**Minutes**

**High Energy Physics Advisory Panel**

**March 17–18, 2011**

**Palomar Hotel, Washington, D.C.**

**HEPAP members present:**

Daniel Akerib Wim Leemans

Andrew Cohen Ann Nelson

Lance Dixon Regina Rameika

Bonnie Fleming Ian Shipsey

Douglas Glenzinski Melvyn Shochet, Chair

Donald Hartill Paris Sphicas

Steven Kettell

**HEPAP members absent:**

Marina Artuso Graciela Gelmini

Edward Blucher Daniel Marlow

**Also participating:**

Linda Blevins, Office of the Deputy Director for Science Programs, USDOE

William Brinkman, Director, Office of Science, USDOE

Julie Carruthers, Senior Science and Technology Advisor, Office of the Deputy Director for Science Programs, USDOE, USDOE

Glen Crawford, HEPAP Designated Federal Officer, Office of High Energy Physics, Office of Science, USDOE

Joseph Dehmer, Director, Division of Physics, National Science Foundation

Marcel Demarteau, Senior Scientist, High-Energy Physics Division, Argonne National Laboratory

Richard Gaitskell, Department of Physics, Brown University

Stephen Geer, Head, Muon Accelerator R&D Department, Accelerator Physics Center, Fermi National Accelerator Laboratory

Marvin Goldberg, Program Director, Division of Physics, National Science Foundation

Young-Kee Kim, Deputy Director, Fermi National Accelerator Laboratory

John Kogut, HEPAP Executive Secretary, Office of High Energy Physics, Office of Science, USDOE

Piermaria Oddone, Director, Fermi National Accelerator Laboratory

Frederick O’Hara, HEPAP Recording Secretary, Oak Ridge Institute for Science and Education

Moishe Pripstein, Program Director, Division of Physics, National Science Foundation

Michael Procario, ActingAssociate Director, Office of High Energy Physics, Office of Science, USDOE

James Reidy, Program Manager, Physics Division, National Science Foundation

James Strait, Project Manager, Long Baseline Neutrino Experiment, Fermi National Accelerator Laboratory

Keith Tucker, Office of Business Policy and Operations, USDOE

Hendrik Weerts, Director, High-Energy Physics Division, Argonne National Laboratory

Andreene Witt, Oak Ridge Institute for Science and Education

Katie Yurkewicz, Director, Office of Communication, Fermi National Accelerator Laboratory

About 45 others were in attendance in the course of the two-day meeting.

**Thursday, March 17, 2011**

**Morning Session**

The meeting was called to order at 9:58 a.m. by the chairman, **Melvyn Shochet**. He expressed sorrow and concern for the high-energy-physics colleagues in Japan, which had been hit by a major earthquake and tsunami. In other news, Judy Jackson had retired from Fermilab, and her successor, Katie Yurkewicz, was introduced. The employees of the University of Chicago and Fermilab would recuse themselves during discussions of the intensity frontier, and employees of Brookhaven National Laboratory (BNL), Fermilab, and the University of Chicago would recuse themselves during the discussions of the muon collider.

**Michael Procario** was introduced to present an update on the activities of DOE’s Office of High Energy Physics (HEP).

In FY10, the Office received $810.5 million; its FY11 request was for $829 million, but the Office actually has received only $799.5 million under the FY11 continuing resolution. In FY10, the Office of Science (SC) had $4,739.3 million; its FY11 request was for $5,129.6 million, but it actually has only $4,826 million under the FY11 continuing resolution.

HEP is now below the FY10 funding level because the Chief Financial Officer (CFO) is holding back the funds for the project engineering and design (PED) for Muon to Electron (Mu2e) Conversion and the Long-Baseline Neutrino Experiment (LBNE) because they are considered to be new starts, which are not allowed under the continuing resolution. The House has passed a budget with SC at $4.17 billion, but the Senate rejected it. This has introduced a lot of uncertainty. Funds that do not have to be spent are not being spent. There was no bottom line for HEP in that budget. There is a lot of uncertainty about what the final budget will be for SC. Senate action on another continuing resolution was expected during this meeting.

HEP has $799.5 million. It makes a financial plan for the national laboratories much like a normal year. The Office of Management and Budget (OMB) gives DOE an apportionment. The CFO of DOE (conservatively) allocates a fraction of the funds to each office. National laboratories have some freedom to move funds around during the continuing resolution to solve short-term problems; when the continuing resolution ends, they have to meet totals specified by the program office. HEP is holding minimal reserves at this point. A detector at the Booster Neutrino Experiment (MicroBooNE), Mu2e, and the LBNE are considered new starts and are not receiving any equipment funding or funding for the PED. Work slowdowns have been instituted to avoid a gap in funding and to deal with the Deep Underground Science and Engineering Laboratory (DUSEL) situation.

The long continuing resolution has delayed grants: 226 grants are planned for the entire year, 45 grant actions have been awarded, 13 have been approved and are awaiting final paperwork, 33 are in HEP for concurrence, and 135 await action. The average delay for awards is 50 days. All new, renewal, and supplemental funding actions for FY11 are currently on hold.

The HEP budget for FY10 was $790.811 million, the FY11 request was $829 million, the FY11 request as amended in March is $794.078 million, the FY12 request is $797.2 million, the FY12 request versus FY10 funding is an increase of $6.389 million. Proton accelerator-based physics ramps down significantly because of the Tevatron shutdown. The FY11 funding of the Office is actually below the FY10 appropriation. The FY12 request is a reduction of $15 million from FY10, putting it between Scenario A and Scenario B of the Particle Physics Project Prioritization Panel (P5) recommendations.

In terms of funding trends, SC is increasing its FY11 and FY12 funding requests. HEP declines in FY12. Since FY05, HEP has been taking periodic hits, making managing programs difficult. Research funding has increased significantly since 1996. Facilities funding has decreased since FY05 (essentially trading facilities for research). Projects declined from 1996 to 2006 (essentially trading projects for more research). Since 2006, the Office has worked to increase funding for the projects (e.g., Minerva and Daya Bay).

The Tevatron will not run in FY12. The proton linear accelerator complex will run for six months to support the neutrino program. Large Hadron Collider (LHC) support will decrease by $6.8 million as the Accelerator Project for the Upgrade of the LHC (APUL) project is completed. There is $10 million to support the Homestake Mine while decisions are made on whether DOE can use the mine for the SC program. [There is $5 million in the budget for the Office of Nuclear Physics (NP) for DUSEL, also.]

The Tevatron is running very well. The P5 advice for an additional 3 years of running was considered. The FY12 request supports the completion of the analyses with the full data sets. The disassembly of the Tevatron detectors and ring is being planned, and opportunities to reuse components elsewhere are being sought.

The Fermilab accelerator complex will run in FY12 to support the neutrino program [i.e., Main Injector Neutrino Oscillation Search (MINOS), MiniBooNE, and Main Injector Experiment ν-A (MINERvA)]. The NOvA [NuMI Off-Axis ve Appearance] Project will install the first detector modules and the required accelerator upgrades in FY12.

In construction, both Mu2e and the LBNE had their first requests for PED funds in FY12. Work on both projects has been slowed to prevent a gap in funding. The FY12 request includes other project cost (OPC) funding for both projects to prevent a funding gap in case there is a continuing resolution at the beginning of FY12.

