**Final Minutes**

**High Energy Physics Advisory Panel**

**October 27-28, 2011**

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

**HEPAP members present:**

Daniel Akerib Klaus Honscheid

Marina Artuso Wim Leemans

Karen Byrum Daniel Marlow

Andrew Cohen Patricia McBride

Lance Dixon Lia Merminga

Peter Fisher Ann Nelson

Graciela Gelmini Regina Rameika

Douglas Glenzinski Ian Shipsey

Donald Hartill Melvyn Shochet, Chair

John Hobbs Hitoshi Yamamoto

Steven Kettell

**HEPAP members absent:**

Edward Blucher Paris Sphicas

Bonnie Fleming

**Also participating:**

Glen Crawford, Director, Research and Technology R&D, Office of High Energy Physics, Office of Science, USDOE

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

Dmitri Denisov, Particle Physics Division, Fermi National Accelerator Laboratory

Robert Diebold, Principal, Diebold Consulting

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

Michael Harrison, Physics Department, Brookhaven National Laboratory

Daniel Hitchcock, Acting Associate Director, Office of Advanced Scientific Computing Research, Office of Science, USDOE

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

John Kogut, HEPAP Executive Secretary and Deputy HEPAP Designated Federal Officer, Office of High Energy Physics, Office of Science, USDOE

Andrew Lankford, Department of Physics and Astronomy, University of California at Irvine

David Lissauer, Group Leader, Directorate of Nuclear and Particle Physics, Brookhaven National Laboratory

Marsha Marsden, Oak Ridge Institute for Science and Education

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

Rene Ong, Department of Physics and Astronomy, University of California at Los Angeles

Moishe Pripstein, Experimental Elementary Particle Physics Program Director, Division of Physics, National Science Foundation.

Chris Quigg, Theoretical Physics Department, Fermi National Accelerator Laboratory

Robert Roser, Particle Physics Division, Fermi National Accelerator Laboratory

James Siegrist,Associate Director, Office of High Energy Physics, Office of Science, USDOE

Kathleen Turner, Program Manager, Office of High Energy Physics, Office of Science, USDOE

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

James Whitmore, Particle Astrophysics Program Director, Division of Physics, National Science Foundation

Andreene Witt, Oak Ridge Institute for Science and Education

About 65 others were in attendance in the course of the two-day meeting.

**Thursday, October 27, 2011**

**Morning Session**

Chairman **Melvyn Shochet** called the meeting to order at 9:00 a.m.

He introduced **James Siegrist** to update the Panel on the activities of DOE’s Office of High Energy Physics (HEP).

Siegrist congratulated Saul Perlmutter (a former member of HEPAP), Adam Reiss, and Brian Schmidt on receiving the Nobel Prize in Physics for discovering the accelerating expansion of the universe.

Siegrist is conducting a listening tour to assess community opinions. The initial focus is on congressional direction on accelerator R&D and on the Intensity Frontier. Task forces and workshops will be used to help formulate the OHEP response. A long-term view and a strategic vision will be developed during the next 12 to 18 months, based on and extending existing plans [the Particle Physics Project Prioritization Panel (P5), Particle Astrophysics Scientific Assessment Group (PASAG), New Worlds New Horizons Decadal Survey, etc.]. The diversity of the program and all the frontiers of high-energy physics needs to be maintained.

Congress has directed DOE to submit a 10-year strategic plan by June 1, 2012, for accelerator technology R&D to advance accelerator applications in energy and the environment, medicine, industry, national security, and discovery science. DOE is working with NSF on this plan. Congress also requested a report that lays out the expected benefits of Intensity Frontier science; a strategy for maintaining U.S. leadership; and the funding needs for the next 10 years (including construction activities) for implementing the proposed strategy. The Office is working on this report.

The Tevatron shut down on September 30, 2011, after 28 years of service. It delivered about 12 fb–1 to the D0 detector (D0) and the Collider Detector at Fermilab (CDF). D0 and CDF analyses will continue for the next few years, focusing on legacy analyses, including evidence for the Higgs boson. To date, the Large Hadron Collider (LHC) has delivered more than 5 fb–1 of integrated luminosity.

On the Intensity Frontier, Double Chooz has been operating well with the far detector since April 2011. It has collected several times the Chooz data. There has been no formal result yet, but the plan is to “open the box” very soon. Near-detector installation is expected by the end of 2012. The NuMI Off-Axis ve Appearance experiment (NOvA) completed its far-detector building at Ash River, Minn., in June 2011. Module production for the 14,000-ton far detector begins next month. MicroBooNE [Booster Neutrino Experiment] received CD-2/3a (critical decision 2/3a) status in September 2011. EXO announced the first observation of two-neutrino double-beta decay in xenon-136 in August 2011. The Main Injector Neutrino Oscillation Search (MINOS) has provided the world’s best measurement of Δm232. There have been indications [with Tokai-to-Kamioka (T2K)] that θ13 is greater than zero. With the MINOS paper of 2007 and the new OPERA [Oscillation Project with Emulsion-tRacking Apparatus ] puzzling results on the speed of neutrinos, a task force was formed to look at the existing data and to make new measurements with a new global positioning system. In the meantime, Daya Bay started taking data with the first two antineutrino detectors in the Daya Bay near hall in July 2011. And g–2 at Fermilab is moving along. The *entire* community needs to be involved in defining the Intensity Frontier. A workshop will be held November 30–December 2, at the Rockville Hilton to reach a consensus.

On the Cosmic Frontier, the Alpha Magnetic Spectrometer (AMS) was launched on the Space Shuttle on May 16, 2011, and installed on the International Space Station. It is performing as expected and has collected more than 6 billion cosmic-ray events. The Dark Energy Survey (DES) imager is complete and will be shipped to the National Optical Astronomy Observatory (NOAO) in November 2011; the DOE deliverables for CD-4 are on schedule for completion by January 2012. The Baryon Oscillation Spectroscopic Survey (BOSS) has completed 2 of 5 years of operations; dark-energy results are planned to be shown at the American Astronomical Society in January 2012. The Mission Need and CD-0 approval for a new ground-based dark-energy experiment was signed in June 2011. HEP is funding a number of Generation-1 direct-detection dark-matter experiments: the Axion Dark Matter Experiment 2a (ADMX-2a), the 60-ton version of the Chicagoland Observatory for Underground Particle Physics (COUPP-60), DarkSide, the Large Underground Xenon (LUX) detector, and the Super Cryogenic Dark Matter Search (SCDMS) at Soudan. The community panels (P5, PASAG, and Astro2010) have called for a balanced Cosmic Frontier program with priority for dark matter and dark energy; staged implementation; and cooperative multi-agency development, as necessary. A funding opportunity announcement (FOA) for the second-generation direct-detection dark-matter experiments is anticipated to be out shortly with selections expected by late FY12 for a FY13 start. HEP needs a coordinated strategy for dark-matter research, including direct and indirect detection methods, theory, and accelerator experiments. The Office is just figuring out the most effective and expedient strategy to get community input.

In dark energy, the HEP projected funding profile supports participation with NSF in the Large Synoptic Survey Telescope (LSST; the top Astro2010 recommendation). NSF will lead the overall project and build the telescope/infrastructure and data-management subsystems. DOE will be responsible for the camera and associated instrumentation. The Stanford Linear Accelerator Center (SLAC) hosts the camera project office. Biweekly meetings of the DOE–NSF Joint Oversight Group are being held. A memorandum of understanding (MOU) for the partnership should be completed soon. The schedule assumes the NSF major research equipment and facilities construction (MREFC) funding will start in FY14. In August 2011, the NSF Preliminary Design Review (PDR) of the entire project was successful. In Nov. 2011, a Lehman review of the LSST camera will be held at SLAC; this review is required for CD-1 approval.

The HEP budget looks flat. The FY12 DOE request has been passed by both the House and the Senate. Overall, Office of Science (SC) funding is approximately $4.8 billion. The House version provides HEP funding at the requested level, which is –7% for projects. (Reductions were restored in the research budgets to match the request.) The Senate version provides HEP funding at the requested level but no funds for Long-Baseline Neutrino Experiment (LBNE) construction (–$17 million) because the “project is not mature enough.” However, currently, the government is under the FY12 continuing resolution until Nov 18. That means no new starts for LBNE, the Muon-to-Electron Conversion Experiment (Mu2e), or MicroBooNE. Small amounts of funding were supplied to keep making progress toward CD-1 for LBNE and Mu2e and toward CD-2/3 for MicroBooNE.

The lack of conceptual-design funding for LBNE is the most serious issue. It will not impact the technology downselect scheduled for December; however, the schedule for CD-1 is at risk if

the continuing resolution is not lifted before calendar year 2012 and/or the FY12 Senate language prevails in the final appropriation. Both the House and Senate bills support the DOE request for $15 million to maintain de-watering and safe operations at Homestake Mine, previously supported by NSF. However, under the continuing resolution, this is also considered a “new start.” DOE and NSF are working together to keep minimal Homestake operations going during the continuing resolution. If supported in the final FY12 appropriation, DOE will take over support for minimal Homestake operations for the rest of FY12, pending DOE decisions on cost-effective options for underground science. The continuing resolution has contributed to a delay in the processing of DOE grant actions, waiting for budget approval. Grants up for renewal are receiving priority attention.

The HEP budget request for FY12 is for $797.2 million. The FY10 appropriation [including the Small Business Innovative Research/Small Business Technology Transfer Program (SBIR/STTR)] was $810 million, so the total FY12 request is a reduction of $13 million from comparable FY10 funding.

The HEP comparative laboratory reviews in Energy Frontier research and detector R&D are planned for summer 2012. This is the second time around for the national-laboratory comparative reviews. The Office has re-diagonalized on the “frontiers” basis for reviews. It has not yet scheduled the comparative laboratory review in accelerator science. There is a pending hire for an Accelerator Science program manager. The strategic plan for accelerator R&D has priority for now. The Office will hold an institutional review at SLAC and a science and technology review at Fermilab this year. The current solicitations are:

* HEP Comparative Review (due Nov. 15)
* Early Career Research (due Nov. 29)
* Scientific Discovery through Advanced Computing (due Jan. 9)
* Next Generation Dark Matter (open soon).

