Draft Minutes
High Energy Physics Advisory Panel
May 21–22, 2009
Palomar Hotel
Washington, D.C.

HEPAP members present:

Marina Artuso
Alice Bean
Priscilla Cushman
Lance Dixon
Sarah Eno
Graciela Gelmini
Larry Gladney
Boris Kayser
Robert Kephart
Steven Kettell
Wim Leemans (Thursday only)
Daniel Marlow
Ann Nelson (Thursday only)
Lisa Randall
Kate Scholberg
Melvyn J. Shochet, Chair
Sally Seidel
Henry Sobel
Maury Tigner
William Trischuk
Herman White

HEPAP members absent:

Hiroaki Aihara
Patricia Burchat
Stephen Olson
Paris Sphicas

Also participating:

Roger Blandford, Director, Kavli Institute for Particle Astrophysics and Cosmology, Stanford University
Travis Brooks, SPIRES Database Manager, SLAC National Accelerator Laboratory
Glen Crawford, HEPAP Designated Federal Officer, Office of High Energy Physics, Office of Science, Department of Energy
Joseph Dehmer, Director, Division of Physics, National Science Foundation
Robert Diebold, Diebold Consulting
Marvin Goldberg, Program Director, Division of Physics, National Science Foundation
Abolhassan Jawahery, Department of Physics, University of Maryland
Steven Kahn, Director of Particle and Particle Astrophysics, SLAC National Accelerator Laboratory
John Kogut, HEPAP Executive Secretary, Office of High Energy Physics, Office of Science, Department of Energy
Dennis Kovar, Associate Director, Office of High Energy Physics, Office of Science, Department of Energy
Marsha Marsden, Office of High Energy Physics, Office of Science, Department of Energy
Piermaria Oddone, Director, Fermi National Accelerator Laboratory
Frederick M. O’Hara, Jr., HEPAP Recording Secretary, Oak Ridge Institute for Science and Education

Katsunobu Oide, Director, Accelerator Laboratory, High Energy Accelerator Research Organization, KEK
Steven Ritz, Astrophysicist, NASA/Goddard Space Flight Center
Natalie Roe, Physics Division, Lawrence Berkeley National Laboratory
Adam Rosenberg, staff member, House Committee on Science and Technology
John Seeman, Assistant Director, SLAC National Accelerator Laboratory
Edward Seidel, Director, Office of Cyberinfrastructure, National Science Foundation
Andreene Witt, Oak Ridge Institute for Science and Education

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

Thursday, May 21, 2009
Morning Session

Chairman **Melvyn Shochet** called the meeting to order at 9:02 a.m., noting that it would focus on the multitude of budgets that the DOE and NSF offices had been wrestling with, the work in Italy and Japan on super B factories with accelerator research of interest to the Panel, and developments in particle astrophysics. He asked **Dennis Kovar** to update the Committee on the activities of the DOE Office of High Energy Physics (OHEP).

There is new leadership at DOE, and William Brinkman, the new Director of the Office of Science (SC), and Steven Chu, the new Secretary of Energy, are known to the high-energy-physics community.

At the previous HEPAP meeting, three budgets were in play and no appropriation was in hand. At this meeting, the FY09 American Recovery and Reinvestment Act (ARRA) holds $236.5 million for OHEP (spending it quickly is the challenge); the FY09 Appropriation held $795.7 million for OHEP; the FY10 Congressional Request asks for $819 million for OHEP; and the FY11 request is in the planning stages.

The primary goal of the ARRA is to bolster the U.S. workforce and economy; a secondary goal is to restore science and innovation as keys to economic growth. The administration has committed itself to transparency (i.e., extensive tracking) in the spending of these funds. In OHEP, $15.0 million has gone to university enhancement and infrastructure, $16.0 million to early-career awards; $52.7 million to Fermilab and industry for SRF [superconducting radio frequency] infrastructure; $20.0 million to the universities and national laboratories for advanced technologies; and $15.0 million for the Long-Baseline Neutrino Experiment (LBNE) R&D and conceptual design; $55.0 million to the University of Minnesota and Fermilab for NOvA [the NuMI Off-Axis ν_e Appearance experiment]; $33.7 million for advanced plasma accelerator facilities at Lawrence Berkeley National Laboratory (LBNL) and the Stanford Linear Accelerator Center (SLAC); $25.0 million for GPP [general plant projects] at Fermilab; and $4.1 million for the Small Business Innovative Research/Small Business Technology Transfer Program.

Across SC, $100 million has been designated for early-career awards. The ARRA money also advances infrastructure provision at Fermilab and promotes industrialization. Advanced technology includes high-field magnets, SRF grants, and detector R&D. The LBNE R&D funds the development of Critical Decision 1: Approve Alternative Selection and Cost Range (CD-1), for which a work plan is in development. The NOvA funds advance the schedule for construction. The advanced-plasma-accelerator-facility money funds fabrication of *both* the FACET [Facilities for Accelerator Science and Experimental Test Beams] and BELLA [BErkeley Lab Laser Acceleration] proposals. GPP at Fermilab has a long backlog, and the ARRA funding addresses that backlog of infrastructure improvements at Fermilab. The total ARRA funding for OHEP is $236.5 million.

Of the FY09 funding, 50% went to proton-accelerator-based physics, 4% to electron-accelerator-based physics, 13% to nonaccelerator physics, 8% to theoretical physics, and 25% to advanced-technology R&D. In comparison with the FY07 budget, the FY09 budget represents a 17.1% increase for proton-accelerator-based physics, a 69.4% decrease for electron-accelerator-based physics, a 66.3% increase for nonaccelerator physics, a 9.6% increase for theoretical physics, and a 5.1% increase for advanced-technology R&D. The total increase for OHEP is 5.8%.

The OHEP program was under some stress because of the continuing resolution but managed to maintain momentum because of FY08 supplemental funding, the termination of B-factory operations, and a change in responsibilities for GPP. Staff were lost at both Fermilab and SLAC. Funding of the President's FY09 Request restores momentum and maintains projects [full Tevatron operations, Large Hadron Collider (LHC) detector support, and research programs]. The FY09 supplemental requests are being acted on now for the International Linear Collider (ILC) and SRF R&D support to be restored to manageable levels and for projects to be restored to baseline funding levels; NOvA had enough funds to stay on a re-baselined schedule.

In the OHEP FY10 request, facility operations stand at $241.1 million, a decrease of 1.2% from the previous year's budget; core research stands at $449.6 million, a decrease of 0.6%; and projects stand at $96.9 million, an increase of 44.9%. Overall, OHEP is requesting $819.0 million, an increase of 2.9%, about even with the cost of living.

There is a change from the trends of the past 10 years when HEP funding was eroded by inflation. The OHEP FY09 funding is up 10% compared to FY08 and above the Office of Management and Budget (OMB) cost of living from FY07. In addition, OHEP is to receive $236.5 million in ARRA funding, and the OHEP FY10 request is above the OMB cost of living compared to FY09.

Reviews and briefings are being held on the FY11 budget; laboratory management budget briefings are scheduled; the OHEP retreat was held in March; the Office's budget submissions are going to SC now; and the OMB passback is scheduled for November.

The Tevatron has offered a run in 2011 that can either exclude the Standard Model Higgs in the favored mass region or report the first evidence of a Standard Model Higgs.

The LBNE does not have a Critical Decision 0: Approve Mission Need (CD-0) yet; OHEP has identified Fermilab, working with Brookhaven National Laboratory (BNL), as the lead on the detector to take responsibility for performing the work needed for approval of CD-1. This effort includes conceptual design, alternatives analysis, etc. Fermilab has been working with the other laboratories to develop a CD-1 work plan. A first draft is due the week of this meeting with the final version at the end of May. OHEP is working with NSF to make it a success, and will work on this for the next 2 years.

At SLAC, planning for the decommissioning and decontamination (D&D) of the Positron Electron Project (PEP-II) is under way. A review has been held, and there are a number of alternatives for disposition of equipment. The Italians [at the Instituto

Nazionale di Fisica Nucleare (INFN)] are proposing a next-generation 10-GeV electron-positron collider facility. A decision by the Italian government is expected in calendar year 2009. The United States might loan them some of the PEP-II equipment; however, this intended work is not in the long-range plans of the Office, so it will have to be seen whether the resources are there.

