HIGH ENERGY PHYSICS ADVISORY PANEL

to the

U.S. DEPARTMENT OF ENERGY and NATIONAL SCIENCE FOUNDATION

PUBLIC MEETING MINUTES

May 9-10, 2024

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) hybrid in-person and virtual conference was convened via Zoom on May 9-10, 2024, at the Hilton Washington DC/ Rockville Hotel/. The meeting was open to the public and conducted in accordance with Federal Advisory Committee Act (FACA) requirements. Attendees can visit http://osti.energy.gov/hep/hepap for more information about HEPAP.

Panel members present *(*Foreign representative)*:

Sally Seidel (Chair), in person
Halina Abramowicz*, remote
Luis Anchordoqui, in person
Ayana Arce, in person
Kenneth Bloom, in person
Sarah Cousineau, remote
Farah Fahim, remote
Thomas Giblin, remote
Sudhir Malik, in person
Chanda Prescod-Weinstein
Breese Quinn, remote
Mayly Sanchez, in person
Monika Schleier-Smith, remote
Philip Tanedo, in person
Jesse Thaler, in person
Natalia Toro, remote
Akira Yamamoto*, remote

Panel members absent:

Andre Luis de Gouvea (ex-officio)
Marcelle Soares-Santos

HEPAP Designated Federal Officer:

John Kogut, DOE, Office of Science (SC),
Office of High Energy Physics (HEP)

Speakers:

Jean Cottam Allen, NSF, Acting Director of the Office of Polar Programs (OPP)
Joel Butler, Fermi National Accelerator Laboratory (Fermilab)
Glen Crawford, HEP, Division Director
Gail Dodge, Old Dominion University
Saul Gonzalez, NSF, Division Director
Karsten Heeger, Yale University
Young-Kee Kim, University of Chicago
Harriet Kung, DOE SC, Acting Director
Jeremy Love, HEP
Hitoshi Murayama, University of California Berkeley
Saul Perlmutter, University of California Berkeley
Regina Rameika, DOE SC HEP, Associate Director of Science
Geraldine Richmond, DOE, Under Secretary for Science and Innovation
Natalie Roe, Lawrence Berkeley National Laboratory (LBNL)
Jim Shank, NSF, Program Director
Roger Snyder, Fermilab

Approximately 290 attendees were present for all or part of the meeting, including:

Mary Bishai, Brookhaven National Laboratory (BNL)
Kevin Black, University of Wisconsin-Madison

John Carlstrom, University of Chicago
Lance Cooley, FSU
Sarah Eno, University of Maryland
Brenna Flaugher, Fermilab
Eric Feng, HEP
Andreas Haungs, Karlsruhe Institute of Technology (KIT)
Harvey Newman, California Institute of Technology (Caltech)
Ritchie Patterson, Cornell University
Kevin Pedro, Fermilab
Michael Procario, HEP, Division Director
Fernanda Psihas, Fermilab
Sarah Ruth, Section Head, Office of Polar Programs, NSF
Vladimir Shiltsev, Fermilab

Recordings are available at the links below:

May 9, 2023: https://vimeo.com/947011451/0b5995a195?share=copy
May 10, 2023: https://vimeo.com/947027739/0d4432d3d6?share=copy

Thursday, May 9, 2024

WELCOME AND INTRODUCTION

Seidel called the meeting to order at 9:00 am Eastern Time and facilitated introductions.

INTRODUCTORY REMARKS BY THE UNDERSECRETARY FOR SCIENCE AND INNOVATION, Geraldine Richmond, DOE Under Secretary for Science and Innovation

Richmond greeted members, expressed admiration for the work done in high energy physics, and expressed appreciation for all the efforts of HEPAP members. Highlights of progress in high energy physics included publication of the Particle Physics Project Prioritization Panel (P5) report, and the first full year of data collection from the Dark Energy Spectroscopic Instrument (DESI), which resulted in the largest and most precise 3D spectroscopic map ever compiled. Construction of the Legacy Survey of Space and Time (LSST) camera has been completed at the SLAC National Accelerator Laboratory (SLAC). LSST holds two Guinness World Records for being the largest and highest resolution camera, and exemplifies the combined prowess of DOE and national laboratories. The Deep Underground Neutrino Experiment (DUNE), supported by the Long-Baseline Neutrino Facility (LBNF) at Fermilab, completed the far site excavation in South Dakota, a major milestone which involved the removal of 800,000 tons of rock.

HEPAP's efforts in answering the Facilities Construction Projects (FCP) charge was acknowledged. Appreciation was expressed for the leadership of the departing Director of SC, Asmeret Berhe, and current Acting Director Kung.

THE OFFICE OF SCIENCE AND THE PRESIDENT'S BUDGET REQUEST FOR FY25, Harriet Kung, DOE SC, Acting Director

Kung expressed appreciation for the dedication and efforts of HEPAP members. Berhe's contributions to SC and notable programmatic accomplishments were reviewed.

The creation of the new Enabling Science and Partnerships (ESP) division, and the Accelerator and Technology (AT) division, which will include Accelerator Research and Development and Production (ARDAP), was announced for the FES and HEP programs, respectively.

The fiscal year 2024 (FY24) enacted budget reflects strong support for SC among the Biden administration, Congress and the scientific community. Notable points include: a budget of $8.24B, representing an increase of $140M over FY23; $40M to initiate Microelectronics Science Research Centers (MSRCs); $45M to initiate Fusion Innovation Research Engine (FIRE) Collaboratives; a reduction of the Energy Earthshots Initiative to $20M; support for user facilities at 89% operations; and direction from Congress to fully fund research awards up to $2.5M, up from a previous cap of $1M. FY24 funding opportunity announcements (FOAs) include the Funding for Accelerated, Inclusive Research (FAIR) and Reaching a New Energy Sciences Workforce (RENEW) initiatives. A new FOA was announced, involving $160M for MSRC projects involving energy efficiency and extreme environments

The FY25 budget request totals ~$8.6B. Highlights include: $259M for artificial intelligence (AI) research, an increase of $93.1M from FY24; $94.7M for microelectronics, an increase of $22M, which includes $45M for Microelectronics Science Research Centers

(MSRCs); an $18.8M increase for U.S. Fusion Acceleration, which includes the FIRE collaboratives; $20M for research on climate change and clean energy; $115M for SC Energy Earthshots, representing a $95M increase; $120M for RENEW, a $68.6M increase; and $64M for FAIR, an increase of $31.6M. Roughly $190M is allocated for scientific facilities, $50M for upgrading core laboratory infrastructure, an increase of $31.7M; and $5M for the Laboratory Operations Apprentice Program, an increase of $2M. The Princeton Plasma Physics Laboratory (PPPL) apprenticeship program for training skilled technicians was highlighted as a model for future training at other national laboratories. $259M was requested for AI and machine learning (AI/ML), representing an increase of $93.1M. The Frontiers in Artificial Intelligence for Science, Security, and Technology (FASST) initiative was highlighted as a mechanism to both recognize the value and mitigate the threats posed by AI/ ML. The five areas of focus for AI/ML are: AI for Science, including Scientific AI Foundation Models; AI Hardware Innovation; AI for User Facilities and Advanced Instrumentation/ Technology; AI Tools for Design and Evaluation of Trustworthy AI Systems; and a diverse AI workforce.

HEPAP's efforts on the P5 report and FCP were applauded. The 2003 publication "Facilities for the Future of Science: A Twenty-Year Outlook" was highlighted, in which previous SC Director Ray Orbach ranked the International Thermonuclear Experimental Reactor (ITER) as having the highest priority among future major facilities across DOE disciplines. The publication has driven 20 years of investment in U.S. scientific excellence, including the Linear Accelerator Coherent Light Source (LCLS), Facility for Rare Isotope Beams (FRIB); Leadership Computing; Continuous Electron Beam Accelerator Facility; and the National Synchrotron Light Source II (NSLS-II).

DISCUSSION

Bloom questioned the sustainability of Diversity, Equity, and Inclusion (DEI) programs in the absence of Berhe. **Kung** explained DEI is a core value of SC. Tim Hallman was appointed to institutionalize DEI into all SC programs.