DOE and NSF had developed a stewardship program for the physics program at the DUSEL: DOE would steward the LBNE while NSF stewarded the facility; NSF would steward the dark matter experiments, and DOE would partner; and DOE would steward neutrinoless double-beta decay, and NSF would partner. The National Science Board (NSB) rejected this arrangement and declined to fund the project any further, suggesting that it was more appropriate for DOE to build the facility.

SC has an interest in three experiments that had been planned for DUSEL: the LBNE, dark matter, and neutrinoless double-beta decay. It has to be figured out how to do this. At the same time, in NP, funding was decreased from $10 million to $5 million for this project. SC has started a review process to determine if any of these experiments can be carried out in a cost-effective manner; that review will inform the FY13 request.

The SLAC B-Factory was shut down in 2008. Funding for support for researchers and computing continues to ramp down. Funding is provided to disassemble the BaBar detector and the second-phase of the Positron Electron Project (PEP-II) accelerator. HEP is investigating the possibility of giving the accelerator components to Italy for its use, which would be less expensive than disposing of them. There has been a big falloff of papers published from BaBar since the peak in 2006.

In non-accelerator physics, there is a $17 million decrease in projects as Daya Bay, the Dark Energy Survey, and SuperCDMS [Cryogenic Dark Matter Search] are completed. The Large Synoptic Survey Telescope (LSST) and dark-matter experiments are in an R&D phase before starting major items of equipment (MIEs). The Office is currently operating with $14.8 million in this budget line.

The Dark Energy Survey is nearing completion and will begin operations in FY12. The Particle Astrophysics Scientific Assessment Group recommended funding the High-Altitude Cherenkov Array (HAWC) and pursuing R&D on at least two technologies to search for dark matter. A mission statement was signed by the Director of SC for a stage-IV ground-based dark-energy experiment. Joint Dark‑Energy Mission (JDEM) R&D will be closed out this year, and no more work will be conducted on that effort. The National Aeronautics and Space Administration (NASA) has the lead on Wide-Field Infrared Survey Telescope (WFIRST), and HEP continues to talk with them. They have funding problems of their own.

Theoretical Physics has an FY12 budget request of $68.914 million, an increase of $0.5 million from FY10. Advanced Technology R&D has an FY12 budget request of $152.744 million, a decrease of $3.604 million from FY10.

The Facilities for Accelerator Science and Experimental Test Beams (FACET) Project to build a beam-driven wakefield-acceleration test facility will be completed this year. The International Linear Collider (ILC) R&D program is reduced by $12.5 million from FY10 as the time scale for starting an ILC continues to recede. Information from the LHC needed to make a decision about the ILC may not be available until 2014 or 2015. The American Regional Team has prioritized the remaining R&D that was planned for the ILC Global Design Effort to maximize its impact.

Dennis Kovar retired at the end of the year. A search for a new associate director has begun. David Boehnlein joined the office as an Intergovernmental Personnel Act (IPA) staffer, Lali Chatterjee has joined the office as the computational program manager, Simona Rolli has accepted an offer to be a program manager, and a new financial analyst has been hired. Chung Leung completed his IPA term, and Amber Boehnlein will be leaving at the end of March. A federal position for a program manager in accelerator science could not be filled. An IPA or detailee is being sought to work in accelerator science and on the accelerator R&D strategic plan. (There has been no progress on the plan because of a lack of personnel.)

The search for new associate director is being headed by Patricia Dehmer. A decision should be made by July 25.

Fleming asked if any part of the DUSEL funding would be forthcoming for instruments for experiments. Procario said that there would be none.

Leemans noted that the job posting did not mention accelerated development responsibilities for the associate director. Procario responded that he had not read it. Julie Carruthers added that there should be nothing read into that omission.

**Joseph Dehmer** was asked to update the Committee on the activities of the Physics Division and Mathematical and Physical Sciences (MPS) Directorate.

The NSF request for FY12 is up 12% in comparison to that of FY10, close to the doubling curve. There will be a lot of chances for that situation to change. The MPS increase is 6%, the lowest increase of any research directorate. MPS will request $1.4 billion, distributed to Chemistry, Materials Research, and Mathematical Sciences, all of which are at or above the average. Physics and Astronomical Sciences are well below the average, but nonetheless positive. The priorities were primarily clean energy, advanced manufacturing, cyberinfrastructure, and Beyond Moore’s Law. Physics has an overlap with those areas that emerge with larger increases. Particle Physics did not have such overlap.

The biggest change is to DUSEL. The bridge award was not approved by the NSB, the funding was zeroed out in the FY12 budget, and the project does not appear in the Major Research Equipment and Facilities Construction (MREFC) list anymore. DOE now has the lead on DUSEL. The DUSEL funding went to the research budget line. Thus, although the funding for the project office has been zeroed, the funding for groups planning experiments will continue in the research budget line.

Barry Barish presented the NSB perspective to the National Research Council (NRC). In FY09, the NSB approved the preliminary design work. Several issues have been raised: the science opportunities assessment by the NRC, the NSF/DOE stewardship and partnership, reliable costing, and what will be needed for an informed go/no-go decision. A DUSEL decision timeline has been made irrelevant by the NSB decision.

The conclusions drawn by the NSB are that: (1) The NSF MREFC program expands the scope of the NSF research program to include large facilities. (2) A procedure (including MREFC) has been put into place; but one size does not fit all. (3) The perspective for future MREFCs includes uncertain budgets, rising operating costs, and science opportunities as the first criterion. (4) DUSEL needs an understanding of the realistic science opportunities; and the DOE/NSF partnership, design, construction costs, operating costs, safety issues, risks, etc. must be determined for the preliminary design report (PDR). A key decision by the NSF/NSB will occur after the PDR is issued and will decide whether to proceed to the final design report.

In summary, NSB has made a decision; the science is highly valued; the partnership plan was deemed unacceptable (the NSB did not want NSF to own and operate infrastructure); the PDR is coming soon; the NRC review is in process; in FY11, $4 million is being allocated for continued pumping of the Homestake Mine; in FY12, DUSEL funding is zero; the Physics Division (PHY) is on the sidelines [it has produced the PDR, and that is all it can do; it is absolutely dedicated to the physics questions involved]; elementary particle physics (EPP) is important; HEPAP needs to advise the agencies what the field needs in order to be vibrant; and after the NRC and DOE reports are published, there should be discussions at a higher level.

Shochet asked what the feeling was from MPS. Dehmer replied that he cannot speak to the future until the DOE scoping study is complete this spring. SC and MPS will look at the situation internally. PHY is discussing what might happen in the future; but the main discussions require the DOE study and participation of higher management.. Those discussions will occur later, and HEPAP will weigh in then.

Kettell asked what mechanisms there were besides MREFC. Dehmer answered, none. All the information that could be hoped for is in hand. If the NSF director and the NSB decided to go forward, it could happen very quickly. It would need to be a broad program. If NSF stewardship of the facility itself were removed, it might go forward.

Akerib noted that a lot of work had been put into planning and asked when that planning might be used. Dehmer responded that it might be used during the FY13 cycle. There will be a push for a midscale program. Akerib asked if the $29 million that was taken out of DUSEL could be put back in the midscale budget. Dehmer answered that the part for principal investigators (PIs) remains. The rest disappears. Midscale is the most important thing to do. Beginning in FY11, PHY will allocate some funds to midscale, with the ultimate goal of reaching $30 to $40 million. The NSB is also discussing midscale.

