Midscale Research Infrastructure (Midscale RI) fills in the gap between MRI top-level funding of $4M to Major Research Equipment and Facilities Construction (MREFC) beginning amount of $70M. The HL-LHC upgrades to A Toroidal LHC ApparatuS (ATLAS) and Compact Muon Solenoid (CMS) now have National Science Board (NSB) approval to make a request for funding and a final design review in September 2019.

Highlights shared included the Institute for Research and Innovation in Software for

High-Energy Physics (IRIS-HEP) which is jointly funded with CISE Directorate, Scalable Cyberinfrastructure for Multi Messenger Astrophysics (CiMMA) which has real deadlines for solutions, a new award for IceCube Gen2 Phase 1: an extension to IceCube to improve resolution, and additional highlights for EPP, PA, and THY.

Discussion

Stubbs asked if the Midscale RI awards include the downstream operating costs. **Gonzalez** explained the tradeoff between research and operations must be carefully evaluated by the different programs. One could argue that having the programs cover the operating costs forces the community to make tradeoffs and optimize the program as it goes forward.

Hewett adjourned HEPAP for lunch at 12:37 p.m. and reconvened the meeting at 2:04 p.m.

NATIONAL QIS INITIATIVES, Jacob Taylor, Office of Science & Technology Policy (OSTP)

Taylor provided an administration level perspective on QIS leadership, discussing the key promises of QIS, and HEP's role. As quantum mechanics and information technology merge, operating in a post-quantum world will need to be defined. Over the past 25 years, basic R&D for QIS has been occurring. The advent of a large quantum industry, especially in the last 5 years, has pushed executive level action. It is up to the U.S. government to maintain leadership in this space; if the U.S. does not invest strongly, the industrial effort will either gradually diminish or move overseas.

Quantum information theory and HEP developments complement and supplement one another. Under the Committee on Science, the National Science and Technology Council (NSTC) subcommittee on QIS was formed to coordinate the U.S. effort in QIS. The Summit on Advancing American Leadership in QIS convened stakeholders and the NSTC published the National Strategic Overview for Quantum Information Science (NSO-QIS, September 2018) that detailed seven policy recommendations: to focus on science and solve Grand Challenges, quantum-smart workforce, industry engagement, key infrastructure and support, economic growth, national security, and international collaboration.

Discussion

Wells requested an executive perspective on cooperation and sharing information; and specifically about QIS research activity in China. **Taylor** explained there is a turning point in any new area of scientific progress when the economic opportunity starts to outweigh the scientific knowledge. The conclusions from the NSO-QIS is we are not there yet. All 13 agencies involved in QIS agreed that it is crucial and critical to engage in fundamental science. Taylor speculated that China notices an opportunity to become preeminent in quantum computing, something important to national identity.

Roser discussed export controls and asked about their effect on SC's expansion of QIS. **Taylor** indicated that the effect of export controls depends on their role in protecting the nation and scientific advancements. There is a balancing act with every technology, but advancements to pure science is not an export.

Cranmer asked for the administration's thoughts about the hype around QIS. **Taylor** said the government approach is to highlight the vast scientific challenges to be overcome. The

government's role is basic R&D, driving that forward, and making certain that good information gets to investors.

Irwin pointed out the wording presented for defining quantum sensing leaves out most of the sensors being used for DM and asked if NSTC is accepting input on the wording. **Taylor** welcomed comments and suggestions.

Spentzouris asked about QIS growth and programmatic management. **Taylor** responded that coordinating across agencies requires awareness, planning, and envisioning opportunities. Program managers and individual agencies need to keep track of what is happening in areas adjacent to their community, must identify other agencies with whom to work, and see opportunities that require immediate investment and shared information at an interagency level.

QIS and HEP, Maria Spiropulu, HEPAP

Spiropulu shared examples of QIS discussions in the HEP community including the Fermilab Physics Advisory Committee Report roll out of the QIS/ HEP exploratory program; publications on Quantum Machine Learning and HEP applications on Noisy Intermediate-Scale Quantum (NISQ) Quantum Computing; and QC workshops at Fermilab and CERN. Detecting the Dark Universe examples included a colloquium at CalTech, Cosmic Visions of DM report, Skipper-CCDs (charge-coupled devices), and technology for Cosmology. Examples in Interferometry and Gravity Space-Time included Atom interferometry, theory of entanglement and gravity space-time, wormholes research, and professional organization involvement. Finally, anecdotal data on QIS/ HEP theorists suggested there is a potential workforce who can teach the next cycle of graduate students. Spiropulu stated that the career opportunities and trajectory for those trained in HEP/ QIS must be considered.