Quinn questioned whether ARDAP's movement back into HEP was due to programmatic deficiencies. **Kung** explained the movement was due to an opportunity to enhance ARDAP's potential for impact, in a manner not possible for a smaller, isolated program.

Sanchez asked whether artificial intelligence (AI) and quantum information science (QIS) are the technologies which compose the AT division, and asked when the research cap increase will be implemented. **Kung** confirmed the AT division will incorporate AI and QIS, but accelerator research and development (R&D) will be the division's focus. Implementation of the new research cap will be a slow process, involving small yearly increases, taking an estimated five years.

REPORT FROM THE DOE, Regina Rameika, DOE SC HEP, Associate Director of Science

Rameika began with highlights of HEP, including: HEP's status as the largest supporter of particle physics in the U.S; HEP's funding of over 180 institutions and 12 DOE laboratories; the 2022 Snowmass Summer Study's support of over 1,120 PhDs and 515 graduate students; operation of two user facilities with over 2,345 users; and support of both facility operations and private research.

Staff and programmatic changes related to ARDAP's movement back into HEP were

reviewed. The AT division will increase interactions with other SC programs that rely on accelerators, such as Basic Energy Sciences (BES), Nuclear Physics (NP), Fusion Energy Sciences (FES) and Advanced Scientific Computing Research (ASCAR), through the mutual use of accelerators. The division puts equal emphasis on technology and fundamental research.

Program highlights were mentioned and included: high precision Large Hadron Collider (LHC) measurements; progress in the high-luminosity upgrade projects, in collaboration with the European Organization for Nuclear Research (CERN); exciting neutrino-based project results, with detectors using liquid argon (LAr); the LSST camera's completion and media coverage, including 1,040 articles, 87 broadcast clips, and 13 news outlet segments; a promising suite of projects aimed at the direct detection of dark matter; theoretical physicist Bernhard Mistlberger's project involving precision next-to-next-to-next-to-leading order (N3LO) predictions for LHC; the Low Background Counting Facility (LBCF)/ DUNE excavation completion and subprojects' critical decision statuses; the Proton Improvement Plan-II (PIP-II) project's recovery from construction shutdown with an estimated early finish date; and major progress in the Muon-to-Electron Conversion Experiment (Mu2e). The Fermilab Accelerator Complex has returned to operation after failures of auxiliary equipment, which underscores the importance of maintenance and facility operational support.

HEP budget allocations depict large investments in projects and operations and less support to the core research program. Methods to better balance allocations are under consideration. The ongoing process for obtaining the FY24 budget was described, which takes roughly a year and involves request, markup and enactment phases. The FY24 budget includes an increase in project directives. Emphasis was placed on the importance of adhering to project timelines, as delays increase total costs. Other notable points from the FY24 budget include: an overall 2.9% increase (+$34M) to $1.2B; an $80M increase for LBNF/ DUNE and PIP-II with total funding of $255M and $125M respectively; no changes to the FAIR and RENEW initiatives; and a 5% decrease in research and operations to $824M.

Notable points of the FY2025 request include total research funding of $395.8M, representing a 7.1% decrease (-$30.4M); $381.7M for facility operations, a 9.5% increase (+$33.2M); and $453.2M for projects, a 6.6% (+$28.0M) increase. Internal planning for the FY26 budget has begun.

Recent events and reviews included: a review of DOE facilities by the Committee of Visitors (COV) on March 11-13, 2024; the HEPAP sub-panel delivery of the FCP report on March 5-6, 2024; the HEP community users organizations' efforts of advocacy with Congress and subsequent report to DOE on April 12; budget briefings in Germantown, MD during April; and work on comparative reviews, which took place in February and March 2024. Additional notable events include the signing of two cooperation agreements between DOE and the Italian Ministry of Universities and Research (MUR), addressing collaboration of the Istituto Nazionale di Fisica Nucleare of Italy (INFN) with DUNE, and INFN's collaboration in the R&D of advanced computing techniques and in QIS, including Italy's partnership with the Superconducting Quantum Materials and Systems Center (SQMS); and a statement of intent between the U.S. and CERN for collaboration in the Future Circular Collider (FCC) factory feasibility study, and an FCC electron–positron Higgs and electroweak (FCC-ee) factory.

Upcoming events and announcements include: a Division of Particles and Fields (DPF)

meeting involving HEP principal investigators (PIs) in Pittsburgh on May 13-17, 2024; a U.S.-Japan Joint Committee Meeting at the High Energy Accelerator Research Organization (KEK) on May 29-30; FCC Week in San Francisco, June 10-14; and the International Workshop on Future Linear Colliders (LCWS) in Tokyo, July 8-11. An announcement was made for an SC Office Hours series, which involves talks from each SC program, and occurs every third Tuesday of the month. Another effort in outreach includes American Association for the Advancement of Science (AAAS) Science & Technology Policy Fellow Jacqueline Smith, who joined HEP in September 2023, and is working with Allan Stone to meet with DOE laboratories and universities to solicit engagement with HEP.

DOE's response to the P5 report was summarized with the following points: P5 provides a path into the future for high energy/ particle physics; the report makes actionable recommendations; the vision is long-term and will take long-term planning; DOE agrees with Recommendation 1, to complete construction projects and support operations of ongoing experiments and research to enable maximum science; and responses to Recommendations 2, 3 and 6 have been initiated.

DISCUSSION

Thaler asked for clarification on the core research budget. **Rameika** explained the budget is an ongoing process and funds will be used as efficiently as possible.

Sanchez requested clarification on the budget's support for operations at Fermilab. **Rameika** explained the problems at Fermilab have been identified and new infrastructure and components are being built. Discussions on setting operational priorities are ongoing.

Abramowicz inquired about U.S. involvement with CERN. **Rameika** explained the cooperation is focused on FCC. While DOE and NSF were involved in drafting the agreement, the signing was done by the U.S. Office of Science and Technology Policy (OSTP).

Bloom commented that numerous investments in facilities and operations are undermined by the current research budget and asked for insight into the thought process on moving forward. **Rameika** explained several ongoing projects are not completed. Future increases to the research budget are dependent on the timely completion of projects. Increasing project timelines will increases total costs.

Newman commented on the benefits of annual trips to Washington, DC, which demonstrate solidarity within the community and enhance efforts of increasing the budget.

Quinn asked for the impact of a $60M decrease in funding on the numbers of PIs, post-doctoral researchers (post-docs) and graduate students employed. **Rameika** explained the numbers are not currently known, but may be available after funds are allocated, and will require employment reports from individual groups.

HEP FUNDING OPPORTUNITIES, Glen Crawford, HEP, Division Director

Crawford emphasized opportunities to obtain funding are announced publicly at PI meetings, office hours and webinars. Updates on recent FOAs included: Accelerator Traineeships, the graduate training program in Accelerator Science and Engineering (AS&E) has 29 student graduates and a total of 74 student participants through academic year 22/ 23 and addresses community input on future workforce challenges; Comparative Review, issued FY24 and FY25 open calls, which support research in the standard areas (Energy Frontier, Intensity

Frontier, Cosmic Frontier, HEP Theory, General Accelerator R&D (GARD), and Detector R&D), with decisions anticipated by late May to early June 2024; the Early Career Research Program, supports research in Computational HEP and HEP-QIS, in addition to the standard areas, has an anticipated decision date of late June; and the NSF Established Program to Stimulate Competitive Research (EPSCoR) now allows up to two applications per program area per institution, has experienced an increase in HEP-related proposals and is in the final decision process.

Active FOAs included: RENEW, which focuses on training at institutions underrepresented in the SC portfolio, applications due on July 23 2024 for either of two application tracks, differentiated by the award size and duration; FAIR, which focuses on building research infrastructure at institutions historically underrepresented in the SC portfolio, applications due July 16; Hardware Aware AI for HEP, which accepts both laboratory and university proposals involving Smart Detectors and AI for Operations, with applications due on July 24 2024; HEP-QIS: Quantum Information Science Enabled Discovery (QuantISED 2.0), with topics informed by community input and includes HEP-QIS Theory, Quantum Sensing, and Pathfinder Experiments with applications for either of two application tracks due July 30 2024; and MSRCs Projects, a laboratory call with a focus on either energy efficiency and/ or on extreme environments involving materials, advanced computing paradigms and architectures, integrated sensing, edge computing, or communication, with applications due July 25 2024.