A joint Advanced Scientific Computing Research (ASCR)–HEP Scientific Discovery Through Advanced Computing (SciDAC) FOA was posted September 11. That research is to advance the HEP mission by fully exploiting leadership-class computing resources in the areas of cosmic frontier scientific simulations, lattice gauge theory research, and accelerator science modeling and simulation.

The Office is formulating a budget structure to deal with general HEP computing more systematically. It is using the results from the February 2011 national laboratory computing review to assess efforts. It is addressing the current community needs and looking to the future; it is considering event generators, data tools, distributed computing, networks, and software. A joint HEP–ASCR workshop on multicore architectures is expected during spring 2012.

The Office is in the final stages of hiring a new program manager for accelerator science. It needs additional help from Intergovernmental Personnel Act staffers (IPAs) and detailees. The federal travel budgets were reduced approximately 25% from those for FY11. This was a congressional action. It has prioritized travel requests to emphasize HEP responsibilities for projects, international agreements, and major reviews. Site visits have been reduced. Comparative reviews will replace on-site university panel reviews.

Shochet noted that the budget scenarios considered by P5 were too optimistic. If the budget remains flat, how do the frontiers advance? Siegrist replied that money going into construction and R&D at all frontiers needs to be increased. It is dicey how one can do that. The Office is also struggling with funding for the Deep Underground Science and Engineering Laboratory (DUSEL).

Artuso asked about the intensity frontier program other than LBNE. Siegrist answered that a broad band of researchers from the energy frontier will attend the workshop. A lot of options will need to be gotten on the table. Some of the issues will be solved during the next month. The LBNE baseline is being developed.

Gelmini asked what will happen with DUSEL. Siegrist said that the pumps will continue to run until the LBNE question is answered. There will be a lot of discussions on how to make LBNE affordable.

Leemans asked if the stewardship role of HEP accelerators was clear. Siegrist replied that the Office of Basic Energy Sciences (BES) is running more accelerators than HEP is. ASCR also supports accelerator science (through simulations). HEP is trying to get all the contributors in SC corralled. The effort needs to be well coordinated with the other SC offices. HEP puts in the lion’s share of accelerator R&D money.

Akerib asked what the urgency of the DUSEL process is. Siegrist answered that it is hoped that that decision will be made in the spring of 2012. The *current* discussions are not budget-limited.

Marlow noted that university groups write proposals and then rely on site visits for clarification. Siegrist responded that, under government rules, IPAs and detailees have a separate travel budget. The Office may use them to provide site visits. This is the second consecutive year of travel-budget cuts.

McBride asked Siegrist to clarify the needs for community input on dark energy and dark matter. Siegrist answered that, for dark energy, the Office needs to know what is the suite of smaller things that need to be done.

Dixon asked what the next step for neutrinoless double-beta decay was. Siegrist replied that Congress was very disgruntled on how DOE and NSF have handled this. A line needs to be defined between the Office of Nuclear Physics (NP) and HEP so one or the other can “own” the construction. The flexibility to do R&D together is needed. NP is on board with that.

Byrum asked what kind of ideas he was looking for. Siegrist responded that the Office was getting flooded with proposals for dark energy and dark matter research. The new technologies and techniques need to be sifted through.

**Joseph Dehmer** was introduced to review the activities of the NSF Physics Division. He thanked Melvyn Shochet for his service as Chairman of this Panel for 6 years. He welcomed James Siegrist to Washington. He thanked Moishe Pripstein and James Reidy for their service to the NSF and wished them well in retirement. He noted that Randal Ruchti is returning and will join the Particle Physics Group and that Tom Allen will come from the National Aeronautics and Space Administration (NASA) and work in astrophysics. Marvin Goldberg, Jonathan Kotcher, and James Whitmore will continue in their current positions. An offer is out for the remaining open position.

The community needs midscale-instrumentation and accelerator-physics support. Congress and the National Science Board (NSB) understand the need. The FY12 budget request has been submitted. Starting in FY12, midscale instrumentation will get funding; $10 million will be allocated to it in response to proposals submitted to the various program offices. There will be a steady growth (to $30 million or $40 million per year) in subsequent years. The underlying programs are responsible for personnel. The LHC upgrade needs will not affect the instrumentation funding. The on-campus accelerator R&D work is being threatened. Support for an accelerator-physics research program exists. Students are needed for the university workforce. The scope transcends all the physics frontiers.

The FY11 budget is known, but not the FY12 one. At this point, flat is considered a good outcome. The priorities of the agencies then become important. If NSF has a flat budget, that does not mean that the NSF Physics budget will be flat. The NSF will be faced with these flat budgets for awhile. The agency will have to plan but not get overcommitted.

In facilities, the LHC has its next 5 years of budget set. IceCube was completed on schedule and on budget. The Laser Interferometer Gravitational Wave Observatory (LIGO) is on schedule. The National Superconducting Cyclotron Laboratory (NSCL) has been renewed for 5 years. DUSEL was not a happy place. DOE has taken over the stewardship of DUSEL. A design review was conducted, and a PDR was completed. The project has come to a good state of readiness. The team and plan can be accurately baselined. A core team is to be retained during the transition year. The National Research Council (NRC) report on DUSEL came out. That document will be key to DUSEL’s success. The fourth solicitation (S4) report has been issued. The scientific community has worked well under difficult conditions. The S4 awards have been included in the FY12 budget request. Early science at the Sanford Underground Laboratory at Homestake continues. The midscale idea is important to DUSEL and *all* of the Directorate’s programs.

Shochet asked if mid-level instrumentation will be controlled by the NSF Division of Physics (PHY). Dehmer replied, yes. He can and will reallocate. The Directorate needs something so that it can phase and plan the profile. It is being talked about in other directorates. MPS is leading the promotion of the idea.

Akerib asked how Dehmer saw funding playing out. Dehmer replied that the dark-matter community will ask about generation two and generation three. The nascent midscale will be largely used for dark matter. If proposals are received for a broader research program, funding will be allocated across all fields, but dark-matter research will be prioritized.

Honscheid asked who will oversee and support midsize projects. Dehmer answered that, if HEP has workshops on that, NSF can attend and use the outcome of those workshops. The people in the program can share needs, also. NSF and DOE personnel see each other regularly and discuss advancing all the frontiers.

Leemans asked what NSF’s role would be if accelerator R&D expands in HEP. Dehmer answered that NSF will support accelerator R&D at universities. It enables important research done by academics and students. That is important to developing the future workforce.

Merminga asked Dehmer where he saw accelerator physics going in the future. Dehmer said that, wakefield acceleration being an exception, frontier research will be done at the frontier facilities. Merminga asked if there would be coordination between NSF and DOE on the R&D program. Dehmer replied affirmatively. NSF will be integrated into that effort. It will lead from behind.

A break was declared at 10:19 a.m. The meeting was called back into session at 10:45 a.m.

**Andrew Lankford** was asked to present the results of the assessment of DUSEL science conducted by the National Research Council.

The U.S. research community has historically played a leading role in underground science

Both the U.S. particle and nuclear physics communities have recognized certain underground experiments as a top priority for their fields. Efforts to develop a major U.S. facility resulted in a proposal for DUSEL, to be located in an abandoned gold mine in Lead, South Dakota. The 2004 National Science and Technology Council report, *A 21st Century Frontier of Discovery: A Strategic Plan for Federal Research at the Intersection of Physics and Astronomy*, recommended that the NSF steward development of concept for a national facility and that DOE collaborate on the conceptual development of physics experiments. This NRC report was commissioned to contribute to the final deliberations.

DUSEL was founded on four experimental-physics pillars (dark-matter searches, long-baselined neutrinos from Fermilab, proton decay, and neutrinoless double-beta decay) and three research tenets (diverse multidisciplinary research efforts in biology, geology, and engineering; additional well-motivated experiments; and integral education and outreach). The four pillars became three experiments (LBNE, dark matter, and neutrinoless double-beta decay).

The Committee was charged to develop an assessment of (1) the major physics questions that could be addressed with the proposed DUSEL and associated physics experiments, (2) the impact of the DUSEL infrastructure on research in fields other than physics, (3) the impact of the proposed program on the stewardship of the research communities involved, (4) the need to develop such a program in the United States in the context of similar science programs in other regions of the world, and (5) broader impacts of such an activity, including but not limited to education and outreach to the public. The Committee was multidisciplinary, international, and independent and included leaders of large experiments and underground facilities.

A peer-review panel was assembled that included National Academy of Sciences (NAS) membership. The Committee was constituted a year ago and carried out its duties from December 2010 to July 2011, when its report was released.

The Committee focused on the intellectual merit of proposed underground science, the assessment of the major physics questions, and the impact of such infrastructure on fields other than physics. Intellectual merit is assessed in the general context of frontier research worldwide, not in comparison with any particular project or investment. Project costs and implementation plans were not reviewed, nor was any agency stewardship model or management reviewed.

The Committee tried to look at the intellectual merit in national, international, and disciplinary contexts and to provide an assessment of broader impacts. The Committee also considered to what extent each of these scientific issues can be addressed without a national facility or with a more limited national facility.

The three underground experiments are the direct detection of dark matter, the LBNE, and neutrinoless double-beta decay. Each of these three experiments addresses at least one crucial question upon whose answer the tenets of our understanding of the universe depend. The three major physics experiments provide an exceptional opportunity to (1) address scientific questions of paramount importance, (2) have a significant positive impact upon the stewardship of the particle physics and nuclear physics research communities, and (3) have the United States assume a visible role in the expanding field of underground science.