At the cosmic frontier, the National Academy of Science's Astronomy and Astrophysics Decadal Survey (Astro2010) is under way and held a town hall meeting at the American Physical Society (APS) meeting in Denver. The Particle Astrophysics Scientific Assessment Group (PASAG) has also started deliberations, which will be reported on later in this meeting. The Joint Dark Energy Mission (JDEM) held a town hall meeting at APS with DOE and the National Aeronautics and Space Administration (NASA) sitting on the panel. The European Space Agency (ESA) may join with JDEM at a later time. DOE is committed to pursuing this opportunity with NASA and implementing a successful mission. Transport of the Alpha Magnetic Spectrometer (AMS) to the International Space Station is planned for 2010 on space shuttle mission #STS-134.

Accelerator R&D has historically had OHEP stewardship at the rate of $150 million/year. Other DOE offices now operate many accelerators. There is no sense in each office having an accelerator R&D program. OHEP has been given the responsibility of operating an accelerator R&D program for SC, so a workshop is being held.

The Research and Technology Division will soon advertise openings for a theory program manager, nonaccelerator program manager, interdisciplinary computer scientist/physicist, administrative support specialist, and program analyst. The Facilities Division is hiring an interdisciplinary general engineer and a Fermilab program manager.

Marlow noted that Kovar has said that $15 million was going for universities but that the request for proposals said $10 million. Crawford responded that there are two pieces of funding: one for infrastructure for $10 million and a payoff of grant mortgages of $5 million.

Tigner asked if there were any details available on the Fermi careers. Crawford answered that the Fermi careers will be announced this summer and will look like the traditional Outstanding Junior Investigator (OJI). It will be an ongoing program of SC. Kovar added that the Office will commit $3 million/year and a yearly $3 million increase in the future.

Artuso asked if there are enough researchers available to analyze the data coming from the extended Tevatron runs. Kovar replied that that is why the spokesmen of the collaborations are being asked to come in. It looks like there will be no problem.

Marlow asked if it makes sense to argue that this is not the time to reduce the number of graduate students in physics. Kovar responded that he would not tell universities what to do. Universities need to make their own decisions. There is a concern for postdocs in the Office, and a postdoc program for the next year is being discussed. Crawford added that the early-career program may have a graduate student component.

Randall noted that the university theory program has been hurt in the past years and that not much ARRA money has gone to correct that problem. Kovar answered that theorists have done well in the OJI competition and that he expects that they will be competitive in the early career program. Investments in infrastructure need to be made because without infrastructure there are no future opportunities.

Joseph Dehmer was asked to discuss the budget situation on the other side of the Potomac.

NSF will have a new program director for theory.

Most grants come from Research and Related Activities (R&RA). From FY09 to FY10, R&RA increased 10.6%. Major Research Equipment and Facilities Construction (MREFC) decreased 228%. The total budget for NSF is up 8.5%. The new administration is supporting research across all fields. Mathematics and physical sciences increased 9.9%. From FY08 to FY09, physics went up about 10% (after going up 1% the previous year). The total increase for the Directorate for Mathematical and Physical Sciences (MPS) is 9.9%.

MPS MREFC projects total about $200 million and might go to 300 million. The Advanced LIGO [Laser Interferometer Gravitational Wave Observatory] is reaching its peak construction funding. IceCube is reaching the end of its construction. The Advanced Technology Solar Telescope (ATST) in Hawaii is the large beneficiary of the ARRA. Of the $100 million the Division received from the ARRA, Elementary Particle Physics (EPP) got $13.99 million, Particle and Nuclear Astrophysics (PNA) got $15.31 million, the Cornell Electron Storage Ring (CESR) got $1.3 million, and theoretical particle physics got $6.8 million.

The ARRA comes in as a delta function. Sustaining it will be discussed. All money for a three-year grant is committed up front to eliminate an unfunded mortgage in the future. There are opportunities for substantial university investment in a number of projects. The use of ARRA money for grants decreases forward mortgages and supports students. The core EPP and PNA were reduced $1 million each for FY09 to provide an early bump for the Deep Underground Science and Engineering Laboratory (DUSEL) life-cycle profile, a lucky coincidence. PNA increases $20 million to match the life-cycle profile starting in FY09. All other increases amount to $1 million or less per program.

In regard to DUSEL funding, $50 million has been committed for the design of facilities, and another $15 million for planning for initial experiments. The magnitude of the planning costs is much better understood now. A life-cycle plan for the needed profile has been drawn up, and an agreement on the funding profile was reached last March.

The fourth solicitation (S4) for DUSEL is for preliminary design on the initial suite of experiments. A project office is being set up at the University of California at Berkeley (UC-B). The water level in the mine is now less than 4850 feet, and a hazard-assessment team is looking at the damage from flooding. A joint oversight group has been set up for DUSEL to oversee joint stewardship. The primary target is to have a Critical Decision 2: Approve Performance Baseline (CD-2) in December 2010. This design would support an FY13 MREFC construction start with an NSF/National Science Board (NSB) decision in FY11. The first annual review of the DUSEL project was held in January 09 at UC-B with 25 world-class experts charged with evaluating the project status and plans. The recommended additional funding will be made available to complete the preliminary design. It also was reviewed last week, and the review results and analysis will be brought to the NSB in August 2009.

The S4 review process is progressing: 25 proposals were received, 15 in physics and 10 in other disciplines. DOE personnel are attending the panel review as observers. Funding decisions will be discussed by the agencies at the July NSF-DOE Joint Oversight Group (JOG) meeting, and decisions will be announced during the summer.

The DUSEL R&RA life-cycle funding plan has been developed by the Physics Division. It supports the design, R&D, operations and maintenance (O&M), and research groups. It is complementary to the MREFC construction funding. The plan has been approved by NSF upper management.

Shochet asked if there was good support of the plan. Dehmer said that the NSB has been notified that a funding plan will be coming to them in August. Senior management has discussed that plan a lot. It is a 30-year plan that includes operation. There is not a baseline, yet.

Cushman asked how the money for the initial suite of experiments will be disbursed. Dehmer replied that cooperative agreements will be made by NSF in response to proposals. A robust plan is desired for this novel activity so there will be confidence in the plan.

Bean asked about the planning for the upgrade of the LHC. Dehmer responded that a strategic portfolio balance was being planned for, with about half of the money going to grants. All construction is being discussed with senior management. Upgrading the LHC is a very high priority for NSF.

Kettell asked if the physics were discussed in the JOG. Dehmer replied, yes. The Physics Division will own the pumps, lifts, etc. The physics will be jointly planned with DOE.

Marlow asked if support for students should be anticipated. Dehmer replied that the program for students will be tripled, although other disciplines than physics are now tapping into it. The NSF is very bullish on students. Its first obligation is to do what it does well. It wants to increase the intellectual capital.

Kahn asked about the plasma science activity at SLAC and LBNL. Dehmer replied that an award has not yet been made and it cannot be discussed.

A break was declared at 10:20 a.m., and the meeting was called back into session at 10:54 a.m. Adam Rosenberg announced that the House Committee on Science and Technology is holding a hearing on high-energy physics in late July to early September.

Natalie Roe was asked to present the report of the Committee of Visitors (COV) to the NSF Physics Division.

COV reviews assess the quality and integrity of NSF program operations and program-level tactical and managerial matters pertaining to proposal decisions, and they comment on how the results generated by awardees have contributed to the attainment of NSF’s mission and strategic-outcome goals. A detailed template is provided to the COV. The charge letter followed those guidelines and focused on the proposal actions; programmatic investments; foundation-wide programs and strategic goals; balance, priorities, and future directions; any response to a prior COV report; and any other issues raised.

The COV had a 3-day meeting at NSF headquarters on Feb. 4-6, 2009. Materials were posted to the web ahead of time, and Subcommittee chairs had a pre-meeting teleconference with the Chair. The agenda began with introductory and overview talks, followed by breakouts into program areas and meetings with program managers. The subcommittees reviewed proposal decisions (approved, declined, and withdrawn) using the electronic e-jacket system. The COV looked at 340 funding decisions out of 2352 for the period FY06–08. The COV findings were drafted by the afternoon of the second day. The COV then reconvened to hear subcommittee reports, followed by presentations on

Physics Division-wide issues. The final subcommittee reports were completed within 2 weeks, and the full report was finished by early March and submitted to the MPS Advisory Committee.