DISCUSSION

Arce commended efforts to engage underrepresented communities and asked whether the funding levels were appropriate for the number of applicants. **Crawford** recalled a significant increase in the number of FAIR proposals, and a smaller increase in RENEW proposals, indicating more outreach is needed.

Malik asked for DOE expectations of grant awardees once the funding is completed. **Crawford** explained programs awarded are evaluated by student career trajectories and participant feedback to inform award renewal. Long term participation is encouraged.

Bloom asked how incoming budget cuts to research programs will affect traineeships and programs aimed at broadening participation. **Crawford** explained the answer is challenging, requires detailed balance, and the evaluation of not only research proposals but the commitment and engagements of the applying groups.

Seidel dismissed the meeting for a break at 10:36 am and resumed the meeting at 10:55 am.

REPORT FROM THE NSF, Jim Shank, NSF, Program Director

Shank presented an overview of the Division of Physics (PHY), beginning with personnel changes and an open job opportunity for the Particle Physics Program Director position. Lack of personnel is currently causing efficiency problems for the division.

The FY25 budget shows an overall increase of 2.3% over FY24. The FY24 budget had an overall decrease of 8% relative to FY23, although the impact on the physics division has not yet been assessed. Historically, budgets have been flat, and decreases are difficult to manage. The Major Research Equipment and Facilities Construction (MREFC) account experienced an FY24 increase of 60% (+ $300K). The LHC upgrade, managed by the Elementary Particle Physics

(EPP) program, is currently funded, but a portion of the funds are pending the final physics division budget. Rebaselining reviews of the high luminosity (HL)-LHC scope occurred in Spring 2023 and resulted in an estimated total cost increase of $10M for the A Toroidal LHC ApparatuS (ATLAS) and Compact Muon Solenoid (CMS) experiments. NSF has approved total project cost (TPC) increases of $83M for ATLAS and $88M for CMS. The upgrade is on schedule and funded to the end of 2028. Details of the LHC beauty (LHCb) upgrade II, scheduled for 2033-2034, are currently under discussion.

The EPP program supports particle physics at accelerators and advances in detector development, and is divided into three areas: high energy physics, precision experiments, and tools for particle physics. Detector development proposals are typically less successful than those involving LHC, which accounted for 70% of the FY23 award budget. A new proposal involved a partnership with the Division of Undergraduate Education (DUE) to incorporate ATLAS and CMS with education professionals. Theoretical HEP and Theoretical Particle Astrophysics/ Cosmology Programs support individuals, Research at Undergraduate Institutions (RUIs), and special facilities or initiatives. The program receives a large number of proposals and is experiencing increasing numbers of new PI applicants, which strain flat budgets. Experimental Particle Astrophysics Programs are divided into three areas: Underground Physics (PA-UG), IceCube Science Program (PA-IC), and Cosmic Phenomena (PA-CP).

DEI progress is a longstanding priority at NSF and DEI related programs are the primary mechanism through which new funding is allocated to PHY. Funding opportunities are currently available for: investigator-initiated research projects, with deadlines in early December; RUIs, with deadlines in early December; untenured faculty who wish to undertake a significant education/ outreach activity, through the Faculty Early Career Development Program (CAREER), with deadline of July 24 2024; pre-tenure faculty at Minority Serving Institutions (MSIs), predominantly undergraduate institutions (PUIs), and Carnegie Research 2 (R2) universities through the Launching Early-Career Academic Pathways in the Mathematical and Physical Sciences (LEAPS-MPS) program, with a deadline of January 23, 2025; supplements to existing NSF grants to fund a new graduate student of an underrepresented group through the Mathematical and Physical Sciences (MPS) Alliances for Graduate Education and the Professoriate (AGEP) Graduate Research Supplements (GRS) and PHY-GRS programs, with no application deadlines; post-docs or graduating PhDs through the MPS Ascending Postdoctoral Research Fellowships (MPS-Ascend) with a deadline October 16; MSIs seeking partnerships through the Partnerships for Research and Education in Physics (PREP) program; and programs involved with broadening participation (BP). Another solicitation, not directly related to HEP, is from the Computer and Information Science and Engineering (CISE) AI Institute, in the areas of AI for the Astronomical Sciences, AI for Discovery in Materials Research, and Strengthening AI, with a deadline of May 17 2024. Details for all funding opportunities, as well as the latest application guide, are available on the NSF website.

The Precision Measurements program involves the search for new physics beyond the standard model and encourages interdisciplinary research across the domains of physics, aimed at developing new small-scale experiments and techniques that could complement large EPP facilities.

Research infrastructure funding can be obtained by individual programs, major research

instrumentation (MRI) programs, midscale research infrastructure -1 (MSRI-1) and midscale research infrastructure -2 (MSRI-2) programs, and MREFC programs. The Research Infrastructure Guide (RIG) and an NSF webinar series are available online to provide guidance for the midscale programs. Midscale deadlines for 2025 have not been released.

DOE PERSPECTIVES ON THE P5 REPORT, Regina Rameika, DOE SC HEP, Associate Director of Science

Rameika presented a general response to major recommendations (RECs) of the P5 report, and specific comments related to the offshore Higgs Factory, DUNE Phase II, evolution of the Fermilab Complex, Advancing Science and Technology through Agile Experiments (ASTAE), generation 3 (G-3) dark matter, and the cosmic microwave background stage 4 (CMB-S4) experiment. The full texts of all six recommendations were not reviewed.

General responses were: REC 1 – DOE fully agrees, REC 1 will be used as the highest priority in the allocation of funding; REC 2 – the CMB-S4, DUNE Phase II, offshore Higgs Factory, and G-3 dark matter projects were forwarded to the Facilities sub-panel; REC 3 - DOE will implement a plan for ASTAE, but DOE will not support the scope towards the LHCb upgrade II, DOE will continue to meet its on-going commitments to Belle-II; contributions towards SuperKEKB will be considered in the context of accelerator R&D toward e^+e^- luminosity improvements, and DOE will work with the DESI Collaboration to decide a scope, schedule and cost; RECs 4 and 5 – DOE will address the RECs in on-going planning; and REC 6 - DOE does not envision a single panel to act on the REC's three topics, but will work with NSF, the DOE Laboratories and the community to form separate panels for each.

An off-shore Higgs factory was the subject of REC 6.1, with a priority of 3 out of 5. Specific comments and relevant plans included: the formation of a task force to evaluate previously addressed activities, which will run in-parallel to the next update of the European Strategy for Particle Physics; DOE will be observers, not full members, of the International Linear Collider Technology Network (ITN), and consider R&D efforts for International Linear Collider (ILC) technologies under the existing U.S.-Japan Cooperation Program; DOE will continue to support and expand participation in FCC-ee, in alignment with the 2020 DOE-CERN FCC feasibility study agreement; and the U.S. linear and circular collider communities are converging to develop detectors for a future Higgs factory, and along with the international partners, realize a future collider. Relevant actions have included: presentation of ITN observation plans to the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) in February 2024; presentation of FCC-ee plans to CERN in March 2024; signing of a statement of intent between the U.S. Government and CERN in April 2024; and jointly with NSF, the initiation of a U.S. based organization for Higgs Factory development efforts. A joint DOE/ NSF charge is in preparation to form a nationally coordinated U.S. Higgs Factory Coordination Consortium (HFCC) for developing the physics, experiment, and detector (PED) program, and a similar approach by DOE is envisioned for developing the Higgs factory accelerator program. The HFCC will be composed of a Higgs Factory Steering Committee (HFSC), a Lab Coordination Group (LCG), and members of the detector community. HFCC maps into CERN's Detector R&D (DRD) initiative. The LCG will include representation from Argonne National Laboratory (ANL), Brookhaven National Laboratory (BNL), Fermilab,

Thomas Jefferson National Accelerator Facility (JLAB), LBNL, Oak Ridge National Laboratory (ORNL), and SLAC. Partners will include the Coordinating Panel for Advanced Detectors (CPAD) in the U.S. and the DRD. The corresponding charge will be available soon.