The U.S. particle physics program is especially well positioned to build a world-leading long-baseline neutrino experiment because of the availability of the combination of an intense neutrino beam from Fermilab and a suitably long baseline from the neutrino source to an appropriate underground site, such as the proposed DUSEL. In light of the leading roles played by U.S. scientists in the study of dark matter and double-beta decay, together with the need to build two or more large experiments of each of these two types, U.S. particle and nuclear physicists are also well positioned to assume leadership roles in the development of one direct-detection dark-matter experiment of ton to multi-ton scale and one neutrinoless double-beta decay experiment on the scale of a ton.

While installation of U.S.-developed experiments in an appropriate foreign facility or facilities would significantly benefit scientific progress and the research communities, there would be substantial advantages to the communities if these two experiments could be installed within the United States at the same site as the LBNE.

There are two additional scientific capabilities of the LBNE that would be of great scientific interest:

• Its sensitivity to proton decay and

• Its sensitivity to neutrinos from supernovas.

Both of these capabilities add significant value to the neutrino oscillation experiment. However, these sensitivities are not so great as to be the primary considerations in choosing neutrino-detector technology or a site for the experiment.

In addition, a small underground accelerator to enable measurements of low-energy nuclear cross-sections would be scientifically important. These measurements are needed to elucidate fundamental astrophysical processes, such as thermonuclear reactions and the production of heavy elements in the sun and the stars. The ability to perform long-term experiments in the regulated environment of an underground research facility could enable a paradigm shift in research in subsurface engineering and would allow other valuable experiments in the geosciences and biosciences.

In terms of programmatic impact, the colocation of the three main underground physics experiments at a single site would be a means of efficiently sharing infrastructure and personnel and of fostering synergy among the scientific communities. The infrastructure at the site would also facilitate future underground research, either as extensions of the initial research program or as new research initiatives.

These added benefits, along with the increase in visibility for U.S. leadership in the expanding field of underground science, would be important considerations when siting the three main physics experiments. If such facility were constructed in the United States for physics experiments, scientists in other fields, such as subsurface engineering, geosciences, and biosciences, would greatly benefit from a mechanism that would allow them to perform research there.

A facility for underground research would have a significant positive impact on the stewardship of the research communities involved. Such a facility would offer the particle and nuclear physics communities access to the underground research space they need to undertake a range of scientifically critical experiments; and it would allow the biosciences, geosciences, and subsurface engineering communities to perform valuable long-term experiments in a regulated environment.

Development of an underground research facility in the United States would supplement and complement underground laboratories around the world. A U.S. facility could develop a long-baseline neutrino experiment using intense beams from Fermilab. It could accommodate one of the large direct-detection dark-matter experiments and one of the large neutrinoless double-beta decay experiments that are needed by the international effort to resolve these critical scientific issues while sharing infrastructure among these three experiments that are of comparable import. It could also host and share infrastructure with other underground physics experiments and with experiments in other fields. It would benefit the U.S. research communities and would guarantee the United States a leadership role in the expanding global field of underground science.

While many of the opportunities for education and outreach of the proposed DUSEL are available to any underground research facility, some opportunities for education and outreach are special at the proposed DUSEL: educational programs for the rural population of South Dakota, education and outreach programs for underrepresented Native Americans, and outreach to tourists visiting the surrounding region.

The initial suite of DUSEL experiments constitutes an excellent scientific program. The three postulated physics experiments are of paramount and comparable scientific importance with a potential for breakthrough discoveries. The facility could also enable a paradigm shift in research in subsurface engineering and in multidisciplinary bio-geo research.

Colocation of underground experiments allows the sharing of infrastructure and personnel, with the result that the cost of the whole is less than the cost of the sum of the parts, and the value of the whole is greater than the cost of the sum of the parts.

In summary, the proposed DUSEL offers an excellent science program, strong programmatic impact, high value and other benefits resulting from colocation and shared stewardship, and education and outreach opportunities.

Shochet asked what response was received from the Office of Management and Budget (OMB) and the Office of Scientific and Technical Policy (OSTP). Lankford replied that they were interested and well-informed. The impacts of scientists’ travel abroad to do research were discussed.

Akerib asked if the science could be done without such a national underground laboratory. Lankford said that the report does not say that. Questions arise, especially worldwide. Other regions could position themselves to do this research. There is a unique opportunity to do it here and now. Akerib noted that the language of the report seemed prescriptive in terms of leadership. Lankford replied that the building of one dark-matter experiment could be envisioned.

**Chris Quigg** was asked to review the accomplishments of the Tevatron collider program. It was the first high-energy superconducting synchrotron, a model for the Hadron-Electron Ring Accelerator (HERA) (e ± p) proton ring, and a key milestone toward the LHC. It got five Wilson prizes and four National Medals of Technology. It started operation in July 1983 with 512-GeV protons and continued operation at 800 GeV from 1984 to 2000. The fixed-target experiments ended in 2000, and then the collider program continued with proton–antiproton collisions. During the final months of operation at 1.96 TeV, the luminosity was typically greater than 3.5 × 1032 cm–2 s–1 with a peak luminosity of 4.3 × 1032. It delivered 12 fb–1, and the experiments recorded more than 10 fb–1. The luminosity was increased by leaps in technology (recyclers, electron cooling, and injectors) during those decades.

CDF and D0 produced the top-quark discovery and very precise measurements of the masses of the top quark and W boson, and Bs oscillations. It developed innovations in technique, such as a silicon vertex detector in a hadron collider, LAr–238U calorimetry in D0, a secondary vertex trigger within multilevel triggering, multivariate analysis techniques, and the mining of petabyte data sets. As scientific interests and capabilities were expanded and deepened, it was able to respond to new opportunities and deliver a lot of results not imagined at the start.

Experimental results on the transverse momentum distribution for the production of jets agreed very well with quantum chromodynamics (QCD) calculations over seven orders of magnitude. The experimental measurements were a tremendous stimulus to the calculations.

In addition, the Tevatron found the angular distribution of dijet production confirming the Rutherford-scattering-like expectation of QCD, found that quarks are pointlike and structureless at a resolution of nearly 3 TeV–1, and discovered that the dijet mass spectrum extending beyond 1.2 TeV shows no evidence for unexpected resonances.

In electroweak physics, each experiment expects O(107) W bosons and 400K Z bosons in each leptonic decay channel. Production cross sections agree with QCD; this is a possible primary luminosity monitor for LHC experiments. Z (plus jets) production tests the Standard Model simulations. Forward-backward asymmetry of leptons produced in W decay provides important information about the up-quark and down-quark parton distribution functions.

The W boson mass was constrained to a narrow range. Heavy flavor physics has been very productive at the Tevatron with the production and decay of quarkonium states, measurements of b- and t-quark production, measurements of the Bc mass and lifetime, measurement of the masses and lifetimes of B mesons and baryons, being a unique source of information on many B-baryons, producing orbitally excited B and Bs mesons, determining the X(3872) mass and quantum numbers, providing important evidence on D0 mixing, making precise charge-parity asymmetry measurements, and conducting high-sensitivity searches for rare dimuon decays.

Determination of the frequency of the Bs oscillations was very important.

The top quark in the electroweak theory was discovered and its mass measured at 173.2 GeV/c2.

The top pair production was found to be in agreement with QCD. No top pair resonances were seen. The top-quark charge is +2/3. 70% of the W bosons emitted in top decay are longitudinally polarized, and the rest are left-handed. The electroweak single top production was observed with a lifetime close to 0.3 yoctosecond. We are now seeing spin correlations in accord with the Standard Model.

The Standard Model Higgs boson search is the ultimate challenge for the Tevatron, including dozens of distinct final states. The Tevatron has been successful in finding where the Higgs *is not*. Projections have been made for 10 fb–1 data.

Diverse searches have been conducted and are being carried out for new phenomena, such as setting limits on supersymmetric particles, extra spatial dimensions, signs of new strong dynamics, leptoquarks, new gauge bosons, and magnetic monopoles. Some observations do not match expectations, such as the forward-backward asymmetry in top pairs (CDF+D0), anomalous like-sign charge asymmetry in b pairs (D0), and excess jet pairs + W (CDF). One week of special runs are being conducted at 300 and 900 GeV at the end of the operations.

Still to come are more results on the Higgs boson, top quark, electroweak theory, B physics, QCD, new phenomena, and characterization of the detectors and their performance over the long period of operation.

He thanked the CDF and D0 collaborators.

**Robert Roser** thanked the funding agencies for their support and presented copies of the physics literature produced by Tevatron researchers to the agencies.

Shochet asked what resources were needed to complete the analysis of the data sets. **Dmitri Denisov** said that it would require a 2012 guest and visitor budget comparable to the 2011 level to bring people to Fermilab for offline and physics leadership/analysis; computing resources at the 2011 level; and continued support to university postdocs and graduate students. Most international collaborators wish to participate in analysis to completion. There is clearly strong support for the accomplishment of these objectives. Shochet asked how long it would take to complete those analyses. Roser and Denisov replied that it would take 1 to 2 years.

Pripstein asked what personnel needs would be required for the data-analysis effort. Denisov answered that a migration can be seen; the workforce is declining about 5% per year. Effort is needed to keep people involved and excited. The Laboratory is in good shape for the next couple of years. Roser added that there is a plan to maintain the data for at least 5 years. Kim said that the detectors are being retained for public tours and as much of the Laboratory as possible will be opened up.

A break was declared at 11:59 a.m. The meeting was called back into session at 2 p.m.

**Thursday, October 27, 2011**

**Afternoon Session**

**Daniel Hitchcock** was asked to give an overview of the structure and activities of the DOE Office of Advanced Scientific Computing Research (ASCR).

ASCR’s job is to (1) understand applications so HEP scientists and others can get the best science out of those applications and (2) see what computers will be needed 10 years from now so they are ready when the scientists need them. It provides computing facilities: high-end and leadership computers, research and evaluation prototypes, and the Energy Science Network (a new network has been built with fibers that can carry 100 Gbs per color). Transoceanic links are being looked at to match that capability.