The general findings were that the review process was excellent; good use was made of both panel and written reviews; the reviewers have both expertise and diversity; conflicts of interest are handled appropriately; program officers follow recommendations closely; the fast lane is easy to use; and decisions are timely. However, program officers have very heavy workloads, and many excellent proposals are rejected or underfunded because of lower-than-inflation growth in funding

The program outcomes are excellent. Many examples were cited showing major research achievements in all areas. New program areas have been started in physical biology and information physics during the past 5 years. The broader agency goals are excellent in diversity among recipients/institutions and in conducting many innovative education and outreach projects.

The program balance is appropriate. Approximately 55% of the funding goes to individual principal investigators (PIs); the remainder goes to large programs like the LIGO, LHC, Pierre Auger Observatory, and Physics Frontier Centers (~10%). However, the "funding desert" for large instrumentation and small experiments continues to be a problem. The Accelerator Physics and Physics Instrumentation (APPI) program started to address this issue but is lacking funds.

The importance of research support for PIs at 4-year colleges was recognized because of the large number of their graduates who go on to obtain PhDs in science.

Career awards to junior faculty just starting their independent research programs are very competitive with a 10 to 20% success rate. Some felt that too much emphasis was placed on "broader impacts" (innovation in education and outreach), given the many demands on these young scientists' time. This problem can be particularly difficult for women (and men) wishing to start a family during this period in their lives. NSF should encourage participation in existing education/outreach programs and resources, a list of which is available from Physics Education and Interdisciplinary Research (EIR).

In the area of large projects, general findings were that several big Physics Division projects are funded by MREFC, or will be in the MREFC queue [e.g., DUSEL, Advanced LIGO, and Large Synoptic Survey Telescope (LSST)]. These projects require careful advance planning, including the estimation of total life-cycle costs to avoid unexpected budgetary problems. This was a major recommendation of the Physics Division COV in 2006 in the wake of the Rare Symmetry-Violating Processes (RSVP) cancellation. Planning for DUSEL to date shows that this message was received. Site selection and R&D processes were well conceived with a dedicated program officer and the selection of a program manager. However, a thorough cost estimate requires significant resources and requires a commitment from the NSF as a whole because the budget may exceed the capability of the Physics Division. Increasingly, NSF is partnering with other agencies and countries on large-scale projects, which also brings in greater complexities for management.

Overall, the COV process went very smoothly, incorporating some procedural suggestions from the 2006 COV. The only real problem was that reviewers had access only to preselected e-jackets/proposals, and program officers would add others to the list at the reviewers' request. Access to all proposals would require a means to prevent access to those proposals on which a reviewer had been a co-PI. Presumably, this problem can be solved by the time of the next COV.

In terms of the programmatic reports, EPP was funded at $56 million in FY08, managed by one full-time federal employee and three rotators. It supports university grants, CESR, LHC operations, and accelerator R&D. It works closely with PNA as well as with DOE OHEP. EPP has been very creative in collaborating broadly across NSF and in leveraging a variety of funding opportunities in computing, interdisciplinary research, education and outreach, etc. The average award is $180,000 to $200,000, with a few large groups receiving about twice that. Women and minorities are well-represented among PIs. There is a good geographic mix of universities, serving a variety of communities with a broad portfolio of research. The annual requests for funding are about twice the available funding. Career-award success rate is only 10 to 20%. Cornell is making a transition, as CESR has ceased operations for particle-physics research. The situation was reviewed by the Witherell panel in 2006. Cornell PIs are now funded through smaller, competitively peer-reviewed grants. Overall funding now includes test-accelerator (TA) support from both NSF and DOE (CESR-TA). The COV stated that NSF was doing a good job overall at managing this complicated transition. Funding at Cornell is tailing off; the historical funding level of $20 million has decreased to $7.4 million and is slated to go to $9.3 million in FY10.

Particle and Nuclear Astrophysics (PNA) is a $16 million program with a broad portfolio that includes cosmic rays; gamma rays; neutrinoless double-beta decay; solar, high-energy, and reactor neutrinos; direct detection of dark matter; and proton decay. It is managed by one federal employee and three Intergovernmental Personnel Act detailees (IPAs), including one dedicated to DUSEL. This situation is a big improvement over that observed by the 2006 COV. Many PNA programs are interdisciplinary, requiring reviews by multiple programs and/or divisions. Larger proposals are reviewed separately from the usual panel-review process. DUSEL has become a model for how to manage large, multiprogram, multiagency projects. PNA is commended for their stewardship of this very broad and complex field of research during a period of rapid growth.

Theoretical Physics, with $20 million, supports the Atomic, Molecular, and Optical Sciences Program, nuclear physics, particle physics, and mathematical theory. The overall funding per PI is low, about $70,000, which supports, on average, 0.3 postdocs and 0.6 students per PI. Some areas have a limited number of grants, while others reduce the grant amount; there is no good solution. The COV suggested stimulus support for postdocs and young faculty. The COV expressed strong support for the Kavli Institute for Theoretical Physics (ITP) at the University of California at Santa Barbara, the “CERN” of U.S. theoretical physics. The program should not be limited by the 10% cap on total funding for Physics Frontier Centers (PFCs); rather, a 15 to 20% step up in annual funding should be made. In addition, support should be added for theory in PNA/DUSEL research areas, but not at the expense of other areas.

Education and Interdisciplinary Research (EIR) was recently established; it has one federal program officer and about a $5 million budget to support education and outreach; expanded participation for women, minorities, and the disabled; and interdisciplinary programs that do not find a natural home elsewhere. The COV recommends increased funding and an NSF-wide framework for interdisciplinary programs. It also encourages alternative funding for the Research Experiences for Teachers (RET) program in the wake of the cancellation of support for the MPS Office of Multidisciplinary Activities.

The Physics of Living Systems made its first awards in 2006 after an incubation period in EIR. It has one full-time program officer and a $4.7-million annual budget. It supports research on the fundamental physical principles of life at all scales. In vitro molecular studies are co-reviewed with NSF's Directorate for Biological Sciences. Only 17% of proposals are funded (10% in 2008), which is lower than the rate for other areas.

Physics at the Information Frontier (PIF) was founded in 2005 to continue support for awards begun in 2000 under NSF's Information Technology Research (ITR) program. The program management was in transition at the time of the review; the COV had high praise for its leadership. Its annual budget of $8.5 million supports grid computing, quantum information science, and computational physics. The Open Science Grid (OSG) receives 75% of grid funding; which is important for LHC and LIGO. There is a substantial overlap of quantum information science and computational physics with other areas. The OSG award expires in FY10; the COV suggests that it should not be supported in the Division of Physics any longer because of the commercial availability of grid-like solutions and anticipated growth in other areas.

The PFCs are intended to support large university-based groups to foster transformational research. There are nine current PFCs, each funded at $1 million to $4 million per year for 5 years. They receive a 2-day site visit after 3 years. The 5-year cooperative agreement includes the possibility of renewal. Current PFCs can compete with new proposals; half will compete at a time on a 3-year calendar. In 2008, there were 69 pre-proposals, of which 19 were invited to submit full proposals; 12 reverse-site visits; and 5 funded centers, including 3 renewals. Two existing PFCs were phased out. In the view of the COV, the PFCs represent a "stellar collection of outstanding clusters of leading scientists. The impact … is profound."

The conclusions drawn by the COV were that the COV process shows NSF's commitment to good stewardship and transparency. The 2009 PHY COV demonstrated many successes across a broad front of science as well as a genuine commitment to "broader impacts." No major problems were identified except for a lack of funding; stimulus money can certainly be well spent in many areas. The major issues that require ongoing attention include management of large projects and the proper care and feeding of interdisciplinary research.

Shochet noted that the intermediate-scale projects need a program between Major Research Instrumentation (MRI) and MREFC and asked if the COV had heard any more about it. Roe replied, no. Dehmer responded that NSF is determined to support midscale instrumentation and is paying for grant needs. It is not a separate program yet and needs funding at $10 to 11 million. It is the last big commitment.

White asked if there was any information about frontier centers on detector development for large projects. Gladney replied that such development does not require a center. The COV saw a large number of proposals made, and they look reasonable.

Trischuk stated that the solution for grid computing did not seem reasonable and would be a waste of R&D that has been done on grid computing. Cloud computing does not do the job. Dehmer responded that the COV is a discovery process, and this is a valid question to ask. But OSG is not toast; it will not be dropped prematurely. Grid computing is still in a period of development.

Randall asked about the role of the IPC. Roe responded that the COV is very supportive of IPC. Randall asked if there had been an evaluation of the impact of education and outreach. Dehmer answered that there was a study of the efficacy of the career program as a whole. It looked at later career success; the difference between grant support and midcareer success was not statistically significant. Roe stated that such an evaluation might be good for EIR. Dehmer said that, in education, one now has to have a professional assessment. One should have some way to tell if one has succeeded.