DUNE Phase-II was referenced in REC 2, with a priority of 2 out of 5. The response consisted of the following three parts: the Accelerator Complex Evolution - Main Injector, Ramp and Target (ACE-MIRT) project is one element of the near-term evolution of the Fermilab Complex; Far Detector 3: will be planned and proposed by the DUNE collaboration, DOE, and international partners, with a priority on cryostat funding; and the More Capable Near Detector (MCND) will be planned and proposed by the DUNE collaboration, DOE, and international partners, with a priority on the Phase 1 Near Detector. Evolution of the Fermilab Complex involves a three-step path to reach the required 2.1 megawatts (MW) of power, including: Post-PIP-II improvements, ACE-MIRT Main Injector upgrade, and booster improvements to ensure reliable operation.

ASTAE was referenced in REC 3. Responses and actions included: fabrication of 1-3 Dark Matter New Initiatives (DMNI) projects; limit FOA's and reviews; limit the R&D/ design phase timeline; ensure projects are completed on time and within budget; and rely on lead laboratories to develop and manage execution plans. The five remaining DMNI projects include: the Axion Dark Matter Experiment - Extended Frequency Range (ADMX-EFR), DM-Radio, the Light Dark Matter Experiment (LDMX), the Observatory of Skipper CCDs Unveiling Recoiling Atoms (OSCURA), and Transition Edge Sensors with Sub-eV Resolution And Cryogenic Targets. (TESSERACT). TESSERACT will be hosted in France and will receive DOE funding starting in FY25. Two additional DMNI projects will be selected in FY26.

G3-Dark Matter was referenced in REC 3 with a priority of 4 out of 5. The response explained only offshore options for the Xenon, Lux-Zeplin and Darwin (XLZD) and liquid argon (ARGO) detectors will be considered.

Accelerator test facilities were referenced in REC 6.2, and the Fermilab accelerator complex was referenced in REC 6.3. Responses and actions included: conducting a review of GARD in August; conducting a comparative review of existing facilities at ANL, BNL, FNAL, LBNL and SLAC in Fall 2024; convening a panel in 2025 test facility roadmap. Plans for Fermilab accelerator complex construction included: formation of a task force no sooner than 2026, led by Fermilab, and composed of the U.S. HEP community and international partners; and demonstration of the plan's compatibility with the long-term vision of achieving a 10 tera electron Volts parton center-of-momentum (TeV pCM) collider.

CMB-S4 was referenced in REC 2 with a priority of 1 out of 5. The NSF has informed DOE of a serious issue with South Pole infrastructure which affects REC 2 and operations in general. Alternative plans are under development.

Two budget scenarios were given to P5, which included higher and lower access to funds. Currently the lower access scenario is more likely. The production of good science may spur future budget increases, but P5 RECs would require a 10% increase of the current budget which is unattainable. ASTAE funding can support one new project per year, but a budget analysis of other RECs has not been completed. Emphasis was placed on the prioritization of REC 1 in fund allocations.

NSF PERSPECTIVES ON THE P5 REPORT, Saul Gonzalez, NSF, Division Director

Gonzalez explained NSF priorities are set by community inputs such as reports and workshops. Particle Physics composes ~1% of research at the NSF and has strong links to the Astronomy Division, the Office of Polar Programs (OPP), DOE, and CERN. The Mathematical and Physical Sciences (MPS) advisory committee created a framework for project prioritization, which includes three categories: Science & Technical need and impact; Readiness to Proceed; and Alignment to Broader Missions. P5 represents an opportunity map, and the full NSF response will include the proposals and projects funded over the next 10 years. Responses are ready for a portion of the RECs; the remaining RECs will be addressed in future meetings.

NSF agrees with REC 1 and will complete ongoing projects and extract as much science as possible from existing or nearly complete facilities. REC 2a will not be implemented as CMB-S4 will not move to the design stage. NSF is prioritizing Antarctic infrastructure recapitalization projects, necessary to maintain viability and safe operations. Options for conducting CMB science without the Antarctic infrastructure are under consideration. REC 2c will be followed, with NSF participating in detector development for a future Higgs factory. REC 2e references the IceCube Generation 2 project, for which NSF has no defined timescale, and is constrained by Antarctic infrastructure. Results from the IceCube upgrade will inform future actions on IceCube Generation 2. NSF agrees with REC 3b, and the FY25 President's Budget Request includes major research instrumentation (MRI), MSRI-1, and MSRI-2 programs. In addition, REC 3c, involving the LHCb upgrade II and the Cherenkov Telescope Array (CTA) observatory, was acknowledged and is under consideration, pending community input. Regarding REC 4, NSF agrees with: 4b, increasing research in theory and other areas in the Division of Physics would be beneficial; 4d, investment opportunities for instrumentation R&D exist in QIS, precision measurements, AI, and multimodal approaches; and 4f, NSF currently supports significant efforts in cyberinfrastructure and R&D in computing through the Institute for Research and Innovation in Software for High Energy Physics (IRIS-HEP), the NSF AI Institute for Artificial Intelligence and Fundamental Interactions (IAIFI), and Accelerated AI Algorithms for Data-Driven Discovery (A3D3) Institute. Regarding REC 5, NSF agrees with: 5a, the Proposal & Award Policies & Procedures Guide (PAPPG) outlines policies that address ethics agreements for conference proposals and safe and inclusive working environments for off-site or off-campus research; 5b, broadening engagement, is supported through numerous programs, listed on the NSF website; and 5e, the dissemination of public results, is included in management and operations (M&O) proposals and the Public Access Initiative. However, REC 5d is proposal-driven, budget-driven, and competes with other priorities. Finally, NSF will work with the DOE to address REC 6a, contribution to a Higgs factory

In summary, NSF aims to exploit existing and new facilities, and is working to follow a shift in the particle physics field from collider to cosmology and astrophysics techniques. Community interest in a Higgs factory and muon collider development, opportunities for instrumentation development and cyberinfrastructure tools, and the importance of the neutrino sector was acknowledged. However budgetary and infrastructure constraints must be considered to set realistic goals.

THE SOUTH POLE INFRASTRUCTURE, Jean Cottam Allen, NSF, OPP Acting Director

Allen described the extreme environment around the South Pole Station (SPS). SPS serves as a multi-disciplinary scientific platform, with projects pertaining to atmospheric and geospace science, seismology, and glaciology, in addition to physics and astronomy. An overview of logistics hurdles included limited cargo shipments, lodging limited by ongoing construction, long distance treks for supplies, an aging Lockheed LC-130 aircraft (LC-130) fleet, and extreme weather.

SPS science projects and infrastructure repairs were deferred for three seasons due to the coronavirus disease of 2019 (COVID), resulting in a substantial backlog. Research stations currently require major elevation procedures to avoid burial by advancing snow walls, which have begun deforming steel structures. Other areas of urgent need include waste and life support systems. The SPS Master Plan describes a multi-year effort to address all required needs and recapitalization projects and will be released by NSF in the near future. Infrastructure projects will negatively impact SPS's capacity for science, but are necessary for safety, stability, and viability.

NSF will not move the CMB-S4 project into the Major Facility Design Stage. SPS priorities include the completion of current science commitments, and refurbishing critical station infrastructure, which will require several years of work. NSF is committed to CMB science and will work with the community to explore possible options for the future.

DISCUSSION

Black questioned how SPS's infrastructure problems affect ongoing projects, such as the IceCube upgrade and IceCube Generation 2. **Allen** explained the IceCube upgrade is a commitment and will be prioritized, but IceCube Generation 2 is a new project and must first move through the appropriate channels at NSF.

Malik asked about the welfare of people working at SPS. **Allen** mentioned the unusual conditions in which SPS's personnel work, and explained the people are valuable and well cared for. A medical team is onsite, and both international partners and the U.S. Air Force assist when an emergency exceeds the onsite capabilities.

Anchordoqui questioned whether the NSF Palmer Research Station was available for SPS use. **Ruth** explained only the NSF McMurdo Station had infrastructure necessary for SPS logistics.

Quinn recalled strong concern from staff of the House subcommittee regarding the state of CMB-S4 and SPS, including a negative perception of NSF and DOE's efforts, and asked for actions Congress could take to provide any assistance.

