**Draft Minutes**

**High Energy Physics Advisory Panel**

**November 18–19, 2010**

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

**HEPAP members present:**

Daniel Akerib Wim Leemans

Marina Artuso Daniel Marlow

Edward Blucher Ann Nelson

Raymond Brock Regina Rameika

Andrew Cohen Kate Scholberg

Lance Dixon Melvyn Shochet, Chair

Bonnie Fleming Henry Sobel

Graciela Gelmini William Trischuk

Douglas Glenzinski Herman White

Steven Kettell

**HEPAP members absent:**

Hiroaki Aihara Stuart Henderson

Patricia Burchat Ian Shipsey

Donald Hartill Paris Sphicas

**Also participating:**

James Alexander, Department of Physics, Cornell University

Charles Baltay, Department of Physics, Yale University

Roger Blandford, Director, Kavli Institute for Particle Astrophysics and Cosmology, Stanford University

Glen Crawford, HEPAP Designated Federal Officer, 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, Diebold Consulting

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

Howard Gordon, Physics Department, Brookhaven National Laboratory

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

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

Dennis Kovar, Associate Director, Office of High Energy Physics, Office of Science, USDOE

Patricia McBride, Computing Division,Fermi National Accelerator Laboratory

Donna Nevels, Oak Ridge Institute for Science and Education

Piermaria Oddone, Director, Fermi National Accelerator Laboratory

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

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

Oya Rieger, Associate University Librarian for Digital Scholarship Services, Cornell University

Lucio Rossi, Head, Magnets, Cryostats, and Superconductors Group, CERN

Randal Ruchti, Department of Physics, University of Notre Dame

Bruce Strauss, Facilities Division, Office of High Energy Physics, Office of Science, USDOE

Andreene Witt, Oak Ridge Institute for Science and Education

About 50 others were in attendance in the course of the two-day meeting.

**Thursday, November 18, 2010**

**Morning Session**

The meeting was called to order by the Chair, **Melvyn Shochet**, at 9:01 a.m. **Dennis Kovar** was asked to report on the activities of the Office of High Energy Physics (HEP).

The House and Senate have made their markups, and a continuing resolution has been enacted until December 3. The FY12 budget request is at the Office of Management and Budget (OMB). Passback is expected on November 29.

Funding projections have been revised during the past year and more are expected. HEP planning uses guidance from HEPAP, Astro2010 [the decadal study of astronomy by the National Research Council (NRC)], and others to allow it to adapt to changing circumstances and to incorporate up-to-date guidance.

In the FY10 HEP budget, research was more than 40% as was facility operations and development, with most of the money going into the energy and intensity frontiers. That budget is supporting about 4280 people at universities and national laboratories.

The HEP FY11 budget request was for $829 million, which is an $18.5 million (or 2.3%) increase over the FY10 appropriation and about 17% of the Office of Science (SC) budget.

The Tevatron will operate in FY11. The U.S. Large Hadron Collider (LHC) program is supported at a level that will allow U.S. researchers to play a leading role. Ongoing major-items-of-equipment (MIE) projects are supported on the planned schedules. First investments are being made to secure a U.S. leadership program at the intensity frontier. The research program is going well.

The House mark is a directed $12.5 million reduction. The Senate mark is a general $8.915 million reduction. There is a significant desire to reduce the budget and deficit. There may be a continuing resolution all year long.

The Particle Physics Project Prioritization Panel (P5) and the Particle Astrophysics Scientific Assessment Group (PASAG) reports give an excellent plan for the outyears.

The LHC research program has been delayed. CERN has developed new plans for the LHC. The Tevatron performance continues to be outstanding. Significant progress has been made on implementing U.S. leadership at the intensity frontier. A model for a joint-agency Deep Underground Science and Engineering Laboratory (DUSEL) physics program has been established. Additional guidance has been obtained on the other opportunities identified in the P5 report. On the cosmic frontier, HEPAP has identified opportunities and priorities for the HEP particle astrophysics program; Astro2010 has identified opportunities and priorities for the U.S. astronomy and astrophysics programs; and the Office of Science and Technology Policy (OSTP) has worked on a coordinated agency response. Delay in the LHC schedule has driven a delay in an anticipated decision on the next lepton collider. The Accelerator R&D Workshop Report provided guidance on opportunities and priorities in that field. Projected funding has been between the 2007 and 2008 levels of effort.

The Tevatron has produced many new results. HEPAP recommended extending the running of the Tevatron *if* additional resources can be found. The performance of the LHC accelerator, detectors, software, and computing has been exemplary. The U.S. agreement with CERN goes to 2017, but that agreement is expected to be extended.

The National Science Foundation (NSF) and the Department of Energy (DOE) have established a DUSEL Joint Oversight Group, and the agencies are collaborating in defining the DUSEL stewardship roles and core research program. An interagency memorandum of understanding (MOU) will define in more detail the roles and responsibilities.

The Office has received proposals for three small, intensity-frontier projects at SuperB in Italy, Belle-II at Super-KEKB [High-Energy Accelerator Research Organization] in Japan, and g-2 at Fermilab. HEP has conducted peer-review evaluations of these proposals. Support for the scientific opportunities depends upon funding in FY12 and guidance on funding projections in the outyears.

Astro2010 recommended that DOE should partner with NSF on the Large Synoptic Survey Telescope (LSST) and should contribute to the Wide Field Infrared Survey Telescope (WFIRST) if funding allows. If funding is constrained, LSST is the priority because the DOE role is critical. Our current projections tend toward the lower funding amounts. HEP will contribute to selecting high-impact experiments with discovery potential to address a particle-astrophysics goals where DOE researchers and investments can play a significant role and make significant contributions. The priorities are going to be dark matter, a leading U.S. role in dark-energy research, and other opportunities.

In dark matter, DOE’s priorities are R&D and prototype detectors. In dark energy, DOE is looking to partner with NSF and with the National Aeronautics and Space Administration (NASA). In cosmic rays and high-energy gamma rays, it will complete currently operating experiments, will not participate in Auger North, and will discuss a role in the merger of the Advanced Gamma-ray Imaging System (AGIS) with the Cherenkov Telescope Array (CTA).

In accelerator R&D over the past 5 years, investments have developed the U.S. competency in superconducting radio frequency (SRF) technology. This positions the United States to construct Project X or to participate in the construction of an International Linear Collider (ILC). The funding for ILC and SRF R&D will be ramped down as planned activities are completed. HEP has made significant investments in plasma wake-field acceleration demonstration projects. It plans investments in a 5-year national muon accelerator R&D campaign. It has some funding for accelerator R&D. It plans to ask HEPAP for an assessment of its Accelerator R&D Strategic Plan to see how to incorporate information obtained from the Accelerator Workshop.

Guidance on HEP out-year funding has changed since last year; funding levels have been reduced, forcing programmatic decisions. The delays in LHC’s decisions have postponed other seminal decisions. Results from recent elections and the national financial status imply additional adjustments. There will be a downsizing. Priorities remain the same as those identified in the P5 and PASAG reports.

Since the P5 report, the field has been in Scenario B [constant funding level]. The situation is expected to evolve to some intermediate point between Scenario A [constrained funding] and Scenario B. If the Office is taken back to FY08 funding, it will have a dramatic impact on the program.

