HIGH ENERGY PHYSICS ADVISORY PANEL

to the

U.S. DEPARTMENT OF ENERGY and NATIONAL SCIENCE FOUNDATION

PUBLIC MEETING MINUTES

December 5 - 6, 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 December 5 - 6, 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:

Sally Seidel (Chair), in person
Halina Abramowicz*, remote
Luis Anchordoqui, in person
Ayana Arce, remote
Kenneth Bloom, in person
Sarah Cousineau, remote
Farah Fahim, in person
Thomas Giblin, in person
Andre Luis de Gouvea (ex-officio)
Sudhir Malik, in person
Chanda Prescod-Weinstein, remote
Breese Quinn, in person
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:

Marcelle Soares-Santos

HEPAP Designated Federal Officer:

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

Speakers:

Jack Anderson, University of Chicago
Colin Bischoff, University of Cincinnati
Eric Colby, OHEP
Douglas Glenzinski, Fermi National Accelerator Laboratory (Fermilab)
Zach Goff-Eldredge, OHEP
Kranti Gunthoti, Los Alamos National Laboratory (LANL), Los Alamos Neutron Science Center (LANSCE)
Young-Kee Kim, University of Chicago
Jeremy Love, OHEP
Tobias Marriage, Johns Hopkins University
Petra Merkel, Fermilab
Lia Merminga, Fermilab
Evan Niner, Fermilab
Mark Palmer, Brookhaven National Laboratory (BNL)
Abid Patwa, OHEP
Michael Procario, OHEP
Srini Rajagopalan, BNL
Regina Rameika, OHEP
Jim Shank, National Science Foundation (NSF)
Paraskevas Sphicas, The European Organization for Nuclear Research (CERN) and The National and Kapodistrian University of Athens (NKUA)

Approximately 200 attendees were present for all or part of the meeting, including:

Mei Bai, SLAC
Mary Bishai, BNL
John Carlstrom, University of Chicago
Keith Davis, NSF
Marcel Demarteau, Oak Ridge National Laboratory (ORNL)
Dmitri Denisov, BNL
Sarah Eno, University of Maryland
Bonnie Fleming, Fermilab
Cameron Geddes, Lawrence Berkeley National Laboratory (LBNL)
Yuri Gershtein, Rutgers University
John Mester, Universities Research Association (URA)
Tor Raubenheimer, SLAC National Accelerator Laboratory (SLAC)
Patricia Vahle, College of William and Mary
Amanda Weinstein, Iowa State University
Stephen Wender, LANL, LANSCE

Recordings are available at the links below:

December 5, 2024: https://vimeo.com/1037521100/a72dcd39dc?share=copy
December 6, 2024: https://vimeo.com/1037544603/98ef7d12a9?share=copy

Thursday, December 5, 2024

WELCOME AND INTRODUCTION

Seidel called the meeting to order at 9:00 a.m. Eastern Time (ET) and facilitated introductions. Ideas for future HEPAP topics were solicited from the community. The end of tenureship for Natalia Toro and Andre Luis de Gouvea as HEPAP members was announced.

Report from DOE including Response to the International Benchmarking Panel Report, Regina Rameika

Rameika presented select program and project highlights. The Large Hadron Collider (LHC) at CERN and LHC experiments A Toroidal LHC ApparatuS (ATLAS) and the Compact Muon Solenoid (CMS), have resulted in significant scientific contributions. The High Luminosity (HL)-LHC accelerator and detector upgrades are required to keep projects on scheduled for completion by the end of the decade. The Long-Baseline Neutrino Facility (LBNF) / Deep Underground Neutrino Experiment (DUNE) has been divided into five subprojects to facilitate management, and all subprojects are on schedule. The Legacy Survey of Space and Time Camera (LSSTCam) accomplished the milestone of safe shipment to Chile, and data collection is scheduled to begin in 2024. DOE charged leadership of the Cosmic Microwave Background Stage 4 (CMB-S4) project to evaluate data collected, expand upon capabilities over the next decade, and optimize the Chile-only concept design. Overall, project planning is guided by *Exploring the Quantum Universe,* the report of the 2023 Particle Physics Project Prioritization Panel (P5), but is limited by budget constraints and government transition.

Budgets currently match the P5 report's low-funding scenario. Cuts to operations and research are required to keep projects on schedule. Points of interest from the fiscal year 2024 (FY24) OHEP budget include: an increase (+) of 2.9% (+$34M) from $1.166B in FY23 to $1.2B; congressional direction set LBNF / DUNE and the Proton Improvement Plan II (PIP-II) at $255M and $125M respectively, a combined +$80M over FY23; additional direction provided floor / ceiling limits for the Sanford Underground Research Facility (SURF), CMB-S4, the Accelerator Controls Operations Research Network (ACORN), HL-LHC upgrade projects, and LBNF / DUNE open platform communications (OPC); congressional directions held the Funding for Accelerated, Inclusive Research (FAIR) and Reaching a New Energy Sciences Workforce (RENEW) programs at FY23 levels; and funding for high energy physics (HEP) research, major items of equipment (MIE) projects, and facility / experimental operations decreased 5% from $868M in FY23 to $824M. Regarding FY24 notice of funding opportunities (NOFOs): comparative review, U.S. – Japan cooperative research, the Established Program to Stimulate Competitive Research (EPSCoR), FAIR and the Early Career Research Program (ECRP) have been completed; RENEW is awaiting announcement; and hardware-aware artificial intelligence (AI), Quantum Information Science Enabled Discovery (QuanTISED) 2.0, and microelectronics are under review. Lessons learned from FY24 will result in a SC-wide limit to the number of awards with budget periods ending between June - July and October - November to reduce project manager (PM) workloads and avoid reviews carrying over to subsequent FYs.

The FY25 President's Budget Request (PBR) for research is $395.8M (-$30.4M, -7.1% below the FY24 enacted budget) and includes: +$24M for AI / Machine Learning (ML), +$8M for RENEW and FAIR, -$4M to the concluding Accelerate Innovations in Emerging

Technologies initiative, no changes to quantum information science (QIS), microelectronics, advanced computing, and accelerator science and technology, and -$59.9M to core research, prompting a focus on high-profile topics. The PBR for facilities operations is $381.7M (+$33.2M, +9.5% above FY24) and includes: $166.9M (+$25.3M, +17.9% above FY24) for the Fermilab accelerator complex, a total of 5,180 operational hours; $17.6M (+$1.1M, +6.9% above FY24) for the SLAC Facility for Advanced Accelerator Experimental Tests II (FACET-II), a total of 3,120 operational hours; $57.3M (+$4.5M, +8.5% above FY24) for the U.S. LHC detector operations; $33M (+$2.1M, +6.7% above FY24) for the Vera C. Rubin Observatory operations; and $35M (no change from FY24) for SURF. The PBR for projects is $453.2M (+$28.0M, +6.6% above FY24) and includes: $280M (+$25M, +10% above FY24) to support LBNF / DUNE's subprojects; $10M (+$5M, +100% above FY24) for ACORN; $4.5M (no change from FY24) for CMB-S4; $33.7M (-$2M, -6% below FY24) for the ATLAS and CMS detectors; and $125M (no change from FY24) for PIP-II. Regarding FY25 NOFOs: comparative review and EPSCoR are under review; U.S. – Japan cooperative research has been deferred to FY26 due to budgetary constraints; ECRP is awaiting release; and RENEW, FAIR, AI for HEP theory and data analysis, and accelerator stewardship awards are awaiting finalization of the FY25 budget. Additional FY25 call details include changes to the NOFO template, EPSCoR's transition to implementation grants, and the absence of new QIS calls.

Despite an overall increase in the research budget, the addition of numerous SC initiatives has reduced the availability of funds for core research. In 2017, core research accounted for 93% of the total budget but accounts for only 69% in 2024. OHEP strives to maintain balance among research, facilities, operations, and project fund allocations.

FY26 brings a unique set of opportunities, challenges, and unknowns. Opportunities involve the implementation of 2023 P5 guidance during the FY26 formulation phase of the budget process; challenges include the transition to a new administration with new political appointees and science and technology (S&T) priorities, communicating 2023 P5 goals to the 119th Congress, and the expiration of the debt ceiling limit on Jan 1, 2025; and unknowns include the new administration's FY26 budget process and a possible change in support for basic research.

Michael Procario is stepping down as director of the OHEP Facilities and Project Division in March 2025. Several new working groups have been formed and include: the cosmic working group, the Fermilab accelerator group, and the neutrino group. Charges are being developed for two additional working groups: advanced technologies, and the energy frontier group.

An International Benchmarking (IB) subpanel was formed to evaluate U.S. leadership in particle physics in a global context. The subpanel's report was approved in November 2023 and contained seven key findings and recommendations. OHEP agrees with all recommendations, which are listed in full at https://usparticlephysics.org/hepap-international-benchmarking-report/. Abridged recommendations are: 1. Strengthen investments to advance particle physics, science, and society overall; 2. Maintain a comprehensive program at home and abroad; 3. Continue support for and actively seek engagement with international collaborations and partnerships; 4. Implement structures for hosting strong international collaborations; 5. Continuously develop critical technologies to maintain and grow U.S. leadership in particle physics at home and

abroad; 6. Enhance and leverage the innovative role particle physics plays in AI / ML, QIS, and microelectronics; and 7. Explore frontier science using cutting-edge technologies to inspire the public and the next generation of scientists, while opening new pathways to diversify the workforce.