Kayser noted that department chairs need to help their students get and use support. The success of the Kavli Institute (inter alia) compels strong support. Shochet noted that the report of the universities subpanel pointed out that theory faculty were the ones urging university support through teaching assistants. Others now are asking for such support, also.

Dixon said that, as a reviewer, he often had no idea how successful outreach efforts are. He asked whether the COV felt the same lack. Roe answered that the COV focused on the relative weights.

Cushman noted that the COV gave excellent grades on avoidance of conflict of interest and asked whether anyone looked at paradigms for dealing with conflict of interest in large collaborations. Dehmer responded that, in such a case, one can go to the General Counsel and spell out the situation, and the General Counsel can provide waivers, given fairness and transparency. The Compact Muon Spectrometer (CMS) project had 60 universities involved.

Abolhassan Jawahery was asked to give a review of physics opportunities at a super-flavor factory during the LHC era.

A rich literature exists on this topic. The reasons for doing flavor physics in the LHC era are that the rare-flavor processes are sensitive to physics at higher energies; at the current precision of the data, flavor physics is sensitive to TeV-scale effects; and the baryon asymmetry problem is still not solved.

It is clear that flavor physics is already sensitive to new physics at energy scales well above 1 TeV and has an effect on the new-physics flavor structure.

If new physics is found at the LHC, then its flavor structure must be discovered because it may involve new charge-parity-violation (CPV) phases, flavor interactions may involve right-handed currents, flavor-changing neutral-current (FCNC) processes could be present, and lepton flavor violation in charged leptons is predicted. If no new physics is found at the TeV energy regime, then flavor physics will serve as a powerful way of probing physics at much higher energies. So the key experimental handles are the Cabibbo-Kobayashi-Maskawa (CKM) parameters, FCNC processes, and lepton flavor violation.

The next generation of flavor experiments will include about 10 fb^{-1} in 5 years at the LHCb and $B_s \rightarrow \mu\mu$ at ATLAS [A Toroidal LHC ApparatuS] and CMS. At a super flavor factory with a luminosity of about 10^{36} s^{-1}-cm^{-2}, the aim is to develop a dataset of 50 to 75 ab^{-1} in 5 years and to use beam polarization.

The B meson was first observed in 1982. B^0 mixing and V_{ub} were measured in 1987. CLEO observed loop-level processes in B decays, and B factory projects were launched in 1993. The B factories started operation in 1999. CPV was observed in B decays in 2001.

Currently, the Standard Model is remarkably accurate in describing flavor-physics measurements, but there are a few areas of tensions with the data. The global-fit algorithms have tried model-independent methods to determine the size and phase of a non-Standard Model component. Reconciling CKM parameters is an enormous undertaking for both experiment and theory. To reach this goal, the accuracy of the theoretical inputs must match the experimental precision. Improved lattice quantum chromodynamics (LQCD) calculations of decay constants and form factors are needed for B mixing parameters, leptonic decays, $|V_{ub}|$, $|V_{cb}|$, etc. The experience of B factories shows that comprehensive measurements are needed for all channels connected through known symmetries.

It is expected that, in 5 years, LQCD calculations to extract CKM will have uncertainties drop by a factor of 2 to 3. Precision data at the same level of accuracy will be needed to test those LQCD calculations.

Searches for new physics via FCNC decays of B need to look at rates of radiated penguins, photon helicity in $b \rightarrow \gamma_L s$, and direct CP violation; $B \rightarrow Kll$ q^2 dependence of the rate; forward-backward (FB) asymmetry; CPV in FB asymmetry; and a search for the modification of Wilson coefficients C7, C9, and C10 and new operators.

Forward-backward asymmetry in $B \rightarrow K(*)l+l–$ is a powerful probe of new physics. BELLE data have already produced some tension with the Standard Model. Flavor violation in lepton decays is very promising; many new physics models predict much larger rates for the branching ratio. Other physics possibilities include CP violation in charm decays and mixing, the possibility of polarized beams enhances the physics reach of the lepton-flavor-violation studies in τ decays, and quarkonium physics.

The Super B and LHCb programs are highly complementary. LHCb will dominate the B_s measurements and some exclusive channels in B_d. Super B will have full coverage of B_d, charm, and τ decays, including inclusive channels and modes containing neutrals. One needs comprehensive measures of charm and τ.

LHCb would observe $\mu^+\mu^-$, but the super B factories would not. The super B factories would see a greater coverage of B and τ.

There is no obvious single "golden" measurement for testing new-physics effects. Sin 2β was considered the "golden" measurement for testing the CKM. In reality, while sin 2β helped establish CPV in B decay, the CKM test required a great number of measurements. For the flavor-physics program in the new-physics era, the "golden" signature is likely to be the emergence of a pattern of deviations from the Standard Model in a key set of channels. A list of "golden channels" has been put together, and the signal patterns for various supersymmetry models have been calculated, showing variations in expected data for the different models.

In conclusion, experimental studies of flavor are a necessary and complementary program to the direct search for new physics at LHC. A super B factory at a luminosity of about 10^{36} s^{-1}-cm^{-2} allows for comprehensive studies of a broad set of rare decay processes in B, charm, and τ decays with sensitivity to new physics in the TeV scale. The overall pattern of deviations from the Standard Model will serve as a means for studying the flavor properties of new physics. The physics reaches of the LHCb and super B factories are complementary, allowing for a complete set of precision measurements, including that of the B_s system. The experience of the B factories has shown that the success in this young but already very mature field depends heavily on having a full set of measurements in all related channels, both to understand and to control the theoretical inputs and to distinguish new-physics effects from the Standard Model background.

Artuso said that one would get a better response from the flavor community if the projects were characterized as competitive rather than complementary. Jawahery responded that there are technical questions about the capabilities of the different machines. To get full coverage, one needs both sets of data.

Trischuk asked whether there are enough people to staff two experiments. Shochet explained that this is a review of the physics, not of potential experiments. Jawahery answered that this work would be very compelling and would likely attract enough people.

Marlow asked what the backgrounds were. Jawahery responded that some are better than others, and the background can be brought down from the current levels. Dixon added that polarization can be a help here but is tricky to carry out.

A break for lunch was declared at 12:32 p.m. The meeting was called back into session at 2:01 p.m., and **John Seeman** was asked to describe the super-B factory being designed for construction at Frascati or the University of Rome's Tor Vergata site.

Super-B aims at the construction of a very-high-luminosity (10^{36} s^{-1}-cm^{-2}) asymmetric e^+e^- flavor factory with a possible location on or near the campuses of the University of Rome at Tor Vergata or the INFN Frascati National Laboratory. The aims of the project are very high luminosity, flexible parameter choices, high reliability, a longitudinally polarized beam of electrons at the interaction point (IP), and the ability to collide at the charm threshold.

A conceptual design report (CDR) is being produced for the accelerator by an international team. Oversight is provided by an international oversight team. It is a circular e^+e^- collider with each beam having a current of 2800 mA, a bunch length of 6 mm, a crossing angle of 60 mrad, and a luminosity of 10^{36} s^{-1}-cm^{-2}.

Its key technical advances are a crossing angle IR with large Piwinski angle, a crab-waist scheme, very low IR vertical and horizontal beta functions, low horizontal and vertical emittances, and ampere beam currents. Design parameter values are in flux, even for the circumference.

There are three sets of magnets, creating very thin beams, and a crab-waist scheme that overcomes the beam-beam problem and makes all particles from both beams collide in the minimum β_y region, producing a net luminosity gain. Experimentally (in DAFNE, the Double Annular Factory for Nice Experiments), the crab cavities increase the luminosity by a factor of 2. Other experiments have validated the crab-waist design.