Bloom asked for clarifications on HFCC member composition, the rationale for signing a statement of intent with CERN given the lack of action on ILC, maintaining a workforce with heavy budget cuts, and whether a multi-year profile of the project and research budgets was available. **Rameika** emphasized the HFCC will be composed of leadership, national laboratory members, and members of the detector community. Additional details regarding HFCC will be presented during FCC Week. The letter of intent was signed because CERN is hosting the FCC, while the ILC does not have a host. Finally, a large portion of the budget is currently tied to projects. Once projects are completed, more investments could be made in research. The budget

needs to be reworked before profiles can be made available.

Cooley (text read by Seidel) questioned the extent to which a Chinese circular electron positron collider (CEPC) project would influence DOE's perspectives on P5. **Rameika** responded that the partnership with CERN will not be affected by the Chinese facility.

Anonymous (text read by Seidel) asked for clarification on the decision-making process involving CMB-S4. **Gonzalez** explained the decision involved internal consultations between the Astronomy Division and OPP and was agreed upon by all of NSF. The reality of the situation at SPS prevents moving forward with CMB-S4 at this time. **Sanchez** stated the community needs more clarification on the meaning of "at this time", such as an estimated timeline, specific needs, and possible requests to Congress. **Allen** explained development of the SPS Master Plan, which will inform dates of SPS repairs and readiness, is in progress, with an estimated completion date by the end of calendar year (CY) 2024. The Antarctic Infrastructure Recapitalization (AIR) program provides a line of yearly funding, with $60M approved for 2024. Additional dollars will not affect SPS's present state, new planes and additional transportation mechanisms are more important. However, there is an estimated 10-year gap between the beginning of funding and the delivery of the first plane.

Anonymous (text read by Seidel) asked for an address to early career scientists building careers on astrophysics in Antarctica, for whom the decision to put CMB-S4 on hold equates to no longer having a viable career path.

Anonymous (text read by Seidel) questioned the decision to put CMB-S4 on hold when Congress extended an offer to help meet SPS's needs.

Murayama made the following comments: DOE funding is currently less than anticipated, but P5's RECs were based on FY23 dollars; the term "offshore" should not be used when referencing the G3-Dark Matter project, as Canada is not offshore; the perceived shift in the particle physics field away from collider techniques is not intentional, but instead the result of utilizing currently available technology; and guidance is needed for mechanisms to adapt and continue the science at SPS. **Allen** emphasized the decision to pause CMB-S4 does not preclude future CMB science at SPS.

Pedro commented the U.S. House of Representatives support recapitulation and development of an LC-130 fleet, in cooperation with the U.S. Department of Defense (DOD), and questioned NSF's negative phrasing regarding SPS, when CMB-S4 would not have started until the 2030's. **Gonzalez** emphasized NSF gave a specific response, to a specific request, without any negative connotations.

Black asked whether organizational plans exist for high-energy colliders. **Rameika** acknowledged the community's interest, but formal organization around colliders will take place after completion of the Higgs Factory.

Newman commented the current discussions have highlighted the community's need for a better channel of communication. An informal study group could be used to synergize communications without overstepping members' respective bounds. **Gonzalez** agreed with the benefits of increased communication, but existing rules must be observed. Details of the study group proposal could be discussed offline.

Shiltsev (text read by Seidel) asked for plans concerning the Higgs Factory accelerator effort. **Rameika** explained plans are under development and more details should be available for

the upcoming FCC-ee and LCWS meetings.

Eno asked for details on SPS financing, including contributions from other agencies and contractor changes, and how changes in contractors impact the overall quality of maintenance. **Allen** confirmed rotations in contractors, but specific performance details are not on-hand. The DOD contributes to infrastructure through aircraft flights, a service paid for by NSF.

Carlstrom clarified the Design Stage is not an NSF commitment, but the first step of involvement for a MREFC project, which enables OPP to develop an understanding of the project's logistic needs.

Psihas commented project completions may require the remainder of the decade and asked if core research will continue to be under-supported for six or more years, and whether the resulting impact on U.S. leadership in high energy physics has been determined. **Rameika** confirmed research funding will not change unless the budget increases. Efforts, such as new initiatives, are ongoing to support research groups as long as possible.

Haungs (text read by Seidel) asked whether the impact of delaying new projects at SPS on international collaborators for IceCube Generation 2 has been evaluated. **Allen** reemphasized no timeline has been established for the IceCube Generation 2 project.

Anonymous (chat text) commented the evaluation of CMB-S4 seemingly missed an opportunity to identify creative solutions compatible with the existing logistical footprint.

Anonymous (chat text) commented the scientific community is not involved in creating the SPS Master Plan and asked for clarification on the inputs used to guide research infrastructure development.

Anonymous (chat text) asked for clarification on the ability of commercial operators to supply airplanes for Antarctica, whether additional Congressional support would facilitate commercial involvement, and whether a proposal for commercial support was communicated to Congress.

Seidel dismissed the meeting for lunch at 12:59 pm and resumed the meeting at 2:10 pm.

DOE IMPLEMENTATION OF THE OSTP "NELSON MEMO", Jeremy Love, HEP

Love discussed the history of Public Access Plans (PAPs), beginning with the 2013 OSTP Memorandum (Holdren Memo) on Increasing Access to the Results of Federally Funded Research. DOE subsequently released a 2014 PAP which included a publication model and Data Management Plan (DMP) requirements, providing guidance to reviewers and PIs. Next, OSTP released the 2022 Memorandum (Nelson Memo) which required all federal science agencies to develop new PAPs, ensuring free, immediate, and equitable access to federally funded research. The Nelson Memo has three main components: access to publications, access to the publication's underlying data, and the creation of persistent identifiers (PIDs). PIDs are defined in White House memorandums as "A digital identifier that is globally unique, persistent, machine resolvable and processable, and has an associated metadata schema." PIDs involve metadata, must be obtained by researchers, and are assigned to R&D awards and intramural research protocols.

Publications and underlying data are covered in section 3 of the memo and have a different timeline than the PIDs requirement, which is covered in section 4. DOE's timeline for implementing the Nelson Memo includes the following dates: February 21, 2023 – section 3,

Public Access Plan due to OSTP/ Office of Management and Budget (OMB); December 31, 2024 – section 3, last date to publish related policies and section 4, provide optional update to OSTP/ OMB; December 31, 2025 – section 3, last date for related policies to be effective; December 31, 2026 – section 4, last date to publish related DOE policies; and December 31, 2026 – section 4, last date for related policies to be effective. FY25 will be considered the transition year, and the full implementation of section 3 is expected in FY26.

Development of DOE's new PAP, led by SC, involved both intra- and interagency coordination, as well as engagement with the community. Publications will move from a 12-month embargo to immediate access upon acceptance. During the FY25-FY26 transition, publications will be available within 60-90 days of acceptance, and as close to the publication date as possible in FY27 and beyond. Accepted manuscripts will be submitted to DOE's Energy Link System (E-Link) earlier in the publication process and access will be provided by the DOE PAGES repository.

The PAP implementation team is composed of the DOE Office of Scientific and Technical Information (OSTI) for publications and PIDs, and SC for underlying data. Work on policy and guidance will continue throughout 2024, in coordination with other federal agencies. A Scientific and Technical Information Program (STIP) group will focus on publisher-related topics.

DMPs will become Data Management and Sharing Plans (DMSPs), contain updated principles to emphasize equity and maximize appropriate sharing, and will explore opportunities to enhance compliance monitoring and evaluation metrics. DMSP requirements include validation and replication of results, timely and equitable access, data repository selection, data management and sharing resources, and data sharing limitations.

DISCUSSION

Thaler asked whether publication archives are considered suitable PIDs. **Love** confirmed.

Bloom asked how the Nelson memo addresses experiments with large data sets and collaborations, and whether new funding was available for implementation. **Love** explained DOE understands the inability to control the data of other funding agencies and works to promote science without violating agreements. No new funding is available.

Bishai explained the Nelson Memo is contradicted by new export control rules, which hinders the sharing of data, and asked how the situation could be reconciled. **Love** explained exceptions exist to maintain the competitiveness of the U.S. and collaborators, and the memo solely governs publicly accessible scientific data.

P5 REPORT ROLLOUT, Hitoshi Murayama, UC Berkeley, and Karsten Heeger, Yale University.