ASCR has done a lot of work with HEP, applied mathematics, computer science, SciDAC, and next-generation networking. It is modeling uncertainty in these complex computations. It has also been looking at multi-scale computations.

SciDAC is now in its third generation. SciDAC 2 had 12 institutions and centers. No one knew which to go to in order to get help. There are now three:

* FASTMATH: Frameworks, Algorithms, and Scalable Technologies for Mathematics
* QUEST: on uncertainty
* SUPER: tools for diagnosing codes

The priorities for the science come from the partners (Fusion Energy Sciences, HEP, NP, Biological and Environmental Research, and Basic Energy Sciences).

The future is in energy-efficient computing. Scaling the Jaguar up by a factor of 1000 would use 3 GW. The demand for computing doubles in 18 months. Dynamic random-access memory (DRAM) was designed in 1983 and is very inefficient; 60% of the power is used to keep the memory alive.

The tools for reducing power consumption are

* Reducing feature size
* Turning the voltage down
* Parallelism

Cutting out memory was considered, but data from events are sent to memory. ASCR is talking to the vendors to see how the energy used by memory can be brought down from 30 pJ to 3 pJ. The technical work is in hand, but the manufacturability is yet to be solved.

One question is what to do about lowering the cost of moving data. One answer is to collocate different computations so one does not have to move the data. Another technique is to use concurrency. In addition, one must include hardware variability in uncertainty quantification (UQ). One can also remap multicores to put as much work per location on the same die, include embedded UQ to increase concurrency, include data analysis if you can for more concurrency, trigger output to move only important data off the machine, and reformulate to trade flops for memory use.

Codesign for the exascale was started this year. Three centers are looking at exascale issues: the Exascale Co-Design Center for Materials in Extreme Environments, the Center for Exascale Simulation of Advanced Reactors, and the Combustion Exascale Co-Design Center.

All hardware trends impact data-driven science (in many cases, in ways other than the computing cycle rate). Data from instruments still double every 18 to 24 months because the detectors are on the CMOS [complementary metal oxide semiconductor] feature size path. 100 gigabit per second per lambda networks are on the horizon with a lot of still-open questions. Disk read and write rates will fall further behind processors and memory. Significant hardware infrastructure is needed to deal with this development, which probably will not be replicated at the users’ home institutions.

ASCR just finished a workshop on Data and Communications in Basic Energy Sciences: Creating a Pathway for Scientific Discovery to find out how to move the trigger closer to the camera, to handle 100-PB/year facilities, and to keep up with increases in luminosity without hugely increasing the power bills.

**Daniel Marlow** was introduced to summarize the activities of one of three informal working groups in HEPAP, the University Group.

The technical infrastructure (equipment and people) at universities has a twofold benefit: In general, it is the people who drive the infrastructure cost. However, they also bring technical expertise, take on tasks that faculty are too busy to handle, work with students and postdocs in a highly synergistic way, and provide a corporate memory of tools and techniques from previous experiments.

Several factors contribute to the demise of technical infrastructure: the high cost and long timescale of the experiments (e.g., CDF); the “physics factory” mode of operations; and a general downward pressure on funding, obliging principal investigators (PIs) to reduce technical staff to make ends meet. There is also an increased emphasis on accounting. Project management systems that are designed to monitor and control costs do not always mesh with university modes of operation. Funding for university groups is increasingly divided into smaller categories, in many cases accompanied by firewalls. The most serious effect is the loss of flexibility for PIs, who ultimately conclude that trying to maintain technical staff is more trouble than it is worth. One must be careful not to sacrifice a substantive good purely for the sake of accounting.

Some have argued that this decline is destined to continue. While it is true that some of the factors are unlikely to change, extreme pessimism is not warranted. A relatively small incremental commitment of resources would have a very positive effect. Some of the changes are revenue-neutral organizational changes. And some changes may actually *lower* costs overall. The available funding for detector R&D, both on the Advanced Detector Research program and in the base budget, is obviously a good thing in this context. A modest expansion would be most welcome. Project funding is often the most important factor. University groups can often handle tasks in a much more cost-effective way than the national laboratories because they have lots of low-cost intellectual capital, have low overhead rates, and often subsidize facilities and services.

The Working Group suggests avoiding adding new barriers and reducing existing barriers between various funding sources. In the past, funding agencies were not so fastidious about the separation between base-grant and project funds. Europe continues in this mode. Creating firewalls between the various funding categories may improve cost accounting, but it produces no real economies.

In addition, the agencies should work with the community to raise the profile of instrument builders.

Glenzinski asked if they did not want to train students in software. Marlow said that they *are* trained in software but not on hardware.

Akerib asked if the Working Group saw graduate fellowships at the national laboratories playing a role. Marlow said that that offers opportunities, but it is not for everyone.

Gelmini noted that the HEPAP members place a lot of emphasis on universities because they themselves got good training at universities.

Crawford stated that what the Working Group referred to as accounting is more than just accounting; it is a management model that leads to more requests for data so managers can manage what they are supposed to manage. Marlow replied that the problem comes when one cannot move money from one budget and reporting (B&R) code to another.

**Ann Nelson** was asked to present the Working Group’s findings on career paths for scientists.

The Early Career Program is the main entry point to long-term funding for untenured university faculty (as well as permanent lab researchers). It works in two ways: Successful candidates receive DOE support and reviews of unsuccessful candidates give guidance for future

proposals and, in some cases, may allow the candidate to be added to an existing grant or funded by other means.

The candidate must be within 10 years of receiving a PhD and be an untenured-tenure-track faculty member at a university or a permanent, non-postdoctoral staff member at a national laboratory. The awards are like a normal grant but require a preproposal that is encouraged or discouraged. This year, the proposal is due Nov. 29. A panel meets in January, and awards are announced in the spring.

This program is a follow-on to the Outstanding Junior Investigator (OJI) program, specific to HEP, in which five to seven awards have been made per year, occasionally also to national-laboratory staff. Circa 2009, a requirement was added to impose a review on existing grants. In 2011, there were 13 early career awards, 8 to universities and 5 to national laboratories. This slightly expands the funding opportunities to university faculty members.

The early career awards appear to work and have expanded somewhat from the OJI program. They seem to serve the purpose of moving new faculty/permanent staff into long-term DOE support. The distribution among various endeavors seems balanced, at least in 2011.

There still are some questions. There is a large difference between the university minimum award ($150,000) and the national laboratory minimum ($500,000). Part of this difference is accounted for by overhead differences, but not all. Is this difference justified? Most new faculty do not receive an Early Career award and move onto existing grants. Is this aspect working properly? What is the right balance between theory and experiment for the Early Career Program? How is this balance managed? There is a big difference for faculty applying for an Early Career award if there is an existing DOE grant in place. How should this be considered in the Early Career Program? How will the Early Career Program work with respect to the new competitive review process? Are the pre-proposals really necessary? The Early Career Program is for untenured faculty and for permanent national-laboratory personnel. These are fundamentally different positions. Does this make sense?

In summary, the Early Career Program is very important to universities and should be made to work as well as possible. The initial assessment is that it seems to do its job, but it needs to make sense in the new era of large projects and competitive reviews.

Shochet asked if the Working Group had looked at the similar NSF program. Nelson replied, no. It was not aware of any changes in that program. The community seems to be happy with it.

Byrum noted that the national-laboratory employees are permanent but not tenured. Fisher commented that the Working Group did not appreciate that fact.

Hobbs asked if there were any discussion on the ability to recognize junior faculty while getting funding. Nelson asked if he meant that DOE should recognize additional people. Hobbs replied, no. People can be listed as being on the grant. Fisher replied that universities seem to recognize merit, not the amount of funding that is brought in. Shochet pointed out that that is not true at all institutions. Artuso called attention to the fact that NSF frequently gives separate funding to junior people. Marlow said that program managers have to be educated about how universities operate. The agencies could send a letter to the junior investigators. Crawford said that, if that were helpful, the Office could look into doing it. He also pointed out that this is an SC program, not an HEP program. The balance between experiment and theory is determined by who writes the best proposals. The preproposals are important because, otherwise, SC gets inundated with proposals for work outside the SC mission. Marlow said that the Working Group knows that this asymmetry between national laboratories and universities is an SC thing, but it still does not think it is right.

Leemans pointed out that the $500,000 covers the salary of the researcher at a national laboratory, but the $150,000 at a university does not. Doing business at a national laboratory is intrinsically expensive. The two should not be equal. Shochet added that HEPAP has tried to make these analyses and corrections but has not been successful in getting the amounts changed.

A break was declared at 3:14 p.m. The meeting was called back into session at 3:43 p.m.

**Hendrik** **Weerts** was asked to review the preparations for the workshop on the science opportunities at the Intensity Frontier, the facilities needed, and the community interest in research at the intensity frontier.

The workshop defines the Intensity Frontier as “those experiments/facilities that measure properties of leptons and quarks with a precision that allows probing contributions from fields not present in the Standard Model. Because nucleons, nuclei, and atoms consist of leptons/quarks and if you have Standard Model predictions for them, they are automatically included.” It had working groups on heavy quarks, charged leptons, neutrinos, hidden sector photons and axions, proton decay, and nucleons/nuclei/atoms. Each group has an experiment convener, a theory convener, and an observer for its leadership. The workshop will occur on November 30–December 2, 2011, to summarize findings, to garner more community input, and to inform the community on the Intensity Frontier. There will be a technical document and a brochure.

Organization was started June 24, 2011; the working groups are having meetings with invited speakers; and conveners are having biweekly meetings. The workshop will have a plenary introduction and then parallel working group sessions; it will conclude with plenary overview talks and working group summaries.

About 175 people have registered so far.

Shochet noted that the current strain on travel funds may limit the number of attendees, and agencies should be made aware of that. Weerts pointed out that the steering committee is also planning a video linkup with CERN [Conseil Européen pour la Recherche Nucléaire [now European Organization for Nuclear Research (Organisation Européenne pour la Recherche Nucléaire)], where a lot of interested parties are located.