The Tor Vergata site has an 1800-m ring and would add onto its linac. The Frascati site has a ring and would also add onto its linac. The superconducting quadrupoles are currently being designed. Several lenses have been investigated to optimize the dynamic aperture, chromaticity correction, ring circumference, final focus properties, and spin rotator. The design is flexible. Emittance and momentum compaction can be easily tuned, and the ring circumference can scale down, maintaining the design emittances. The Super-B latttice is now being looked at for the ILC damping ring 3-km-long option. For the longer circumference (the Tor Vergata site), beam-dynamics and emittance-tuning studies are ongoing. The flexible arc-lattice solution is based on decreasing the natural emittance by increasing μ_x/cell, and simultaneously adding weak dipoles in the cell drift spaces to decrease synchrotron radiation. All cells have $\mu_x = 0.75$, $\mu_y = 0.25$, leading to about 30% fewer sextupoles. There is a better dynamic aperture because all sextupoles are at –I in both planes. The distances between magnets are compatible with PEP-II hardware. All quads-bends-sextupoles are in the PEP-II range. The design and achieved beam emittances have been compared. Emittance-tuning techniques and algorithms have been tested in simulations and experiments on the ATF and on the other electron-storage rings to achieve such small emittances. Tune-point optimization is done together with beam-beam simulations and luminosity and lifetime optimization.

Polarization of one beam is included in Super B. Longitudinal polarization times and short beam lifetimes indicate a need to inject vertically polarized electrons. There are several possible IP spin rotators. At the present time, solenoids, with an expected longitudinal polarization at the IP of about 85%, look like the best choice.

The geometry looks weird, adding about 200 m to the ring, so the design is for a roughly 1900-m diameter now.

The plan is to use the PEP-II RF system and cavities. At least 18 MW will be needed for the RF system. The feedback system works right now. A new feedback kicker has been designed and will be prototyped next year. A hundred measurements will be able to be made each second because of the feedback rate.

Because of the reuse of the PEP-II magnets, only 30 dipole magnets will need to be made, and only 180 magnets will need to be manufactured rather than 800. All PEP-II magnets can be used because their dimensions and fields are in the required range and the present PEP-II RF system meets the RF requirements. DOE conducted a 2-day review of removing and disposing of PEP-II components. A table was drawn up of component weights, volumes, and areas. Environment, safety, and health (ES&H) studies have been done and are ongoing. Many parts could go to a future Super-B in Frascati. That transfer would require about 350 shipping containers. Some parts (about 60 shipping containers) could go to Project X at Fermilab. Some parts would stay at SLAC for a future PEP-X. The remainder would go to disposal. PEP-II reuse would result in a €130 million cost saving for Super B, which would still have to build an injector.

Super B has an advisory committee, which has met twice. It has stated, "The MAC [Machine Advisory Committee] now feels secure in enthusiastically encouraging the Super B design team to proceed to the TDR [technical design report] phase, with confidence that the design parameters are achievable." Recent progress has been made on the crab-waist tests at DAFNE, beam-beam measurements (DAFNE) and simulations, interaction-region (IR) design, the lattice, and the polarization spin rotators. The advisory committee continued, "Nonetheless, much detailed work remains to bring the design to the level where (a) ground-breaking, (b) final engineering of accelerator components can commence." Further needed work areas include the emittance tuning and evaluating tolerances, dynamic aperture calculations, IR and arc vacuum systems, the injection system, vibration studies, and the polarization lattice. A TDR topic list has been drawn up. A white paper will be published next year and then the TDR.

In summary, the Super-B parameters are being optimized around a luminosity of 10^{36} s^{-1}-cm^{-2}. The team is addressing the Accelerator MAC suggestions from the April meeting. The present design for the interaction region is a solid basis; now engineering features need to be added. The interaction-region polarization (spin) rotators have now been added to the High-Energy Ring (HER) lattice. Polarization has changed the geometry of the layout. Beam-beam and lattice dynamic-aperture calculations are continuing. The new lattice layouts show improvement. Beam loading and RF parameters have taken the next solid step and look acceptable. Organizing and planning for the TDR are aimed at an issuance in fall 2010.

Kephart asked how large the design team was. Seeman responded, 4.5 FTEs; and 10 people will increase to 20 in the future, with three in France and Russia.

Gelmini asked when Frascati will decide. Seeman answered, by the end of the year. Gelmini asked if the beams will produce excessive background in the detector. Seeman responded, no. So far they look compatible.

Diebold asked what is needed from DOE and on what schedule. Kovar replied that all that would be needed is transport money and a loan agreement. That decision has not been made yet and probably will not be made for 5 years. The components will be brought down to warm maintenance and maintained. Whether the Office of Basic Energy Sciences (BES) has any plans for the equipment remains to be seen. If the United States had some investment at the site, there would be some funding. The Particle Physics Project Prioritization Panel (P5) did not give this project are very high rating. Gelmini asked what type of commitment would be required from the Europeans. Kovar responded that discussions have been held with the Europeans; this would involve about $25 million for the detector with personnel in addition. Crawford added that P5 looked at three scenarios, starting with $60 million and going down. The current position is a little bit below Scenario B.

Edward Seidel was asked to describe the work going on at the NSF in advanced computing.

Thirty-five years ago, Stephen Hawking posited what would happen if two black holes collided. He produced kilobytes of data. Fifteen years ago, a team recalculated the collision, producing about 500 MB of data. Ten years ago, the calculation produced 50 GB of data.

All areas of science are making similar transitions, producing petabytes of data, placing huge requirements on computers, software, networks, tools, etc. In addition, vastly different communities have to be brought together to use the models in multiscale collaborations. Cyberinfrastructure enables all of these collaborations.

The technology crisis is that the number of processors is approaching 1 million, and a lot of things will be failing all the time. Rather than the clock speed, the number of cores is doubling each 18 months at the desktop level as well as in high-performance computers.

The data challenge is that, about three years ago, more data were generated in one year than had been generated in all previous human history. The questions arise: How are those data to be shared? How are those data to be analyzed?

The software crisis is that the machines last a couple of years, and new machines need new software. The investment in software is greater than that in the machines. Version control of software is critical but difficult.

How can science be supported in such an environment? Within NSF, the TeraGrid is the largest investment. Centers provide modeling and simulation, data analysis and visualization, user support, training, common user environments, tools for educators, and science gateways. Track 2 facilities are $30 million apiece. A new machine is going in at Oak Ridge National Laboratory and The University of Tennessee, an award has been made to the Pittsburgh Supercomputing Center, and the University of Illinois will have a new facility in 2 years. Task forces are being set up to control these efforts. Growth of computing capability is increasing rapidly. The Blue Waters System, an IBM Power 5, will have a petaflop sustained performance.

The Open Science Grid (OSG) is supported by NSF and DOE. It is a data-analysis platform for the LHC, but it is also used for other purposes. Software environments are being developed for OSG under a “Campus Bridge” model. NSF is interested in exploring ways to integrate campuses better with national centers and instruments, TeraGrid–OSG cooperation, understanding example science communities that can benefit from and drive this effort, and related international cooperation.

In data, NSF’s goals are to catalyze the development of a system of science and engineering data collection that is open, extensible, and evolvable; to support the development of a new generation of tools and services for data discovery, integration, visualization, analysis, and preservation; and to integrate this national digital data framework into the national cyberinfrastructure. DataNet is a $100 million program over 5 years for supporting data-driven science.

As bigger centers are opened, a number of issues will need to be rethought: the services offered, how to bring in small clusters and facilities, and what to do about the university people (the throughputs to universities are slow, and they are significantly under-invested). There are funds available to upgrade campus networks. Data archives are distributed and have to be integrated. The computing, data, and software are becoming highly complex.

A task force has been set up to look at human factors in cyber infrastructure. Computing may be the third pillar of research, but it is a pillar of sand. To address that problem, investment will be needed in

- Campus bridging;
- Data virtualization;
- High-performance computing, including grids and clouds;
- Software;
- Education and workforce; and
- Grand challenges in virtual organizations.

Shochet asked about the long-term view of OSG. Seidel said that OSG may not live forever, but something like it will be important from now on. Shochet asked if it will be replaced by cloud computing or other commercial systems. Seidel responded that a long look at a replacement would have to be taken before jumping to it.

Trischuk asked about green computing. Seidel replied that it is being worked on, and he needs to update his presentation with information about it.

A break was declared at 3:19 p.m.; the meeting was called back into session at 3:50 p.m., and **Wim Leemans** was asked to summarize the work going on in advanced accelerator R&D.

Collider size is set by the maximum particle energy, and the maximum achievable gradient is limited by breakdown. These issues motivate R&D for ultra-high-gradient technology. New driver technologies are being worked on with laser-based systems or electron-beam systems. The devices can be made smaller with plasmas (10 to 100 GV/m vs 10 to 40 MV/m). The principle of the laser/plasma wakefield accelerators was proposed in 1979. The beam driver was proposed in 1988.

For operation in the bubble or blow-out nonlinear regime, most experiments to date have high gradients and can produce narrow-energy-spread beams. However, they have limited control, are self-trapping, can easily go unstable, and do not work well for positrons.