DISCUSSION

Bloom commented the reduction of funds for core research contradicts the last two P5 reports and all HEPAP subpanel reports which called for protecting core research and asked about progress in forming the task force for project management and oversight recommended by the IB report. **Rameika** responded no progress has been made.

Quinn requested the definition of high-profile research as mentioned in the PBR and a list of topics not being focused on. In addition, lacking host lab environments that are conducive to international research teams, as recommended in the IB report, is a longstanding complaint of the community. **Rameika** explained high-profile research topics are mentioned in the 2014 P5 report and include LHC physics, neutrino physics, and cosmic experiments. There are no lists of topics considered low-profile. Facilitating host lab environments is currently a high priority and a work in progress.

Sanchez questioned the rationale behind the PBR's large increase in funds for Fermilab, budget guidance for the CMB-S4 Chile-only site, and whether costs for CMB-S4 are expected to increase significantly. **Rameika** informed the funds are intended to help the Fermilab Accelerator Complex return to efficient levels of operation and to prepare for the upcoming neutrino program. Costs for the new CMB-S4 layout cannot exceed historical figures, the quality and volume of science produced must not lapse, and the project will remain a joint effort between NSF and DOE.

Yamamoto asked for clarification on the deferment of the U.S. – Japan Cooperative Research NOFO and expressed disappointment for the insufficient notice given to the Japanese government. Insight was sought into the mechanism of the deferment. **Rameika** commented the program is important, but several details require reevaluation. Mechanistic details are not yet available, but discussions with Japanese colleagues are on the Spring agenda. The program will return stronger and better than previous iterations.

Thaler requested responses to the P5 report's fourth recommendation, regarding resource development, and fifth recommendation, regarding workforce engagement and conduct. **Rameika** explained both areas are under active engagement and development. More detailed responses will be presented in future meetings.

Anchordoqui requested a status update on the projects highlighted in the P5 report to operate in the low-funding scenario. **Rameika** informed calls for proposals are not likely until FY27.

Report from NSF including Response to the International Benchmarking Panel Report, Jim Shank

Shank presented an overview of the Division of Physics (PHY).

Operation and upgrades in the Elementary Particle Physics (EPP) program were funded as expected in FY24. The LHC ATLAS operations, CMS operations, and HL-LHC upgrade projects are funded through April 2025. Current plans support full LHC construction up to 2030.

Long Shutdown 3 (LS3) has been delayed and elongated and, together with LS4, will affect project delivery dates to CERN but will not affect costs. Tools for Particle Physics was noted as an undersubscribed area of EPP, receiving the least number of proposals, and submissions were encouraged. A total of 16 EPP proposals were funded in FY24, primarily for the ATLAS, CMS, and LHC Beauty (LHCb) experiments.

Theoretical HEP and theoretical particle astrophysics / cosmology programs support individuals, research at undergraduate institutions (RUIs), and special facilities or initiatives. There is a continuing trend of receiving many proposals and increasing numbers of new principal investigator (PI) applications to the program. Thirty-five proposals were funded in FY24 for theoretical HEP and theoretical particle astrophysics / cosmology. Experimental particle astrophysics programs are divided into three areas: underground physics (PA-UG), the IceCube science program (PA-IC), and cosmic phenomena (PA-CP). Twenty-one proposals and three faculty Early Career development program (CAREER) awards were funded in FY24 for experimental particle astrophysics.

NSF's responses to the IB subpanel's seven key recommendations are as follows: 1. NSF agrees and is using P5 as a roadmap for the PHY mission and priorities; 2. – 4. The areas are informed by the community. NSF follows the science in all activities, both domestic and offshore; 5. NSF agrees and the breadth of disciplines across the PHY and NSF can be an important resource to develop new technologies and advance particle physics; 6. NSF agrees and PHY is active in multiple national initiatives such as QIS and AI; and 7. NSF agrees and considers workforce development a crucial element of the discovery and innovation ecosystem.

Details for current funding opportunities are listed on the NSF website. Notable solicitations include: investigator-initiated research projects; RUI; CAREER for untenured junior faculty; launching early-career academic pathways in the mathematical and physical sciences (LEAPS-MPS) for untenured faculty at minority-serving institutions (MSIs), predominantly undergraduate institutions (PUIs), and Carnegie research 2 (R2) universities; MPS alliances for graduate education and the professoriate - graduate research supplements (MPS AGEP-GRS); PHY-GRS; and MPS ascending postdoctoral research fellowships (MPS-Ascend). Computer and information science and engineering (CISE) AI institute solicitations are available in the astronomical sciences, materials research, and strengthening AI categories. The precision measurements solicitation resulted in several FY24 awards. NSF has multiple mechanisms to fund research infrastructure and current opportunities fund awards up to $100M.

DISCUSSION

Fahim sought insight into the general undersubscription to the Tools for Particle Physics program and questioned whether partnerships with CISE for instrumentation grants have been considered. **Shank** believed potential applicants understand the area has not been a priority for PHY, and proposals would therefore have a low chance of being funded. CISE partnerships exist for many topics other than AI.

Overview of Cooperative Agreements between CERN and the United States, Abid Patwa

Patwa delineated DOE's guiding principles for fostering and strengthening international partnerships which included: advancing fundamental science, driving technology innovation, supporting joint collaborative projects and initiatives, sharing expertise, resources, and costs,

training and education, and facilitating program mission and strategic priorities. Government-to-Government Agreements facilitate cooperation by establishing general frameworks, ensuring partnerships are mutually beneficial and transparent, and setting guidelines for intellectual property (IP) and exchanges of personnel or equipment between the parties. The International Cooperation Agreements (ICAs) with CERN employ protocols to establish the domain of cooperation, and addendums to the protocols establish specific details of the project or initiative. Further specifications of technical details are captured in subsequent memorandums of understanding (MOUs).

U.S. - CERN collaboration began in the 1960's with CERN's assistance in building a linear accelerator (LINAC) at Fermilab. The first ICA between the U.S. and CERN was signed in 1997 and served as an overarching cooperation agreement. The 1997 ICA resulted in three protocols, involving the ATLAS and CMS detectors, and LHC accelerator and LHC studies. The 2015 ICA, DOE-NSF-CERN Cooperation Agreement for Scientific and Technical Cooperation in Nuclear and Particle Physics, renewed the overarching agreement and resulted in four protocols and five addenda to the protocols between 2015 – 2020. Protocol and addenda items involved: ATLAS, CMS, and HL-LHC upgrades; neutrino programs; a Large Ion Collider Experiment (ALICE); the Future Circular Collider (FCC); and LBNF and Imaging Cosmic And Rare Underground Signals (ICARUS).

Standalone written instruments with CERN include: a loan agreement among DOE, CERN, and Italy's Ministry of Education, Universities, and Research concerning ICARUS, signed in 2018; a framework agreement between CERN and NASA to collaborate in open science, signed in 2023; and a statement of intent between the U.S. and CERN concerning large research infrastructure facilities, advanced scientific computing, and open science, signed in 2024.

A non-topical, multi-purpose DOE-CERN general operational protocol is currently under preparation to provide a general framework applicable to all future collaborative activities. The U.S. and CERN continue to enjoy a strong and long-standing partnership in particle and nuclear physics to advance science, technology, and innovation. DOE plans to carry its partnership with CERN far into the future.

DISCUSSION

Tanedo questioned whether the general operational protocol would cover a U.S.-hosted collider. **Patwa** confirmed the possibility of coverage.

Malik expressed concern over the problems graduate students have been enduring over visas and hoped resolutions were incoming. **Patwa** ensured the problem is being addressed through provisions in cooperation agreements, but the process will be subject to the individual country's laws.

Bloom sought insight into operationalizing the multiple agreements for interactions presented. **Patwa** explained once an agreement is in place and funding is secured, an operational addendum or MOU can be initiated.

Seidel dismissed the meeting for a break at 10:52 a.m. and resumed the meeting at 11:03 a.m.

OHEP Strategy and Vision for AI / ML, Jeremy Love

Love explained the growth of OHEP QIS and AI / ML initiatives began in 2018 and they now account for roughly 30% of the total budget. Highlights of the U.S. AI / ML timeline include: an Executive Order to Maintain American Leadership in AI, signed in 2019; the National AI Initiative Act of 2020; creation of the National AI Initiative Office in 2021; and the Executive Order on the Safe, Secure, and Trustworthy Development and Use of AI, signed in 2023. The 2024 President's Council of Advisors on Science and Technology (PCAST) report, *Supercharging Research: Harnessing AI to Meet Global Challenges,* provides five recommendations for the role scientific research can play in addressing challenges laid out in the 2023 executive order.

HEP is a data intensive discipline which exemplifies the benefits of interdisciplinary AI research through the utilization of tools and methods developed outside the particle physics community. On average, OHEP has received 25% of the SC AI / ML Initiative funding. Implementation is achieved through two thrusts, embedding AI / ML into OHEP subprograms and through core research to facilitate future AI / ML advancements. The programmatic thrust focuses on research which primarily addresses existing technical challenges using ML, while the core research thrust seeks to support the full development cycle of advanced AI applications, broaden participation to increase the impact of AI / ML advancements, and leverage technical development supported beyond HEP. Current core research NOFOs include hardware-aware AI for HEP research review; AI for HEP theory and data analysis; and AI workforce development through traineeships. In addition, the CompHEP software package provides opportunities to participate in OHEP NOFOs and build and maintain a base AI program.