Glenzinski asked for an explanation of the NSB decision. Dehmer explained that there is no written explanation. It was clear that the NSB felt that NSF should not underwrite infrastructure that will require long-term funding. That financial responsibility would be a very substantial burden for DOE.

Nelson noted that the NSB’s reasoning was more substantial than Barish’s presentation to the NRC. Dehmer agreed. The dire consequences were not mentioned. The team has been reduced significantly. The FY12 budget is a fact.

Dixon asked if there should be a distinction made between experiments and facilities in the future. Dehmer agreed that it would be very useful, but the separation is usually ambiguous.

Oddone noted that there are many NSF PIs in the LBNE. Dehmer said that the NSF supports the physics and the people. In the future, it might be asked to “pay other people’s construction costs,” topping off other agencies’ budgets. Oddone suggested working with the NSB to represent the interests of the researchers that would use DUSEL.

Fleming asked what would happen to the skeleton team after the PDR is done. Dehmer replied that they will have gotten all the money they will get. It is desirable to have the PDR certified. The team probably has enough money to operate through summer. Future support is not assured.

Weerts said that he would have expected Dehmer to have said that the NSF is a proposal-driven agency and funds proposals. Dehmer agreed.

Shochet stated that the NSB decision has had a negative effect on elementary particle physics. The NSF needs to come up with and support a plan. Dehmer said that the NSF and DOE are continuing to discuss the terrain.

Strait stated that the cost has not been determined. NSF partnership would make more science possible. It is not just topping off someone else’s budget. Dehmer said that, at this time, he could not say that the NSF will be a partner.

**Glen Crawford** was asked to respond to the Committee of Visitors (COV) report on the Office of High Energy Physics (HEP). The report contained 22 recommendations. The responses of HEP are posted on the web. In response to those recommendations, the Office

* Plans to submit a charge to HEPAP in 2011 to formulate a strategic plan for strengthening and expanding the stewardship role of HEP in accelerator science and technology
* Will work to implement the HEP strategic plan, which calls for increased investment in projects
* Will fill allocated federal positions and will seek approval for any additional positions needed to carry out the Office’s responsibilities
* Will implement an appropriate review process of university grants in the physics research programs that is comparable to the review process for national laboratories
* Will streamline its procedures and show improvement in providing feedback to PIs on submitted proposals in a timely manner
* Will participate in developing an SC-wide database on grant statistics and participants for all programs
* Is developing a new electronic portfolio management system for program managers
* Will work with SC to incorporate lessons learned from past program cycles of the Early Career Awards to improve that program
* Will examine last year’s travel usage and use the findings for planning travel in coming years
* Has established templates for reviews in some HEP subprograms and will expand their usage across the Office
* Will identify options for initiating MIEs in a more timely way while still being in compliance with DOE policies and practices
* Will work to ensure that all substantial subfields represented in theory proposals are reviewed by knowledgeable reviewers
* Will set up a calendar and track progress to ensure that proposal decisions are made and communicated within months
* Will not open the eligibility requirements of the theory home institution program to all advanced high-energy-physics graduate students because the program was set up to address the specific needs of the Office for theory grants and because SC already has a graduate student fellowship program that is open to all
* Will consider expansion of the home institution graduate student fellowship program on the basis of its merit and performance in the context of other priorities in the theory program
* Will continue to encourage grant applications from all eligible PIs and make awards on the merit, promise, and feasibility of the proposed work
* Will update and communicate the procedures governing the approval process of modest funding changes between funding streams in response to evolving circumstances
* Will articulate and communicate to the field a method and timeline for defining operation metrics for HEP facilities and their annual adjustment
* Has updated the HEP review-procedures memo to incorporate into the facility review process responses to recommendations from previous reviews
* Has updated the HEP review-procedures memo to ensure that the facility review process always includes a useful closeout presentation
* Will work to include reviewers in the triennial reviews of the laboratory program who are familiar with and knowledgeable about the mission, roles, and methods of laboratories, while avoiding conflicts of interest
* Has developed and obtained initial critical decisions (CD-0) for projects once it is clear that funding to implement the project has been identified and a clear scientific need has been articulated and reviewed

Shipsey asked what recommendations from the 2007 COV were implemented. Crawford replied that about two-thirds of those recommendations were implemented. Several were not actionable.

Glenzinski asked what the HEP participation was in the SC Graduate Research Fellowship Program (GRFP). Crawford answered that HEP had 14 or 15 out of the 180 SC fellows across a broad spectrum of theory and experiment. The SC GRFP is not funded in FY12. HEP will continue participation with the DOE-funded program.

Sphicas asked if the monetary implications of the recommendations of the reviewers were being calibrated. Crawford said that systematic calibration has not been conducted overall; that is done only for the early steps of the review.

Gaitskell asked if anyone else was disturbed by the disparity between national laboratories and universities in the Early Career Awards. Crawford responded that it is an ongoing topic of discussion in all programs and offices.

Pripstein asked if these COV members were satisfied with the charge. Crawford noted that they sometimes went outside the charge.

Kim asked how well HEP has done in the SC Graduate Research Fellowship Program competition. Crawford replied that HEP’s success rate was comparable to that of other offices. There was not a quota. There were 3200 applications, and HEP got about 10% of the awards.

A break for lunch was declared at 11:53 a.m.

**Thursday, March 17, 2011**

**Afternoon Session**

The meeting was called back into session at 2 p.m.

**William Brinkman** was asked to review the FY12 budget request for DOE’s Office of Science (SC).

The people on the Hill are getting fed up with continuing resolutions. A budget for the year may be arrived at soon. If it ends up at the House mark, DOE will be in a bad situation. If it ends up with the Senate version, DOE will be in a manageable situation.

SC has done well in science, supporting more than 100 Nobel Prize winners (22 in the past decade); 45% of federal support of basic research in the physical sciences; and 27,000 Ph.D.s as well as graduate students, undergraduates, and high school students and a wealth of facilities serving more than 26,000 users a year.

President Obama noted that the United States faces greater competition now than ever before and that competition will be focused on clean energy and new energy technologies. SC is in a good position to respond to that national need. It has six research directorates. It supports major user facilities, national laboratories, and researchers. It has 40,000 proteins in a structural database. The FY12 budget will make a three-fold attack on energy problems by addressing materials by design (for nuclear power and photovoltaics), biosystems by design (for environmental remediation and bioenergy), and modeling and simulation (of climate, biofuels, and reactor design). There is a huge amount of data coming out of these programs and we need to learn how to manage these data efficiently and effectively. The Cray XT5 at Oak Ridge National Laboratory (ORNL) and the Blue Gene/P at Argonne National Laboratory (ANL) are important in this process.