At SLAC, an electron pulse was injected and studied with coherent transition radiation, an interferometer, optical transition radiators, a Cerenkov gas cell, an imaging spectrophotometer, and a Cerenkov radiator for X-ray diagnostics and the formation of electron-positron pairs. Focusing and matching electrons, X-ray generation, electron wakefield acceleration, focusing and halo formation of positrons, electron-beam reflection at the gas-plasma boundary, and positron wakefield acceleration were studied.

At LBNL, a plasma-based electron-positron linear collider was looked at. The primary issues were the need to understand the acceleration of electrons and positrons, luminosity, requirements on the plasma acceleration, better beam control, and the use of a drive-beam through multiple stages.

SLAC has proposed Facilities for Accelerator Science and Experimental Test Beams at SLAC (FACET) to provide a high-quality 25-GeV positron and electron beam for studies of plasma wakefield acceleration. Plasma wakefield acceleration could reduce the cost per GeV significantly for linear colliders and could provide an easy upgrade for free-electron-laser (FEL) facilities. The FACET will also be used to develop beam-driven dielectric acceleration and plasma focusing concepts as well as other beam-physics studies. The 25-GeV beams are expected to have a peak current of 20 kA and 10×10 μm spot sizes. The SLAC linac can deliver a terawatt on target. This is a powerful driver. The bunch self-ionizes the medium it goes through. A single Final Focus Test Beam (FFTB) bunch sampled all phases of the wake, resulting in an energy spread of about 200%. A second bunch is now being produced with a driver and a witness beam. These two electron bunches formed by a notch collimator will allow the study of energy doubling, high-efficiency acceleration, and emittance preservation. They came up with the "sailboat" dual chicane to gain a unique opportunity to study the acceleration of positrons by an electron bunch. With this scheme, one can also look at electromagnetic fields. This technique offers a number of unique scientific opportunities as a plasma-beam source for the Linear Collider or Basic Energy Science, a plasma lens for compact focusing, a bent crystal for beam collimation or photon source, a positron and electron acceleration study essential for a laser wakefield accelerator (LWFA) and plasma wakefield accelerator (PWFA), a dielectric wakefield acceleration, an energy-doubling for existing FEL and other facilities, and the generation of THz radiation for materials studies.

Both programs are awaiting CD-1. The PWFA experimental program expects to demonstrate electron acceleration, a single stage on an electron PWFA-Linear Collider, an optimum positron acceleration mechanism for a PWFA-Linear Collider, and a design plasma cell with stability and cooling.

With the Berkeley Lab Laser Accelerator (BELLA), the issues associated with a laser plasma linear collider can be studied.. The technical challenges are high-quality beams, staging, optimized structures, lasers with high average power, multi-GeV beams, modeling, and diagnostics. It is hoped to phase the electrons in a controlled injection that traps the in-phase electrons by slowing down the wave or by boosting the electrons. A gas-jet nozzle machined into a capillary can provide the needed local-density perturbation. The gas-jet-triggered injection provides for enhanced stability and tuning.

Staging laser accelerators is required to reach TeV levels. The accelerator length will be determined by (minimized) staging technology. The structure-to-structure length (between the injector/capillary and the mirror) is about 10 m. Proof-of-principle staging experiments have been designed.

The BELLA Project is under way with a state-of-the-art facility for laser-based accelerator science with a 1 Hz repetition rate petawatt-class laser, a laser bay and target area, and laser diagnostics. The BELLA laser faces a huge challenge in increasing the repetition rate from 1 Hz to more than 10,000 Hz. Ceramic materials have increased the average power, peak power, and high wall-plug efficiency.

In summary, the TeV collider is extremely challenging for any technology, let alone multi-TeV. A steady, phased approach is needed to address major technological challenges. BELLA and FACET are now launched, providing cornerstone facilities for advanced accelerator R&D. They will address key technological challenges for collider designs, keep plasma-based accelerator R&D in the United States competitive with that of the rest of world, train students and postdocs, and produce important spin-off applications. A workshop on laser technology for driving future accelerators is planned with the blessing of International Committee of Future Accelerators (ICFA) and International Committee for Ultra Intense Lasers (ICUIL).

Oddone asked about the efficiency into the particle beam. Leemans answered, 2% for plasma to electron beam. The approach is to make the laser transfer shape shape the field. Because of depletion and phasing, one has to increase the density of the plasma bunch to make it drive the same phase. One *can* get 50% efficiency for all-electrons only.

Diebold asked how big these efforts at LBNL and SLAC were. Leemans said that SLAC and LBNL each had about 10 people working on these projects.

Gelmini asked what was going on in Europe. Leemans answered that a lot was being done at Rutherford Laboratory and in Paris; about eight new groups have popped up in Germany, Sweden, Portugal, Shanghai, Myanmar, Korea, and Japan.

Katsunobu Oide was asked to describe the upgrade at the KEKB [the High Energy Accelerator Research Organization B Factory].

The B Factory is still running after 10 years, operating at more than double the design peak beam current. The best day ever produced 1.33 fb^{-1}. The crab increases the luminosity of 17.6 to 19.6/nb-s and decreases the Low-Energy Ring (LER) beam current from 1.65 to 1.60 A.

Improving the aperture in 2008 improved the beam lifetime. In 2009, new sextupoles corrected the chromatic coupling at the interaction point.

There are two options for SuperKEKB: a high-current option and a nanobeam option. In the high-current option, beam current would be 9.4 A in the LER and 4.1 A in the HER; the vertical beta-star would be 3 mm, the vertical beam-beam parameter would be about 0.3, and the luminosity would be 8×10^{35} cm^{-2}- s^{-1}.

The coherent synchrotron radiation (CSR) in SuperKEKB has been studied by T. Agoh since 2004, as reported at the KEKB Accelerator Review Committee. An independent estimation was done in 2008, which took the realistic shape of the beam pipe and other impedances into account. These analyses have had a large impact on the design parameters of SuperKEKB. CSR dominates all other wakes. Microwave instabilities occur; no stable state is reached. A longer bunch length relaxes the instability. A 25-mm beam pipe does not solve the problem; a 45-mm beam pipe with negative alpha may be the best choice. (There is no problem in the HER.) The minimal achievable bunch length at the design bunch length is 3.1 mm.

In the interaction region, the crab crossing needs a horizontal tuning very close to a half integer ($\nu_x = 0.503$) to achieve the very high beam-beam parameter $\xi_y = 0.3$. Such a horizontal tuning enhances the dynamic β and dynamic emittance effects to enlarge the beam size at the final quadrupoles by more than a factor of 10. No design of the interaction region has been technically found that is compatible with $\nu_x = 0.503$ and $\beta_x^* = 20$ cm. Thus, the parameters were relaxed to $\nu_x = 0.505$ and $\beta_x^* = 40$ cm.

Two crab cavities were used in the middle of the sextupoles, which are not strong. In the LER, the aperture shrinks but is still acceptable. The impact on the luminosity is a decrease from 8 to 5.5 (assuming that the crab crossing works perfectly).

In the nanobeam scheme, solutions for the lattice exist, preserving the present tunnel, Optimization of the dynamic aperture is ongoing. The interaction region has a large crossing, with independent quads for both beams. The LER emittance must be higher than 2.5 nm at 3.5 GeV, taking intrabeam scattering into consideration. Electron-cloud mitigation has been studied at KEKB; results from CESR-TA will also be important. The design of the positron damping ring has been completed. The luminosity gain is a factor of 40. The arc-cell lattice of the KEKB LER can be modified to the low-emittance version by weakening the magnetic field of the dipoles. There is no need to change any other components, beam pipes, or geometry. The HER's emittance is reduced by replacing the arc cells. The designed interaction region fits into the existing tunnel. A preliminary design of the superconducting final quadrupole has been developed for the nano LER. A new strip-line-type electrode was developed. It is a very thin electrode and insulator with low beam impedance and high thermal conductivity. The electrode and an electron monitor were set up face-to-face in a test chamber, and it depicted a smooth decrease in the density for a positive electrode voltage. It is effective for various bunch-filling patterns. The groove experiment was carried out in collaboration with SLAC. The electron current was measured under the same conditions as those for the clearing electrode, and the data for a flat surface were compared with those for a clearing electrode. The electron density for the groove was lower than that for the flat surface by about 1 order of magnitude. Aging was still proceeding, when plotted by electron dose (integrated electron current). The 1-GeV positron damping ring would be 132 m in circumference.