A Committee of Visitors (COV) review was held. There are two openings posted. Demographic information is being collected from national laboratories and universities; those who do not respond will get a telephone call from the director.

Shochet asked what the timeline will be for understanding the impact of an extended Tevatron run. Kovar replied that February will be important. Much more will be known then.

Glenzinski asked what the charge to HEPAP will be. Kovar answered that it is a work in progress, but it will come out soon.

Diebold asked what guidance the Office was getting from the administration. Kovar responded that the Department and the administration identify initiatives to support. HEP did not do so well. The priorities are climate change, jobs, and energy. The administration is committed to doubling the physical sciences budget, but there are the priorities. It remains to be seen what response there will be to the desire to control the budget.

Trischuk asked what topics were being discussed with CERN. Kovar replied that the path forward is determined by CERN. They determine the running schedule and plan upgrades. The budget will determine how much the United States can partner with CERN. Trischuk asked if the Office were taking a proactive or reactive stance with CERN. Kovar answered, a little bit of both. The Office works with them to see how best to use its resources.

Brock asked how discussions were likely to progress. Kovar answered that there are plans through 2015. CERN’s program shifted, and the Office lost that money. The sooner CERN and the LHC lock down their schedule, the more likely HEP is to not lose the money again.

**Howard Gordon** was asked to present the first physics results from the LHC.

2010 has been a spectacular year for the LHC: pp collisions started on March 30, 2010. The machine has increased the instantaneous luminosity for pp by 5 orders of magnitude to a peak of 2 × 1032 cm–2s–1. All four major experiments have taken a large data set and are working well. There have been many publications about new phenomena and some limits beyond the Tevatron. Fundamental measurements have been made that are critical for determining the backgrounds for such major discoveries as supersymmetry or the Higgs.

There were 368 bunches at the maximum. They started commissioning 50-ns bunch spacing, but this was limited by electron-cloud effects. A transition to heavy ions was made with the first collisions on November 7.

United States physicists constitute about 24% of the LHC collaborations with 1722 collaborators from 94 institutions and 397 graduate students.

The total integrated luminosity at ATLAS [A Toroidal LHC ApparatuS] has increased to ~45 pb–1. ALICE [A Large Ion Collider Experiment] has accumulated less, by choice.

Things are working well. ATLAS has some difficulties: optical links continue to be a worry, there is a higher-than-expected background in Pixels, and there are more high-voltage trips at higher luminosity. Planning for the winter shutdown from December 6 to mid-February is under way.

The ATLAS trigger has evolved over an increase in luminosity of 5-orders-of-magnitude; the plan is to gradually commission it and then apply high-level trigger (HLT) rejection.

Through summer 2010, there was a lot achieved in terms of performance and in understanding that performance. There was very good data taking, and we began to understand QCD and electroweak backgrounds and exactly what we had been measuring. Elements of the Standard Model were rediscovered at 7 TeV, and the first new-physics searches were conducted, looking for new states of dijet resonances and others. There is now a data set of about 45 pb–1, allowing more-precise measurements of the Standard Model at 7 TeV, the study of top-pair production at 7 TeV, and the search for Z′ and other objects. It also lays the foundation for early Higgs searches in 2011.

Some highlights: Tracking is working, inner-detector material mapping is progressing, b tagging is commissioned, the muon trigger and reconstruction are advancing, the EM calorimeter energy scale and resolution are improving, the jet energy scale is well understood, photon identification has been achieved, the missing transverse energy is understood, and τ identification is working. The momentum scale is now known to a few per mil, resolution is as expected, and complex algorithms worked well. Work now is on resolution and refining alignment.

The Level 1 and HLT triggers work beautifully. The Compact Muon Spectrometer (CMS) has even better resolution. The electron identification and energy scale are just what were predicted by Monte Carlo modeling. The jet energy scale is understood well. The missing transverse energy in the calorimeter is just what Monte Carlo models predicted.

Direct photon selection is a challenge with the jet rejection being less effective than for electrons and the process being complicated by isolation.

Ws have been seen for a long time. CMS observed a beautiful ZZ event.

Some of the first physics results are minimum-bias multiplicity, pT distributions, and the underlying event, which is critical for tuning Monte Carlo calculations for all backgrounds. In quantum chromodynamics (QCD), there have been results on the ridge effect from CMS, jets, the search for dijet resonances, and the search for contact interactions. In W and Z production, the background for top and supersymmetry (SUSY) has been identified. There have been lead–lead results.

The minimum-bias distributions reported earlier have been followed up to more than 100 particles with close correlation with Monte Carlo predictions.

Long-range, near-side angular correlations in proton–proton collisions were observed. The impact on the scientific community has been sizable. Jet energy scale is close to Monte Carlo predictions; the jet multiplicity has been observed out to eight jets. Measurement of inclusive jet and dijet cross-sections in proton–proton collisions at 7-TeV center-of-mass energy have been measured with the ATLAS detector.

The search for new particles in two-jet final states in 7-TeV proton–proton collisions has been conducted with the ATLAS detector.

Analysis of χ distributions excludes quark contact interactions with a compositeness scale Λ below 3.4 TeV, significantly exceeding previous limits. CMS made a similar measurement. Contact interaction is excluded for Λ less than 4 TeV.

The CMS leptoquark search has excluded a mass of greater than 330 GeV. This measurement will be improved. The measurement of the missing transverse energy shows that the data and the contribution to the data are understood from the Standard Model.

W and Z cross-sections are very good and agree with other experimental results.

The decay of Bs mesons to the vector mesons J/ψ and φ was well described, and the decay to Ds2 χμν and then to D0K+ have been observed with about 46 events.

The decay of B0 to πK, ππ, and KK were measured and is interesting for charge-parity asymmetries.

B tagging has been done in CMS, and the top production cross-section has been measured at 7 TeV.

The Higgs mass exclusion reach of 5 fb–1 would exclude the Higgs over the entire preferred mass range.

In the past few days, there have been lead collisions, testing the triggers etc. at extreme conditions. Two jets were observed. Measurements showed that the detectors are working very well, that energy is produced in all directions, and that the π0 peak looks the same as for pp.

All four experiments have had an exciting and productive year. 2011 is expected to see the accumulation at least 1 fb–1 and therefore could yield some real discoveries. U.S. participation shows significant leadership in the physics results and the collaborations appreciate the support from DOE and NSF.

Denisov asked if the ATLAS saw the ridge effect. Gordon replied, no. The results from this CMS trigger favored high multiplicity.

Nelson noted that Gordon had said that the error budget has a 5% error in theory and asked how one was going to get to 1% resolution on the energy scale. Gordon responded that there are many contributions to the jet energy scale. They can tune the showering model to get to a few percent error.

Dixon asked if there were any issues with pileup. Gordon replied that the machine’s luminosity accumulated slowly at first without pileup. That allowed studies of the underlying event.

A break was declared at 10:17 a.m. The meeting was called back into session at 10:59 a.m., and **Marvin Goldberg** was asked to present an update on the NSF Elementary Particle Physics (EPP) program. The program will have several vacancies in the near future.

In a time of tight budgets, partnerships and synergies with other programs will significantly enhance EPP’s program scope.