SC is asking for a 14.8% increase in its budget: 21.0% in the Office of Advanced Scientific Computing Research (ASCR), 0.6% in HEP, 19.9% in NP [largely the 12-GeV upgrade of the Continuous Electron Beam Accelerator Facility (CEBAF) and the new start at Michigan State University], and 22% in Biological and Environmental Research (BER). The budget request fully funds the Fuels from Sunlight Energy Innovation Hub that was begun in FY10 and serves as an integrating focal point for the solar-fuel R&D community with collaborations with 20 Energy Frontier Research Centers. There are two others: one on nuclear-reactor modeling and one in the Office of Energy Efficiency and Renewable Energy (EERE) on better buildings. This year, SC is proposing the establishment of a Batteries and Energy Storage Energy Innovation Hub to push energy storage closer to the theoretical energy density. Batteries are needed that can store hundreds of megawatt hours of power.

ASCR is delivering world-leading computational and networking capabilities to the energy R&D community. The Jaguar has lost its world-leading status to a computer in China but should regain the lead when it is upgraded this spring. ASCR is proposing investments for exascale computing to leverage new chip technologies; to develop libraries, tools, and software for these new technologies; and to create public–private partnerships to develop platforms and codes. Uncertainty quantification is a major issue at the exascale. Long-haul trucks get an average 6.7 miles per gallon at 70 mph. There are 1.3 million trucks on the road with 300,000 being added each year. Computer modeling and simulation have shown that a simple redesign can increase their mileage by 6.9%.

In Basic Energy Sciences (BES), DOE is proposing science for clean energy, computational materials and chemistry, and enhancements at user facilities. The integration of the different scientific disciplines is still not optimal. The free-electronic laser at SLAC can hit a liquid jet that has nanocrystals of a protein with a 50-nsec X-ray pulse and produce diffraction patterns for proteins, revealing the structure of the protein. SC R&D on cathode materials has produced high-energy lithium batteries, increasing the energy density of the batteries by a factor of 2. These new batteries will be used in the GM Volt.

BER is working on climate and bioenergy through (1) clean-energy biodesign of plant and microbial systems, (2) a comprehensive Arctic-environmental-system model, and (3) support for the Bioenergy Research Centers (which have filed 66 patent applications in 2 years) and other facilities. BER is also tackling major climate uncertainties. The community is looking forward to systems that will not produce biofuels that need blending or conversion (like ethanol) but can be used directly (like butanol).

Fusion Energy Science is working on the International Thermonuclear Experimental Reactor (ITER), which would produce 10 times as much power as goes into heating the plasma. The United States is providing management and is establishing cost and schedule baselines. Precision manipulation of the magnetic field of a tokomak can prevent dangerous heat-flux transients that cause plasma instabilities. Construction of ITER has begun. The United States is to build the central solenoid for ITER.

In NP, the Facility for Rare Isotope Beams (FRIB) is being designed. A new form of antimatter has been discovered at the Relativistic Heavy Ion Collider (RHIC). Work at the High-Flux Isotope Reactor at ORNL contributed to the discovery of a new element (number 117), hinting at a valley of stability in the chart of the nuclides. The Isotope Development and Production Program is making hundreds of isotopes available, 20% to scientific research, 20% to industry, and 60% to the medical community. An important action is integrating the activities and output of the current, widespread, and diverse domestic sources of isotopes. The nuclear community has two major projects to support and is unlikely to get large increases. That situation prompted the decision to close the Holifield Radioactive Ion Beam Facility (HRIBF). The decision had to be made quickly with no time to consult with the scientific community.

HEP has had successes with the Fermi Gamma-Ray Space Telescope. The Tevatron at Fermilab has been running extremely well as has the LHC. An extended Tevatron run was considered, but a doubling of the integrated luminosity would take several years, so the President’s budget request does not call for running the Tevatron beyond 2011. The LBNE at Fermilab along with DUSEL is a high-priority experiment and is being reconsidered in light of the refusal of the NSB to endorse the DUSEL. DOE had planned to use it in many experiments. DOE has urged NSF to keep the pumps running to November, and DOE would budget to operate the site after that. A group has been asked to conduct an assessment of how DOE can do the three experiments (LBNE, neutrinoless double-beta decay, and dark matter).

The Office of Workforce Development for Teachers and Scientists is supporting the Science Bowl, research experiences at national laboratories for teachers and students, and graduate fellowships.

SC is asking each advisory committee to look into their respective office’s practices and policies on the dissemination and long-term stewardship of the results of unclassified research. Shochet noted that a group of HEPAP members has been asked to prepare a draft response to the charge on data dissemination and stewardship.

Nelson asked for more information about the DOE response to the NSB’s decision on DUSEL. Brinkman replied that SC wants to do those three experiments. It is not known if they would be stand-alone activities or would all be done at the same place. Shochet noted that, if there is no MREFC from NSF, the cost of DOE goes way up. Brinkman replied that DOE has told NSF that the budget preparation has a short fuse and their input is needed by the end of May.

Fleming asked what DOE’s intention was for the early experiments at DUSEL [e.g., the Large Underground Xenon Detector (LUX) and Majorana]. Brickman answered that DOE is going to continue funding them.

Akerib asked what other input about DUSEL DOE was seeking in addition to the March report and the PDR. Brinkman’s replied that DOE would like to get something from NSF.

Gaitskell asked what timescale would be needed for a response from NSF. Brinkman responded, well before the end of May.

**Michael Procario** was asked to discuss the implementation of the Intensity Frontier program. Those from the University of Chicago and Fermilab were asked to recuse themselves.

P5 provided a framework for managing the programs in the intensity frontier. The physics includes neutrino mass; neutrino oscillations; neutrinoless double-beta decay; CP violation; proton decay; rare decays of muons, kaons, and B mesons; and precision measurements like g-2. The tools that could be needed include a deep underground laboratory, a multi-megawatt proton source, B-factories/super B-factories, nuclear reactors, innovative detectors that can reject backgrounds, and large yet affordable detectors for neutrinos.

The ongoing program includes MINOS, MiniBooNE, and MINERvA. They are all taking data today at Fermilab. MINOS and MiniBooNE are pursuing discrepancies that they have seen in their antineutrino data. MINERvA is carrying out a program of precision cross-section measurements made possible by the high power of the Neutrinos at the Main Injector (NuMI) beam. The BaBar and Belle collaborations continue to publish results on B physics.

Nearing completion are the Daya Bay Reactor Neutrino Experiment and the NOvA far detector building; assembly of the detector is to start at end of 2011.

There are some approved initiatives:

* The Mu2e Conversion Experiment received CD-0 in November 2009. PED funds were requested in the FY11 budget; but because it is a new start, the PED funds are not available under the continuing resolution. The goal is to have a CD-1 review this summer.
* The MicroBooNE experiment has received CD-1. It uses the Booster neutrino beam to study neutrino oscillations and cross-sections. It provides a technology demonstration for liquid-argon time-projection chambers (TPCs). MicroBooNE appears in the FY11 request for the first time as an MIE, which makes it a new start, so fabrication cannot be started until there is a budget.
* The LBNE CD-0 was approved in January 2010 and PED funds were requested in the FY 2011 budget. Like Mu2e, its PED funds were held up by the continuing resolution. The project is surviving on carryover funds. It was to be sited at DUSEL but the decision of the NSB has forced reconsideration of the options. The LBNE team has been preparing for the Review of Underground Science at Homestake. Costing will be done for both liquid argon at 800 ft and water Cerenkov at 4850 ft. Decisions about how to continue with LBNE will be made after the review. The mission need still exists. Alternative sites can be considered. The cost to DOE will probably be higher than planned because of reduced NSF participation. A large investment was being made by NSF. The FY12 budget request includes both OPC and PED funds to avoid continuing-resolution disruptions.