Discussion

Ping Gie, Workforce Development for Teachers and Scientists, SC, asked for advice for federal agencies to encourage, stimulate, and nurture the bigger environment and embolden universities to develop programs. **Taylor** responded that fundamentally the aim is getting students interested early and engaging with stakeholders who are already trying to do such things. For example, the Institute for Quantum Information and Matter (IQIM) worked with Steven Hawking and Hollywood stars Paul Rudd, Zoe Saldana, and Keanu Reeves.

Hewett called a break at 3:55 p.m. and reconvened the meeting at 4:25 p.m.

QuantISED, Lali Chatterjee, SC, HEP

Chatterjee mentioned NSTC, QIS in SC and HEP, QIS 2018 Awards, and QIS progress highlights. The NSTC states that the U.S. government efforts in QIS will focus on a science-first approach. SC's contributions to QIS include fundamental science and tools, equipment, and instrumentation. HEP has been involved with QIS since 2014 through workshops, roundtables, and working groups.

In 2018 HEP opened an FOA on Quantum Information Science Enabled Discovery (QuantISED) for High Energy Physics that included two tracks: pioneering pilots, and HEP-QIS consortia. There were 15 university-led and 17 lab-led awards made totaling $31M. The proposals were distributed across five categories with the majority (40%) in QIS based Quantum Sensors for HEP. Interagency partnerships include National Institute of Standards and Technology (NIST)-HEP and Department of Defense (DOD)-HEP, as well as SC Program

partnerships between HEP and Basic Energy Sciences (BES) and HEP and ASCR. Example highlights of these partnerships included quantum error correction, DM radio, gauge theories, and quantum machine learning and computation. Future FOA's are anticipated in 2019.

Discussion

Stubbs asked how program success would be determined. **Chatterjee** admitted success is not completely defined, but HEP is hoping projects will make progress in 18 months and potentially have a down select at the end of two years.

Lucchesi referred to Europe's Quantum Initiative, and asked about collaboration with HEP. **Chatterjee** thought collaboration was a possibility, and noted HEP has permission to collaborate when doing open science.

NSF AND QIS, Alex Cronin, NSF, PHY

Cronin shared the past, present, and future views of NSF's involvement in QIS with examples of programs, workshops, awards, and investments. NSF's support of QIS goes back to 1982 with an award on quantum cloning, NSF has held QIS workshops since to 1999, multiple NSF programs support QIS, and many proposals in QIS theory and experiments were funded in 2018. Highlights of QIS support included Bell's Inequality, quantum light-matter interfaces, topological fluids in synthetic lattice, many-body dynamics, and quantum simulation.

Investments in QIS through Quantum Leap focus on quantum workforce, convergence quantum research, and a robust research community. Quantum Leap is leading the next quantum revolution by conducting fundamental science, enabling breakthrough discoveries in quantum systems, and designing next generation quantum devices and technologies. NSF uses the 3-Cs approach: convergence, collaboration, and community. For FY19 and beyond NSF has released new solicitations for Quantum Materials Science, Engineering and Information (Q-AMASE-i); QIS faculty Fellows; and Transformational Advances in Quantum Systems (QII-TAQS) Incubators. National Quantum Initiative legislation may create quantum research centers in various sub-fields.

Discussion

None.

Hewett adjourned the HEPAP meeting for the day at 5:39 p.m.

FRIDAY, NOVEMBER 30, 2018

HEPAP was convened at 8:33 a.m. ET by Chair **JoAnne Hewett.**

DPF REPORT, Joseph Incandela, HEPAP

The APS Division of Particles and Fields (DPF) annual report covers standard and new DPF activities, prizes and awards, and the DPF April meeting and program committee mission. DPF is contributing to the European Strategy. A new DPF newsletter will be distributed monthly. Snowmass studies will start 2021–2022. Four prizes and six awards were given across nine opportunities; HEPAP was encouraged to nominate more applicants for these awards. Eleven new DPF fellows were announced.