SC held a series of six AI roundtables, three of which with significant OHEP presence, in the Fall of 2024 to identify high impact research opportunities. Each roundtable was a two-day in-person event with 25-50 participants from relevant research communities. An SC roundtable report is in preparation and is expected by mid-2025. OHEP is working with the community to develop HEP-specific AI / ML guidance. The engagement is expected to produce a Basic Research Needs (BRN) report to establish research priorities.

DISCUSSION

Prescod-Weinstein referenced budget constraints and questioned how funding increases to QIS and AI / ML will affect viability, workforce development and U.S. leadership in other areas. **Love** explained no guidance is provided on funding balance, and high-quality proposals in all relevant areas are funded as received. However, an AI literate workforce is required to meet administration priorities.

Abramowicz commented the HEP community has less expertise in method development than computer scientists and requested comments on interdisciplinary proposals involving computer science and HEP data. **Love** emphasized the statistical rigor and analytical capabilities of the community which mirrors and adds balance to the value of computer scientists. It is important to identify the projects in which the community can uniquely contribute without engaging in direct competition with industry.

Thaler requested details on the balance between the programmatic and core AI / ML thrusts and mentioned the importance of having traditional techniques as a crosscheck for newer

efforts. **Love** revealed the balance is still to be determined and will involve community engagement and planning.

Malik questioned the shift in funding trends involving the Energy Frontier and Intensity Frontier programs. **Love** reiterated funding is not directed but depends solely on the quality and variety of proposals received.

Fahim inquired on the possibility of crosscuts involving multiple initiatives. **Love** confirmed the possibility and informed efforts are underway to evaluate program overlap.

Bloom emphasized the importance of supporting both theoretical and applied research. **Love** agreed.

OHEP Strategy and Vision for QIS, Zach Goff-Eldredge

Goff-Eldredge described the National Quantum Initiative Act of 2018, which established the National Quantum Initiative (NQI), a whole-of-government quantum thrust authorizing research at the National Institute of Standards and Technology (NIST), NSF, and DOE. NQI created interagency coordinating bodies and encompasses 23 agencies, $2.6B in investments, 14 major research centers, >150 companies, and it is in collaboration with the OHEP QIS program. QIS involves many subfields, much expertise, and many platforms, and is relevant across multiple P5 themes.

The OHEP QIS vision revolves around three specific goals: seizing the NQI opportunity, uniting the cutting edges of HEP and QIS, and opening new horizons. Research is organized through Fermilab's Superconducting Quantum Materials and Systems (SQMS) center, the QuantISED grant programs, and five national quantum information science research centers, individually hosted at Berkeley lab, Fermilab, BNL, Argonne National Laboratory (ANL), and ORNL.

SQMS consists of a collaboration of hundreds of experts from more than 30 DOE national labs, academia, industry and other federal and international entities to bring transformational advances in QIS. The center has devised a 10-year roadmap with major focus on two-dimensional quantum processing units (2D QPUs) and 3D quantum bits (qubits), which include superconducting radio frequency (SRF) cavities. SQMS highlights include over 250 publications; first-of-a-kind SRF cavity systems for quantum information storage and processing, and dark photon dark matter experiments; new facilities and capacity; and an ecosystem supporting >200 students, postdocs, and the 2023 QIS Summer School with 150 participants.

The QuantISED grant programs focus on synergistic and mutually beneficial applications of QIS and HEP. QuantISED 1.0 projects ran in 2018-2019 and 2021-2022, and highlights include: a world record search for dark photon dark matter; the Matter-wave Atomic Gradiometer Interferometric Sensor (MAGIS-100) project to construct a 100-meter atom interferometer for probing dark matter and gravitational waves; and discovery of new many-body teleportation techniques and design of implementation for Rydberg, trapped-ion, and superconducting circuit systems. QuantISED 2.0 launched in 2024, received over 100 applications, and focus on theoretical research, sensing quantum states, and experimental concepts with the potential of facilitating new science.

Next steps involve a transitional phase as the NQI Act seeks renewal in 2025 and a new administration takes office. Additional efforts will aim to integrate the potential renewal of NQI

into existing programs and maximize the mutual relevance to HEP; use SQMS and other national lab facilities as a base of QIS excellence and a nexus for interdisciplinary collaboration; build a robust HEP-QIS community by providing opportunities for researchers to collaborate; launch QuantISED 2.0 proposals and hold workshops for planning.

DISCUSSION

Thaler inquired about the existence of a programmatic QIS thrust equivalent to AI / ML programmatic efforts. **Goff-Eldredge** confirmed a similar, less structured programmatic thrust exists. However, the most focused efforts are through QuantISED and SQMS.

Malik sought an estimation of the experimental HEP community's level of participation in the QIS ecosystem. **Goff-Eldredge** did not have the participation numbers, but all proposals were reviewed for having a credible path towards HEP contribution.

Report on the DOE OHEP Accelerator and Technology Division and on the GARD Review, Eric Colby

Colby explained the Accelerator and Technology (A&T) Division was established in March 2024 through an SC realignment, with the goal of improving the efficiency and effectiveness of SC investments in OHEP. The realignment also returned the Accelerator Research and Development and Production (ARDAP) program to OHEP. The division's mission includes significant, coherent contributions to facilities and experiments, research and development (R&D) that will advance the state-of-the-art in particle accelerators and detectors, and R&D to enable new and transformative capabilities in QIS and AI / ML. Work is done synergistically with other SC programs and federal agencies on five connected technology areas: accelerator programs, detector R&D, microelectronics, computational HEP and AI / ML, and QIS.

Accelerator programs consist of General Accelerator R&D (GARD), Directed Accelerator R&D (DARD), facility operations and experiment support, and acceleration stewardship and accelerator development. The GARD program supports basic R&D to identify and develop the next generation of accelerator technology, develop the workforce, and foster international collaboration. GARD areas of focus include accelerator and beam physics, which includes modeling, simulation, and beam instrumentation and controls; advanced accelerator concepts, such as beam and laser driven wakefield accelerators, beam manipulations and high gradient radio frequency (RF) breakdown studies; particle sources and targetry; RF acceleration technology which includes SRF, normal conducting radio frequency (NCRF) and RF sources; and superconducting magnets and materials. The DARD program supports risk-reduction R&D, technology transfer, and vendor preparation for accelerator technologies. Accelerator stewardship and accelerator development supports accelerator R&D of broad benefit to federal programs and industry, facilitates access to accelerator test capabilities, and bolsters the accelerator community.

The detector R&D program aims to advance particle detection, develop the next generation of instrumentation, provide instrumentation training, and support related infrastructure. A current R&D effort aims to explore synergies between the microelectronics initiative and HEP work. OHEP had successful applicants in the SC-wide Microelectronics Science Research Center (MSRC) projects for energy efficiency and extreme environments.

The AI / ML initiative aims to realize the potential benefit of AI by developing advanced applications, increasing the impact of AI on HEP and broadening participation in relevant research. Computational HEP addresses current and future computing challenges of broad interest to OHEP programs. The QIS initiative supports R&D to develop technologies for computation, information processing, and detection that overcome classical limitations using quantum effects.

Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) programs attempt to optimize federal R&D investments with the goal of commercialization and production by small businesses. Topics are chosen to complement A&T core technology programs, and include materials, components, software, and subsystems. National laboratories are polled annually for topic suggestions.

GARD reviews are comparative reviews of the major GARD-funded accelerator R&D programs at the DOE laboratories, which includes ANL, BNL, FNAL, LBNL, and SLAC. The latest review was held in August 2024 and the general findings: reaffirmed GARD's vital role in advancing accelerator technology and sustaining U.S. leadership; indicated, in the context of P5, the need to re-examine the balance of activities in the portfolio; and emphasized the importance of strengthening workforce development efforts. The final report is currently under review.

Future program planning involves multiple workshops and roundtable meetings in FY25. Funding opportunities exist in technology R&D, and workforce development and new research capability, with both SC-wide and OHEP-led calls in each area.

DISCUSSION

Quinn sought insight into the coordination and overlap between the A&T and facilities and projects divisions. **Colby** explained the divisions have separate budgets, but operations and projects overlap.

Sanchez questioned whether the rebalancing of the GARD portfolio will be defined by the GARD review, or a separate internal process. **Colby** replied the review panel will collect community input and give advice on how to proceed. SC will then determine how to implement the advice.

Cousineau asked how the GARD review report will affect funding opportunities. **Colby** noted the review will have implications outside of GARD, which will involve the many facilities that support the program.

Fahim requested an explanation for the apparent lack of emphasis on microelectronics, and insight into the lower levels of competition for the GARD and detector R&D programs, including relevant future changes. **Colby** planned to increase emphasis when microelectronics grows into a strong synergistic component of OHEP. While GARD and detector R&D programs are competed, no further details of definitive plans could be given.

Fleming sought clarification on whether accelerator design was included in the accelerator development program. **Colby** explained the program is not involved with accelerator or facility design.

Seidel dismissed the meeting for lunch at 12:26 p.m. and resumed the meeting at 1:18 p.m.