In the FY10 budget, EPP accelerator-based programs were funded at $25.792 million. The Cornell Electron Storage Ring (CESR) was zeroed out; work there was shifted to an accelerator-research program. Particle and Nuclear Astrophysics (PNA) and IceCube were funded at $20.0 2 million, LHC operation was funded at $18 million, accelerator and ILC detector R&D was funded at $0.3 million, DUSEL was funded at $4.09 million, and EPP plus astronomy/cosmology theory were funded at $13.2 million, totaling $81.40 million. Major Research Instrumentation (MRI) went up to $8.93 million from $2.76 million in FY09. Partnerships increased the $81.4 million budget to $101.21 million.

In dark matter, the NSF-PNA program is funding DarkSide-50 in the Borexino Counting Test Facility (CTF) with a start in FY10, is continuing to support DRIFT-II [the second-generation Directional Recoil Identification From Tracks], and made a new award in FY10 to the Dark Matter Time Projection Chamber (DMTPC).

In IceCube, the correlation of observed muon rates with long-and short-term variations in the South Pole atmosphere has demonstrated that the measurements closely probe the time dependence of the stratospheric temperatures in the Antarctic ozone layer and the ozone-hole dynamics.

Geoneutrinos are antineutrinos produced in the radioactive decays of uranium, thorium, potassium, and rubidium found in ancient rocks deep within our planet. These decays are believed to contribute a significant but unknown fraction of the heat generated inside Earth, where this heat influences volcanic activity and tectonic-plate movements. Borexino serves as a window to look deep into the Earth’s core and report on the planet’s structure. The recent Borexino measurement of the geoneutrino rate is 3.9 events per 100 tons per year. This measurement rejects the hypothesis of an active georeactor in the Earth’s core with a power about 3 TW at a 95% confidence level.

The Neutrino Ettore Majorana Observatory (NEMO) experiment recently set new upper limits on the mass of this particle by searching for examples of neutrinoless double-beta decay. In addition, a lower limit was set on the half-life for neutrinoless double-beta decay; this, in turn, sets an upper limit on the neutrino mass of 4.0 to 6.8 eV.

The Office of International Science and Engineering (OISE) now has Partnerships in Research and Education (PIRE), which will contribute to a globally engaged and internationally trained workforce, increase minority participation in science and engineering, and develop lasting connections between the participants and their counterparts at foreign institutions. The ability to involve undergraduates is innovative because, in contrast to most high-energy physics collaborations, these exchanges will occur with foreign collaborators at the universities rather than in the laboratory. Another PIRE partnership with OCI intends to help develop long-term, persistent storage for scientific data and state-of-the-art services for integrating, analyzing, sharing, and archiving scientific data.

The proposed Accelerator Physics and Physics Instrumentation (APPI) program can support accelerator R&D at universities. EPP now possesses no accelerator laboratory facilities to support accelerator research at universities for Project X, colliders, and SRF.

The partnership between the Atomic, Molecular, and Optical Sciences Program (AMOP) and Division of Physics (PHY) supports proof-of-concept experiments on plasma accelerators that require an expertise in plasma physics, lasers, and beam physics.

NSF supported the publication of *International Science Grid This Week* (*ISGTW*, now *The Digital Scientist*).

In partnership with HEP, NSF supports university group activities in ATLAS and CMS collaborations (following detector construction for $81 million). A 5-year funding profile is before the National Science Board (NSB) now.

Base support for universities from the EPP program is about $14 million per year. All funding areas are improving the computing for LHC.

The decision has been reaffirmed to keep the LHC detector R&D funding support in the Operations Program to stimulate a focused R&D effort by a closer coupling between actual operating experience and perceived upgrade goals; there is the possibility of U.S. support from NSF-wide programs, such as MRI. The upgrade construction strategy has been totally changed because of the changes and remaining uncertainty in the LHC run plan and upgrade schedule. The strategy is now focused only on the “initial” upgrades. Possible funding support will be available no sooner than FY13. Meanwhile, possible earlier support from other sources may be forthcoming from the MRI program.

Theory and cosmology are intense, vibrant disciplines, where many people are exploring new ideas at the intersections of particle physics, astrophysics, and cosmology. FY10 initiated the era of the LHC. Data from the LHC will be truly transformational. High-energy-physics theory spans many orders of magnitude in energy and runs the gamut from hard-core, data-driven collider phenomenology to abstract model building and considerations of the “ultimate theory.” The LHC Theory Initiative provides graduate student and postdoctoral fellowships to promising young theorists working on LHC-related physics. The program was created by the U.S. particle theory community in anticipation of the data to come from the LHC. In 2010, the program funded six postdocs and four graduate students.

NSF provides the major continuing grant for the Aspen Center for Physics summer program; this grant is coming up for renewal in FY11. The Physics Frontiers Centers at the Kavli Institute for Cosmological Physics at the University of Chicago and the Kavli Institute for Theoretical Physics University of California at Santa Barbara are also supported by NSF. PNA has grown a lot since it was spun off.

For FY11 and beyond, there are huge budget uncertainties. DOE knows its budget before NSF knows its budget.

Shochet asked why accelerator and detector R&D had dropped to nearly zero. Goldberg replied that most of that was ILC related; also, some programs at Cornell were moved to another category.

Marlow stated that he had been under the impression that PIRE grants were not renewable. Goldberg said that they are but have to have a plan for what to do if there were no more money. There is nothing that says they cannot be renewed.

**James Alexander** was asked to present the report of the COV to the Office of High Energy Physics, which Committee met at DOE a month before.

These COVs are held every 3 years, and are mandated by SC. This COV was charged to assess (1) the efficacy and quality of the processes used to solicit, review, recommend, monitor, and document application and proposal actions; (2) the breadth and depth of the resulting portfolio; (3) the response to P5; and (4) actions needed for a healthy national laboratory/university program.

The Committee was broken down into five topical subpanels that worked in parallel. The strategic issues that were identified were

* OHEP is following and appears fully committed to carrying out the roadmap constructed by P5 in 2008.
* While the energy frontier has moved to Europe with the LHC, the need for accelerators for discovery science, security, energy, environment, industry, and medicine has continued to grow. HEPAP should convene an expert panel to formulate a strategic plan for strengthening and expanding stewardship role of HEP in accelerator science.
* Projects underlie the future of the program. For the period under review eight projects were under way with budgets totaling about 5% of HEP funding. This was a historic low, and in the period since, projects under HEP stewardship grew to about 10% of HEP’s funding. The fraction of the total HEP budget devoted to projects should be increased.

Issues that are common to all of OHEP are: The program emphasizes high-quality science and is meeting goals. The international standing is excellent. The stability of international partnerships is much improved. The program managers and all of the administrative personnel are hard-working, but there are too few people for the size of the mandated workload. Adding more staff is a perennial problem in the Office. Creative approaches may be useful, such as part-time consultants from the ranks of recently retired DOE or NSF personnel and continuing and extending the standard practices of using federal employees, laboratory detailees, and Intergovernmental Personnel Act staffers (IPAs). Directed recruitment activities might be useful. The new office structure appears to be a real improvement. Cross-channel couplings by program manager interactions appear to work in most cases but are informal and ad hoc. A little more formal structure might be useful. Use of review templates should continue and expand. Some faster response and prompt forwarding of reviews to proposers are important to improve feedback. The renewal rate is very high, and changes in funding levels are often not very responsive to changes in reviews. Comparative reviews via specially convened panels are strongly recommended. Early Career awardees working at national laboratories receive about three times as much funding as university-based awardees doing similar work. Disparity arises because freed-up salary funds are available for other uses. University candidates must be untenured, but national laboratory candidates can come from any level, and former Outstanding Junior Investigator (OJI) winners are eligible. HEP should work with SC to address the disparity in funding between university and national laboratory awards.