Murayama shared highlights of recent media coverage of particle physics, and a letter of support from the American Physical Society (APS) for community-driven consensus reports on the effective use of federal funding. Support for the SPS through replacement of the aging LC-130 fleet was demonstrated through a letter circulating in both the House and Senate. Presentations were given to a variety of agencies and communities, including Congressional Staffers on Appropriation Committees, OSTP, funding agencies in Japan and Europe, the

Astronomy and Astrophysics Advisory Committee (AAAC), Nuclear Science Advisory Committee (NSAC), Board on Physics & Astronomy (BPA), Universities Research Association (URA), national laboratories, and international facilities. A community visit to Capitol Hill involved distribution of the P5 report and other literature to 532 of 538 Congressional Offices.

Evaluating HEP funding in a historical context shows a four-year gap between the previous P5 report and a budget increase above inflation. Similarly, the latest P5 report could positively impact core research and projects, despite current budget constraints.

COORDINATING PANEL ON SOFTWARE AND COMPUTING, Joel Butler, Fermilab

Butler described the recommendation for forming the Coordinating Panel for Software and Computing (CPSC), under DPF, by the Snowmass 2021 Computational Frontier (CompF) group. CompF identified four key areas where increased investment would significantly enhance the physics output of the U.S. high energy physics community: 1. Long-term development, maintenance, and user support of essential software; 2. Support for R&D efforts cutting across projects or discipline boundaries; 3. Support for computing professionals to enable us to use heterogeneous resources effectively; and 4. Strong investment in career development for HEP S&C researchers.

A formation task force (FTF) was created by DPF to create a founding report, as was done for CPAD, describing CPSC's charge, governance, internal organizational structure, and initial activities, including awards programs and community meetings. Significant progress has been made on the report, and the final version is due in Spring 2024. The main goal of the CPSC is to facilitate communication, to help identify issues and problems, and coordinate responses among subsections of the high energy physics computing ecosystem. The CPSC will launch studies of important issues and findings will be made available to the software and computing (S&C) community.

The first report's first draft has established CPSC governance and organization, a method for generating a new name for the panel, and initial implementation suggestions. Details on governance and organization include guidance on selecting panel members, panel member number and term length, CPSC's ability to appoint affiliates and create working groups, and the role of the DPF Executive Committee (EC). CPSC is a working name and will be replaced with the winner of a competition for the most appropriate name and acronym/ abbreviation. Implementation suggestions include: the formation of Technical Working Groups (TWGs) to study issues of concern; the appointment advisors and consultants; annual meetings and virtual town meetings; the development and support of communications tools for the S&C community; and administration of prizes and awards in collaboration with DPF.

Next steps include evaluation and acceptance of the report by EC, and distribution of the report to HEPAP and other community members for comment. Ultimately, the CPSC will help advance the role and practice of computing in high energy physics and all of particle physics.

DISCUSSION

Thaler asked for a contrast of CPAD and CPSC organization. **Butler** explained CPAD had a more inclusive group and a more specific charge.

Malik asked whether the software developers are included on publications or have other career-building opportunities, and whether there is funding to send non-core staff to conferences. **Butler** replied all mechanisms to acknowledge efforts and maintain a thriving workforce are

open to consideration. Conference organizers could be encouraged to send invitations to non-core staff.

PCAST LETTER ON ADVANCING PUBLIC ENGAGEMENT WITH THE SCIENCES, Saul Perlmutter, University of California Berkeley (presentation via Zoom)

Perlmutter explained the President's Council of Advisors on Science and Technology (PCAST) is an independent FACA, composed of industry, academia, and non-profit members. PCAST letter reports are drafted by working groups, releases are decided in public, with discussion and voting, and are not subject to any interagency review or approval process. Organizations and experts consulted for the Letter on Advancing Public Engagement with the Sciences included federal agencies and external experts.

American confidence in scientists is stressed by the changing media and information landscapes, legacies of societal inequities, and an overall decline of trust in institutions. Americans want personal values and priorities to be integral to policy development, which points to the need for public policies that are informed by both scientific understandings and community values. Meeting the need requires access to accurate and trusted scientific information and dialogue between government R&D agencies, experts, and communities. The working group identified the need to move from science communication to science engagement, with an increased focus on listening to the public.

Two major RECs from the letter were:1. Federal agencies should make science and technology communication and public engagement a core component of their strategy, by including public engagement experts in policy development and decision making; and 2. Establish a new office to support federal efforts in participatory public engagement and technology communications. Responses to the letter included: a U.S. General Services Administration (GSA) meeting with 16 federal agencies elevating the importance of public engagement; an OMB call for feedback to develop a Federal framework, guidelines, and leading practices for public participation and community engagement (PPCE) activities; and the OMB/ GSA "challenge.gov", Public Participation and Community Engagement Evidence Challenge.

In the context of HEPAP, the complexity of relative subjects, such as particle physics, may hinder enthusiasm for public engagement. However, public interest provides access to longer term thinking than is generated by legislation and election cycles. An educated public, given the chance to deliberate with the help of experts, could provide effective advocacy for the increased funding of basic research. In addition, public outreach would benefit from the sophisticated problem-solving skills developed by the high energy physics community.

DISCUSSION

Bishai commented high energy physics resonates with the public as it involves answering questions bigger than the individual, and the science diplomacy of the subject is being undersold to the public and in U.S. engagement with international efforts. **Perlmutter** agreed and commented the public could aid in the encouragement for additional international collaborations.

Seidel dismissed the meeting for a break at 3:25 pm and resumed the meeting at 4:25 pm.

ACCESS AND SECURITY AT FERMILAB, Roger Snyder, Fermilab, Site Office Manager (presentation via Zoom)

Snyder acknowledged community concerns regarding Fermilab site access and explained investigation and efforts towards remediation have been long underway. Several millions of dollars were invested in 2020 as part of a long range improvement plan. Statistics which help frame current access issues include: 1600 access requests per month; 5K-8K public visitors per year; and over 600 U.S. visitors receiving same day service, within the last 30 days.

The most impactful improvements after the COVID lockdown include: improved communications, involving dozens of stakeholder meetings and frank conversations; the opening of major buildings to badged personnel; a streamlined, single-form access request, which has reduced approval times by a factor of three; and the reopening of public spaces in Wilson Hall, involving a new access control system for non-public spaces.

Efforts to identify hazards on the campus began just before the lockdown. Hazards included sources of radiation; areas with unknown radiation levels; and beam energy in public areas. Security and safety areas currently enforced on the campus include: Public General Access Area (GAA), open to the public but requires REAL ID for site access; Business, for badged personnel and business visitors; Safety, for badged personnel with required training and hazard mitigations; Security, Property Protected Area (PPA), higher security, access limited to individuals appropriately screened and approved by line management.

Upcoming developments include: updated software for public visitors, leading to less time at the gate; Fermilab Welcome & Access Center (FWAC); new state-funded Guest Housing Facility; and a re-evaluation of village security. The systems described have resulted in notable improvements and were built upon the lessons learned from problems encountered in 2020-2022. Upcoming efforts will continue to improve the experience of all users at Fermilab.

DISCUSSION

Tanedo commented the problems at Fermilab lie in the alignment of charges and metrics of success with both the directorates of science and operations. Security implementations at Fermilab differed from those of comparable national laboratories, and users lack trust in management's operating decisions. **Snyder** explained SC metrics include safety and security as well as science. As a federally owned facility, Fermilab has different requirements, and must also consider the safety of visitors. Open communication is the key for meeting user needs, and anyone with concerns are invited to express them during an onsite visit.

Seidel mentioned the perceived difficulty in directly communicating with Snyder, and asked for methods to submit feedback other than an onsite visit. **Snyder** explained communicating with the Site Access Steering committee can be done online.

Quinn asked how the current number of public visitors compares to pre-COVID numbers and commented the government manages, not owns, Fermilab and the public are the owners. Historically, Fermilab is special among national laboratories as the place where the public could live, play and rub shoulders with scientists. The public's opportunity to visit the 15th floor of Wilson Hall and be involved at Fermilab cannot be lost, or SC will suffer. **Snyder** responded the number of visitors is comparable. Reopening the campus is a journey, and progress has been made. Wilson Hall is closed pending repairs, but strategies for its reopening, and increasing access in general are under consideration.