The European Strategy for Particle Physics, Paris Sphicas

Sphicas explained the European Strategy for Particle Physics (ESPP) is a continuous community driven process which began in 2006. The ESPP consists of a secretariat, which includes the chair of the European Committee for Future Accelerators (ECFA); the European Strategy Group (ESG); the Physics Preparatory Group (PPG); and nine working groups (WGs). Notable recent events include the 2013 HL-LHC decision; the 2020 post-HL-LHC decision, which established the Future Circular Electron-Positron Collider (FCC-ee) as the next collider at CERN and recommended the creation of a global detector R&D roadmap; and the commencing 2026 update. Highlights from the current update's timeline include: appointment of PPG members and open symposium venue selection in September 2024; deadline for the submission of community input in March 2025; open symposium in June 2025; deadline for the submission of final national input in November 2025; submission of the draft strategy document to the council in January 2026; and discussion of the draft and ESPP update in March and June 2026.

ECFA formulated a set of questions and issues for discussion by the national HEP community. In addition, the ESG tasked ESPP to determine: the preferred option for the next collider at CERN and prioritized alternative options if the preferred choice becomes unfeasible; other areas of priority complementary to colliders; and other experiments for CERN, laboratories in Europe, and in projects outside Europe.

ESPP has developed guidelines for input from large-scale projects to allow straightforward comparisons. In addition to the project's physics and technical description, a standardized set of technical data must be submitted. Technical data includes stages and parameters, timeline, resource requirements, environmental impact, technology and delivery, dependencies, and commentary on current project status.

Currently, PPG is working to define physics and engineering benchmarks for distribution to the projects and to identify members. The upcoming symposium will aim for more plenary time and more discussions than the previous ESPP. Participation from U.S. colleagues is encouraged.

DISCUSSION

Bloom asked how DOE and NSF plan to engage with ESPP. **Rameika** commented DOE is not officially engaging but community representatives will be involved. To ensure consistency in messaging, all community whitepapers must be reviewed by DOE before submission to ESPP **Sphicas** noted the U.S. is an observer state and ESG contains a U.S. member. **de Gouvea** added the American Physical Society's (APS) Division of Particles and Fields (DPF) will also submit a whitepaper.

Yamamoto questioned the possibility of having a muon collider (MC) as a backup to the FCC-ee. **Sphicas** confirmed the submission of an MC proposal.

U.S. Higgs Factory Steering Activities, Tor Raubenheimer and Srini Rajagopalan

Rajagopalan explained the U.S. Higgs Factory Consortium Committee (HFCC) was created by DOE and NSF to provide direction and leadership on the development of the Physics, Experiment, and Detector (PED) and Accelerator (ACC) programs for a potential future Higgs factory. HFCC is led by the Higgs Factory Steering Committee (HFSC), composed of HFSC-PED and HFSC-ACC groups. HFCC coordinates efforts in the following areas: physics and

technical feasibility studies; prioritization and stewardship of the national R&D efforts; development of the pre-project R&D scope; conceptualization of software and computing; development of funding models; and cost-effective collaborations.

The U.S. is the largest national CERN partner and HFCC has been instructed by DOE and NSF to provide input to the current ESPP update. Input will draw from P5, community engagement from three open meetings, and other U.S. national inputs, and consist of: strategic inputs which respond to the data required by ESPP for large-scale projects; and technical input highlighting areas of U.S. contribution. An editorial board has been created to prepare and deliver input in the form of a white paper. The editorial board's timeline consists of a white paper outline by mid-December 2024; the first complete draft by late-January 2025; the final draft by late-February 2025; and white paper submission by late-March 2025.

As the Higgs factory will be built and operated by early career scientists, it is critical to engage the scientists who will be working on the experiments and accelerator. In addition, a strategy to engage the pre-scientists who could be early career scientists in 20 years is required. Engagement will be discussed in the white paper, and early career sessions will be arranged at the open meetings held in SLAC and Fermilab.

Final comments include: community support for an FCC-ee; funding for MC demonstration is compatible with U.S. contribution to a Higgs factory; geopolitical tensions may limit U.S. ability to participate in China's Circular Electron Positron Collider (CEPC); funding may be challenging for the Future Circular Collider (FCC) program; and in the event FCC is not feasible, several options exist for CERN.

DISCUSSION

Arce requested comments on the current state of early career scientist engagement. **Rajagopalan** noted four early career scientists work on the editorial board and are actively working to bolster engagement.

U.S. Muon Collider Collaboration Activities, Mark Palmer

Palmer highlighted historical community planning and P5 processes, which included: the 2020 EPPS update and subsequent formation of the CERN-led International MC Collaboration (IMCC); the MC forum, active during the 2021-2022 Snowmass processes which found a strong physics case for a 10 tera electron volt (TeV) MC, consensus regarding MC physics extraction with near-term detector advances, and the possibility of synergistic physics beyond the energy frontier; and the P5 report which offered recommendations to support U.S. leadership and a robust U.S. collider effort. The accelerator, experimental, and theory communities have self-organized post-P5 to produce a workshop, an R&D status & priorities report, and elections for an interim organization; hold the 2024 inaugural U.S. MC Community (USMCC) meeting, involving over 300 participants and IMCC leadership participation; and create a grassroots effort to realize the P5 muon timeline. In addition, the community has utilized experimental and theory base grants, laboratory directed research and development (LDRD) grants, university specific funding, private sources, and theory institutes for workshop funding.

Recent highlights from the individual communities include: strong theory engagement, resulting in over 100 publications with "muon collider" in the title since the recent Snowmass; experimental progress in suppressing beam-induced backgrounds, and the Muon Accelerator

Instrumented Apparatus (MAIA) and Muon Smasher for Interesting Collisions (MUSIC) design concepts for a 10 TeV detector; accelerator progress in final cooling; and an LDRD funded study towards a MC demonstrator at Fermilab.

USMCC was created to help execute the P5 MC recommendations, and aims to maintain and leverage theory, experimental and accelerator community collaborations. Official USMCC tasks are to organize U.S. activities, interface with the IMCC, prepare a U.S. site proposal for a cooling demonstrator, and prepare a U.S. site proposal for a collider, meeting P5 recommendations. USMCC input to the ESPP will summarize U.S. activities and plans, describe U.S. resources and a demonstrator proposal, and emphasize the common goal of worldwide R&D. Input will be finalized for a March 2025 submission. Future goals include maintaining community engagement, staying on schedule with P5 recommendations, maintaining balance with MC and generic R&D efforts, and staying on path towards a U.S. energy frontier future.

DISCUSSION

Bloom requested an estimate on the amount of people and hours involved in the described efforts. **Palmer** noted the efforts involve of hundreds of participants but could not provide an accurate estimate of hours.

Tanedo asked for near-term critical decisions that will affect the MC. **Palmer** noted the U.S. is years away from matching the European effort to deliver a collider demonstrator proposal, pushing the timeline to the early 2030's.

Prescod-Weinstein questioned why the MC is still considered feasible, given the current budget constraints. **Palmer** explained the project is justified as no other options exist for achieving 10 TeV parton center-of-mass.

Sanchez inquired whether any forums exist for facilitating community feedback into the evolution of demonstrator facilities. **Palmer** mentioned the IMCC workshop, and the regular community discussions regarding the MC, but noted the difficulty of establishing an official forum in the absence of funding.

Bishai sought insight into improving workforce development in non-traditional areas which are synergistic with future technologies. **Palmer** replied establishing the required development would require additional funds, but documenting areas of overlap will focus efforts once funding arrives.

Seidel dismissed the meeting for a break at 2:28 p.m. and resumed the meeting at 3:03 p.m.

Test Beam Facilities for Particle Physics Instrumentation and Accelerator Development, Petra Merkel, and Mark Palmer

Merkel noted test beam facilities allow for the qualification of new technologies by allowing the community to test detectors under conditions matching future applications. Test beams are crucial for collider and neutrino detector technologies and have synergies with technologies outside of HEP, such as Electron-Ion Colliders (EICs) and satellite experiments. Facilities are capable of offering multiple beam energies, intensities, shapes and particle configurations, along with fine beam control and characterization.

All active test beam facilities and respective specifications have been listed in a Snowmass white paper, *Test Beam and Irradiation Facilities*, which is available online at

https://arxiv.org/abs/2203.09944. The three facilities which are key for current collider experiments will experience multiyear shutdowns for planned construction. Facilities and downtimes are as follows: The Fermilab Test Beam Facility (FTBF) will be down from January 2027 to June 2030; the Super Proton Synchrotron (SPS) at CERN, from September 2026 to June 2029, and the Deutsches Elektronen-Synchrotron (DESY) – II, from 2030 to 2032. New and planned facilities include: The Linac to End Station A (LESA) at SLAC, which expects first beam experiments in Spring 2025; planned PIP-II facilities at Fermilab; and a planned upgrade for the Positron–Electron Tandem Ring Accelerator (PETRA) IV at DESY.

A broad array of test beam capabilities is required to develop the next generation of detectors for tracking, calorimetry, and particle identification. Current detectors have 30 picosecond (ps) time resolution. Meeting future detector goals of 1-5 ps resolution will require test beams with a high repetition rate and extremely short pulses. In addition, future colliders with high radiation fields such as MC will require radiation-hard detectors, which would benefit from colocation of test beam and irradiation facilities for ease of handling and storage, and faster turnaround times.

Palmer reported the existence of 11 accelerator-based SC national user facilities, including light sources, spallation neutron sources (SNS), nuclear physics facilities, the Fermilab accelerator complex, and facilities focused on accelerator development and workforce. All facilities are accessible for academic R&D on a competitive basis, at no cost to the user.