In accelerator-based research, the program includes many world-class experiments performed at U.S. facilities. Many of these experiments have substantial participation from abroad. There are U.S. groups supported by HEP in most important overseas experiments. They push the intensity or the energy frontier, both parts of the key mission of HEP. The distribution of HEP American Recovery and Reinvestment Act (ARRA) funds was timely and effective; the delays in the Chicago Field Office were caused by a check-writing problem, not an award-process problem.

The United States is a leader in nonaccelerator-based research, a fast-moving, highly competitive area. Grants are being evaluated based on historical strength of the group rather than the current strength or productivity of the group. Comparative reviews can be a powerful tool for addressing this issue and for keeping the program in peak form. HEP should develop ways to mitigate the delays in funding produced by the requirement that MIEs must appear in the budget request.

In theory research, the recent management restructuring is a positive development. The theory program manager’s load is daunting. Theory group proposals can be quite diverse. Levels of funding often reflect history as much as the balance of positive and negative comments in the reviews. The program manager has implemented two new programs for graduate students.

The theory subpanel had a lot of recommendations, many of which overlap with the recommendations from other subpanels.

In advanced accelerator R&D, the overall staffing shortage in HEP is most acute. The R&D is world leading, and the program is of great depth and breadth.

In facilities and operations, the Tevatron ran through the 3-year period being reviewed and regularly exceeded its performance metrics. LHC detector operations performed among the best of the international collaborators. HEP facilities have been highly productive and held international leadership positions in multiple frontiers. Flexibility is needed to make budget-neutral shifts of funding among budget codes; the procedures are not clear. Metrics for performance measurement evolve in nontransparent ways. Facility reviews continue to be of high quality.

In projects, the subpanel found the efficiency and quality of the processes used to monitor active projects is high. Staffing levels are marginal; an additional staff member will be needed.

In conclusion, the overall portfolio of research facilities and projects is professionally managed by HEP. The performance and standing of the program are of the highest caliber. HEP is closely following the strategic plan of the field as laid out by P5. The need for additional staff continues to be a serious problem. The research portfolio shows some inertial effects and could benefit from incisive judgments of comparative review panels. Agility is important in the fast-moving nonaccelerator area. Management of facilities and projects is on a firm footing; nonetheless, the COV made some suggestions to refine national laboratory–agency interactions.

Marlow asked if former OJI winners at universities can upgrade to Early Career Awards (ECAs). Crawford replied, yes. Marlow stated that there was a long time between ARRA grants being made and the money being advanced from Chicago.

Glenzinski asked what issues there were with staffing. Alexander responded that there were two: getting people to apply and the gauntlet that one has to go through to be hired at DOE. That latter process should be streamlined.

Nelson asked if funding were an issue. Crawford said that the funding available for relocation etc. is competitive. One has to convince people that the work is interesting and rewarding.

White noted that there is a constraint for foreign nationals. Alexander agreed that there are some strange requirements imposed by DOE human resources.

Akerib asked if there had been any response to the recommendations. Crawford answered that the Office will respond to the recommendations within 30 days and will discuss those responses at the next HEPAP meeting. The DOE hiring process is being refined.

Artuso asked if there were any recommendations on the funding of people on the basis of past history rather than what is proposed. Alexander responded that, on ECAs, it is a program of SC. OHEP needs to go to SC and get funding used more optimally. In proposal reviews, the funding sometimes continues despite nonstellar reviews. Brock noted that the COV of 2005 also brought up the issue of inertia in funding of programs.

Kettell asked if there had been any thought about bringing younger researchers into HEP. Alexander replied, no. The COV focused on getting IPAs from the national laboratories, either full-time or part-time. Kim suggested getting some comments from the Office about splitting IPAs’ time between a home institution and DOE. Crawford said that such an arrangement would be welcome.

Shochet asked for a vote on accepting the COV report; the vote was 18 in favor of accepting and zero against.

A break for lunch was declared at 12:19 p.m.

**Thursday, November 18, 2010**

**Afternoon Session**

The meeting was called back into session at 1:45 p.m. **Daniel Marlow** was asked to synthesize the comments from the community about relations between HEP and the university community.

A letter had been sent out to the principal investigator (PI) community, and it contained a suggestion that it be circulated among senior investigators known to the recipients. It asked for specific and constructive suggestions or kudos on a list of topics. About 33 people responded. The comments were merged into about 28 categories.

Infrequent comments related to paperwork demands, notification of PIs when funds are sent, perceived bias against religious institutions, enforcement of page limits, late arrival of funds, funding-level discrepancies, the university/national laboratory funding balance, capping faculty summer salaries, and review bias.

Common comments related to requiring junior researchers to apply several times through the ECA Program to gain funding, keeping the quality of grant monitors high, a perceived bias against senior scientists in funding decisions, the double-edged sword that project funds maintained infrastructure but are not predictable or subject to peer review, and the unhelpfulness of the distinction between base support from NSF and DOE.

Frequently cited comments included kudos to the DOE Graduate Fellowship Program, the expansion of the OJIs into ECAs, continuing agency support, and making reviews more rigorous. Less positive comments included the small number of ECAs, the large ECA awards to national laboratories, the end of the explicit HEP University Program, funding delays, the partitioning of funds into seemingly artificial categories, and the maintenance of university infrastructure (including critical personnel).

In summary, ECAs would benefit from fine-tuning. Discussions should be held on better coordination of DOE and NSF funding for theory. Technical infrastructure should be supported. Students and postdocs in high-energy physics should get experience with detector hardware.

Pripstein asked if any of this came as a surprise. Marlow responded that the perception that a hardware focus in a proposal counts against one was surprising. Also, the rationalizing of DOE versus NSF theory funding was surprising.

Kim emphasized that students *should* be given the experience of detector hardware; a school would be helpful.

Artuso said that the surprising thing to her was that not many people responded. It is important to sustain R&D at universities to train upcoming professionals. Marlow rejoined that the response was greater than expected. People are busy. Many letters were quite thoughtful.

Pripstein asked how many people the survey was sent to. Marlow answered, about 280, but one would not expect a response from many on the list used.

Goldberg asked whether it wasn’t good for the field to have two agencies funding theory. The two agencies do things differently, producing a diversity. Marlow said that respondents saw groups of comparable competence treated differently. Shochet said that diversity does not occur if grants are just to the traditional PIs of a given agency.

**Roger Blandford** was asked to review the conclusions of Astro2010.

A draft report was issued August 13, 2010. The charge covered space- and ground-based astronomy and astrophysics. It covered the activities of NASA, NSF, and DOE. There was a lot of DOE representation on the Committee and a broad community involvement, including 324 white papers and 108 requests for proposal information.

The process started with five frontier panels. Each panel was given four questions to address on three science objectives: cosmic dawn, new worlds (exoplanets), and the physics of the universe (dark energy, dark matter, the epoch of inflation, and general relativity). An independent analysis was made of risk, technical readiness, schedule, and life-cycle costs.