The DPF Program Committee was formed in 2017; the strength of the April meeting is to provide connections to other Divisions, to foster interconnections, and provide students with opportunities to give talks at an international conference. The 2019 April meeting will introduce new types of activities including invited sessions, Glam Slam, mini symposium, and community-wide discussions. DPF called for U.S. particle physics community input for a white paper from the DPF to the European Strategy group. Editors of the report sections have been identified. The rough draft of the white paper was posted on November 16, 2018 with a deadline for comments on December 11, 2018.

Discussion

Lucchesi asked about U.S. priorities for the European Strategy with respect to China. **Incandela** noted the DPF document is not making priorities or recommendations. **Siegrist** stated that P5 set a clear direction on the priorities. P5 highlights the Japanese machine and discussion will occur upon their request. CERN is a very important partner to the U.S. and there is a lot of interest in CERNs future. China is not seen as competitor.

Siegrist said some additional topics in the DPF report for Snowmass are needed. He suggested a theory category and encouraged more emphasis on technology. **Incandela** indicated DPF was trying not to open up a new program and or appear to be launching into a new Snowmass. DPF's objective is to suggest what comes after, or is complimentary to, P5.

Goodman referred to Snowmass and asked where QIS meshes with astrophysics and other things. **Incandela** noted DPF discussed holding a quantum session or a joint session on QIS.

Wells cautioned against the DFP report overemphasizing P5 and limiting the categories; the U.S. enthusiasm for developments in other regions should be expressed. **Incandela** indicated DPF was attempting to communicate enthusiasm and welcomed comments.

Siegrist proposed that DPF consider broadening the student focus to be much deeper, similar to the Astronomy meeting. **Incandela** said DPF has been investigating other Divisions' activities and opportunities for students.

Roser asked if DPF was planning to ask Division of Physics of Beams to co-sponsor the next Snowmass. **Incandela** said that would make sense.

CLIMATE, CULTURE, AND CONSEQUENCE IN ACADEMIA, Frazier Benya, University of Minnesota and NASEM

Benya gave an overview of a consensus study, which originated in 2015. The statement of task directed the Committee to review the prevalence of sexual harassment for women in the fields of science, engineering, and medicine; to assess the research on the impact sexual harassment had on recruitment, retention, and advancement of women in these fields; and examine the policies, practices, and strategies that are most successful in addressing and preventing sexual harassment. The Committee interpreted this statement of task to include women at all levels in academia, and to focus on the sexual harassment of women.

The four overarching messages from the report involve enacting policies, identifying damages to the research enterprise, looking beyond the legal approach, and making system-wide changes. The Committee found there are three types of sexual harassment (sexual coercion, unwanted sexual attention, and gender harassment); sexual harassment is common in academic science, engineering, and medicine (50% of women in academia will experience sexual harassment); and two characteristics most associated with high rates of sexual harassment (male dominated organizations and organizational climate). The key recommendations for academic

institutions are to create diverse, inclusive, and respectful environments; to diffuse hierarchical and dependent relationships; to provide support for targets; to improve transparency and accountability; to strive for strong and diverse leadership; and to make the entire academic community responsible. Key recommendations for federal agencies are to increase support for research and evaluation on policies, procedures, and training; attend to sexual harassment at the same level as research conduct; reward and incentivize academic institutions for evidence-based programs that reduce and prevent sexual harassment; and require institutions to report violations of sexual harassment and hold both the PI and institution accountable.

Discussion

Incandela asked if the statement about transparency included accusations about sexual harassment. **Benya** referred to the Committee's suggestion to shift from identifying and removing the bad actor to focusing on public health and the environmental situation. Transparency it is not about naming names but about demonstrating to the community, broadly, that sexual harassment is being taken seriously. In that regard, even reports that are not investigated should be in an organization's annual report.

Trodden asked if there are models outside of academia on how to address sexual harassment and if something in the academic arena makes it extra challenging. **Benya** said there are factors that make dealing with retaliation more challenging in academia. Retaliation can be in the informal ways recommendations are made, the abstract way that authorship is defined, and may appear in reviews for journal articles and professional societies; all are ways in which the retaliation is specific to someone's professional success.