Siegrist thanked the conveners for doing this important work.

**Michael Harrison** was asked to present an update on the R&D phase of the International Linear Collider (ILC).

The reference design developed in 2007 has been changed for the 2012 baseline. Those changes include a single tunnel for the main linac, moving the positron source to the end of the linac, reducing the number of bunches by a factor of 2, reducing the size of damping rings, integrating the central region, including a single-stage bunch compressor, and improving low-energy performance. The nominal cost reduction is about 11%.

Three beam-delivery system tests are being conducted. At the Accelerator Test Facility-2 at the High Energy Accelerator Research Organization in Japan (KEK), the researchers are studying beam-delivery optics and tuning, beam-stability feedback systems, and interaction-point instrumentation. The TESLA Test Facility/Freie-Elektronen-LASer in Hamburg (TTF/FLASH) 9-mA experiment at the Deutsches Elektronen-Synchrotron (DESY) produces a beam that is close to the ILC beam (3.2 nC bunch charge, 2625 bunches, 970 µs pulse length, and a 9-mA current). Cornell is doing electron cloud R&D and measuring the accumulated collector current density characteristics of undulators and other components.

Most efforts go to superconducting radiofrequency (SRF) technology; there has been a dramatic increase in the ability to build and test cavities. The ability to produce superconducting cavities has been perfected in the past year, largely because of the development of the means for diagnostics and the repair of cavities.

One problem is the number of cavities needed (15,000). An effort has begun to see how to get so many cavities manufactured. Qualification of cavity manufacturers has begun. There are four in Europe, one in Japan, and one in the United States. Several are on the sidelines in the United States. The European X-ray Free-Electron Laser (EU-XFEL) at DESY will use 800 cavities, producing more certified manufacturers.

In design integration, the ILC team is trying to bring the different components together from a variety of laboratories.

The technical design report will include the new technical baseline design, the results of the risk-mitigating R&D program, project implementation planning, and a new cost estimate done globally in a purchasing power parity metric (more than just the exchange rate). There will also be a detector/physics volume.

CERN is looking at both linear colliders and LHC upgrade options for its next big project and considering potential layouts. Their ILC effort has been increasing, but they are focused on Compact Linear Collider (CLIC); no one has ever built an accelerator like it. They have an experimental area to investigate the structures and plan to build two modules soon.

In Japan, two sites have been put forward for potential ILC locations. There has been progress registered at the Kyushu candidate site, at the Tohoku candidate site, and in the discussions of the Council for Science and Technology.

The LHC is starting to exclude the standard Higgs across a wide mass region and should close up the region next year. CERN needs 5 fb–1 to exclude the Standard Model Higgs at the 95% level. It already has 5.6 fb–1. Operations at 7 TeV will continue for one more year, which will result in 10 to 15 fb–1. The luminosity will increase but at a much slower rate. The LHC will stop for about 16 months to repair the interconnects to allow higher-energy operations (at more than 13 TeV). Data taking will resume around 2015, and another 2-year run will start. What is obtained by 2012 is all that will be gotten until 2015. After 2012, the LHC 7-TeV run ends. The ILC technical design report (TDR) [and CLIC conceptual design report (CDR)] will be available. The particle physics community needs to follow the LHC (and Tevatron) results, interpret these results, update the linear-collider physics case (if there is one), and adjust the energy and luminosity correspondingly (either up or down). The European particle physics strategy (a 5-year plan) will be announced in early 2013. The GDE mandate expires at the end CY12 (as does the ILC Steering Committee); a new linear collider collaboration will be needed to continue the global program.

Will the ongoing LHC run produce enough physics results to motivate a linear collider by the end of 2012? Probably not. Will there be any guidance on an appropriate energy scale for a linear collider? Early indications are possible. Will the ongoing run be able to rule out new physics below 1 Tev? Possibly, but it is likely that the 2015/16 LHC run will be needed to really understand what new physics is emerging in this energy regime.

How does one get there? Something needs to replace the current linear collider organization. A new structure that includes CLIC is being looked at. Rolf Hauer, the CERN Director General said at the International Committee for Future Accelerators (ICFA) that the most appropriate organizational form for global projects needs to be defined now and needs to be open and inventive. Accelerator laboratories in all regions must partner in accelerator development, construction, commissioning, and exploitation.

A proposal for a U.S. ILC program for 2013–2015 was sent to OHEP by the U.S. Linear Collider Steering Group for a 3-year R&D program covering SRF value engineering, cavity gradient increases, cryomodule production (1 per year) leading to Fermilab system tests at its New Muon Lab (NML), selected R&D topics, and a small core team within the global linear collider organization. It would continue the virtual-laboratory structure.

Yamamoto noted that there was a workshop in Granada. The consensus was that, if the Higgs were found below 400 GeV, then the ILC would be worth building.

Glenzinski asked if all the cost estimates for CLIC are going to be as inclusive as those for the ILC. Harrison replied, yes.

Dixon asked if they are going to give a cost estimate at various energies, and how does the cost vary by energy. Harrison replied that the linac is 75 to 80% of the cost at 500 GeV.

Leemans asked Harrison if he could say anything about the leveraging of the development and manufacturing costs of cavities by other uses. Harrison responded that what is difficult is the volume of production. No one will put in the infrastructure to build the cavities until they know the ILC is going to be built.

Diebold asked at what point will one get a meaningful comparison with CLIC. Harrison replied that technical verification is in hand that our design will work. CLIC will not be at that point for 6 years.

**Glen Crawford** was asked to talk about the DOE Comparative Review Process.

The issue of the open-skies rule has been solved so national laboratory employees can now travel on non-US-flag carriers under certain conditions. Travelers should read the instructions carefully.

The Early Career Research 2012 Announcement is out; proposals are due Nov. 29. Pre-applications were required. All PIs have been notified. One should expect roughly the same number of awards as last year; however, there are differences in the details. PIs may propose to both the Early Career Program and the HEP Comparative Review solicitations but must have different research scopes.

Three current HEP Early Career winners also received 2010 Presidential Early Career awards.

There had been lots of additional grant actions in FY09–10 because of the Early Career awards plus American Recovery and Reinvestment Act (ARRA) infrastructure supplements plus incremental funding actions. The Office has returned to a “normal” workload in FY11. It has also made a conscious decision to reduce the number of supplements. The average time-to-award has improved somewhat. For FY12, approval was received from the Chief Financial Officer to release funds for grants on October 14, 2011. These awards will be based on the available funding under the continuing resolution and planned actions. HEP is working through a prioritized list of 42 actions. Conferences, no-fund extensions, and renewals have priority. More actions will move up in the queue when/if additional appropriations are provided. If a researcher’s institution experiences urgent cash-flow problems, he or she should let the Office know.

All HEP grants renewing in FY12 are affected. The intent is to close out all these grants and institute new ones. The Office is hitting the reset button. Grants responding to the Comparative Review FOA (DE-FOA-0000573) are due Nov. 15.

The goal of this effort is to improve the overall quality and efficacy of the HEP research program by identifying the best proposals. Before, proposals were reviewed individually. Now they are evaluated in relation to the other proposals submitted. Program managers feel the need to directly compare groups working in the same area to optimize their programs, particularly in an era of tight research budgets. There are general concerns about fairness of the funding distribution across the program. This process allows for a better alignment of research programs with priorities. This change in process has been recommended by several DOE advisory committees, most recently the 2010 HEP Committee of Visitors.

The basic process is that all FY12 grants renewing before April 31, 2012, will be given a short “terminal” renewal (or no-fund extension) at approximately the FY11 level. There is a standard proposal plus a lightweight review process for this part. The funding level will depend on carry-over and local conditions. Grants renewing later in the year can be handled case-by-case but are encouraged to submit to the Comparative Review. There will be a new FOA for grants renewing in FY12; it will request separate sub-proposals for the three frontiers, theory, and technology R&D. Proposals will be due Nov. 15. The “separate” proposals can still be under a single umbrella. Process and strategic guidance on research directions will be announced in advance to the community and will be copied, as appropriate, in the FOA. PIs can propose to more than one program. Separate mail/panel reviews will be conducted for each subarea. The Office expects to get reviewers from the two-thirds of the community who are not in the hopper for this renewal cycle. Panels are scheduled for mid-January, and reviewers are being lined up now. Lower performers will be phased out in some reasonable way. New awards will start May 1, 2012, and will likely have less than a 12-month initial period. The process will be repeated annually until the 3-year cycle is completed.

This exercise is not just for existing DOE HEP groups. New grant applications are welcome.

However, proposals must be for a scope not funded elsewhere. Proposals must be for HEP research or related technology R&D. Proposals for conferences, experimental operations, etc. should be submitted to the general Office of Science FOA [DE-FOA-0000600]. There are hard page limits (nine pages per senior investigator). PIs can submit proposals to more than one solicitation, but they have to be for a distinct research scope. HEP Early Career proposals will be reviewed and evaluated in parallel with the Comparative Review process. Grants renewing late in FY12 and other new proposals are strongly encouraged to submit a new proposal to the new Comparative Review FOA. New or renewal proposals submitted to the general solicitation will be reviewed following standard merit-review criteria; however, the funding available to respond to proposals submitted to the general solicitation will be extremely limited.

All proposals must be to HEP by December. The Office is identifying reviewers now. A timely turn-around is needed on mail reviews. Review panels are set for Jan 19–27 (one panel per day). Currently, the estimated number of proposals is 25 proposals in Theory, 20 in Technology R&D, 13 in the Cosmic Frontier, 12 in the Intensity Frontier, and 20 in the Energy Frontier. About one-third of these proposals are “umbrellas” with multiple pieces. HEP program managers will meet in February to assess the reviews and to decide funding. It is hoped that the FY12 budget will be resolved by then. New awards are expected to be issued to Chicago procurement by the end of February for a May 1 start date.