Four panels reviewed program priorities:

1. Radio, millimeter, and submillimeter from the ground,
2. Optical and infrared astronomy from the ground,
3. Electromagnetic observations from space, and
4. Particle astrophysics and gravitation.

Balance was considered very important in large/small activities, existing/new facilities, no science/discovery science, promise/risk, ground/space, and 2020/2030 investments.

In large-scale space programs, the top priorities are WFIRST, Explorer Program augmentation, the Laser/Interferometer Space Antenna (LISA), and an International X-Ray Observatory.

WFIRST is a near-infrared wide-field telescope for dark energy, exoplanets, and a broad survey. The Explorer programs have been extraordinarily successful, and augmentation would bring great rewards. The inflation technology development program would seek B-mode polarization. The large-scale ground-based program would include (by priority) the LSST, a midscale innovation program, the Giant Segmented Mirror Telescope (GSMT), and the Atmospheric Cerenkov Telescope Array (ACTA). The LSST should be entered into the Major Research Equipment and Facilities Construction (MREFC) queue as soon as possible.

Two budgets were developed: a fixed budget (the pessimistic one) and survey budgets (the optimistic ones). In lower budget scenarios, DOE participation in LSST is recommended ahead of WFIRST because the contribution is relatively larger and the technical role is relatively more critical. The small-scale program and ACTA have lower priorities.

Other infrastructure improvements were recommended.

The Committee paid a huge amount of attention to computation, and devoted a whole chapter of its draft report to collaboration.

In summary, this is an extraordinary time in discovery. The program recommended is science-driven. A balanced program should be maintained. Activity cost, risk, and technical readiness should be considered. Decisions should be made on the basis of recommendations from an independent, strategic advisory committee. Astro2010 has had unprecedented involvement and support from the astronomical community.

Shochet noted that the Joint Dark Energy Mission Science Working Group (JDEM SWG) proposed a more cost-effective means of pursuing dark energy and asked what the Committee’s view of that proposal was. Blandford replied that that proposal came in too late for it to be considered. Other activity is also going on. The James Webb Telescope costs have ballooned tremendously and will stress NASA’s funding. ESA’s Euclid also was too late to be considered. A new NRC panel will give advice on Euclid and complementary projects.

Glenzinski asked what the cost of WFIRST was. Blandford answered, $1.6 billion for a 5-year mission and a cheaper telescope. Glenzinski asked who was spearheading these efforts. Blanchard replied that JDEM presented two designs [the International Dark Energy Cosmology Survey (IDECS) and JDEM-Omega]. The Committee chose the cheaper JDEM-Omega mission. At the moment, NASA is trying to cope with cost overruns on the John Webb Telescope and trying to collaborate with the European Space Agency (ESA) on Euclid and awaiting guidance from the NRC. It has set up a WFIRST working group. Kovar added that WFIRST is not a dedicated dark-energy mission. DOE is awaiting NASA’s recommendations and costing. HEP would expect some of its PIs to apply to collaborate, and HEP would support that. Blandford said that NASA is looking at a cooperative program and possibly a collaborative one.

Gelmini asked how the organization of this global program was visualized. Blandford responded that perhaps there should be a global decadal survey, but the Committee argued for more cooperation. It is hard to make a generalization. Most big projects are international. The United States puts a premium on accurate costing.

Marlow asked how large the Explorer projects were. Blandford replied that they are much smaller. Marlow asked what history there was of publicly accessible archives leading to professional publications. Blandford said that there is a long history of successful use of data archives. They allow experience and data to be matched up. This will be an issue with the LSST, also. Marlow asked if NASA gave any instructions on what to do in case of a deflationary spiral. Blandford replied, no; no one knows where this economy is going.

A break was declared at 3:15 p.m. The meeting was called back into session at 3:44 p.m., and **Charles Baltay** was asked to review the activities of the Organisation for Economic Cooperation and Development’s Global Science Forum’s Working Group on Astroparticle Physics. The Global Science Forum advises governments on global science policy. The Working Group was established in October 2008 to develop a 20-year vision for the scientific opportunities in this new field. There was no intention to develop a prioritized plan or roadmap.

Astroparticle physics is the study of particles and radiation from outer space and of rare, cosmologically significant elementary-particle reactions. It is at the intersection of cosmology, astrophysics, particle physics, and nuclear physics. It deals with the questions:

* What is the universe made of?
* What is the role of high-energy phenomena in the universe?
* What is the nature of matter and interactions at the highest energies?

There was a split of opinion on what should be included in astroparticle physics; different countries had different views. Some of the Europeans felt that nonaccelerator physics is not currently globally coordinated and should be included here so it did not “fall in a crack.”

The emergence of this new field is timely because major fundamental challenges in the field are within the reach of experimental capabilities. Extreme astrophysical phenomena that produce high-energy particles and radiation are of intrinsic interest because they have a major influence on the structure and evolution of the universe.

The conclusions drawn are that it is highly probable that the complexity of future dark-matter experiments, the potential worldwide scarcity of target materials, and the funding required will necessitate global collaborations. If a dark-matter discovery claim is made, independent confirmation will be needed that uses a wide variety of techniques, including different target nuclei. If it is found in an accelerator, one will have to link that discovery with what exists in space.

In dark energy, systematic international consultations among the relevant agencies could ensure that the future array of ground- and space-based telescopes exploits the full spectrum of desirable capabilities and experimental methodologies. In some cases, pooling of funds and merging the projects could be the optimal solution; international coordination is very important.

In high-energy cosmic messengers, coordination and coherence among scientists has been achieved and is very important.

In gravitational waves, there is a high level of international collaboration, but the projected size and billion-dollar cost of third-generation facilities makes them candidates for global-scale planning, funding, and implementation.

In neutrino physics, healthy competition among projects is the rule; however, global-scale coordination and avoidance of duplication would be beneficial, especially for the procurement of crystals and scarce enriched isotopes. A future generation of experiments will use targets approaching one ton and will certainly need international coordination.

In proton decay and other underground experiments, megaton-scale proton decay and neutrino detectors’ cost, complexity, and multiple links to neighboring scientific disciplines present a strong case for worldwide convergence or for avoidance of unnecessary duplication. The Working Group recommended the establishment of a venue for consultations among officials of funding agencies that make significant investments in the field. The new consultative group would be called the Astroparticle Physics International Forum and would be a subsidiary body of the OECD Global Science Forum. The emphasis should be on providing a venue for the agencies to talk to each other about international coordination.

There are now about 4200 people working in this field, mostly in Europe and Russia. Europe and Russia provide the majority of the investment.

Glenzinski asked how large the neutrino community was. Baltay replied, not large in comparison to the whole astrophysics community, and this does not count DUSEL and other underground experiments.

Gelmini asked what the framework of this new panel would be. Baltay responded that it would be a representative standing group, meeting regularly.

Shochet asked whether it would be advisory or like the Funding Agencies for the Large Collider (FALC). Baltay said that it would probably be more like FALC.