Over 50 specialized accelerator R&D capabilities exist across the SC complex. SC test beam capabilities include: the Argonne Wakefield Accelerator (AWA) at ANL, focusing on advanced acceleration, beam production, and beam manipulation and diagnostics; the Accelerator Test Facility (ATF) at BNL, focusing on novel particle acceleration techniques, beam instrumentation and manipulation, high-brightness radiation sources, ion generation and acceleration, and mid- and long-wave infrared laser development; the Fermilab Accelerator Science and Technology (FAST) and Integrable Optics Test Accelerator (IOTA) facilities, focusing on frontier R&D topics, HEP intensity-frontier accelerator R&D, and R&D for concepts and technologies needed for Fermilab's future accelerator complex; the upgraded injector test facility at the Thomas Jefferson National Accelerator Facility (JLab), focusing on tests of new accelerator technologies and serving as a venue for low-energy physics experiments with polarized electron beams; the Berkeley Lab Laser Accelerator (BELLA) at LBNL, focusing on laser wakefield acceleration and application development; the Beam Test Facility (BTF) at ORNL, focusing on optimization of SNS systems and unique high-intensity beam R&D; and FACET-II at SLAC, focusing on beam-driven plasma wakefield accelerator research, beams with unprecedented brightness and other novel research. Additional beam types of potential interest to OHEP exist but were not presented.

Test beam facilities provide: the means to evolve key accelerator physics concepts and technologies; testing capabilities required for operating facilities; resources for academia and industry; and training for the future workforce. Funding and alignment with community needs are pertinent challenges, and investments must ensure the next generation of capabilities are available when needed. BeamNetUS is a new model for facility access and the facilitation of collaborations. The model's pilot year begins in FY25, and more details are available at https://www.beamnetus.org.

DISCUSSION

Quinn requested details on the impact of key facilities shutting down for multiple years, and noted DESY, although available until 2030, is fundamentally different from Fermilab and CERN. **Merkel** believes most applications will be completed in time for the shutdown. DESY could possibly cover a portion of the downtime. Other beams traditionally not used by the U.S. could come under consideration.

Thaler referenced the benefit of test beam and irradiation facility colocation, questioned whether the setup is a current practice or a future goal, and asked for the location of current irradiation facilities. **Merkel** explained the setup is aspirational and would avoid the shipment of highly irradiated materials.

Seidel requested details on the beam types not presented but of potential interest to OHEP. **Palmer** mentioned the repurposed muon cooling (muCool) beam at Fermilab which can no longer support the MC community, and the mismatch between available beams and current application requests.

Yamamoto mentioned the possibility of using Japan's Ko Energy-kasokuki Kenkyukiko (KEK) facility to mitigate the upcoming U.S. shutdowns. **Merkel** agreed. **Palmer** noted the ATF at KEK could test a wide range of components of interest.

Cousineau informed of a test beam facility session at the APS global physics summit in 2025. **Palmer** confirmed and added an additional session may be required to match the magnitude of interest received.

Malik praised the FTBF and noted many students at the University of Puerto Rico have received training and completed master's theses at the facility.

Bai mentioned additional facilities for community use at SLAC, including the Next Linear Collider Test Accelerator (NLCTA) for novel RF structure and the megaelectron volt ultrafast electron diffraction instrument (MeV-UED).

Procario questioned whether the Facility for Rare Isotope Beams (FRIB) has been considered. **Palmer** noted the facility has the required technology but does not currently provide test beam capabilities.

Geddes noted the need for detectors with 1-5 ps resolution may be met at facilities investigating wakefield acceleration. **Merkel** believed the use should be investigated. **Palmer** noted success may vary with individual request parameters.

The Fermilab Test Beam Facility, Evan Niner

Niner revealed FTBF was founded in 2005, has served over 1000 users from over 30 countries, and conducts general detector R&D supporting all P5 thrusts. The irradiation test area (ITA) follows the optimal configuration of having a collocated beam on site. The beam is available for roughly 8 months a year and has two available beamlines: MTest, a high energy beam for experiments lasting up to a month utilizing a plug-and-play infrastructure; and MCenter, a lower energy beam utilized for experiments with longer timescales, with significant configuration variation between experiments, often installed by individual experiment teams. MCenter has a recently refurbished 0.7 tesla (T) magnet, and three neutrino program experiments supporting P5. Additional beam infrastructure and upgrades include silicon telescopes capable of precision-tracking particles of roughly 5 micrometers, heavily used by CMS and ATLAS; an

upgrade for particle-tracking Fenker chambers; an upgrade for the large area picosecond photodetector (LAPPD) for particle identification; and a gas mixer system upgrade, designed and built by seniors from Northern Illinois University in 2023-2024.

FTBF users include: projects such as LBNF / DUNE, HL-LHC (CMS / ATLAS), Muon-to-Electron Conversion Experiment (Mu2e), muon magnetic moment minus 2 (Muon g-2) and the Strongly interacting particles Pioneering High Energy Nuclear Interaction eXperiment (sPHENIX) / EIC; students for skill development and theses; and early career scientists, often consisting of previous students and postdocs. Beam use in FY24 consisted of seven weeks of beamtime, following sitewide downtime to upgrade the accelerator safety envelope and technical delays in preparing the switchyard beamline. FY25 beam requests, 25% of which is deferred work from FY24, represent over 100% of standard operating capacity, with 24 groups requesting 75 time slots. In addition to the upcoming 3.5-year shutdown in 2027, recently discovered infrastructure issues will prevent all operation of the Main Injector beam in FY25. Furthermore, the Switchyard beam line requires refurbishment and efforts to maintain operation are considered unsustainable. All ITA operations will end with in the shutdown of the original LINAC in 2028.

Notable excerpts from recent panels and community input include: the Fermilab Physics Advisory Committee encouraged a future planning exercise on the long-term evolution of the FTBF / ITA, involving community input to identify synergistic applications between the Fermilab Facility for Dark Matter Discovery (F2D2) and the 120 GeV DarkQuest program; the FCC-ee PED task force identified FTBF as critical to FCC-ee R&D phases; and test beam and irradiation facilities utilized survey input to produce a list of long-term needs. A proposed solution to meet community needs in alignment with P5 and restore irradiation facility capabilities is the construction of a new facility. The facility would occupy a new location within the main accelerator complex security footprint, incorporate a shorter beam path and new components to reduce maintenance, and combine the test beam and irradiation facility under one roof as a potential fixed-target campus.

DISCUSSION

Denisov questioned whether FTBF will be restarted in 2030, or in 2026 with a new facility. **Niner** replied FTBF will be restarted in 2030 but will need refurbishments. The new facility is pending current efforts to assess the community's future needs.

Irradiation Facilities for Particle Physics Instrumentation Development, Petra Merkel

Merkel informed irradiation facilities are used by the HEP and nuclear physics (NP) communities to test the lifetime and performance of detectors under relevant conditions. Custom detector components are often developed to sustain the intense radiation field requirements, as off-the-shelf parts are usually not radiation hard. Typical applications include silicon sensors; crystal and plastic scintillators; application-specific integrated circuits (ASICs), single-event effects (SEE), and other readout electronics; auxiliary components; and materials. Radiation facilities currently in heavy use include CERN, ITA, LANSCE, and the Rhode Island Nuclear Science Center (RINSC). Future applications will require radiation doses two orders of magnitude greater than current systems, requiring new high-dose-rate environments to deliver

the anticipated integrated dose in days, as opposed to months or years.

Community recommendations for irradiation facilities and test beams include: a Basic Research Needs (BRN) report which identified precision test beams as an area in which the U.S. could assume a world-leading role; Snowmass input which noted the importance of facilities for detector development and included test-beams and high-dose irradiation on a list of current technology gaps; and P5 which encouraged investments in test beam and irradiation facilities to enable detector innovation.

Both test beam and irradiation facilities attract interest outside of HEP, including the National Aeronautics and Space Administration (NASA) and private industry. A charge model for beamtime could be implemented to generate additional support for the facility. As irradiation facilities are a scarce commodity, HEP users occasionally meet irradiation requirements at non-HEP facilities, such as hospitals.

Despite the crucial roles of irradiation and test beam facilities, beamtime at current facilities is sparse and not always optimal. The development of new technologies requires adequate facilities capable of simulating relevant conditions.

DISCUSSION

Denisov commented the community should leverage existing low dose radiation facilities outside of HEP. **Merkel** mentioned the need to compare the cost and availability of beamtime at other facilities against operating at community owned facilities.

Quinn questioned the lack of availability of radiation-hard components from the aerospace industry. **Merkel** was unsure about the scarcity and mentioned proprietary issues as a possible cause. **Fahim** added aerospace components do not meet HEP requirements and have substantially lower radiation tolerances.

Irradiation Facilities at Los Alamos National Laboratory, Kranti Gunthoti and Stephen Wender

Gunthoti shared historical information about LANSCE, which came online in 1972 and has been an important National Nuclear Security Administration (NNSA) facility since the mid-1990's. LANSCE is a multi-user, multi-beam facility that uses energetic protons to make intense sources of neutrons via spallation reactions, and supplies proton beams for isotope production in support of basic and applied science research. Major facilities include the Isotope Production Facility (IPF) which produces radioisotopes for medical, industrial and NP applications; the Proton Radiography (pRad) facility used to diagnose dynamic experiments; the Ultra-Cold Neutrons (UCN) source for fundamental physics research; the Lujan center used for material and nuclear science experiments; the Weapons Neutron Research (WNR) facility for irradiation of semiconductor electronics and nuclear science experiments; and the Blue Room (BR) used for proton irradiation and nuclear science experiments.