The Japanese government has allocated about $27 million for R&D of SuperKEKB as a part of a stimulus package. Construction would start in JFY09, and beam operation would begin in JFY13.

In summary, the high-current scheme for upgrading KEKB has a few issues that are not easy to solve. Mitigation techniques may work but may also introduce more complexity. More attention has been paid to the nanobeam scheme, and the design work is proceeding in that direction. KEKB needs collaboration with accelerator scientists around the world for the success of this challenging project.

Shochet asked if there were an estimate of the effect of the crab waist and when a choice might be made between the options. Oide replied that the luminosity would increase by 50% and the decision has already been made.

Marlow asked what the $27 million could be used for and whether KEKB could be restarted if more funds were forthcoming. Oide responded that the money will be used for new components and that the KEKB could not be restarted.

Artuso asked about the status of the R&D. Oide answered that the R&D was being considered as part of the upgrade construction.

The meeting was adjourned for the day at 5:16 p.m.

Friday, May 22, 2009

The meeting was called back into session at 9:00 a.m., and **Steven Ritz** was asked to update the panel on the Particle Astrophysics Scientific Assessment Group (PASAG).

The charge to the PASAG is for advice on the cosmic frontier. While there are very important questions to answer in accelerator-based particle physics, there are also such questions in particle astrophysics. Direct detection of dark matter, dark energy, neutrinos, and the cosmic microwave background have their own issues. These must be considered within budget constraints in an effort to balance new work with established research projects. The preliminary answers are to be presented in August to inform the next budget cycle. The Group started meeting on April 20, 2009, and is meeting regularly via telephone.

The Group has subgroups on dark matter; dark energy; cosmic rays, cosmic gamma rays, and cosmic neutrinos; and cosmic microwave background (CMB) and other issues. They are working in parallel to collect information and to draft the main issues that the full panel will address. They are attempting to collect most of the information without individual project presentations. They are learning how the national laboratories think about particle astrophysics, and getting community input. A request for information was distributed. Information garnered is being collected on a website to be shared by the Group. Face-to-face meetings are scheduled for June and July.

Cushman asked how the Group would form a line between dark matter and double beta-decay detectors, which are similar. Ritz replied that it would look at the dark matter aspect.

Dixon noted that CMB is not in the charge and there was no request for information for CMB. Ritz answered that P5 mentioned CMB, and a piece of CMB fits in with particle astrophysics. The Group does not want to survey and assess the whole field of CMB. It is discussing what portion of CMB is appropriate for PASAG. Shochet noted that CMB is the most difficult topic to deal with.

Gelmini asked how the Group would make priorities in an international area. Ritz answered that international coordination is important. The Group polled various international agencies about who could help do this, and they suggested Christian Spiering of the Deutsches Elektronen-Synchrotron (DESY), so he sits on the subpanel. Dark matter was treated by the Dark Matter Science Assessment Group (DMSAG). With limited resources, R&D is needed for new techniques to take science where it needs to go. However, at some point, one has to start building the experiment. The Group has to grapple with that balance. It will judge the proximity of that balance point. Sobel commented that the most important thing is the availability of funding. Funding could get some of this R&D under way.

Kayser asked whether the cosmic neutrinos in the list were meant to include those from the Big Bang. Ritz replied, no.

Bean asked how the Group developed its list of experiments for which to gather information. Ritz answered that it made one overall list and then asked the panel to consider whether those were the appropriate ones. It did not issue a general request to the community. It does not want to interfere with the Decadal Survey. It is trying to deal with the dark-energy issue in the same way that P5 did. It is not interested in starting from scratch. It wants to help things move forward in a coherent manner.

Randall asked three questions: (1) Is the Group considering projects related to each other or in relationship to available funding? (2) What technology is being considered, and how does it fit in? (3) Where are the boundaries? Ritz replied that the Group knew the overall high-energy physics budget but not the budget for the particle astrophysics programs. It must say: for these resources, this is what can be done in particle astrophysics, and this is how they can fit together. Detector development has historically been important, and then there is overall R&D. All these have to be part of PASAG's discussions. Important questions exist at the boundaries between particle astrophysics and astrophysics, and some projects exist in both areas. Those are often interesting questions, but money collapses away from them. The communities must get together to address these questions. It is a matter of budget. They cannot be invested in if there is a bare-bones budget. The National Research Council is sensitive to this problem of overlap. In addition, the timescales of the different research areas are different.

Cushman asked if there could be a public website that lets people know how the Group is proceeding. Ritz responded that it has considered that possibility, but it wants to be sure that the issues selected are the right ones. Such a website would allow broader comment and participation by the research communities. The interests of various agencies have to be taken into account.

Kahn asked if the Group was going to pass some judgment on levels of expenditure, noting that operating plans (e.g., when to turn off a project) and multi-agency cooperation (e.g., in funding) have to be taken into account. Ritz replied that the Group did not know how to do overall budgets. It is going to make suggestions on how the agencies should think out these things. This is not a senior review. Kovar added his interpretation of what the agencies have said: When this subpanel is trying to prioritize new projects within a budget guideline, one of the issues that may come up is whether the agencies want to run some existing programs for an extra 5 years or whether they want to use that opportunity cost and those funds for something new. The subpanel will have to grapple with that issue. To that extent, it may consider the issue of funding. Ritz observed that the agencies constantly get great ideas for new projects, and they often respond, "That sounds really great. What should we not do to take this new project on?"

Ritz asked if the Group could get some anonymous readers to review this report. Shochet said, yes but the HEPAP membership is normally used for that.

White asked if theory is included in this report. Ritz responded that he did not know. If the CMB groups suggested simulation or other theory, it would be put in. However, now there was no assessment of the need for theory.

Kovar commented that this is an important exercise and is on the right track. This is the first look at the science opportunities at the cosmic frontier. Areas should be chosen in which an impact can be made. The agencies want to mount a program that can be defended.

Roger Blandford was asked to present a progress report on Astro 2010, the Decadal Survey.

The Survey is organized around three pillars: scientific frontier activities, state-of-the-profession activities, and program prioritization. There has been unprecedented community buy-in to the process. The Survey is including unstarted projects. It is to produce improved cost, readiness, and research assessment. Increased international and private collaboration is being seen. The survey is having to deal with the rapidly changing economic and political background.

An executive committee is responsible for managing the process and for communicating with the astronomers and other community members. The panel has 23 members, broken up into subcommittees on the science frontier, state of the profession, and programs.

The science-frontier subcommittee has five panels (Planetary Systems and Star Formation, Stars and Stellar Evolution, The Galactic Neighborhood, Galaxies Across Cosmic Time, and Cosmology and Fundamental Physics) to find the most compelling science program. It is charged to identify four key questions and one discovery area. Its input included 324 white papers, 18 town hall sessions, and thousands of e-mails. Significant choices and omissions are emerging.

The six infrastructure study groups (Computation, Simulation, and Data Handling; Demographics; Facilities, Funding, and Programs; International and Private Partnerships; Education and Public Outreach; and Astronomy and Public Policy) are primarily fact-finding consultants providing input to the state of the profession subcommittee.

The four programmatic prioritization panels (Radio, Millimeter, and Submillimeter from the Ground; Optical and Infrared Astronomy from the Ground; Electromagnetic Observations from Space; and Particle Astrophysics and Gravitation) will write independent reports with National Research Council (NRC) review for the main Astro 2010 committee.

The charge to Astro 2010 included the topics of space- and ground-based astronomy and astrophysics, priorities for the most important scientific and technical activities, and new and previously identified concepts. It is to produce a concise report addressed to the agencies, Congressional committees, and the scientific community, identifying the common ground between fundamental physics and cosmology; experimental data, physics-based theoretical models, and numerical simulation; and a portfolio of small, medium-sized, and large projects. It is also to impose a priority order to maximize future scientific progress and to develop an organization of research programs within the federal agency structure.

The scientific-frontiers panel has done some writing already. The infrastructure study groups have issued some draft reports. And the program-prioritization panels are reading request-for-information responses and white papers; undertaking a detailed study of activities, requesting more information; and preparing for external technical readiness and costing studies.

The panels will meet in Pasadena during the summer. The whole committee will meet in October and December/January to finalize recommendations. The report will be written between January and March 2010 with NRC review from April to July and release in August.