**Patricia McBride** was asked to address the issue of visas for short-term visitors to attend U.S. conferences.

This issue came up in the C11 Committee of the International Union of Pure and Applied Physics (IUPAP). IUPAP includes about 20 communities in physics and sponsors many international conferences and collaborations. One such conference is the annual International Conference on High-Energy Physics. The last time it was held in the United States was in 2008, and the younger scientists were urged to attend. But it was not as well attended as previous conferences. The difficulty of getting visas was cited as a reason (inter alia). The next summer conferences will be in Mumbai, India, and Melbourne, Australia. Proposals for the 2013 and 2014 sites were received from Europe and the United States (SLAC and Fermilab). The issue of visas was vociferously brought up and dominated the discussions.

IUPAP has adopted a policy that “no bona fide scientist will be excluded from participation on the grounds of national origin, nationality, or political considerations unrelated to science.”

It was desired to hold the 2013 conference in Northern California hosted by SLAC. The conference will compete with the European Physical Society’s HEP 2013 and the Division of Particles and Fields (DPF) meetings. The 2014 conference will be held in Valencia, Spain.

A lot of information about this issue is anecdotal. People are hesitant to host a conference because of liabilities (e.g., failure to fill the hotel room block). There are further complications if a person is resident away from his or her home country.

To get a U.S. visa, one has to give details of funding for travel, details of flight bookings, make an appointment, pay a fee, then go to a U.S. consulate to be fingerprinted, and then wait for a decision. The average time to clear has declined from 75 to 15 days, but the general advice is to apply 3 to 4 months in advance. One has to plan ahead. The Department of State has a lot of information online, but not information on length of wait for administrative processes. There are several international conferences in high-energy physics in the next few years. But the question arises, can the scientific programs be developed well enough in advance? Perhaps the U.S. high-energy-physics community should be more proactive. The United States needs to plan ahead if it wants to be able to attract the 2016 summer conference.

Shochet worried about being able to get major HEP conferences in the United States in the future. The large international collaborations are not going to choose their speakers six months in advance; they will go someplace it is easier to deal with. He asked if the relevant heads of agencies had tried to go to the Department of State and impress them with the needs. McBride answered that she did not know. Strauss said that there are parts of the Department of State that are sympathetic, but there are others that are not.

Marlow asked if the affected countries included Europe. McBride replied, no. The affected countries were largely China and India. Marlow suggested that one way to approach this would be to guarantee each participant a poster presentation. This could get things started. Strauss said that there were 1600 people at a recent Washington, D.C., conference, and three from China were denied visas.

Kim suggested starting to collect statistics at each conference. Accurate statistics would help. McBride added that educating people about visas needs to be started a year in advance.

Goldberg said that, at the Paris meeting, the decision on who was to speak was made one month in advance.

Pripstein said that this is déjà vu all over again. This is not just a high-energy-physics issue; all scientific organizations have to get involved for a better chance at success. McBride said that some positive experiences are needed so one could point to them for future conference organizers. It also irritates people, keeping them from coming back to the United States.

Kim asked what the action item here was. Shochet answered, making it clear to conference organizers that they have to plan ahead and collect statistics.

**Oya Rieger** spoke via telephone on arXiv sustainability planning. In January 2010, the Cornell Library announced a new business model. arXiv is a program within the Library. It was established in 1991, moved to Cornell in 2001, and was gradually transferred to the Library.

Downloads come from the United States (32%), Germany (14%), the United Kingdom (10%), and Japan (9%). The largest individual users are from Cornell (0.5%) and Max Planck Institute (3.1%). Its budget is about $400,000 per year. It needs to improve to meet the needs of the user community.

In 2009, it was decided that the Library could not fully support the arXiv. 75% of its use was coming from 200 institutions. Those institutions were asked for financial support, and $340,000 was received from 122 institutions. This is only the tip of the iceberg. More disciplines, including high-energy physics, are using arXiv, but the infrastructure used is invisible and taken for granted even though it requires investment.

Users worry about charges being assessed and open access being challenged. Libraries worry about free riders, replacing the formal journals, opening a floodgate to libraries starting many uncoordinated digital archives, and charges to libraries.

arXiv should be invested in to support the scholarly communication process. arXiv provides awareness, registration, certification, discovery, archiving, data mining, etc.

Publishing an article in both the journal literature and arXiv increases the impact factor by a factor of 4 over each of the individual modes of publication.

arXiv, the Stanford Public Information REtrieval System (SPIRES), and the Astrophysics Data System (ADS) complement each other. But SPIRES and ADS get government support. It is hoped that arXiv will, also. arXiv has 630,000 articles, 60,000 submissions a year, and 30 million downloads a year. It is serving multiple disciplines (e.g., condensed matter and mathematics). At the same time, its subject coverage is growing.

arXiv’s budget is $380,000 plus in-kind contributions, which breaks down to $7.00 per submission and 1.4 cents per download.

A strong institutional structure is now being developed for arXiv with an International Sustainability Advisory Group and a Scientific Advisory Board. It is holding discussions with publishers and societies. Agencies and foundations are being looked to for financial support, and arXiv’s architecture and services are being reviewed. A sustainable arXiv will have to have very diverse support from the stakeholders. It may need both an operations budget and a research budget.

Marlow asked what would be wrong with charging everyone $10 to upload a paper. Rieger replied that arXiv was trying to uphold the principle of open access. Dixon offered that, as an author, he would agree to pay $10 to submit a paper. He asked if any thought had been given to merging arXiv and SPIRES. Rieger answered that the two systems are complementary. However, Cornell is looking at moving arXiv to Invenio so they could share the same platform. The hosts are pleased with the fact that the arXiv subject domain is growing; it brings arXiv closer to SPIRES and ADS. Maybe they could be merged in the future.

Akerib asked if the funding collected from the 100+ institutions was an annual fee or a one-time donation. Rieger responded that it was an annual fee, agreed to for 3 years. Akerib noted that the American Physical Society has a list of department chairs and that that would be a place to start in soliciting contributions.

Gelmini said that the value of donations by authors might be a way to gauge the acceptability of leveling a fee for submission. Rieger said that the Library wants to build these scientists into the development of a new revenue model. It does not want to make authors the sole source of revenue.

Akerib noted that libraries are cutting back on hard-copy subscriptions; this may be the time to ask for them to contribute to arXiv.

Marlow worried about the stability of such a system of many library supporters. The ideal model would be to get an endowment. It is a wonderful part of the scientific enterprise. Rieger said that they had been looking for an endowment for the past 4 years. Marlow pointed out that the local university foundation might not be a financial friend here. Cohen asked if they had approached Google and suggested that they do so.

Rieger asked what kind of relationship arXiv should seek with publishers. Marlow offered that one advantage of a single donor would be that the quid pro quo would be clear. He cautioned them not to get involved with publishers. [Murmurs of agreement]

The meeting was adjourned for the day at 5:35 p.m.

**Friday, November 19, 2010**

The meeting was reconvened at 8:58 a.m. **Lucio Rossi** joined the meeting by telephone to present the long-range plan for the LHC. The first studies for the LHC project were conducted in 1982. Physics operations began in 2010. An electric arc between two magnets shut down the LHC in September 2008. All of the work conducted since November 2008 has been done to make sure that a repeat of that disaster can never happen again. Now all buses can be measured from *inside* the magnets. But, a different possible failure scenario was discovered in April 2009 that could produce an electric arc in the copper stabilizers of the magnet interconnects. So it was decided to run at 3.5 TeV to reach an integrated luminosity of about 1 fb–1 by the end of 2011. Then the machine will be shut down for at least 16 months to consolidate the whole machine for 7-TeV operations.