Irradiation facilities include the neutron irradiation houses, Irradiation of Chips and Electronics (ICE)-I and ICE-II, and the proton irradiation BR. ICE houses provide neutron spectra like the cosmic ray induced spectra in the atmosphere, and are used by national laboratories, industry, and academia to test semiconductor devices for SEE at a fast rate. BR has multiple operational capabilities including remote sample positioning, laser alignment of

samples, three cameras, a Bergoz integrating current transformer, low-temperature radioactive storage and an external data room. Due to shielding limitations and deleterious effects to other facilities, beamtime to BR is limited and only high priority experiments are scheduled for the facility.

LANSCE is capable of meeting HEP proton fluence requirements by utilizing an irradiation time of 52.8 hours. Current efforts aim to reduce the irradiation time necessary. Details about conducting experiments at LANSCE can be found online at https://lansce.lanl.gov/facilities/Radiation%20Effects/index.php. As an NNSA designated facility, no dedicated funding exists to support external users. Future iterations of the operating model will include cost recovery, requiring users to pay for beamtime.

Seidel adjourned the meeting at 4:40 p.m.

Friday December 6, 2024

WELCOME AND INTRODUCTION

Seidel called the meeting to order at 9:02 a.m. ET.

Polarization/Inflation Measurements at the South Pole Site, Colin Bischoff

Bischoff reviewed the science of using B-modes to constrain inflation. Inflation is the most accurate theory for elucidating the initial conditions observed in the universe. Inflation models predict the existence of a primordial gravitational wave (PGW) background, which imprints a B-mode signature on the polarization of the cosmic microwave background (CMB). In B-mode measurements, the tensor-to-scalar ratio is a benchmark of sensitivity. Moving beyond current limits of B-mode measurements requires increased sensitivity, achieved through the operation of many detectors over many years with high observing efficiency; observations at multiple frequencies to separate CMB from galactic foregrounds; high signal-to-noise and moderately high-resolution data from large aperture telescopes (LATs) for delensing; and excellent control of systematic errors.

Observations from the South Pole have produced field-leading tensor-to-scalar ratios for more than a decade. South Pole features that enable precision measurements include: optimal atmospheric properties; constant access to the "Southern Hole," an area with very low galactic foregrounds; a clean environment for systematic error control; and minimal solar contamination and heating.

The South Pole Observatory (SPO) is a collaboration between the Background Imaging of Cosmic Extragalactic Polarization (BICEP) and the South Pole Telescope (SPT) programs to measure B-modes from the joint analysis of a common survey field. BICEP small aperture telescopes (SATs) provide degree angular scales, and SPT provides arcminute scales for delensing. Continuing South Pole B-mode measurements will require the precursor small aperture telescope (PreSAT) project to deploy a fourth BICEP array telescope and an upgrade to the SPT camera named SPT-3G+. PreSAT and SPT-3G+ are partially funded by the NSF Major Research Instrumentation (MRI) program and align with NSF's intention to support South Pole and CMB research without logistical footprint expansion. Additionally, SPO operations must be extended through 2034. Using a conservative forecast of past performance, modest SPO investments would achieve the target tensor-to-scalar ratio value of 0.001 by 2034.

DISCUSSION

Anchordoqui sought clarification on the effort required to ship the SPT-3G+ upgrade. **Bischoff** noted the relatively small size of the upgrade and foresaw no logistical difficulties. **Carlstrom** added the camera would not overly burden the yearly shipment allocation but would require coordination with the NSF Office of Polar Programs.

Thaler asked for reconciliation of the Snowmass reported tensor-to-scalar ratio value of 0.003 with the target value of 0.001. **Bischoff** explained the numbers are consistent as the Snowmass value refers to an older BICEP forecast for 2027, while 0.001 is the current forecast for 2034.

Quinn requested the one sigma error for CMB-S4's target tensor-to-scalar ratio. **Bischoff** reported the value as 0.0005.

Anchordoqui questioned whether the forecast to 2034 denotes the start date of CMB-S4. **Bischoff** could not predict the date CMB-S4 would start but planning is currently in progress.

Polarization/Inflation Measurements at the Chile Site, Tobias Marriage

Marriage shared the history of CMB polarization studies from the Atacama Desert, Chile sites, beginning with the cosmic background interferometer (CBI) which ran from 1999-2008 and found the first E-mode measurements. The Q/U Imaging ExperimenT (QUIET, 2008-2010) extended the polarization measurements to larger angular scales. The Atacama B-mode Search (ABS, 2012-2014) was the first experiment to feature rapid front-end polarization modulation, allowing for noise reduction by over two orders of magnitude, and volumetric detectors. The POLARization of the Background Radiation (Polarbear) / Simons Array Experiment (2012-2024) achieved sensitive measurements on small angular scales. The Atacama cosmology telescope polarization (ACTPol, 2013–2022) contributed to E-mode and B-mode spectra and constraints on matter distribution. Finally, the cosmology large angular scale surveyor (CLASS, 2016-Present) currently observes 75% of the sky and produces large angular scale measurements.

The Chile site has an ideal atmosphere for microwave observations, unrestricted access to North America, access to 75% of the sky, and continues to produce results which push the limits of cosmology. Unique site challenges include emissions from atmospheric turbulence and ground structures, systematic error signals from wind, cloud polarization, internal reflections, polarization leakage, and RF interference from nearby infrastructure. Modulator systemic errors exist but can be adapted for beneficial applications. Several methods have been developed to mitigate site challenges.

The Simons Observatory (SO) houses three SATs and a high-throughput LAT and will be fully operational by 2025. Contributions from the United Kingdom and Japan have funded a 2026 expansion which will double the number of SATs and install a solar array to power all of the SO. SATs are currently operational, are exceeding requirements, and are on-schedule to deliver high signal-to-noise maps of CMB polarization. LAT data provides insight into neutrino mass, the effective number of relativistic species, tilt of the primordial scalar spectrum, large-scale structure non-Gaussianity, galaxy clusters, galactic science, and transients.

A revised, all-Chile CMB-S4 configuration is under development. CMB-S4 has two LATs, each with 50% more detectors and mapping speed than SO LATs, and the equivalent of three SO SATs. CMB-S4 goals include: an ultra-deep survey for inflation science; a delensing survey to support the B-mode search; and a wide-deep “legacy” survey to address many other science topics over seven years. Optimization studies are organized in five main areas:

simulations and forecasting, SAT design, LAT design, site design, and cost modeling. SO is participating in CMB-S4 design studies and forecast assumptions via members simultaneously involved in both collaborations. Meeting CMB-S4 science goals by the 2040's will require a delensing LAT and roughly 20 additional SATs.

A merged effort of CMB-S4 and SO will provide more expertise and resources for the most difficult measurements, and leadership is eager to discuss partnership. Due to the unique challenges of the Atacama Desert site, the best strategy would involve a phased deployment approach of telescopes. The phased project structure allows for improvements made to instrumentation and lessons learned from data to greatly enhance future observations.

DISCUSSION

Thaler questioned whether preliminary measurements should be made to bolster confidence in meeting forecast targets. **Marriage** revealed high confidence in meeting targets, and explained success would be best predicted by working with the main measurements.

Sanchez asked for an estimate of the additional equipment needed to match the sensitivity of SPO. **Marriage** explained additional telescopes are needed. However, the overall effort required at both sites is comparable. Combining the SO and CMB-S4 communities will yield additional benefits.

Weinstein (chat text read by **Seidel**) requested a cost estimate for the additional telescopes required at the Chile site. **Marriage** did not have the estimate and mentioned cost details would be provided in upcoming reports.

Quinn questioned the rationale of moving to a CMB-S4 Chile-only site, requiring 20 years to meet goals, instead of waiting for NSF to fix infrastructure issues at SPO. Quinn perceived a sense of passivity on behalf of the community in losing SPO science. **Marriage** reported NSF's plans for the infrastructure are unknown, and many years will be lost waiting for repairs. The CMB-S4 and SO collaboration will preserve the scientific momentum and workforce. The community is not passive and was advised any proposals mentioning SPO will be rejected without review.

Anchordoqui requested the difference in timelines had the CMB-S4 stayed in the SPO. **Marriage** revealed delays due to funding would have produced a similar timeline with a 2040 forecast. However, the additional telescopes will increase the overall cost.

Report of the Office of High Energy Physics Facilities Division Committee of Visitors, Young-Kee Kim

Kim reviewed the 2024 charge to the Committee of Visitors (COV) from then OHEP Interim Chair Seidel, regarding assessment of the OHEP Facilities Division during fiscal years 2016 through 2022, focusing on: the efficiency and quality of the processes to solicit, review, recommend, document, and propose actions, and to monitor active awards, projects, and programs; and the quality of the resulting portfolio, including breadth and depth as well as the national and international standing. The full COV report is available online at https://science.osti.gov/-/media/hep/hepap/pdf/Meetings/2024/December/DOE-OHEP-FD-COV-Report-2024.pdf.

The report contains thirteen recommendations from the COV. Abridged recommendations are as follows. In regard to P5 alignment, 1. Establish a mechanism in consultation with HEPAP to advise OHEP when a programmatic choice must be made that significantly deviates from the P5 plan or when the context for that choice has evolved

significantly from P5 expectations, and 2. Strengthen coordination between the Facilities Division and the Research & Technology Division and factor in research and operations support when making decisions about proceeding with projects. Regarding DOE OHEP staffing, 3. Seek detailees or part-time consultants with specific expertise in needed areas; regarding ethics, diversity and inclusion, 4. Regularly solicit demographic information from the external entities and encourage project / operations leaders to employ transparent mechanisms in allocating project / operations tasks to groups at national labs and universities, and 5. Create a code of conduct for OHEP.