Bloom commented if onsite visits are desired, the difficulty in meeting with Snyder should be reduced. Fermilab needs more engagement than communication, and no other national

laboratory has suffered comparable levels of national and international reputation damage through safety and security measures implementation. An update was requested for a recent site access review by DOE SC, including whether the resulting report is publicly available, methods to track progress, and accountability. Clarification was requested on the use of the pronoun "we" during the presentation, and a graphic showing access clearance for a small percentage of U.S. citizens requiring multiple weeks. **Snyder** explained the report is not public as it contains sensitive information, and laboratory director Lia Merminga, and Snyder are accountable. The report resulted in an action plan, but current system improvements were not available at the time of the review, and the review committee may be invited back next year for reevaluation of the site. Individuals behind the pronoun "we" are the Fermilab workforce and DOE, and access delays could be caused by the daily processing limits of the workforce, errors or discrepancies on access forms, and the throughput of older computer systems.

Psihas commented security policies placed extreme limitations on the Fermilab community despite the lack of classified research or hazards comparable to other national laboratories. Justification for the expenses and workflow disruptions accumulated by ramping up, and now rolling back, security measures, at a time of reduced budgets for core research, and an assessment of the amount of taxpayer money spent was requested. **Snyder** explained budgets for safety/security and physics originate from different sources in SC. Due to a lack of flexibility in waiting for delayed returns on investments, restrictive elements were leveraged to enable facility evaluation by safety and security staff. Workflow disruptions were the result of a series of incidents and were used by lab leadership as a tool to communicate requirements and expectations. Measures were adapted, not rolled back, and use of taxpayer money is dependent on the number of visits processed by Fermilab, as it is cheaper to be closed than open.

Snyder stated the need to depart the meeting due to a lack of mobile phone battery charge.

Bishai read the text of SC's mission aloud and commented delivering scientific tools and discoveries is what advances U.S. security. A forum is needed in which the international scientific community can be involved in the interpretation and implementation of the DOE orders which place restrictions on international contributions.

Patterson identified as an experienced Fermilab user, and recalled a recent visit to the facility during which a staff scientist escort was required at all times. The escort requirement was burdensome and degraded the effectiveness of both parties.

Seidel adjourned the meeting at 5:26 pm.

Friday May 10, 2024

Seidel called the meeting to order at 9:04 am.

REPORT FROM THE DOE FACILITIES SUBPANEL, Natalie Roe, LBNL

Roe briefly reviewed the history of DOE SC facilities assessments, starting in 2003 with Ray Orbach's Facilities for the Future of Science, a second in 2013 by William Brinkman, which was not publicly released, and the current charge, issued by Asmeret Berhe, which is similar to the 2013 charge. Berhe's charge requires the identification of new or upgraded facilities, requiring a minimum investment of $100M, to best serve the community's needs in the next ten years, with discussion of each facility's potential to contribute to world-leading science in the next decade, readiness for construction, and cross-cutting interests and connections, including the

scientific interest of HEP in specific facilities under consideration by other SC programs. Potential to contribute to science should be categorized as either: (a) absolutely central; (b) important; (c) lower priority; or (d) don't know enough yet. Readiness for construction should be categorized as either: (a) ready to initiate construction; (b) significant scientific/ engineering challenges to resolve before initiating construction; or (c) mission and technical requirements not yet fully defined. The subpanel's assessments were guided by the P5 report, and the facilities considered were already down selected and rigorously ranked by the report. However, budget scenarios are less favorable than assumed by P5.

Regarding cross-cutting interests, HEP is the steward of accelerator physics for SC, which benefits the Basic Energy Sciences (BES), Nuclear Physics (NP), and Fusion Energy Sciences programs. In addition, HEP develops cutting edge detector technologies. In return, HEP relies heavily on Advanced Scientific Computing Research (ASCR) computing facilities, and are early adopters for artificial intelligence and machine learning (AI/ ML) applications, and beta testers for new computing facilities.

Facilities with a science assessment of (a) absolutely central, include: LBNF/ DUNE Phase 1, LBNF/ DUNE Phase 2 - ACE-MIRT, Far Detector 3 (FD3), and More Capable Near Detector (MCND), CMB-S4, Stage-5 Spectroscopic Experiment (Spec-S5), G3-Dark Matter, Offshore Higgs Factory, Advanced Accelerator Test Facilities Kilo Berkeley Lab Laser Accelerator (AATF – kBELLA), and the 10 TeV pCM Collider. The two remaining facilities, receiving a science assessment of (d) don't know enough yet, were Far Detector 4 (FD4) and Accelerator Complex Evolution – Booster Replacement (ACE-BR).

Facilities with a readiness for construction assessment of (a) ready to initiate construction include: LBNF/ DUNE Phase 1, LBNF/ DUNE Phase 2 - ACE-MIRT and FD3, CMB-S4, Spec-S5, and the Offshore Higgs Factory. Facilities with a readiness for construction assessment of (b) significant scientific/ engineering challenges to resolve before initiating construction include: LBNF/ DUNE Phase 2 – MCND, G3-Dark Matter, and AATF – kBELLA. Finally, facilities with a readiness for construction assessment of (c) mission and technical requirements not yet fully defined include: FD4, ACE-BR, and the 10 TeV pCM Collider.

Synergistic potential exists for the R&D done at AATF. Cost-effective kilowatt-kilohertz (kW-kHz) ultrafast laser technology is of interest to applications such as security, medicine, and industry, and supports U.S. leadership in lasers. The targeted beam parameters of kBELLA are highly desired for a next generation compact X-ray Free Electron Laser (X-FEL). ACE-BR R&D also has notable potential synergies. Synergies include: high-power superconducting radio frequency (SRF) systems and fast cycling magnets, which overlaps with fusion energy science and nuclear science; improved radio frequency (RF) power systems, higher accelerating gradients for proton linac, and H-ion stripping technology, which is relevant to nuclear science and basic energy sciences; high-intensity beam dynamics with space charge, of interest to HEP, NP, BES and common to all high-intensity machines; and a need for high-power targets which overlaps NP and FES.

In conclusion, the field of high energy physics has developed an exciting and forward looking plan with broad community support, described in the P5 report, and the facilities subpanel endorses the P5 science priorities. HEP has strong connections with other offices within SC, in addition to strong connections with NSF and the global particle physics community.

Acknowledgements were given to P5 for identifying the key facilities, subpanel members, projects for prompt responses, question and answer (Q&A) sessions and presentations, and Fermilab's hosting.

DISCUSSION

Malik noted DUNE has a Phase 1, Phase 2 and FD4, and asked if there was a Phase 3. **Roe** responded a Phase 3 was not on the list of facilities. **Sanchez** explained Phase 2 includes FD3, and FD4 is an additional detector, not a Phase 3.

Quinn asked for a contrast of the scientific assessment category "scientific goals not well defined" and the technical readiness category "mission and technical requirements not fully defined", which also references scientific goals; the meaning of the colors used on slide 17, Executive Summary; and an explanation for 10 of 12 facilities categorized as absolutely essential, including MCND, which was not selected by P5. **Roe** explained assessment of technical readiness requires knowledge of technical goals; the different color shades were used in error; and the facilities assessed were already culled from a larger list by P5, ensuring high levels of importance. MCND was rated absolutely essential to enable consideration in the most favorable budget scenarios. **Procario** added the categorizations fit with the charge's requirements. **Thaler** agreed with the categorization of MCND as absolutely essential, although it could be delayed beyond the 10-year profile of the charge.

Thaler noted the uniqueness of the CMB-S4 project and asked whether infrastructure was considered during facility assessment. **Roe** recalled site availability as a component of the charge, but no infrastructure evaluation was made for CMB-S4, due to the Parque Astronómico Atacama (PAA) site in Chile currently hosting CMB experiments. **Anchordoqui** asked for clarification on moving CMB-S4 to Chile without additional analysis. **Roe** emphasized there was no implication of moving CMB-S4.

Sanchez asked whether Spec-S5's categorization as ready for construction was intended only for the most favorable budget scenario. **Roe** explained budget scenarios were considered to compile the list of facilities for evaluation, not for individual facility assessment. **Murayama** clarified the Spec-S5 options assessed by the subpanel, differed from the options assessed by P5. It is the efforts of the subpanel which designates Spec-S5 as absolutely essential.