In 2008, the P5 report called for more investments at the Intensity Frontier to establish a world-leading U.S. program. In one of the mid-range funding scenarios (Scenario B), P5 called for modest U.S. participation in an overseas “Super-B factory,” that will significantly extend the search for new physics and complement the domestic Intensity Frontier program centered at Fermilab. Two US proposals (with Japan and Italy) were submitted to respond to this recommendation. Subsequent to the P5 Report, DOE also received a revised proposal to re-mount the g-2 experiment at Fermilab, which would require about the same level of investment as U.S. participation in the Super-B projects. All three proposals were sent out for review, but the results were inconclusive. To help decide among these competing proposals, HEP convened a comparative review panel to prioritize the three proposals.

The clear recommendation from the panel was to fund both g-2 and U.S. participation in the Japanese Super-B proposal, if possible. The Italian Super-B proposal was not recommended for funding. The FY12 HEP Budget Request does not have a construction start for either g-2 or U.S. contributions to Belle-II. However, DOE/HEP is interested in supporting g-2/Belle-II, including contributions of equipment if a feasible cost and schedule can be arranged. Proponents were encouraged to work with their international colleagues, laboratory management, and other funding agencies to identify revised project schedules and budget plans that meet the needs of all parties. During the week of this meeting, proponents met with DOE for very useful discussions. DOE will try its best to accommodate these projects in its out-year planning, subject to budget uncertainties. Mission-need statements will be prepared as soon as possible.

The review panel endorsed the scientific merit and competency of the U.S. groups in the Italian Super-B proposal as excellent. However, the panel felt the proposal was too ambitious and potentially exposed the U.S. HEP program to significant cost risks if the project encountered difficulty. The Italian government has formally announced its support for the Super-B proposal. DOE would be pleased to supply reusable PEP-II and Babar detector components to the Italian Super-B project if provided assistance with disassembly efforts and shipping costs. Individual university PIs or national laboratory staff who wish to participate in the Italian Super-B research program should submit proposals for merit review. The priority of DOE/HEP in this research area will be Belle-II.

The stages of the intensity frontier have an ongoing program, the first two of which are dominated by neutrinos. The approved initiatives are dominated by muons. No kaon experiments have been approved yet. P5 considered a proposal for a kaon–pion–double neutrino experiment and stated that such an experiment that observed 1000 events would be very important.

These programs would produce a leadership role for the United States at the intensity frontier. The intensity frontier is a centerpiece of the U.S. high-energy-physics program for the coming decade and can maintain U.S. leadership in the worldwide HEP arena. To control its own destiny, the United States needs more than a collection of good experiments. It needs a community with expertise, high-quality tools, both facilities and technologies, and a program with breadth. It should do science while training students and advancing technology. If one does all this, one will attract the best physicists from around the world.

To carry out these programs, a multi-megawatt proton source was envisioned by P5 as an important future intensity-frontier facility. Fermilab has been developing this concept during the past several years. It has evolved from an ILC-like accelerator well-suited to neutrinos to a more flexible accelerator capable of supporting a broad program. The program can include muons, kaons, and short- and long-baseline neutrinos. The Office is working with Fermilab to determine the next steps in developing this program and expects to come back to the community for further input.

The floor was opened for discussion. There was none. A break was declared at 3:12 p.m., and the meeting was called back into session at 3:30 p.m.

**Piermaria Oddone** was asked to discuss the intensity frontier at Fermilab.

There are two principal approaches to the intensity frontier: proton superbeams to study neutrinos and rare decays and quark factories. The principal gap is the understanding of neutrinos and the observation of rare decays coupled to new-physics processes. The Fermilab strategy is to develop the most powerful set of facilities in the world for the study of neutrinos and rare processes, well beyond the present state of the art. The facilities would be complementary to LHC and have a discovery potential (in terms of mass) that would go beyond the LHC. DOE has the central role and will define the role of U.S. facilities in the world. Currently being run are MINOS, MiniBooNE, MINERvA, and SeaQuest. Other programs being planned or discussed are NOvA, g-2, MINOS, LBNE, Project X, and others.

More radio frequency power is needed. The proton throughput needs to be doubled. That can be done in the next few years.

MINOS has done a good job measuring atmospheric neutrinos. There seems to be a tension between neutrinos and antineutrinos. MINOS has not been designed for that. In the NOvA era, MINOS would have sensitivities to new physics at its high energy and high flux. There are important measurements to be made.

MiniBooNE has shown an anomaly in the low-momentum neutrinos. Neutrinos and antineutrinos may be different.

MINERvA has started producing results. It gives very good data and will measure neutrino cross-section parameters.

NOvA is under construction, which is going well.

A new g-2 proposal is being put together to reach an uncertainty of 0.14 × 10–11.

Mu2e is a challenging experiment. The conversion of a muon into an electron in the field of a nucleus has a negligible rate in the Standard Model and a measurable one in many extensions of the Standard Model. It will be very sensitive to new physics. The needed beam can be produced. A campus could be constructed to host both the Mu2e and g-2. The most important foundation is to commit to building the most intense and flexible source. The foundation *cannot* be the present front end of Fermilab that is 40 years old. Existing and proposed sources elsewhere are pulsed linacs and synchrotrons, both having fundamental limitations in usable intensity. The source would be much more powerful.

Project X would provide the appropriate beam structure for kaons, nuclei, and muons. The beam could also be fed to a pulsed linac for feeding the Main Injector to produce neutrinos. It is large, but not bigger than what has been done before.

The continuous-wave (CW) linac would be a unique facility for rare decays: a continuous wave, very high power, superconducting 3-GeV linac. Such a facility will not exist anywhere else. A CW linac greatly enhances the capability for rare decays of kaons and muons and is the ideal machine for other uses: Standard Model tests with nuclei, possible energy and transmutation applications, and cold neutrons.

An example is the decay of kaons to a pion, an antineutrino, and a neutrino. A pencil beam can be made and have one decay in the detector with each pulse. The Standard Model precision is about 3%. These decays are so suppressed in the Standard Model, that anything that is added makes a huge difference. Sensitivity will be improved significantly.

The CW linaccoupled to an 8-GeV pulsed linac and to the Recycler and Main Injector gives the most intense beams of neutrinos at high energy (LBNE) and low energy (for the successors to Mini and MicroBooNE). It makes use of modern accelerators at Fermilab (Recycler and Main Injector), and its scope would be difficult to reproduce elsewhere without this established back end. It eliminates proton economics as the major limitation: all experiments run simultaneously. Project X benefits from the world-wide ILC R&D: superconductiong radio frequency (SCRF) and photo-electron cloud. SCRF R&D positions the United States to play a leading role in the ILC. Capabilities and infrastructure developed for Project X will be useful for other domestic HEP and non-HEP projects. Project X with upgrades can be the front end of a neutrino factory or a muon collider, opening paths for the development of the intensity frontier and a road back to the energy frontier.