Cranmer noted that multiple institutions are involved in large experiments, which makes it difficult to report an incident or take action. **Benya** paralleled cross-institutional issues with field research sites. Field research sites with lower rates of sexual harassment indicated the leadership had up-front conversations that made clear the expectations of behavior and the reporting mechanisms. Sharing the expectations gives people the knowledge and when they deviate the behavior can be corrected.

Irwin asked about sexual harassment's impact on the size of the scientific workforce. **Benya** said the economic research available is not robust enough to determine that.

Goodman asked if there is a way to keep data about a person who may be serially harassing at a low level. **Benya** said some mechanisms collect data about serial perpetrators. One the Committee mentions is an online system called Callisto, which allows an individual to document their experience, name the perpetrator, and decide among three actions. The institutions using Callisto receive statements of how many reports are being made; names are excluded until a formal report is made. Most institutions have not paid attention to contra-power harassment, when a student harasses a faculty member. Multiple perpetrators, such as multiple students harassing the same faculty member, can be contributing to a hostile environment and emphasize the public health perspective suggested by the Committee.

Kay shared that the difficulties of institutional behavior in large collaborations is being addressed by diversity officers in several of the LHC experiments.

Habib requested suggestions to create a positive environment that sets expectations of behavior. **Benya** explained that if small sexist comments are made and no one says anything, it reinforces an environment that supports sexual harassment. She suggested the use of climate surveys and informal mechanisms of reporting to help with the environment. Institutions can use those reports to address an entire department rather than one individual.

Godbole asked about the Committee's membership and recommendations for professional societies. **Benya** said members were from the National Academy of Engineering (NAE) and National Academy of Medicine (NAM). No recommendations were made to professional societies, but many boards at the National Academies have been briefed and they will make recommendations to federal agencies or other societies. All three of the membership organizations are drafting codes of conduct that will address behaviors of members.

Siegrist asked if there were culture change experts on the Committee. **Benya** said no one on the panel had expertise in culture change in part because culture change, as a solution, was recognized part way through the process. The Committee laid out the key aspects that need to change but not the mechanisms to address change.

Stubbs encouraged broadening the scope to include intellectual harassment, where there are rapidly changing norms and expectations across academia and the research enterprise.

Incandela stated funding agencies have a role to ensure big experiments adopt a similar program; the onus should be on the labs and the experiments themselves. **Siegrist** noted the focus at the labs is liability to the institution and not culture change. **Benya** warned that one should not assume what has been happening is happening now. In some instances, the General Counsel's office is thinking beyond the legal compliance approach to help institutions address sexual harassment before it begins.

Lucchesi thanked Benya and the Committee, acknowledged the issues for women are the same worldwide, and stated the work is important especially for international agencies.

PUBLIC COMMENT PERIOD

None.

Hewett called a break at 10:17 a.m. and reconvened at 10:43 a.m.

AMO APPLICATIONS TO HEP, John Gillaspy, NSF

Gillaspy shared the Atomic, Molecular and Optical Physics Experiment (AMO-E) portfolio of awards and experiments from 2015-2018. He discussed AMO high energy physics related funding for intense lasers and precision measurements. Support for intense lasers included particle acceleration and vacuum pair production, and precision measurements support included optical clocks, virtual particles, fundamental symmetries and constants, and quantum detectors. Co-funded projects for DM included Global Network of Optical Magnetometers for Exotic physics (GNOME), Global Positioning System as a dark matter observatory (GPS.DM), and optically searching for new physics from DM. AMO and Nuclear Physics supported experiments have included rare nuclear reactions, neutrino mass, and electric dipole moment (EDM). Gillaspy closed with information on locating awards on the NSF website.

Discussion

Habib asked about the connection between NIST and NSF. **Gillaspy** said there is no formal agency connection, but PHY does fund projects through the Joint Quantum Institute and the AMO program has called upon NIST experts to review proposals.

Conrad asked what NSF does to ensure young scientists who bridge two fields are supported. **Gillaspy** emphasized that there is a new Program Director and PHY is particularly good at collaborating. There are funds set aside to encourage multi-disciplinary efforts and there is ongoing work behind the scenes to encourage collaboration among program directors.