Thaler asked for the cost of the Argonne Wakefield Accelerator (AWA) Facility upgrade, commented on the importance of emphasizing AATF R&D synergies, and suggested the report include more details on the synergies. **Procario** responded AWA's cost is under $50M. **Roe** agreed with including more details on AATF synergies.

Arce suggested the use of color to highlight synergies and cross-cutting opportunities and asked if nuances in the language used for facility assessment was intentional. **Roe** agreed with the use of color and informed no alternate meanings were intended in the language used.

Seidel called a vote to accept the report as expressed. Modifications to the final language are possible but will not impact the report's conclusions.

The report was accepted with 11 approvals, 0 disapprovals and 0 abstentions.

REPORT FROM THE DOE FACILITIES COMMITTEE OF VISITORS, Young-Kee Kim, University of Chicago

Kim identified as Chair of the Committee of Visitors (COV), and introduced the COV's task of assessing HEP's Facilities Division operations during FY16-FY22. The assessment required comment on DOE's implementation of the long-term goals and priorities outlined by the 2014 P5 report, and identification of any additional issues not addressed by the COV but require additional consideration. While the COV typically meets every three years, an overwhelming number of projects and disruptions due to COVID prevented Facilities Division assessments after FY16. The COV is composed of 11 members, divided into Projects and Operations subgroups, and roughly equal representation from national labs and universities. HEP organizational charts, staff changes and position vacancies were reviewed.

The COV assessed the nine projects completed since FY16, and 15 currently incomplete projects. Project construction costs from FY16 to FY23 were roughly $130M per year. Recent progress includes a February 2, 2024 virtual meeting for organizational purposes, March 11-13, 2024 in-person meetings in Germantown, and a virtual meeting on April 10, 2024 to finalize results. Next steps include two additional virtual meetings in May-June, 2024 to obtain more information on Fermilab facilities operations and finalize the report.

DISCUSSION

Thaler referenced the long gap since the last COV report, asked how the cadence of meetings impacted COV members, and whether a COV assessment on the Research Division will soon occur. **Kim** commented the gap increased the COV's workload and believed a return to the standard timeline will occur. The COV prefers to assess both the Facilities and Research Divisions simultaneously, but COVID and current project scales caused the current deviation. **Procario** confirmed SC guidelines require a COV meeting every three to four years for both facilities and research, indicating a COV assessment on the Research Division is upcoming, and acknowledged the heavy workload resulting from the reporting gap. **Rameika** commented the COV process requires reassessment as HEP now has three divisions. A lesson learned from current COV efforts is the importance of showing how SC works together as a whole, and the connections between facilities and research.

Bishai suggested the COV investigate the disconnect between scientists and operational offices in the interpretation of mission needs and compliance with DOE orders. **Rameika** responded COV involvement requires thought, as national laboratories have individual site offices. **Kim** explained it may not be a task for the COV, but other mechanisms are likely possible. **Procario** explained COVs are organized by DOE Deputy Director for Science Programs (DDSP), not field operations, and a mechanism to address the matter is currently unclear.

Bloom asked for the estimated date of completion for COV's current assessment. **Kim** estimated report finalization in two months and a presentation of findings during the next HEPAP meeting.

Seidel dismissed the meeting for a break at 10:36 am and resumed the meeting at 11:07 am.

THE NUCLEAR SCIENCE ADVISORY COMMITTEE LONG RANGE PLAN, Gail Dodge, Old Dominion University

Dodge described the Nuclear Science Advisory Committee's (NSAC) process in producing long range plans (LRPs). The process begins with a charge from DOE and NSF, occurs every five to eight years, and involves community engagement such as town hall meetings organized by the Division of Nuclear Physics of the American Physical Society (DNP) and whitepapers. The LRP writing committee was composed of 62 members, which includes two international observers, divided into 11 subcommittees to address writing and budgeting tasks.

The broad nature of the nuclear science field requires the use of many tools, techniques and laboratories. Areas addressed include: quarks and gluons forming protons, neutrons, and atomic nuclei; the rich patterns observed in the structure and reactions of nuclei emerging from the interactions between neutrons and protons; nuclear processes that drive the birth, life, and death of stars; and the use of atomic nuclei to uncover physics beyond the Standard Model.

The LRP resulted in four RECs. REC 1 is the most important, and involves prioritization of investments already made in support of the nuclear science community, and requires: increasing the research budget; effective operation of national user facilities and completion of the Relativistic Heavy Ion Collider (RHIC); raising graduate researchers' compensation to match local cost of living, without contraction of the workforce; and expanding policy and resources to ensure a safe and respectful environment for everyone. An estimated $8M is required for matching nuclear science student stipends to the local cost of living, but the funds are limited by constrained research budgets.

REC 2 and REC 3 are of equal importance and involve neutrinoless double beta decay experiments - the highest priority for new experiment construction, and completion of the Electron–Ion Collider (EIC) - the highest priority for new facility constructions, respectively. REC 2 requires a U.S. led international consortium, that will undertake a neutrinoless double beta decay campaign, involving ton-scale experiments with multiple isotopes and detector technologies. Three current ton-scale experiments include the Large Enriched Germanium Experiment for Neutrinoless double beta Decay (LEGEND), the Next Enriched Xenon Observatory (nEXO) and the CUORE Upgrade with Particle Identification (CUPID).

REC 4 involves capitalization on the unique ways in which nuclear physics can advance discovery science and applications for society by investing in additional projects and new strategic opportunities. Strategic opportunities exist in: projects that lay the foundation for the discovery science of tomorrow, such as the Facility for Rare Isotope Beams 400 MeV/ u energy upgrade (FRIB400), Search for Oscillations with a Lithium-6 detector (SoLID), LHC upgrades, electric dipole moment (EDM) experiments, and ν mass measurements; detector and accelerator R&D; emerging technologies: computing and sensing; multidisciplinary centers; and nuclear data.

Nuclear science benefits to the nation through synergies with other physics fields, a trained nuclear workforce, many application in other areas including energy and healthcare, and the development of computational techniques. Efforts to foster a thriving workforce have been successful, but more can be done in the areas of financial and medical support, skill development and providing resources to establish and maintain enforceable Community Agreements, for standardizing behavior and creating welcoming environments.

Maintaining the U.S.'s world-leading position in nuclear science requires investments in people, facilities, and projects/ experiments. The community must realize the promise of a welcoming and respectful environment, by removing barriers and enabling all people to participate in the scientific enterprise.

DISCUSSION

Arce asked for clarification on the $8M figure quoted for matching graduate stipends to costs of living. **Dodge** explained the figure was the result of an informal survey. An SC goal of providing every graduate student with a $45K annual salary would require $20M. But cost of living expenses do not equate to $45K in all locations.

Bloom asked whether NSAC has tracked the completion and success of previous RECs. **Dodge** confirmed most RECs are successfully completed.

Malik mentioned the synergy between software training in high energy physics and nuclear physics.

Abramowicz mentioned synergies exist between the EIC and high energy physics but were not mentioned in the report. **Dodge** agreed the synergies could be better highlighted.

Feng asked for the q^2 of EIC, and benefits of the EIC above the H1 and ZEUS experiments at the Hadron-Electron Ring Accelerator facility (HERA). **Dodge** explained the q^2 is up to 1000, but will need more information about the parameters of H1 and Zeus to fully answer the question.

GENERAL DISCUSSION

Kim identified as the president of APS, explained leadership in the physics community have named 2025 as the International Year of Quantum Science and Technology, and the endeavor has been endorsed by a United Nations (UN) resolution. 2025 will provide many opportunities for the high energy physics community and participation in upcoming events is encouraged. The APS website will provide details on upcoming global events.

Abramowicz suggested the need for mechanisms to gauge the quality of students recruited and the current levels of interest for high energy physics programs. **Seidel** requested examples of metrics used in gauging student quality and interest. **Bishai** mentioned national laboratories have access to programs such as Science Undergraduate Laboratory Internships (SULI), which contains information on undergraduate student's grades and interests, and is managed by SC's Office of Workforce Development for Teachers and Scientists (WDTS).

Seidel adjourned the meeting at 11:45 am.

Respectfully submitted,
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