This FY12 grant processes is getting started after some expected delays. The Office is prioritizing actions within boundary conditions. Eventually, the Comparative Review process will move the grant start dates away from the beginning of the fiscal year and avoid some built-in delays.

Byrum noted that, at any given time, the Office was reviewing one-third of the universities and asked why they did not look at an entire program. Crawford replied that some grantees would have gotten their funds a year ago and would be having those grants taken away and would be being put in the hopper again, even the grants in multiple areas.

Honscheid asked if there were any safeguards against special problems. Crawford answered that the program managers should know the history behind the grants. Furthermore, if someone were caught up in such a problem, they could come back again the following year.

Gelmini noted that an organization could have researchers in several frontiers under an umbrella grant and asked if they would have to split them into separate proposals and awards. Crawford responded that one could write several proposals or put them all together in one umbrella proposal. There are benefits and drawbacks to each approach. If one has one big grant, one has more flexibility to move funds around. Shochet noted that the Office had always considered umbrella proposals together.

Yamamoto asked what the categories were that could be funded. Crawford answered that the five categories are Theory, Technology R&D, the Cosmic Frontier, the Intensity Frontier, and the Energy Frontier. Reviewers will cover each proposal. Each panelist will have some subset of proposals to look at intensively, and then the panelists will discuss all the proposals.

Akerib observed that there would be some proposals that would transcend several categories. Crawford replied that one would have to break such a proposal up as best one could. One can even have a person split over several categories.

Fisher asked if this were similar to the NSF process. Crawford replied, yes, except that NSF’s panels are set up as Federal Advisory Committee Act (FACA) panels and can come to consensus and make specific recommendations.

Dixon asked if one would be able to hire someone during the first year of the grant subsequent to the award. Crawford answered that that could be a problem. He would look into it.

Leemans asked if the open skies policy applied to shipping equipment. Crawford said that he did not know.

The meeting was adjourned for the day at 5:23 p.m.

**Friday, October 28, 2011**

The meeting was called to order at 8:59 a.m.

**James Whitmore** was asked to review the Cosmic Frontier activities of the MPS/PHY Division of NSF, whose purpose is to support Particle Astrophysics (PA) projects doing world-leading, potentially transformative science at any location inside or outside the United States. It responds to proposals three times a year (for different topics). These proposals are reviewed by mail, and site visits are held.

The agency confidentially discusses programs with DOE HEP and NP. With PI permission, it also discusses projects with other international agencies and international finance boards. It holds discussions with the Organisation for Economic Cooperation and Development–Global Science Forum Astrophysics Working Group, Instituto Nazionale di Fisica Nucleare, and Institut National de Physique Nucléaire et de Physique des Particules, and it attends scientific committee meetings at national laboratories.

PA funding rose from FY02 to FY06, was flat for several years, got a major increase from ARRA, and is elevated now because some projects were forward funded.

Construction funding has declined from $2.20 million to $0.47 million from FY07 to FY11, while R&D funding has increased from $0.91 million to $9.49 million dollars during the same period.

Funding goes to dark matter (35.5% of the funding), ultrahigh-energy gamma rays (18%), cosmic rays (15%), solar neutrinos (9.1%), ultrahigh-energy neutrinos (8%), neutrinos (7.1%), double-beta decay (4.3%), dark energy (1.9%), and other topics. The program supports 68 institutions with 98 funding actions to 140 investigators, 52 postdocs, 118 graduate students, and 98 undergraduates.

In dark matter, PASAG recommended that a complete technical review of the second-generation level should happen in the next 1 to 2 years. (It is expected to happen in 2012 with PA coordinating/co-reviewing with HEP.) It also recommended a technical review of Super Cryogenic Dark Matter Search (SuperCDMS) in FY10 to evaluate the performance of the new detectors currently in operation at Soudan. A DOE–NSF review was carried out in August 2009, and subsequent mini-reviews were held in March and July 2010. Funding has been approved to complete the five towers at Soudan, including some of the new Interdigitated Z-dependent Ionization and Phonon (iZIP) detectors. It recommended a future xenon program that avoids duplicate efforts. (Efforts to combine continue, but not before the third-generation level.) PASAG recommended that the use of depleted argon should also be explored. (PA funded DarkSide-50 with a start in FY10 and upgrades to depleted-argon (DAr) extraction.) PASAG recommended that all scenarios support the continued R&D into detectors with directional sensitivity. PA continues to support second-generation Directional Recoil Identification From Track detector (DRIFT-II) and made an award in FY10 to the Dark Matter Time Projection Chamber (DMTPC).

In high-energy gamma rays, PASAG recommended significant funding for the Advanced Gamma-ray Imaging System (AGIS) in Scenarios B, C, and D. PASAG also strongly encouraged the AGIS and the Cherenkov Telescope Array (CTA) groups to work together. (The merger has occurred. DOE and NSF are considering their next steps for the CTA project.) PASAG recommended the construction of the High-Altitude Water Cherenkov Experiment (HAWC) and the funding of the Very Energetic Radiation Imaging Telescope Array System (VERITAS) upgrade in all four budget scenarios. (DOE and NSF made a decision to fund the HAWC project, starting with FY11 funding from NSF. NSF funded the VERITAS upgrade with an MRI award in FY10.)

The top three recommendations of the NAS report are funded by PA. It funds 31 projects. Of the 13 underground laboratories, PA supports activities at 9.

In dark matter (35.5% of PA’s budget), the program supports direct-detection WIMP [weakly interacting massive particle] searches [Xenon-100, SuperCDMS, the Wimp Argon Programme (WARP), LUX, COUPP, the Project In CAnada to Search for Supersymmtric Objects (PICASSO), Coherent Germanium Neutrino Technology (CoGeNT), DarkSide, the small Cryogenic Low-Energy Astrophysics with Noble gases detector (MiniCLEAN), DRIFT, and DMTPC] and axion searches [Axion Dark Matter Experiment – High-Frequency (ADMX-HF)]. Xenon-100 will lead to Xenon-1T. It was approved at Laboratori Nazionali del Gran Sasso (LNGS), and significant U.S. and non-U.S. funding has already been obtained. PA has provided funding to collect depleted argon from underground sources that are greatly reduced in the radioactive component (39Ar). This makes it an excellent choice for very-low-background experiments. In FY10, PA funded the DarkSide-50 project to go inside the Borexino Counting Test Facility (CTF, which is fully funded). It is expected to start taking data at end of 2012.

PA supports the cosmic-ray experiments S. Auger and the Telescope Array (TA, which is located in Utah); two different experiments are needed because some of the results are different.

Two gamma-ray experiments are supported. The first, VERITAS, discovered TeV sources of gamma-rays and established indirect dark matter limits from dwarf spheroidal galaxies. They just discovered pulsed gamma rays above 100 GeV from the Crab Pulsar, the highest energies ever detected from a pulsar by an order of magnitude. Their energy spectrum indicates a completely new and unexpected component. The second, HAWC, started construction with $3.7 million in FY11, and PA will provide $6.7 million out of about $12 million. It will consist of 300 large water Cherenkov tanks, each 7.3 m in diameter and 5 m deep. It is located at a high altitude (4100 m in Sierra Negra). Seven tanks have been completed. It is co-funded by the United States and Mexico.

In neutrinos, IceCube was funded 50-50 with the NSF Office of Polar Programs (OPP). Construction was completed at the South Pole on December 18, 2010. The main IceCube detector now contains 5160 optical sensors on 86 strings embedded 2 km below the NSF’s Amundsen-Scott South Pole Station. It includes six strings of Deep Core and is now taking data very well.

Two reactor neutrino experiments are supported. Double Chooz has been taking data with one far detector since April 13, 2011. Daya Bay started taking data in August with two near detectors. PA also funds neutrino-mass measurements at the Microcalorimeter Arrays for a Rhenium Experiment II (MARE-II), which is measuring the beta decay of 187Re for the sensitivity goal of 0.1 to 0.2 eV/c2. In neutrinoless double-beta decay, PA funds the Cryogenic Underground Observatory for Rare Events (CUORE), Majorana Demonstrator (MJD) at the Homestake mine, the 200-kg Enriched Xenon Observatory (EXO-200) in New Mexico, and Neutrino Ettore Majorana Observatory (NEMO-3) at the Modane Underground Laboratory in the French Italian Alps. In solar neutrinos, it has funded Borexino for many years, and that facility is taking a lot of data on geoneutrinos now. It also funds MiniLENS [Low-Energy Neutrino Spectroscopy], which studies the neutrino-flavored phenomena and astrophysics of solar neutrinos.

In structure of the universe, PA funds the Advanced Compton Telescope (ACT), the Q/U Imaging Experiment (QUIET), and the LSST.

In underground physics, PA funds experiments in barium tagging for EXO and the provision of depleted underground argon with about 80 kg produced to date. It has also put a little money into the NaI counter in the Borexino CTF and into germanium purification for the MJD.

In high-energy cosmic rays, the program funds the Air-shower Microwave Bremsstrahlung Experimental Radiometer (AMBER), which conducts indirect observation of secondary emissions from the residual tenuous gas of excited particles and plasma left when the shower of particles transits the atmosphere. It is currently applied only to optical fluorescence of molecular nitrogen. PA also funds the bistatic radio detection in TA. That collaboration has successfully commissioned a 2-kW bistatic radar transmitter station, in Delta, Utah. The receiver station is under construction, and they have begun characterizing the transmitter output. With an FY11 Major Research Instrumentation (MRI) grant, they can now operate a donated 20-kW analog transmitter. PA funds studies of the Askaryan Effect, which occurs when ultrahigh-energy neutrinos interact in a dense medium, such as ice, producing an enormous cascade of secondary particles in an intense sub-nanosecond pulse of coherent Cherenkov radiation at radio wavelengths. The Askaryan Radio Array (ARA) R&D (MRI with OPP) is designed to detect the RF emission from neutrino-induced showers in RF-transparent media. The receivers installed in IceCube boreholes were designed to be sensitive in the range of 100 MHz to 1 GHz.