Abridged recommendations from the Projects Subpanel include the following. Regarding the timing of critical decision-0 (CD-0), 6. Investigate the possibility of establishing a "directed R&D" line to retire major technical and programmatic risks for proto-projects prior to CD-0 approval. Regarding challenging projects and lessons learned, 7. Maintain multiple sources of contracts for large projects until one particular vendor has demonstrated the capability and commitment to deliver successfully. 8. Communicate with leadership of small projects to ensure availability of the resources needed for successful execution, 9. Let delegation oversight to a national laboratory be at the discretion of the OHEP Associate Director (AD) based on demonstrated commitment and capabilities of the laboratory, and 10. In cases of interagency partnerships, negotiate and document detailed arrangements between the agencies before a project advances to CD-0.

Abridged recommendations from the operations subpanel included the following. As a general comment, 11. In collaboration with the experiments, the national labs, and international partners such as the CERN open data portal, develop a mechanism to manage data preservation after operations end. Regarding Fermilab operations, 12. Continue to work with Fermilab and the DOE Site Office to find solutions for the site access issues. Regarding cosmic operations, 13. Share best practices and lessons learned for coordinating project, operations, and research resources.

DISCUSSION

Quinn commented the Fermilab access issues should not be written in the past tense, and recommendation 10 should explicitly push for more science at SPO. **Kim** noted Fermilab access is a DOE issue and outside of the charge's scope, but the statement was made as it concerns the community. The CMB-S4 review was made before NSF announced the SPO shutdown, and no detailed COV discussions took place. **Sanchez** asked for clarification on the possible request of a mediation plan from Fermilab. **Kim** noted the issue was outside of the charge's scope and no relevant discussions took place among the COV.

Giblin asked whether recommendation 1 was in response to an observed issue or advice for future events. **Kim** explained the recommendation is for future P5 implementation.

Prescod-Weinstein requested additional insight into recommendation 5. **Kim** noted COV was not aware of any specific issues but sought the development of general guidelines.

Arce foresaw difficulties in applying recommendation 4's request for demographics at universities and noted communication of the intent behind the recommendation would assist in OHEP's compliance. **Kim** agreed collecting demographics could be difficult for universities. Collecting demographics is the first step in discovering underlying issues and communicates OHEP's awareness and interest in diversity.

Yamamoto questioned whether recommendation 7 indicates a systematic issue in the field. **Kim** referenced the increasing complexity and size of projects and cited the lack of specific

policies to guide the contract process as the rationale behind the recommendation.

Response from DOE to the COV Report, Michael Procario

Procario's upcoming retirement has prompted the development of procedures to track the completion of DOE actions in response to COV recommendations and assist the incoming facilities director.

Abridged responses to the 13 COV recommendations are as follows. 1. A significant deviation to P5 would be addressed with a request to HEPAP and / or a charge to form a subpanel to study the issue at hand. If further community input is desirable, the OHEP AD will, in consultation with NSF, recommend to the SC Director that the advice of HEPAP be sought on the matter. 2. The OHEP AD charged several working groups to bring together staff from the two divisions to work on common issues. 3. Work is in progress, and laboratories have been solicited for candidate identification. Use of federal staff and detailees must be balanced. 4. All laboratories have diversity, equity, and inclusion (DEI) programs to ensure a diverse workforce. Guidance is requested on the language "employ transparent mechanisms." 5. OHEP uses the SC code of conduct, which is based on the APS code of conduct. 6. The approach will be implemented but has been met with resistance in the past. 7. Strong laboratory procurement departments would be the best solution. OHEP can make inquiries, but not direct procurement actions. 8. OHEP agrees, and implementation will be crucial for the Advancing Science and Technology through Agile Experiments (ASTAE) program. 9. OHEP agrees and will work with the Office of Project Assessment (OPA) for guidance on implementation. 10. It is unlikely that other agencies will agree to partner before CD-0, which represents DOE's first commitment to pursue a project. 11. SC policy on data management and preservation can be found online at https://science.osti.gov/Funding-Opportunities/Digital-Data-Management, and the research division will be consulted for additional guidance. 12. Significant progress has been made and further improvements will be sought. 13. OHEP agrees.

DISCUSSION

Seidel explained the meeting is significantly behind schedule and made the decision to forgo public questions. Members and attendees were encouraged to contact Procario privately with questions.

Bloom expressed strong disappointment. **Sanchez** shared the disappointment.

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. Further discussion on possible amendments will occur at the COV's discretion.
The report was accepted with 14 approvals, 0 disapprovals, and 0 abstentions.

Seidel dismissed the meeting for a break at 11:30 a.m. and resumed the meeting at 11:41 a.m.

User Support for Security and Access at Fermilab, Douglas Glenzinski

Glenzinski described the formation of a site access steering committee (SASC) to address widespread dissatisfaction with Fermilab's site access policies. The committee is comprised of laboratory representatives and relevant subject-matter experts (SMEs) intended to capture a range of perspectives. SASC conducted reviews of DOE orders providing frameworks

for physical site access, feedback from a 2023 SC commissioned assist visit report, benchmarks against peer DOE laboratories, and feedback from a broad spectrum of stakeholders to implement a broad communications campaign and define a desired realistic end-state.

Calendar year 2023 (CY23) site access requests averaged 1.6K per month, with wait times of eight days for U.S. citizens and 21 days for non-U.S. citizens. Additional statistics include roughly 20K total requests, a 96% access approval rate, roughly 10K business and 5K user / affiliate visitors, roughly one-third of user / affiliate requests from international colleagues, and over 5K public visitors.

SASC implemented a sustained program of improvements informed by community feedback. Highlights of access accomplishments include expanded access to office spaces for all badged personnel; the reestablishment of public access to Wilson Hall; the reestablishment of programs with local schools for monthly field trips; laboratory tours; and the reestablishment of science, technology, engineering, and math (STEM) programs. Conference organizers were solicited for feedback on improvement and over 1.7K scientists and engineers participated in on-site conferences and workshops in 2023. In addition, Fermilab Welcome and Access Centers (FWACs) facilitate site access and address questions for collaborator, business, subcontractor, and public visitors. Access request software improvements were guided by metrics aimed at identifying sources of mistakes and delays, and reduced approval time for U.S. citizens and non-U.S. citizens by 65% and 30%, respectively, and reduced errors by 50%. A prioritized plan has been implemented for a suite of additional IT improvements. New access categories and improvements to the foreign national access program streamline restrictions and serve to facilitate ease of international access.

SASC's intentions for Fermilab are summarized by four primary objectives: be a destination of choice for cutting-edge science and innovation, be a preferred science partner, be a STEM role model to inspire future scientists and engineers, and be a welcoming haven for neighbors. A prioritized project plan has been developed to guide the completion of primary objectives, achieve a future-state responsive to the Fermilab community, and comply with DOE requirements.

DISCUSSION

Tanedo questioned whether the reports are publicly accessible. **Glenzinski** replied only badged users have access, but the reports can be shared with HEPAP.

Quinn inquired whether reestablishing public access to the Wilson Hall 15th floor observation area is a goal of SASC. **Glenzinski** confirmed it was a goal.

Bloom requested clarification on the language "desired realistic end-state", and an explanation for the rejection of 4% of site access requests. **Glenzinski** explained it involves meeting all milestones required by the primary objectives, all of which are explicit responses to communicated concerns. Several reasons exist for the rejections, with the most common being duplicate requests.

Bishai lamented on the resources required to address multiple and often conflicting directives. **Anderson** commented leadership is open to conversations and exploring new ideas for moving forward.

Prescod-Weinstein expressed concern over the intersection of current anti-Asian and anti-Arabic racism with the new security measures at Fermilab, which may lead to pre-emptive exclusions. Insight was sought on upholding the 1964 Civil Rights Act Title VII protections from employment discrimination and choosing the topics requiring additional investigation.

Glenzinski noted exceptions to Title VII include countries identified as sponsors of terror. Topic controls include export-controlled information and areas identified in the DOE S&T technology risk matrix. PIs are required to undergo training when involved with sensitive research to ensure all rights are preserved.

Malik recommended a modernization of Fermilab's website and suggested the inclusion of access requirements on the front page. **Glenzinski** appreciated the feedback.

Report from the Leadership of FermiForward, Jack Anderson

Anderson identified FermiForward as the winner of the Fermilab contract recompete, with managerial responsibilities beginning on January 1, 2025. Five of the ten key initiatives of FermiForward are considered field-defining and align with P5 goals: neutrino science, the Higgs boson, muon science, the dark universe, and accelerators. Three of the initiatives are emerging sciences and synergistic with field-defining initiatives: QIS, AI, and microelectronics. The remaining initiatives include user and stakeholder engagement and core capabilities. The absence of efficient operations spurred the recompete and will be addressed by nine additional initiatives: project management excellence, small business first, work planning and control, site access enhancement, campus forward, enterprise financials, procurement improvement, safety culture, and the BISON integrated management system.

Keys to Fermilab's success include executing an ambitious and expanding S&T program; delivering a $5.5B portfolio of projects safely, on time, and within budget; and establishing discipline and efficiency to operations. Success will require a leadership team trusted by DOE and the community, improvements in business practices, an enhanced level of management rigor, and open communication regarding the incoming changes. Primary partnerships will be maintained with the University of Chicago and the URA. To address shortcomings in operations, Amentum and Longenecker & Associates will serve as integrated subcontractors. Value and experience will be added through partnerships with an additional 18 research institutions.