The other part of the vision is the LBNE, a key experiment in the neutrino area that already engages a very broad collaboration. It can start with the 700-kW beam developed for NOvA. It would ultimately have more than 2000 kW in the Project X era. About half the investment needs to be made at Fermilab; the rest has to be made in the detectors (a Cerenkov detector at 4850 ft or a liquid argon detector at 800 ft). A committee is looking at all the options.

There is a 3-GeV linac for muons, kaons, nuclei, and materials; a 3- to 8-GeV pulsed linac for neutrinos and antineutrinos and for muons, and 8- to 120-GeV existing machines for long-baseline neutrino acceleration.

Sequencing is flexible. One could do (1) LBNE at 700 kW, a 3-GeV initial program, an 8-GeV initial program, and the LBNE at 2300 kW or (2) a 3-GeV initial program, an 8-GeV initial program, and the LBNE at 2300 kW. An earnest effort is being made to get a CD-0 for Project X. It would garner a lot of support and collaboration from other countries, but it needs an agency behind it.

The 3-GeV linac would cost $1.2 billion for the accelerator and $0.2 billion for the experiments. The 3- to 8-GeV pulsed linac would cost $0.5 billion for the accelerator and $0.2 billion for the experiments. The 8- to 120-GeV project would cost $0.1 billion for the accelerator and $1.0 billion for the experiments. The Main Injector needs upgrades, and that is what contributes the $0.1 billion accelerator cost to the last stage. For a TPC, a 3-GeV CW linac would cost $1.2 billion for the accelerator and $0.2 billion for the experiments. The net offsets would be $0.3 billion and $0.1 billion for the accelerator and experiments, respectively, for the 3-GeV CW linac; $0.1 billion and $0.05 billion for the 3- to 8-GeV pulsed linac; and $0 and $0.2 billion for the 8- to 120-GeV existing machines. This has been done before with the Spallation Neutron Source. What is needed is a bump-up of $150 million per year for 10 years.

This project would serve the LBNE, three stations (kaon, nuclear, and muons), and a muon collider.

Nelson asked about the possibility of non-HEP funding. Oddone said that the beam would be provided by Project X, and experimental stations would be funded by others. Construction should be an HEP project. Nelson asked if Congress would have to appreciate this collaboration. Oddone replied, yes. Project X would be helping others, and that would help its case.

Dixon asked what the number of HEP experimental users might be. Oddone responded, about the same number of users as Fermilab has today. A lot of bright young people would be attracted to this scientific opportunity.

Leemans asked what linac R&D would have to be done. Oddone answered that the superconducting R&D is the main challenge: the shapes of cavities, high-frequency, etc. A new type of cryomodule needs to be developed. That should be done first. Cornell University (supported by NSF) is involved along with Jefferson Laboratory. There are significant areas where CERN {the Conseil Européen pour la Recherche Nucléaire [now European Organization for Nuclear Research (Organisation Européenne pour la Recherche Nucléaire)]} could be helpful.

Kettell noted that a staged development had been proposed except for kaons and that these are very complicated experiments. He asked if there were any intermediate step for kaons. Oddone said that a kaon experiment had been proposed but it would require the operation of the Tevatron, a great expense. There is an intermediate experiment in Japan.

Sphicas asked what would happen if a signal were observed at the LHC. Oddone said that the plan is to quickly understand whether the proper energy could be reached by the ILC. If not, a very-high-energy machine would be required. An increase in R&D would be needed to respond to such a signal. Sphicas asked if a muon collider would be jumped to. Oddone responded that there is a lot of work that has to be done before one goes to a muon collider. It is a great R&D project.

Nelson asked if an ILC scenario could be seen on the horizon. Oddone replied that, if supersymmetry were found as well as the Higgs, the topic of the ILC would come up. Japan has been pushing to host the ILC, as would CERN. The cost would be too large for the United States.

**Marcel Demarteau** was asked to review the recent detector R&D workshop that was held at Fermi Lab at the end of 2010.

New technologies and instruments are science enablers. Many measurements would not have been possible without silicon detectors. There was (and is) no alternative to this technology. The next generation of experiments will require a new generation of detectors with greater precision, physical size, cost, and development time.

The complexity, cost, construction, and running time of the current generation of experiments has evolved significantly during the past two decades. This evolution of the field is believed to possibly have led to

* Too small an investment in the development of new instrumentation to adequately address the future scientific questions;
* Insulation from new developments in other fields, such as materials science;
* Insulation from instrumentation advances and innovations in industry;
* Difficulties in retaining and training of experienced technical personnel;
* Descoping of the scientific reach of future projects;
* Erosion of the hardware skills of younger physicists; and
* The erosion of infrastructure at universities and national laboratories.

The field as a whole needs an enabling instrumentation program to pursue research at the energy, intensity, and cosmic frontiers. The DOE program officer for detector R&D at that time, Dr. Howard

Nicholson, initiated a review of the detector R&D programs at the national laboratories to assess the quality of the recent scientific performance of the national laboratory groups, and the merit and feasibility of their proposed activities for achieving the scientific goals and milestones of the field. An evaluation was asked for along specific programmatic thrusts. In addition, the reviewers were asked to comment on the size and scope of the current core detector R&D efforts at each national laboratory, the breadth of support for detector development that the national laboratories provide to the entire HEP community. That committee observed that the R&D program at the national laboratories is more or less following the P5 recommendation; there is some duplication of effort among the national laboratories; significant leveraging was observed at multidisciplinary national laboratories; more coherence and collaboration among the national laboratories is encouraged; more collaboration between universities and national laboratories is encouraged; the community needs an organized set of visible goals, endorsed by the field, that can be judged by the community; and the possibility of an annual workshop on detector development should be explored.

Fermilab organized a workshop on detector R&D. The workshop goals were to survey the detector R&D currently being carried out at national laboratories and universities; to identify the areas of detector R&D that hold greatest promise; and to identify the current challenges and future needs of all stakeholders. It was held October 7–9, 2010. It had laboratory talks, physics and technology talks, survey talks, a poster session, and special-topic talks.

The national laboratories have unique strengths and programs, which continue to have major impacts on the field. They highlighted their use of facilities and beam test facilities (at Fermilab and SLAC), which are an incredible resource to the community that has to be maintained.

There were two types of surveys. One looked at successful university-laboratory collaborations. One such collaboration was the construction of a liquid-argon detector. Funding, infrastructure that universities would never have, and combining the project with real neutrino data made this project a success. The bringing together of different areas of expertise can also lead to success. Another survey was carried out by the European Committee for Future Accelerators (ECFA) Instrumentation Panel on understanding detectors and instruments. The ECFA survey asked 600 participants (undergraduates, graduate students, postdocs, and senior people) how well they understood their detectors (completely lost, marginal, adequate, or expert). For the younger generation, the results are heavily biased toward marginal knowledge of the instrumentation.

The European perspective on detector R&D was presented at the workshop. Europeans are concerned about the emergence of “global” projects without a central host laboratory, the scale of those projects, and the scale of the detector R&D. Funding starts to become an issue, arousing concerns by some national funding authorities on the review processes. Funding is addressed by tapping the European Union (for infrastructure with a review process decoupled from the rest of the HEP community). The European Union Detector Program within Framework 6 got €7 million for 30 institutions. Reviews of some detector R&D groups were carried out by the Deutsches Elektronen‑Synchrotron (DESY) Peer Review Committee, even though the projects were not at DESY. ECFA is in the process of setting up a panel for European detector R&D to review some European detector R&D efforts.