The LHC has commissioned bunch trains, gone to 150-ns bunch spacing, and conducted a new setup of all phases of LHC under the new conditions needed for safe operation with high-intensity bunch trains. We are now running with 24 MJ of stored beam energy and a peak luminosity of 2.05 × 1032 cm–2 s–1. We are now beyond any other accelerator in integrated luminosity while operating at 3.5 TeV. The beam was lost when stored energy exceeded 28 MJ, so the intensity limit for 150 ns may have been reached. A gradual degradation of vacuum has been seen. A pressure rise was seen in common-beam pipe regions, particularly at unbaked warm–cold transitions. Two effects seem to be occurring: an electron cloud driven by the closely spaced passage of successive bunches and synchrotron-radiation-induced desorption. The LHC has reached a stage where interesting things are beginning to pop up, such as the electron clouds, a vacuum-pressure rise that creates an additional load on the cryogenic system, and electrons in the beam pipe feeding back to affect the beam stability. These effects can be eliminated by conditioning (scrubbing) the surface. The region ±5 cm of IP1 was equipped with solenoids, which worked well. Cleaning also improved the situation.

With scrubbing, one can hope to gain 2 orders of magnitude in about 16 hours. This is the price to be paid for eventual good vacuum conditions. At least a partial memory effect will occur. Also, sudden local losses occurred, triggering a beam dump. They were attributed to dust particles (unidentified falling objects or UFOs) falling into the beam, creating scatter losses and showers propagating downstream. It is not known what the source is.

The colliding of lead ions started on November 4 and created a lot of interest. Bunch length increased at injection, decreased during the ramp, and increased again at 3.5 TeV.

Primary ion-beam losses are seen at the collimators. Several features (e.g., ion dissociation and fragmentation and lower ion-beam lifetimes) contribute to the more severe ion-loss problems. The effects are clearly seen in monitors and the equipment. At the moment, there is no workaround for this single-event upset.

In 2010, bunch-train operation with 150-ns bunch links was a big success, with the maximum number of bunches colliding being 368, the peak luminosity being about 2 × 1032 cm–2 s–1, the delivered luminosity being about 50 pb–1, and stable beam operation with 25 MJ per beam. There has also been a 50-ns run and an ion run. Lessons learned include: The LHC is mechanically very reproducible, the head-on beam-beam limit is higher than foreseen, the aperture is better than foreseen, the beam did not cause a single magnet quench, and a careful increase in the number of bunches is all right. The concerns are the long setup, non-optimal quench levels for fast and slow losses, and UFOs. 25% of the nominal intensity (with 680 bunches in each beam) was reached, and beam optimization is ongoing; 850 bunches was reached on November 18, 2010.

After the Christmas break, the beam will be back around February 21 and, with technical stops and pauses for machine development and setup, will run until December 12, producing about 200 days of proton physics in 2011. The running conditions in 2011 will use maximum beam energy, a bunch spacing of 50 ns, and an integrated luminosity evaluation. The goal is 1 fb–1. “Reasonable” numbers include 4 TeV, 936 bunches (at 75 ns), a 3-μ emittance, and 1.2 × 1011 protons per bunch. The ultimate reach is 4 TeV, 1400 bunches (at 50 ns), a 2.5-μ emittance, 1.5 × 1011, and a Hubner factor of 0.2.

There will be a long shutdown from 2012 to 2013 to upgrade the busbars and copper stabilizers. The LHC will then be run between 6.5 and 7.0 TeV for magnet training. Four new collimators need to be inserted into the cold zone DS, displacing 24 magnets and 6 cryomodules. Up to 15 dipoles also need to be replaced.

The integrated luminosity forecast is for 3 fb–1 in 2011, about 80 fb–1 by 2015, and around 200 fb–1 by 2019. An upgrade will be needed in 2019/20 to overcome radiation damage, which causes a rise in halving time.

For LHC high luminosities, a luminosity lifetime becomes comparable with the turnaround time, leading to low efficiency. Preliminary estimates show that the usual integrated luminosity is greater with a peak luminosity of 5 × 1034 cm–2 s–1 and a longer luminosity lifetime. Luminosity leveling is accomplished with beta\*, crossing angle, crab cavities, and bunch length. The upgrade will include an upgrade of the intensity in the injector chain, new high-field insertion quadrupoles, an upgraded cryosystem for IP1 and IP5, crab cavities to take advantage of the small beta\*, upgraded correctors, recommissioned DS quadrupoles at higher gradient, new Q5/Q4, and a larger-aperture D1/D2.

The full timeline includes splice consolidation, first DS collimation, and R2E shields in 2012; cryomodules for radiofrequency, a crab cavity test, further DS collimation, and the first superconducting link in 2016; and High-Luminosity LHC (HL-LHC) installation and an upgrade of detectors in 2020/21.

The HL-LHC design study is being launched. A grant from the European Union has been applied for, and strong participation by the United States and Japan is anticipated. The total cost is estimated at about €21 million.

A new generation of magnets is needed. Most magnet research is done in the United States. It will be a big leap in operational field. The very-long-term objectives are a beam energy of 16.5 TeV, a dipole field of 20 T, 1404 bunches per beam, and a stored beam energy of 479 MJ.

To do this, high-field 20-T dipole magnets based on Nb3Sn, Nb3Al, and high-temperature superconductor would be needed along with high-gradient quadrupole magnets, fast-cycling superconducting magnets, emittance control, cryogenic cooling of the synchrotron-radiation heat load, and dynamic vacuum.

Shochet noticed that a steady increase in luminosity had previously been projected but that the graphs shown were flat from 2018 to 2020 and asked if anything had changed. Rossi responded that there are many limitations to luminosity and what the maximum luminosity will be is not known.

Glenzinski asked if the cloud effects will affect bunch spacing. Rossi replied that the machine was at the injection limit and that there were many electrons. Scrubbing seems to work. Glenzinski asked if the scrubbing produced a self-correcting condition; that is to say, does it stay scrubbed once it has been scrubbed. Rossi answered, yes.

Artuso asked about the possible extension of LHC running into 2012. Rossi responded that the run may be extended into 2012. A request has been made to assess the effects of an extended run. If the physics say that something interesting is being seen, the run will be extended for two months or for a year. Eventually, the machine has to be shut down for maintenance.

**Joseph Dehmer** was asked to present news from the NSF. NSF has a new Director, Subra Suresh, a high-caliber researcher and administrator. He has interviewed all of the division directors. The other new appointment is the Assistant Director for Mathematical and Physical Sciences, Ed Seidel.

The optimistic view of the budget is a continuing resolution all year. Under such a continuing resolution, NSF would forgo a 7% increase in the House and Senate markups. A major discovery may change how we think, but day-to-day problems will detract from that excitement. The Laser Interferometer Gravitational Wave Observatory (LIGO) has finished its initial run and has high prospects during the next decade. IceCube is making its last installations and is in partial operation. In DUSEL, both agencies have agreed to baseline studies. The agencies are cooperating very well. The preliminary design report (PDR) is becoming very solid. The NRC assessment panel will meet in December. The funding for the PDR is out; the follow-on funding is being worked on. A main driver for multi-agency involvement is the particle physics community. HEPAP and P5 should keep their eyes on the ball. Unlike most experiments, this project has broad impact across many fields.