The contract recompete indicated DOE's desire for change and a reimagining of the laboratory. Analysis of Fermilab's strengths and weaknesses and identifying improvements required resulted in the promises made in the recompete proposal. Delivering on promises will require achieving strategic goals, enhancing community engagement, overcoming operational challenges to the mission, and resolving infrastructure readiness.

Contract transition began in October 2024 and ends on December 31, 2024. Required actions include notating thousands of subcontracts and preparing new employment offers for all employees. Although difficult, the transition process will provide an invaluable assessment of Fermilab's current state and inform additional improvements. The transition is currently ahead of schedule.

DISCUSSION

Quinn questioned whether the 18 new partnerships will result in a subset of favored institutions and asked what the institutions are getting in return for resources. **Anderson** noted a portion of the partnerships are existing alliances taken to new levels of commitment. **Fleming** added the new institutions have committed more resources than other URA members, but the contributions will not diminish the status of any other collaborations. **Mester** explained the commitments are mainly joint appointments for graduate students. The commitments will neither grant additional rights nor affect the rights of the other users.

Bloom sought additional clarification on the 18 new partnerships and noted the existing 93 URA member universities received no communication about the existence of a formal bid process. The specifics of incoming changes were requested as the prior management team and participating entities remain in place, and concern was expressed for the possible disruption of Fermilab's science mission. **Anderson** explained specific details are not yet available and are subject to ongoing assessment by various subject matter experts. Groundwork, planning, and expectations had to be established, but implementation will take time.

Gershtein noted transitions typically result in changes of leadership and asked whether the current state of the laboratory in terms of conducting business, upholding morale, and fulfilling its role as a steward of particle physics science for the U.S. was acceptable. **Anderson** revealed the direct answer is no, which explains the many initiatives intended to make significant improvements.

Sanchez commented change can be expensive, and asked how changes will be implemented under constrained budgets without disrupting science. **Anderson** explained difficult decisions and vigilance over forecasts and events in Washington are required.

Vahle mentioned the neglect and subsequent failure of infrastructure eroded the trust of U.S. and international users and asked for plans to regain trust. **Anderson** revealed additional investment in predictive and proactive capabilities will be implemented for campus infrastructure.

Bishai revealed community concern regarding improper reduction in force (RIF) procedures at Fermilab and asked how FermiForward would protect employee rights. **Anderson** noted evaluation of the paths forward are still in progress.

Report from the Fermilab Director, Lia Merminga

Merminga believes Fermilab's current process of transformation will result in a new era of scientific discovery. Recent challenges include financial strain leading to reduced activities and hiring in FY24 and RIF in FY25; operational challenges including reduced accelerator complex operation in FY24 and infrastructure failures preventing Main Injector operation in FY25; a culture climate survey revealing reduced morale; and the uncertainty created by contract recompetition. Plans to address all issues are being urgently developed with partners. Strategies to move forward will rely on core capabilities and the science drivers of P5.

The existing experimental program and project portfolio, the largest in SC, is roughly 46% complete, and total completion is a priority. In accordance with P5, delivering LBNF / DUNE is the highest priority. Notable neutrino initiative highlights include the 2X2 demonstrator installed in the Neutrinos at the Main Injector (NuMI) beamline, the NuMI Off-Axis νe-Appearance (NOvA) experiment and short-baseline neutrino (SBN) program, the PIP-II upgrade completion of three prototype SRF cryomodules, and completion of the coldbox. Notable Higgs and energy frontier initiative highlights include hosting an MC, which requires completion of the HL-LHC CMS upgrade. The muons initiative has two major activities: Muon g-2, with a current focus on publishing results by 2026; and Mu2e, which is 93% percent complete and transitioning to operations. The dark universe initiative produced record-breaking detection results with Skipper charge-coupled devices (CCDs) in the sub-electron noise Skipper-CCD experimental instrument (SENSEI) experiment and the search continues for the quantum chromodynamics axion in the Axion Dark Matter generation 2 (ADMX-G2) experiment. The accelerator S&T initiative has been focusing on preparations to run LBNF / DUNE after the long shutdown and Mu2e'a first data run. Plans to recover accelerator operations in FY26 will involve

relocation of a transformer, replacement of failed bushings, and repair of Main Injector heat exchangers, with a long-term goal of replacing all transformers and heat exchangers at or near end-of-life to restore resiliency. The accelerator infrastructure readiness task force (AIRForce) works across organizational boundaries and has been charged to develop a plan which ensures accelerator complex operations will be ready to support reliable beam delivery for LBNF / DUNE.

Highlights and goals of emerging technologies and national initiatives include the QIS initiative, focusing on renewal proposals for SQMS and quantum science centers (QSCs); the microelectronics initiative, in which Fermilab was awarded the lead of two MSRCs and will participate in three others, and a demonstration of AI-on-chip by HL-LHC CMS upgrade chips; and the AI for science initiative, in which Fermilab is a leader in intelligent sensing and real-time AI.

Discovery on the Prairie is a new user and stakeholder initiative, which recognizes the essential role partnerships with the scientific community, region, and nation play in delivering Fermilab's mission. In addition, the initiative provides on-site housing for the upcoming DUNE collaboration. As a reimagined Fermilab village, the campus and infrastructure will be revitalized as needed by the community. Initiative highlights include: $30M investment from state of IL; modern daycare, recreational and community amenities; world-class STEM and community-outreach facility; and a technology and innovation park with university and industrial partners.

Plans to achieve excellence in business and laboratory operations require strengthening safety performance and culture, managing budgets with greater precision, realizing improvements in business systems, implementing responses to the DOE financial management review, and providing assurances requirements are being met. Fermilab aims to be a global leader for sustainability and recently received an Outstanding Net-Zero Building Program / Project Award, a High-Performance Sustainable Building Award, and a Green Fleet Award. In addition, implementation of solar photovoltaics is in progress, funded by a $10M DOE grant.

The current focus on building a culture of excellence will serve to boost employee trust and morale. Launching in 2025, the initiative aims to maximize performance, drive culture change through exemplifying core values, and deliver positive change where needed. Through continuous engagement with the community, Fermilab will attain unprecedented heights of scientific discovery, technological innovation, and inspiration.

DISCUSSION

Prescod-Weinstein referenced the 2018 sexual assault and requested details on the actions taken to prevent similar occurrences. **Merminga** noted the assault predates the entire leadership team and explained the current code of conduct includes consequences which scale according to the transgression. In addition, Fermilab is in the process of hiring an ombudsman.

Sanchez questioned whether an external panel of SMEs will review AIRForce findings and asked how the long-term plan for replacement of all transformers and heat exchangers at or near end-of-life will be funded. **Merminga** noted external reviewers are not part of the charge, but AIRForce reports will be sent to DOE for review. Roughly $6-10M has been earmarked for transformers and heat exchangers, and additional savings will accrue by not running the Main Injector.

Eno commented achieving the Fermilab vision requires the planning and work from a critical mass of scientists, questioned the likelihood of achieving critical mass in a low budget scenario, and asked how prioritizations will maintain critical mass. **Merminga** explained

working with universities and students provides a mechanism to extend the workforce, and prioritizations follow P5 guidelines.

Bloom questioned the rationale of expecting new outcomes by addressing known, long-standing problems with the same management partners and leadership team. **Merminga** reemphasized the commitment of the team to deliver solutions. Many problems were not known, and, moving forward, the root cause of problems will be addressed instead of applying temporary fixes.

Bishai expressed concern for overhead infrastructure costs being charged to projects. **Merminga** replied a full answer is not available now, but the financial management review response will involve a reevaluation of Fermilab's financial model.

Demarteau commented particle physics is a global discipline and HL-LHC is the priority for the field. Fermilab is the only laboratory working on CMS and has been struggling to deliver on the upgrade for the past three years. HL-LHC must be the top priority, and a successful delivery will benefit the entire field.

The DOE Viewpoint on Fermilab, Regina Rameika

Rameika disclosed DOE assumes responsibility for Fermilab's problems, and efforts toward reconciliation are in progress. Laboratories account for 80% of the OHEP budget, and 70% of the laboratory budget is spent on Fermilab research, operations, and projects. While OHEP would not traditionally provide further oversight of the distributed funds, the repercussions of recent infrastructure failure have prompted increased levels of involvement to ensure the delivery of science.

OHEP is coordinating with laboratory leadership and FermiForward to operate the booster neutrino beam and commission Mu2e in 2025 and run the switchyard, Main Injector, and Neutrinos at the Main Injector (NuMI) beam in 2026. In addition, the requirements for PIP-II beam delivery at LBNF and the feasibility of the Accelerator Complex Evolution - Main Injector Ramp and Target (ACE-MIRT) must be determined. HL-LHC is a major priority, and progress is under close observation.

P5's suggestion of an MC at Fermilab to bring the energy frontier back to the U.S. is an appropriate and attainable vision. The task will require international collaboration and all of U.S. HEP working together.

GENERAL DISCUSSION

Quinn reiterated the lack of transparency and communication regarding the 18 new institutional partners announced by FermiForward. The community needs to know the purpose of the partnerships, how selections were made, and details of the agreements.

Seidel adjourned the meeting 2:06 p.m.

Respectfully submitted, December 27, 2024,
Patrick J. Cosme, PhD
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