Howard Nicholson’s perspective was that future research in high-energy physics requires an enabling detector R&D program to pursue that research at the three frontiers. This program should develop novel new detector technologies and methods, improve the characteristics of existing detectors, and develop cheaper technologies for large detector systems. Such a program would enhance the leadership ability of the U.S. HEP community, enable the U.S. HEP community to mount world-class experiments, and help optimize the use of limited funding.

The workshop showed obvious tensions in the form of enormous experimental challenges for the next generation of projects; approved projects versus new projects; erosion of university infrastructure and opportunities; pressures on and within the laboratory system; graduate student training separating from hardware; and industry is moving beyond us.

The question posed at the end of the workshop was: Should the community attempt to craft a national program of detector R&D? The answer was, yes. The Division of Particles and Fields (DPF) established a DPF task force on instrumentation in high energy physics to address these issues. Its charges are organized along three categories:

* The structure for a National Instrumentation R&D Strategy requires
* Need, merit, and a process for evaluating and promoting the national R&D program through a National Instrumentation Advisory Panel
* An appropriate role for a standing panel on instrumentation vis-à-vis existing and new projects
* Models for university–laboratory collaborative projects
* Strategic links to other scientific disciplines
* Strategic links to industry
* Models for entrepreneurial instrumentation science include targeted resources at each of the five national laboratories to specifically support particular needs of individual researchers.
* Graduate students need to be linked with instrumentation.

The task force will meet at the American Physical Society meeting and at the Technology and Instrumentation in Particle Physics 2011 conference and will deliver a preliminary report in August. The task force would very much welcome active NSF participation. It is exploring how to involve the NSF at this early stage of the process to provide input. The academic training of new generations of physicists especially would benefit greatly from NSF involvement.

In summary, a review of the detector R&D programs at the five national laboratories led to a self-organization of the community. A workshop dedicated to an overview of detector R&D in the United States was organized and held. The workshop was very informative and positively received by the community. A lot of high-quality R&D is being carried out. There seems to be an acute awareness that, for a sustained viability of the field, a renewed investment in sensor and detector development with the appropriate organization is needed. A DPF taskforce has been established to address the organization of HEP instrumentation.

Leemans asked how much overlap there was between industry’s research now and the community’s future needs. Demarteau replied that it is true that the involvement of industry is crucial. The Valley of death must be overcome right at the beginning.

Kim noted that there is an international school on instrumentation; the first was held at CERN, and the next will be held at Fermilab.

Reidy asked how many people from industry were on the working group. Demarteau replied, none. Feedback from industry is needed. There should be a national advisory panel that includes members from industry. Shipsey added that many companies in the country are being contacted and invited to participate. Industry found a school on the topic to be very attractive. Industrial partners were very willing to pay to participate and could partner with the NSF to fund graduate student fellowships. Without instrumentation, the enabler of our science is removed. Innovative instrumentation can totally transform the future of high-energy physics. The movement of the science into industrial applications would make the value of high-energy physics obvious.

The meeting was adjourned for the day at 5:06 p.m.

**Friday, March 18, 2011**

**Morning Session**

The meeting was called back into session at 8:59 a.m. Shochet announced that inspections at the Japan Proton Accelerator Research Complex (JPARC) accelerators revealed no significant damage after the earthquake and tsunami. There was significant damage to a power supply and a building. [It was later found that the **injection linac** at Kō Enerugī Kasokuki Kenkyū Kikō (KEK) **did suffer significant but “manageable” damage;** no serious damage was reported at Belle or in the KEKB main ring.]

**Stephen Geer** was asked to review muon-collider R&D. Those from BNL, the University of Chicago, and Fermilab were asked to recuse themselves.

If one can build a muon collider, it is an attractive multi-TeV lepton collider option because muons do not radiate as readily as electrons. Because of that, one can build a muon collider that is compact, uses multiple-pass acceleration, can produce multiple collisions in a ring, produces a narrow energy spread, and can support two detectors. However, muons are produced as tertiary particles. To make enough of them, one must start with a megawatt-scale proton source and target facility. Muons decay, so everything must be done fast, and one must deal with the decay electrons. Muons are born within a large 6-D phase-space. For a muon collider, one must cool them by O(106) before they decay. A new cooling technique (ionization cooling) must be demonstrated, and it requires components with demanding performance. After cooling, the beams still have a relatively large emittance compared with traditional accelerators.

One begins with an intense proton source that is impinged on a mercury target, producing pions and kaons that decay into muons, which are cooled, accelerated, and stored in a ring. The front end of a muon collider is the same as that for a neutrino factory.

During the past decade, neutrino factory feasibility studies have been completed, launching the ongoing International Design Study for a Neutrino Factory (IDS-NF) to provide a solid basis for planning the Muon Collider Design Feasibility Study (DFS) and real progress on understanding how to make enough muons, capture them into bunches, reduce their energy spread, and begin to reduce their transverse phase space (ionization cooling). The IDS-NF community plans to produce a reference design report (RDR) in about 2 years. An interim design report (IDR) is being finalized now and is to be reviewed by an ECFA subpanel in May. A 4-MW proton source would enable O(1021) muons per year to be produced, bunched, and cooled within the acceptance of an accelerator.

MERIT [Mercury-Intense Target] provided a proof-of-principal demonstration of a liquid mercury jet target in high-field solenoid in 2007. It successfully demonstrated a 20m/s liquid mercury jet injected into a 15-T solenoid, hit with a suitably intense beam (115 KJ per pulse). The results suggest that this technology is all right for beam powers up to 8 MW with a repetition rate of 70 Hz.

The biggest challenge is the cooling design to reduce the 6-D phase space. Some components are beyond the state-of-the-art [very-high-field high-temperature-superconductor (HTS) solenoids and high-gradient radio-frequency cavities operating in fields of a few teslas]; and the solenoids in the last stages of cooling (the original design needed 50-T solenoids, but recent improvements suggest that 30-T solenoids would be sufficient) are challenging.

The MuCool Test Area (MTA) was built at the end of the Fermilab linac for ionization cooling component testing with a 5-T magnet, an RF power at 805 MHz and 201 MHz, a clean room, liquid-hydrogen-handling capability, and a 400-MeV beam from the linac. In February 28, 2011, the first beam was achieved.

The Muon Ionization Cooling Experiment (MICE) is being carried out at Rutherford Accelerator Laboratory (RAL). It will be completed in 2014. It tests short cooling sections in a muon beam, measuring the muons before and after the cooling section to learn about cost, complexity, and engineering issues associated with cooling channels. It varies the RF, solenoid, and absorber parameters and demonstrates the ability to simulate the response of muons.

Electrons are produced by the decaying muons, so the detectors must be protected from them. Emittances are large, but the muons circulate for only about 1000 turns before they decay. High-field dipoles and quadrupoles are needed that operate in large muon-decay backgrounds. An open mid-plane magnet design has been studied and looks all right. More engineering studies are needed. Detector shielding and performance studies are under way.