Gonzalez mentioned the Big Idea on Convergent Research that requires collaboration between disciplines. **Randy Ruchti** stated that faculty might apply to the base program or to CAREER grants; there is co-review between programs.

Godbole asked about funding for interdisciplinary work. **Gillaspy** said the Office of Multi-disciplinary Activities has a significant amount of money to stimulate interdisciplinary collaboration.

BASIC RESEARCH NEED (BRN) WORKSHOP REPORT: DARK MATTER, Glen Crawford

Crawford explained BRN's are less formal than HEPAP meetings but more formal than community workshops. HEP has been charged by DOE to hold BRN's with the objectives to present DOE with a short menu of options for the future, and deliver a report with recommendations for Priority Research Directions (PRD). Outcomes should be funding opportunities, grand challenges, and research centers and hubs.

Discussion

Irwin asked how the BRN's interact with P5. **Crawford** explained the BRN's follow on the P5 recommendations of maintaining a diverse and balanced program at different scales, and a general recommendation about the DM science driver.

BASIC RESEARCH NEED WORKSHOP REPORT: DARK MATTER, Rocky Kolb, University of Chicago

The motivation for the DM BRN is based on the 2014 P5 report. DM is one of the five priority science drivers and corresponds to a P5 recommendation for HEP to have a portfolio of small projects to enable the flow of high-priority science results. The DM BRN met in October 2018 and included plenary and breakout sessions, discussions, and four panels on accelerators, direct detection, ultralight, and cross cutting. The PRD's are to create and detect DM at accelerators, detect galactic DM underground, and observe wave DM using innovative techniques. Together these cover the entire range below Proton Mass.

Discussion

Stubbs asked about the wave DM domain and galactic DM. **Kolb** said the goal is to go down to the QCD axion range.

Trodden asked about the theory motivations and target energies in DM. **Kolb** said the idea of searching for weak scale DM was extremely well motivated, but it is getting harder to see a scenario where it will be detected. Many of the theoretical models are motivated by extensions of the general freeze out idea to lower mass particles with mediators that have a mass smaller than the weak scale and couple to standard model particles with a much smaller coupling constant. In the ultra-light range, a popular idea is that the Dark Photons are produced during inflation by the same type of particle creation that produced the fluctuations in the microwave background but also related to the Schwinger Effect.

BASIC RESEARCH NEED WORKSHOP REPORT: MICROELECTRONICS, Supratik Guha, ANL

Guha explained the motivations for the microelectronics BRN were the U.S. economy, success of Moore's Law, and maintaining market growth. The BRN is being pursued now

because semiconductors and microelectronics need radically innovative new technologies because of the slowing of Moore's Law and rise of data intensive and edge computing. HPC and simulation underpin DOE missions, future computing technologies hold promise for next-generation DOE mission applications, and new directions for applied mathematics and computer science are likely to emerge that will enable new science. The charge to SC was to organize a BRN to assess the science associated with advanced microelectronics, identify critical science challenges, emphasize energy-relevant applications, examine complementary metal-oxide-semiconductor (CMOS) and beyond CMOS technologies, and focus on co-design. There were five plenary sessions and four panels on big data, co-design, power control, and cross cutting themes. The five PRD's focused on a top-down paradigm, revolutionizing memory, reimagining information flow, leveraging unexploited physical phenomena, and reinventing the electric grid. The full report will be available in February 2019.

Discussion

Cranmer asked if discussions about more energy efficient chips arose in the BRN. **Guha** said the BRN did not look at nearer terms approaches that would provide incremental benefit; rather they focused on long-term ideas for the underlying science.

Wells inquired about certifying hardware for reliability. **Guha** said there was discussion about reliability. **Habib** added that people are worried about reliability.

Siegrist thanked Guha and Kolb for their work on the BRN's. The experimental program cannot proceed without the massive investment in microelectronics now. To do the next generation of experiments HEP will have to deal with these issues.

CLOSING REMARKS, JoAnne Hewett

Hewett acknowledged the 11 HEPAP members whose tenure with HEPAP is ending in March 2019 and thanked them for their service.

Hewett adjourned the meeting at 12:54 p.m.
Respectfully Submitted,
T. Reneau Conner, PhD, PMP, AHIP
Oak Ridge Institute for Science and Education
December 14, 2018

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

(insert electronic signature here), (date)