In the Physics Directorate (PHY), two solicitations are now ongoing. There will be a high level of competition.

Innovation is not linear and direct. One does not get it from simple planning. A viable midscale instrumentation program is needed. In FY11, even under a continuing resolution, funding for such a program will be started.

Cyberinfrastructure Framework for 21st Century Science (CF21) is close to the heart of the new Assistant Director for Mathematical and Physical Sciences. There will be solicitations and investment in this program.

“Data policy” is a “thing” now at NSF. New facilities will have to have an open data policy. When LIGO was renewed, it had to develop an open data policy and a cost estimate for it. LHC will be up for renewal and will need to meet this requirement. A data plan will be required in all proposals.

Decisions and balances will be made in investments. Half of the money in PHY will go to PI grants. There are about 1000 PIs, 1000 postdocs, and 1000 students.

Blucher asked if the agencies have decided what to do about the unknown θ13 over the next few years. Dehmer replied that the agencies expect to know about θ13 about the same time construction timelines are set. He was confident that the field will be supported over a long term.

Akerib asked what the strategy was for supporting early work at Sanford Laboratory. Dehmer said that early science work is being funded there but it is subordinate to the planning for the research that the agencies have contracts for.

Artuso asked if there will be a real solicitation for mid-scale instrumentation. Dehmer responded that there would be. It will take time to develop a large program like that (more than $100 million). One has to capitalize the program and then fund research. Right now it is used as an identified reserve for proposals that come into the program rather than as an open solicitation.

Marlow observed that a data policy does not necessarily mean that one’s data is made public. Dehmer said that that is right; it also covers the collection of the data. The research and data analysis produce value added. One has to work through this to arrive at something that makes sense for the situation.

Marlow stated that HEPAP’s meeting with Koonin indicated that the pendulum is swinging toward applied research and asked about the views of the new NSF director. Dehmer responded that one will have to wait and see. NSF has a different mission than does DOE. NSF administrators are working hard to support basic research.

Kettell asked Dehmer if he had a specific recommendation to HEPAP on “keeping an eye on” DUSEL. Dehmer suggested that they keep in mind the most important things that they want to achieve.

A break was declared at 10:31 a.m. The meeting was called back into session at 11:00 a.m. **Randal Ruchti** was asked to talk about the impact on the workforce and education of the HEP programs at DOE and NSF.

High-energy physics makes an effort in workforce development (training and education, professional development, and science centers), education (formal and informal; especially NSF), and outreach (public events, websites, and social networking).

One has to identify target audiences, approaches, and implementations. Afterwards, one has to consider evaluation and sustainability.

One PIRE program is a consortium of universities, a five-year program of scientific research (in particle physics and silicon pixel detector technology) and education (study abroad and undergraduate research). It now has seven graduate students and twelve undergraduate students engaged.

The Michigan research experience for undergraduates (REU) has 139 students enrolled at 15 universities. Students are abroad at CERN for eight weeks in a summer program that includes lectures, research activities, and travel. There also is a teacher component that runs for three weeks in August. Five people are selected for the program each year.

The national laboratories have education offices that have programs for teachers and students. They may include exhibits, field trips, symposia, and classroom presentations. In FY 10, Fermilab served 65 postdocs, 551 graduate students, 78 undergraduate interns, 2499 K–12 teachers, and 37,629 K–12 students. LIGO, DUSEL, Soudan Underground Laboratory, and Cornell Laboratory for Accelerator-Based Sciences and Education all have extensive programs for students and teachers. DUSEL expects to serve about 600 graduate students, about 85 postdocs, 20 staff scientists, 12 engineers and technicians, and a trained underground workforce of about 105. Soudan provides historic tours to 40,000 people per year, and 4000 students and teachers tour the laboratory each year.

Broad-scale education projects are conducted with the Cosmic Ray Observatory Project (CROP), Mixed Apparatus for Radio Investigation of Atmospheric Cosmicrays of High Ionization (Mariachi), Center for High‑Energy Physics Research, Education, and Outreach (CHEPREO), QuarkNet, and Interactions in Understanding the Universe (I2U2). CROP puts cosmic ray detectors on the roofs of high schools, and students and teachers collect and analyze data. Mariachi installed scintillator counters at high schools, and students and teachers make instruments and collect and analyze data. CHEPREO is based at Florida International University, and its fellows engage in high-energy-physics computer activities. It has a huge research and learning community. The institution of the program marked a dramatic ramp-up in the number of physics majors and in the number of physics BS degrees awarded. QuarkNet is in its 13th year of DOE/NSF funding. It operates 52 centers in 25 states and Puerto Rico with 500 high school teachers, 80 mentors, and 100 high school students each year. It is an immersive research experience for high school teachers and students. I2U2 takes data from experiments and has teacher/student collaborations analyze it with grid-based tools. QuarkNet and I2U2 provide CMS data to students and teachers as well as LIGO gravitational data.

Scientists author books, have public websites, do public lectures, and participate in social media. Social media meet people where they are (online), are inexpensive, reach people that the traditional media miss, and allow interaction.

The high-energy physics community makes a substantial effort in education, outreach, and the workforce out of enlightened self interest. A number of programs have been created that are exemplars in these domains. It is about networking and sharing the great physics that high-energy physicists do.

Artuso said that this is wonderful work, making high-energy physics interesting to the public.

Glenzinski asked how the people who make decisions get informed about the results of these activities. Ruchti responded that these programs build on the energies and time available to/from the scientists. The funding agencies are cognizant about this work. These programs are directed at getting students interested in high-energy physics. Congressmen are more interested in talking about education than about funding science.

Dixon noted that, in NSF, there are Faculty Early Career Development (CAREER) proposals that require “broader impact.” He asked if they are the seeds of these larger projects. Ruchti replied, no; people prepare CAREER proposals to contribute to these larger programs.

Kovar announced that he was retiring December 31 after 20 years of research and 20 years in government. He believes that the scientific community has accomplished what he wanted to see done. There are things left undone and challenges looming on the horizon. Every year has a crisis. The COV report recognizes the dedication and quality of the program managers, and he believes that that recognition is well-deserved. He thanked everyone for their help and support. [Applause]

Shochet said that Kovar had been enormously successful and helped the enterprise tremendously. On behalf of the whole field he wanted to thank Kovar for what he had done. [Applause]

Dehmer said that high-energy physics could not have had a better steward that Dennis Kovar, who understands the federal role and responsibility. He has had a distinguished career and was a great partner in the enterprise. [Applause]

Kim thanked Kovar for all that he had done. The program is much stronger than it was when he first arrived. [Applause]

Shochet listed the points that would be put in the letter to the agencies and stated that a draft of that letter would be circulated to the panel members for their review and concurrence.

The floor was opened to public comment. There being none, the meeting was adjourned at 12:12 p.m.

Respectfully submitted,

Frederick M. O’Hara, Jr.

Recording Secretary

November 24, 2010

Corrected by

Melvyn Shochet

HEPAP Chairman

March 15, 2011

The minutes of the High Energy Physics Advisory Panel meeting held at the Palomar Hotel, Washington, D.C., on November 18-19, 2010, are certified to be an accurate representation of what occurred.

Signed by Melvyn Shochet, Chair of the High Energy Physics Advisory Panel on March 15, 2011.