Dennis Kovar requested for the lab to conduct the Muon Accelerator Program (MAP), the mission of which is to develop and demonstrate the concepts and critical technologies required to produce, capture, condition, accelerate, and store intense beams of muons for muon colliders and neutrino factories. The goal of MAP is to deliver results that will permit the high-energy physics community to make an informed choice of the optimal path to a high-energy lepton collider and/or a next-generation neutrino-beam facility. Coordination with the parallel Muon Collider Physics and Detector Study and with the International Design Study of a Neutrino Factory will ensure MAP’s responsiveness to physics requirements. The main deliverables for the R&D are to make MICE and IDS-neutrino factory studies a success and to deliver a collider design. That study constitutes an end-to-end simulation of a muon-collider complex based on technologies in-hand or that can be developed with a specified R&D program. It includes hardware R&D and experimental tests to guide and validate the design work. It is to develop a rough cost range and an R&D plan for longer-term activities.

We tried to assess the impact of the Muon Collider Design Feasibility Study. The technological readiness assessment indicated that significant progress would be achieved. Funding has increased from about $4 million per year for the first decade to a request of about $15 million in FY11.

A workshop will be conducted June 27 to July 1 in Colorado.

MAP is up and running. There is a real chance to show, within about 6 years, that a multi-TeV Muon Collider is feasible with an estimated cost range and with a specification of the remaining R&D needed. The proposed plan requires about $15 million per year and has many challenges, but we believe we can succeed.

One could add to Project X a neutrino factory with muon and kaon programs, providing an excellent muon collider testbed.

Shochet asked what the latest understanding was on a detector’s ability to withstand the intense radiation environment. Geer replied that the sensor response is very energy-dependent. From studies with 1.5-GeV particles, the preliminary assessment is that the neutron dose in the inner detectors is 0.1 of that in LHC (1034), but because of the bunch structure, it is more like 1035. The photons and electrons are also equivalent. The other stuff is less of a concern. There is good hope, but a lot of work is yet to be done.

Nelson asked what type of luminosity might be achieved. Geer replied 1034. Nelson asked what influence the LHC would have. Geer answered that the energy being studied now is 1.5 TeV; the range of energy being sought is 1 to 4 TeV. Whatever the LHC finds, the focus of attention will be on the MICE results.

Dixon asked how much cooling had been achieved to date. Geer answered that MICE will be able to test the cooling channels in about 2014. That would only be a small amount of cooling.

Shochet asked if they had been any ideas for 6-D cooling. Geer said that there are several alternatives. The choice will depend a lot on the R&D results. The gradient in the magnetic field will allow a choice in cooling channels.

**Linda Blevins** and **Keith Tucker** were asked to describe the progress on the new DOE Portfolio Analysis and Management Systems (PAMS).

There has been a lot of discussion of data management and the grant process, resulting in recommendations from COVs. DOE has been working on the problem for several years. In recent years, SC has had about 150 federal programs, 3000 active grants, 1000 awards, 2500 new proposals, 10,000 reviews collected, and 1750 proposals for Early Career awards. The business process for universities is to issue a solicitation; receive proposals; send encouragement/discouragement decisions; receive proposals; log and assign proposals to program managers; perform an administrative review; execute peer review; and make selections. If an award is accepted, the process continues to negotiate the scope and budget; receive a revised budget and scope; document the award decisions; place money in a monthly financial plan (STRIPES, the STRategic Integrated Procurement Enterprise System); create a requisition and obtain concurrence; approve the award recommendation; route the requisition to the Chicago Operations Office; negotiate the final award; issue the award; return reviews to the principal investigator; release the continuation or supplemental funding; receive and approve final technical reports; and close out the award. If the award is declined, the process continues to document the decision to decline; obtain approvals for the recommendation to decline; issue the declaration letter; return reviews; and close out the award. For the most part, the business process for national laboratories is much the same except that site offices rather than the Chicago Operations Office process the awards. This past year, Chicago Operations processed about 5000 awards, about 25% more than usual.

The current system tracks proposals but does not retain the proposals. The new system will collect data for COVs. It is desired to collect all reviews and provide them to the submitters and to have as much data and information in PAMS as possible.

PAMS is web-based government off-the-shelf (GOTS) software in use at several federal agencies. It automates currently manual portions of the grants-management and national-laboratory research-project funding processes. It supports the grants-management process from end to end. The system has a service-oriented design and has already been integrated with grants.gov and financial management systems at other federal agencies.

PAMS supports the complete research-funding process. It fills processing gaps, making it a seamless process to manage grants from solicitation through award to publishing the final results. It consolidates and integrates with existing information systems. It replaces outdated information systems, some of which have proposals or reviews in them but just track those proposals, but it does not duplicate the functionality of externally managed information systems. It improves data management (responding to seal the recommendations) by forging associations between people and research proposals or projects and by compiling grant-proposal demographics. An effort will be made to standardize data exchanges and enable flexibility in process implementation.

PAMS will be deployed iteratively. There has been a period of up-front planning preceding the release. There will now be a series of test cycles of the detailed design, development, system integration, training, and migration making up the deployment. The refinement of requirements is in its final steps. A gap-analysis estimate has been completed, showing how much work is needed to modify the baseline GOTS software to meet the requirements of SC. Requirements have been prioritized and partitioned into multiple iterations. The project schedule for building PAMS iteratively is in progress.

Hartill asked how long it will take. Blevins replied that the first iteration will be carried out in 2011; the entire implementation will be completed in 2 or 3 years.

Shochet noted that the STRIPES software was said to be friendly to procurement but not to grants. Tucker replied that STRIPES was not designed for grants. There is a grants module available, but DOE decided to develop PAMS instead. STRIPES procurement data will be handed off to PAMS to manage grants. Blevins added that STRIPES is not designed for grants. DOE went through an analysis of gaps and needs to support STRIPES and to develop PAMS. Work continues on the issue.

Shipsey asked what other customers there were for STRIPES. Blevins said that there were a lot of customers for STRIPES and Prism, including the National Institutes of Health (NIH). Shipsey asked if these were commercial products. Blevins replied that Prism is a commercial product. STRIPES is a government off-the-shelf.

Shochet noted that there was an ongoing situation at the Soudan Mine. Kim noted that there are two detectors there. The shaft is owned and operated by the Department of Natural Resources of the State of Minnesota. There was a fire in the shaft, starting the previous night. It was not clear what the cause might have been. DOE workers were the only ones there on the previous day. There was no one in the mine when the fire was first detected. The power was shut down, and the detectors were working off batteries. This is the only shaft to the laboratory.

A break was declared at 10:10 a.m.; the meeting was called back into session at 10:30 a.m.

Shochet noted that the next meeting will be June 23–24 at the Rockville Hilton Hotel and Executive Meeting Center. He read the list of highlights of the meeting that he intended to include in the letter to the agencies. The draft of the letter will be circulated to the Committee members a week after the meeting.

The floor was opened to public comments. There being none, the meeting was adjourned at 10:42 a.m.

Respectfully submitted,

Frederick M. O’Hara, Jr.

Recording Secretary

March 26, 2011

Corrected by

Melvyn Shochet

HEPAP Chairman

June 13, 2011

The minutes of the High Energy Physics Advisory Panel meeting held at the Palomar Hotel, Washington, D.C., on March 17-18, 2011, are certified to be an accurate representation of what occurred.

Signed by Melvyn Shochet, Chair of the High Energy Physics Advisory Panel on June 13, 2011.