The FY10 funding for NSF research and related activities (R&RA) was $5.615 billion, the FY11 appropriation was $5.563 billion, and the FY12 request was for $6.253 billion. Currently, the House Appropriations Committee recommends $5.607 billion, an increase of $43.1 million or 0.8%. The Senate Appropriations Committee recommends $5.443 billion, a decline of $120.9 million or 2.2%. The MPS FY12 budget request is for a 13% increase. The PHY budget request for is for a 3.7% increase.

Shochet asked how the offices coordinated on proposals that are in both physics and astronomy. Whitmore said that they got together and talked and co-reviewed such proposals.

Gelmini pointed out that China is starting to compete with HAWC and other experiments and asked if there were any plans to collaborate with the Chinese. Whitmore noted that the Chinese come to international meetings and that the United States is cooperating with them on Daya Bay.

Fisher asked how the icebreaker shortage was affecting research. Whitmore said that he believed that the icebreaker issue was solved by renting a ship. NaI has been put in the bottom of some holes, and the detectors are working.

Marlow asked what frequency range was being looked at in the Utah experiment. Whitmore said that there was a possible signal seen at 2 kW in a Mariachi prototype.

Lissauer commented that, on collaboration between the United States and China, there is an annual meeting. This fall, the meeting is being held at Brookhaven National Laboratory.

Akerib asked how projects will be closed out. Whitmore responded that panel reviews will be held to see if funding should be continued. NSF will work with DOE.

Siegrist presented Shochet a plaque memorializing his 6 years of service, leadership, and contributions to DOE and NSF as chair of HEPAP. [Long round of applause.] Shochet accepted the honor and said that it was a rewarding effort but that he would not miss it.

**Kathleen Turner** was asked to review the HEP activities on the Cosmic Frontier, which have been subdivided into dark matter, dark energy, high-energy cosmic and gamma rays, and the cosmic microwave background radiation plus other fields.

PASAG recommended an optimized program during the next 10 years under four funding scenarios. It said that dark matter and dark energy remain the highest priorities, dark-energy funding should not compromise U.S. leadership in dark matter, and these should not completely zero out other activities. It recommended pursuing at least two technologies for the direct detection of dark matter. The HAWC and VERITAS upgrade were recommended in any funding scenario; Auger-North and AGIS/CTA can only be done in the higher funding scenarios.

In 2010, HEP took part in the Astro2010 study. For DOE, that study recommended funding of LSST (in partnership with NSF) and the Wide-Field Infrared Survey Telescope (WFIRST) (contributing to be NASA mission), with LSST as the priority.

HEP is seeking a balanced Cosmic Frontier program with priority for dark matter and dark energy and with staged implementation, cooperative multi-agency development (as necessary), and global coordination. In addition to HEPAP, the Astronomy and Astrophysics Advisory Committee (AAAC) also reports to NASA, NSF, and DOE on areas of overlap, and it monitors the status of the Decadal Survey. There is also the Global Science Forum study, which extended the AStroParticle ERAnet (ASPERA, the European roadmap) to coordinate with the Americas and Asia. It is a 2-year study of global coordination and planning of astroparticle physics experiments. Its report came out in December 2010. A follow-on, the Astro-Particle International Forum (APIF), started in spring 2011.

Direct-detection experiments exhibit many creative approaches, so HEP is working in partnership/coordination with NSF-PHY on current efforts and future planning. The current ones we are involved in are SuperCDMS–Soudan, LUX-350, COUPP 60, DarkSide-50, ADMX, and Xenon-100. COUPP will be commissioned and move to the Sudbury Neutrino Observatory (SNOLAB) in FY12. CDMS will see commissioning and operations in FY12. ADMX will do fabrication and commissioning in FY12. LUX will have commissioning and operations on the surface in FY12 and then move underground in FY13. DarkSide-50 will perform fabrication and commissioning in FY12.

Saul Perlmutter received the Nobel Prize in Physics. In his press conference, he noted that the things that enabled this work included the resources of a national-laboratory environment, the computing facilities and other infrastructure of a national laboratory, and long-term support. The dark-energy projects that HEP participates in are the Baryon Oscillation Spectroscopic Survey (BOSS), currently in operation and planning to show dark-energy results at the American Astronomical Society; the Supernova Cosmology Project, the Nearby Supernova Factory, and other supernova surveys; the Dark Energy Survey (DES), which is finishing fabrication in early FY12, then installing, commissioning, and starting to take data at the end of FY12; and the flagship project in this area, LSST, the top-ranked ground-based project and a priority for DOE. LSST is a Stage IV experiment and is Critical Decision 0 (CD-0) approved. Its August 2011 NSF Preliminary Design Review was successful. A Lehman review of the camera project will be held at SLAC in November 2011 in preparation for requesting CD-1 approval. FY12 funding is provided for LSST R&D. This project is set up to advance science in a number of ways.

Type-Ia SN 2011fe was discovered by Peter Nugent of Lawrence Berkeley National Laboratory, leader of the type-Ia supernova group on the Palomar Transient Factory (PTF) less than 12 hours after the explosion; it is the closest supernova to Earth in more than 25 years. Discovery and follow-up used multi-agency resources and worldwide collaboration. This early discovery allowed precision measurements to be made during the entire explosion, enabling strong constraints to be placed on progenitor systems.

HEP is involved in Auger,VERITAS, Fermi Gamma Ray Telescope, Alpha Magnetic Spectrometer (AMS), and HAWC. AMS is performing as expected and has collected more than 6 billion cosmic ray events since installation. VERITAS detected an unexpected pulsed gamma-ray emission from the Crab Pulsar between 150 GeV and 40 GeV. HAWC’s seven-tank prototype array is complete, and it is being commissioned in FY12. A baseline review was held in November 2011, and fabrication can start when the continuing resolution is lifted.

In the cosmic microwave background, HEP has small research efforts on a few experiments: the South Pole Telescope (SPT, which is taking cosmic-microwave-background polarization measurements to study the inflationary era) and the European Space Agency (ESA)/NASA Planck mission (for which HEP is providing computing resources for data processing and analysis).

The budget for the Cosmic Frontier went up a little in FY11 and has gone down a little under the continuing resolution.

Most collaborations are planning their next step. Technology choices will need to be made going forward in the next phases. DOE is now planning for the second generation of dark matter experiments. An FOA for such experiments will be announced within a few months. Experiments are expected to be selected in late FY12 and move into R&D in FY13. These activities will be done in coordination with NSF and will need global coordination.

DOE is now planning for the second generation of dark-matter (DM-G2) experiments, which will be 10 times more sensitive than G1. Most G1 collaborations are planning G2 versions. It is anticipated that an FOA for R&D for G2 experiments will be announced within a few months.

In dark energy, there is a proposal for BigBOSS to fabricate a new 5000-fiber spectrograph covering a 3-degree field to mount on an existing telescope. NOAO reviewed and accepted the proposal for the Stage IV experiment on the Mayall telescope at Kitt Peak in late 2010. A proposal has been submitted to DOE. The Joint Dark Energy Mission (JDEM) R&D has been closed out. Several DOE scientists are participating on the WFIRST Science Definition Team. There are no current plans for DOE participation in WFIRST. Several DOE scientists joined the Euclid science team in August 2011 (no hardware contributions are planned). Euclid was approved to move forward by ESA earlier this month.

The CTA is a Europe-led next-generation gamma-ray experiment. A U.S. collaboration submitted a proposal for an R&D program leading to fabrication with several options. HEP is coordinating with NSF to determine how to review and respond.

In its future dark-matter planning, HEP expects a coordinated strategy for dark-matter research, including direct and indirect detection methods, theory, and accelerator experiments.

It is investigating the most effective and expedient strategy to get community input. Similarly, it wants to do planning on dark energy. LSST is its priority for the next experiment to be developed. HEP wants to be proactive in developing a robust dark-energy program and needs input on near-term and low-cost options. It wants to support other agencies. NSF Astronomy has announced their portfolio review, and HEP wants to have options available when it is seen where they are going.

The DOE/HEP Cosmic Frontier program is planning a graduated review process to start in

spring 2012. It will be based on recommendations from the Committee of Visitors. All experiments will continue to have monthly or quarterly reports and discussions with the agencies, as appropriate. For projects below the major items of equipment (MIE) limits, each experiment/effort’s Project Execution Plan (technical status, cost, schedule, and management) will be reviewed. Projects above the MIE limits but below the Lehman limit will have individual R&D and “baseline” reviews. Projects above the Lehman limit may choose to have an independent review of the pre-conceptual R&D phase and science before moving to a Lehman review. This process will be an annual checkup on the projects.

Operating experiments may be reviewed every 2 or 3 years. Operating plans, status reports, and budget reviews will be required. The details on how to do this are still being worked out.

Shochet observed that more and more of these experiments are moving to Europe and asked if HEP were coordinating planning with European groups. Turner replied that HEP does not have discussions with ESA; NASA may. For CTA and dark-energy experiments, HEP is participating in the International Science Forum.

Akerib asked how priorities are set for the national laboratories. Turner replied that guidance is coming from HEPAP, laboratory advisory committees, and other organizations’ studies. National laboratories are supposed to design experiments in cooperation with universities.

Honscheid asked what the definition of “low-cost” was. Turner replied, it varies; one has to look at the science case, available funding, etc.

Ong noted that the Scientific Assessment Group for Experiments in Non-Accelerator Physics (SAGENAP) brought people together each year to discuss what they were doing and that such a forum was useful. There must be a way to do that legally. McBride replied that the Instrumentation Task Force worked through the American Physical Society’s Division of Particles and Fields. Also, international advisory committee of the International Union of Pure and Applied Physics (IUPAP) has requested a new working group on astroparticle physics.

Byrum noted that, a few weeks ago, SLAC held a West Coast workshop on dark matter. A similar workshop is expected to be held in the Chicago area. Turner responded that coordination on direct, indirect, and accelerator experiments is needed. There is also a need for community buy-in for a complementary program.

Shipsey noted that PASAG and Astro2010 pointed out that the identification of the nature of dark energy would require a coordinated effort involving all three approaches (baryon acoustic oscillations, weak lensing, and supernovae). Great strides are being made with LSST and Euclid. Europe might join the United States in operating LSST. He asked if a similar arrangement could be set up for the United States to support Euclid. Turner answered that that has not been looked into. NASA is exploring a possible collaboration with ESA. Siegrist added that there has been advice to do this, and NASA has the lead. HEP does not have much flexibility.

Byrum asked what HEP was going to do with regard to CTA. Turner said that a review has not been set up yet. It would be good to have information about it, but there is no money for new starts. Crawford added that that is why workshops would help, so the Office knew what possibilities there are and could come to some intelligent decisions. Siegrist added: And a balanced portfolio in dark matter.

Dixon stated that some cautions should be exercised. To connect the three areas of direct detection, indirect detection, and missing-energy searches at the LHC, theories are needed of what dark matter is, and one may not be able to judge the complementarity of the different modalities. Turner agreed that that would be very good to know.

A break was declared at 10:27 a.m. The meeting was called back into session at 10:59 a.m.

**Ian Shipsey** was asked to present the report of the Division of Particles and Fields (DPF) Task Force on Instrumentation in Particle Physics. The Task Force recognized that instrumentation is the great enabler of science, both pure and applied, and that instrumentation is critical to the mission of HEP. However, today’s instrumentation represents both a towering achievement and, in some cases, a scaled-up version of techniques used in the past. Today’s accelerators, huge and costly as they are, de-scope detectors and their capabilities to the detriment of physics reach. In addition, the timescales of those experiments insulate researchers from instrumentation advances and innovations in the industry. Instrumentation R&D has the potential to transform this situation, but DOE and NSF funding for instrumentation R&D has declined during the past two decades. If this trend is not reversed, the golden age of HEP discovery will be stalled and its goals unfilled. The development of both evolutionary and transformative detector instrumentation should be coordinated across the national laboratories and with the university community, international partners, and other disciplines. DPF formed a task force to that end. Its charge was organized in three broad areas: structure for a national instrumentation R&D strategy, models for an entrepreneurial instrumentation science strategy, and graduate student and postdoctoral training.

A 12-member panel was formed. It asked advisers to respond to questions posed by the panel; about 30 responded. Six subgroups were formed:

1. Coordination of a national program,
2. Targeted resources at the national laboratories for the community,
3. National fellowships,
4. Instrumentation schools and education,
5. Interdisciplinary aspects of instrumentation, and
6. APS instrumentation award.

These subgroups met in parallel to develop position papers and reported to the Task Force frequently. Two of them (Coordination of the National Program and Targeted Resources) merged. The community was encouraged to join these subgroups. The overriding goal was to begin to create the conditions that will lead to a vigorous national program of transformative instrumentation development that will enable science. The program will have strong international connections and change the way instrumentation is viewed in the United States.

The charge was written December 2010/January 2011; Task Force members were identified in February; national and international advisers were identified in March and April; working groups were created at the end of April; a Task Force kickoff meeting was held May 2; a meeting was held on June 8; and a town hall meeting for community input was held on June 9. Regular subgroup and Task Force meetings were held since then. By August, the main ideas and recommendations were well advanced and available for community comment and input. Draft position papers were made available to the community on August 8, the Task Force met on August 11, and a Task Force web page was launched on August 12. Since then, a town hall meeting was held, the position papers were refined, and the draft final report was compiled and is being released at this meeting.

The primary recommendation of the Task Force is that a Detector R&D Coordinating Panel (DRDCP) be formed under the auspices of the DPF Executive Committee as a largely self-organized standing committee to promote and assist in generic detector R&D. It would not be a program advisory committee, a standing review body for proposals, or a roadmap developer. A possible membership model is one representative from each national laboratory, an equal number of representatives from the university community, and observers from outside the United States.

The second recommendation is that instrumentation resources at the national laboratories should be coordinated and collaboratively used. Proposed initial steps include

* Each laboratory’s naming a point of contact on generic R&D to make the nature of these facilities and their capabilities more widely known and accessible and
* Creating centers for sensors and detectors.

The third recommendation is to establish a national instrumentation fellowship program to increase participation of young U.S. scientists in leading-edge instrumentation R&D, to maintain and enhance the impact of the United States in detector instrumentation, and to contribute instrumentation expertise to society. These would be named fellowships supporting graduate students later in their studies to encourage support and greater participation in instrumentation R&D. Oversight of the fellowship program would be provided by the DRDCP, selection would be through competitive proposals from national laboratories and universities, industry sponsors would be sought, the offering of PhDs in instrumentation would be encouraged, and instrumentation work rather than teaching would be encouraged during the early stage in a graduate student’s career.

The fourth recommendation is that the Excellence in Detectors and Instrumentation Technologies (EDIT) school sponsored by the International Committee for Future Accelerators (ICFA) should be strongly supported in its organization and participation. This year’s school was held at CERN; the next one will be at Fermilab.

The fifth recommendation is that the U.S. Particle Accelerator School (USPAS), a well-recognized consortium providing graduate-level education with academic credit, be broadened to include detectors and instrumentation. In the longer term, it should organize a new session dedicated entirely to detectors, perhaps held at various national laboratories on a rotating basis.

The sixth recommendation is that dedicated detector in instrumentation courses be offered to the high school and university summer students participating in the national laboratories’ summer research experience programs.

The seventh recommendation is that advanced topical schools be instituted at national laboratories or universities on specific detector techniques or detector systems; these could be of potential interest to industry, serving as a platform for the dissemination of knowledge of the latest industrial technological advances and providing education for the industry’s technical staff. The companies that benefit from these schools are potential sponsors of national instrumentation fellowships (which would be named after the company).

The eighth recommendation is to develop detector-technology teaching facilities based on parts of retired experiments, such as D0, CDF, the B B-bar Detector (BaBar), and CLEO. A dedicated test-beam facility should be established for the demonstration and examination of various detection techniques.

The ninth recommendation is to develop semester-long courses on particle detectors at U.S. universities; these courses could be developed by consortia of universities and/or in collaboration with national laboratories or CERN.

The tenth recommendation is to establish an APS DPF award for excellence in instrumentation development to recognize and reward important contributions to the field by colleagues who excel in instrumentation development.

The 11th recommendation is that the field of high-energy physics should reach out to other communities (including other offices in the Office of Science, NSF, the medical community, NASA, and the national-security community) through workshops, SBIR/STTR proposal calls, the highlighting of examples of migration of instrumentation technologies, and a repository of available equipment at U.S. universities that could be used for instrumentation development.

In conclusion, priority within high-energy physics should be given to the coordinated development of evolutionary and transformative detector instrumentation. While the fundamental science questions addressed by HEP remain compelling, the economic situation is challenging, and the prospects are for flat or declining funding for most branches of science. In the national laboratories, funds available for generic instrumentation R&D and the associated infrastructure are very limited. In the universities, technical infrastructure has seen a significant and sustained decline. In this challenging environment, the use of the available resources must be optimized to develop new, innovative, cost-effective instrumentation, and the HEP portfolio should be rebalanced to increase the fractional support of instrumentation because this is the best hope to successfully accomplish the mission of HEP.

With this presentation, the draft report was released for comment during the following two weeks.

Glenzinski commented that this self organization seems to risk that just an elite group could advance its own opinions. Shipsey replied that they do not need to be micromanaged but rather need the freedom to go out and look at the opportunities available.

Leemans commented that one could replace the word “instrumentation” in the report with the word “accelerators.” There is the accelerator stewardship ongoing. Could some parallel effort be made in instrumentation? Shipsey replied, yes. The accelerators are more fundamental at the Intensity Frontier. DOE no longer has the most important accelerators. The community working with HEP could remedy this deficiency and raise the public interest in this field (and thereby the interest of Congress). The community should engage the public.

Akerib said that he appreciated Shipsey’s passion. He asked if there should be a graduate fellowship program to encourage groups to support instrumentation fellows. Shipsey pointed out that that is in the report. Such a program would also raise the prestige of the field. Instrumentation should be celebrated as the true enabler of science.

Gelmini noted that some university groups support accelerator R&D and asked Shipsey if he envisioned a similar interest in this branch of physics. Shipsey responded, absolutely! They now expect students to go for an MS in instrumentation. University departments have to be convinced that instrumentation R&D is equal to analytical R&D.

Marlow said that creating these new fellowships would be difficult. Perhaps the DOE Graduate Research Fellowship Program could be expanded. Crawford replied that that program has been discontinued. It may be allowed again in the future.

Marlow pointed out that one cannot teach a program for two students. Doing it regionally makes sense. Shipsey agreed. In Scotland, students go from one university to another to take courses in specific topics in instrumentation. One can string together the students to achieve a critical mass.

Kim said that conferences, workshops, and talks specifically on instrumentation would be helpful.

McBride thanked the Task Force for its hard work on behalf of the Board of the DPF. There are a lot of recommended actions. The Coordinating Panel will be important in following up. Recommendations for membership on that panel are requested.

Shochet reviewed the topics to be included in his summary letter to the agencies and requested additional comments. The draft of the letter will be distributed to the HEPAP members for additional comments before submission to the agencies.

The floor was opened for public comment. There being no further business or discussion, the meeting was adjourned (for Shochet’s last time) at 12:05 p.m.

Respectfully submitted,

Frederick M. O’Hara, Jr.

Recording Secretary

Nov. 11, 2011

Corrected,

Melvyn Shochet

Chairman

December 11, 2011

The minutes of the High Energy Physics Advisory Panel meeting held at the Palomar Hotel, Washington, D.C., on October 27-28, 2011, are certified to be an accurate representation of what occurred.

Signed by Melvyn Shochet, Chair of the High Energy Physics Advisory Panel on December 11, 2011.