Shochet asked how one maximizes scientific progress in such a broad scientific community with different scientific priorities. Blandford replied that the panel *does* deal with a broad range of communities, proposing 10 times as much research as can be funded. The situation has arisen in each of the past five decades. The panel looks for the best science. Shochet noted that the high-energy-physics community has a consensus on what the most pressing questions are, but they might be quite different than those in the very broad astronomy community. Blandford responded that one argument that is used for dark energy is the universality of the science and that it catches the imagination. The connection between astronomy and elementary particle physics needs to be known. Gravitation is a similar issue. Kayser commented that it appears that dark energy is about 75% of the mass of the universe and would be of interest to anybody. Shochet stated that the question is whether it is highly ranked, not whether it is interesting.

Cushman asked about the landscape of the federal and private agencies funding astronomical research. Blandford answered that it includes DOE, NASA, and NSF; private organizations endow big telescopes. Many foundations have contributed to the giant telescopes. The job of the panel is not to mediate among these parties but to seek scientific recommendations. The international and private partners will use this information in their deliberations and decisions. The panel pays attention to what they recommend, too.

Artuso asked how one can factor in unanticipated opportunities and findings. Blanchard said that the panel spends a lot of time worrying about that problem. It needs to build opportunity space in to accommodate unexpected discoveries. It cannot exclude something just because it does not have a specific parameter to measure. One way to do this is to look for cases where measurement precision is improved into a new regime. The panel takes this problem immensely seriously.

Dixon asked where astronomy is with neutrinos and high-energy cosmic rays. Blanchard answered that the agencies select the activities for the panel to look at. Neutrinos and cosmic rays are in four of the five science panels. Gravitational waves are part of the perspective. Advanced LIGO is off the table because it is a started project. The Laser Interferometer Space Antenna (LISA) and others *are* being considered.

A break was declared at 10:34 a.m. The meeting was called back into session at 11:01 a.m., and **Travis Brooks** was asked to describe the development of the next-generation high-energy-physics information system, INSPIRE.

The current information landscape includes the Stanford Public Information REtrieval System (SPIRES; at SLAC, Fermilab, and DESY); arXiv.org (at Cornell and the NSF); the Particle Data Group [PDG; at LBNL, DOE, NSF, Conseil Européen pour la Recherche Nucléaire (CERN, now Organisation Européenne pour la Recherche Nucléaire), etc.]; CDS [CERN Document Server]; publishers (at APS, Elsevier, JHEP [Journal of High Energy Physics], Springer, etc.); and other resources, such as HEPDATA [High Energy Physics Databases]at Durham University, Google/Google Scholar, and NASA-ADS [Astrophysical Data System].

In 2007, people at SLAC, Fermilab, and DESY started thinking about where physicists search for high-energy-physics information. They found that physicists went to SPIRES 48.2% of the time, arXiv 39.7%, Google 7.8%, Google Scholar 0.7%, CDS

2.6%, ADS 0.7%, library services 0.2%, and commercial databases 0.1%. SPIRES collects and puts in a framework a greatly disparate variety of information sources. SPIRES is community driven and defined. It gets 1 to 1.5 million queries per month, accessing 35 years of high-energy-physics literature. Its software dates from the 1970s and an IBM 360. It provides citation linking/counting; author and affiliation searching; user contributions and corrections; additional community information; job information; and lists of conferences, institutions, and experiments. It is a powerful sociologic reference, also.

High-energy physics is becoming more interdisciplinary, including particle astrophysics and other fields. The literature is growing more complex, including computer code, objects that are not papers but are information, datasets, figures, tables, recent advances in information systems, modern coding and design, mashups, and Web 2.0.

In 2007, 2000 physicists were asked if they would be willing to tag papers, and about 20 full-time equivalents (FTEs) were found to be available in the community. That potential cannot be tapped with SPIRES' current configuration. SPIRES should grow with the field and with the technology. SPIRES' 35-year-old infrastructure cannot take advantage of new tools. It needs a solid foundation on which to build. Three to four years ago, SPIRES began looking for migration possibilities. It could build new systems, but that would be expensive, and data would be unlikely to integrate well. So, adapting an existing system was considered. In May 2007, the INSPIRE [a combination of "Invenio" and "SPIRES"] project emerged from discussions at the first annual Particle and Particle Astrophysics (PPA) Information Resource Summit; and CERN, DESY, Fermilab, and SLAC joined to provide a new HEP information system based on the existing CERN Invenio software and the existing SPIRES content and feature set.

Invenio is a modern system that is stable, has an extensible software stack, provides a variety of search and display options, is fast, has a well-defined application-program interface (API) for mashups etc., belongs to the Open Source community, already has substantial HEP use (at CERN, ILC, etc.), has more than 100 installations worldwide, and is supported by the development and design expertise at CERN. Complementing SPIRES' strengths are decades of trusted, curated content; experience managing a discipline-wide information resource; a close relationship with a worldwide user community; and operational resources at DESY, Fermilab, and SLAC.

Since summer 2007, the initial project concept and planning has been completed; initial testing and data mapping have been performed; an expression of interest has been signed by the research directors at CERN, DESY, Fermilab, and SLAC; the alpha version of the end-user interface has been completed; the user interface has been refined; tools for the INSPIRE staff to maintain and enrich the database have been constructed; maintenance tools have been improved; and automated content classification and keywording have been implemented. In the near future, the tools and interface will be finalized, a workflow tracking system will be put in place, the user-correction interface will be improved, the system will be stress tested, INSPIRE will be released for users, and new features enabled by new technology will be developed and deployed.

INSPIRE will be run by CERN, DESY, Fermilab, and SLAC as a collaborative service. They will partner with HEP publishers, arXiv, PDG, NASA-ADS, and other information resources and will work closely with the HEP community. It will have new tools, such as listing frequent co-authors of an author, a detailed record, script for generating keyword lists, harvest figures from arXiv, and process TEX.

Operational staff will continue forward from SPIRES to INSPIRE. The cataloging/user service staff will be more efficient. Enhanced ongoing computing resources will be needed to support infrastructure and prevent decay. Development will become globally distributed as the system becomes operational, enabling the service to grow with the field's needs. The near-term opportunities include the ability to claim one's own papers, disambiguating entries like "J. Ellis." Full-text "Google-like" searching; hosting pre-arXiv preprints and out-of-copyright material; hosting figures, tables, plots, and other objects; and an improved jobs system for HEP will be available. Formats for author lists will be standardized, and ADS will be more closely worked with.

INSPIRE can remove boundaries between HEP and other fields, between papers and other objects, between information providers, and between researchers and curators, moving from an aging black box to infrastructure for a community.

Eno asked about user suggestion of keywords. Brooks replied that that updating ability already exists for other fields and will be applied to keywords.

Scholberg asked how one could get local librarians to make INSPIRE available. Brooks said that INSPIRE is so specialized, even university libraries do not notice it; perhaps they would if it were charged for.

Cushman asked what the standardization of author names was. Brooks replied that now, a PDF list is used to pass from one resource to another. That is the worst way to communicate it. A new format will be used that allows more information to be included.

Sobel asked about making people's searches harvestable. Brooks responded that there are privacy concerns. A first objective should be a user-interactive taking process.

Shochet summarized the topics he would report to the agencies as a result of the deliberations of the meeting:

- HEPAP is pleased with the FY09 funding and the President's FY10 budget request for DOE and NSF, that ARRA funds will provide new grants for young scientists, and that the NSF graduate fellowship program will triple in size.
- Interagency cooperation between DOE and NSF on DUSEL and with NASA on the JDEM mission seems to be working well.
- An upcoming accelerator R&D workshop will help set priorities for high-energy physics and the broader needs of the nation.
- A pre-construction funding profile has been agreed upon for DUSEL, and an NSF–DOE Joint Operating Group will oversee the physics program; a preliminary-design project baseline is expected by the end of 2010.
- The recent COV review of the NSF Physics Division found the proposal-review process, scientific outcome, and impact on society to be excellent; developing a program for funding midsized projects remains to be done. HEPAP disagrees with the suggestion of the COV that the Open Science Grid program be terminated in favor of commercial options.
- HEPAP heard reports on the design effort for super-B factories in Italy and Japan, which will allow much greater precision in consistency tests of the CKM picture and provide much greater sensitivity to lepton flavor violation in tau decay. A proposal has been made for the Frascati Super-B Factory to use the PEP-II magnets, an in-kind contribution valued at approximately 130 million Euros. The

- The NSF is addressing several cyberinfrastructure issues in supporting large communities doing large-scale computing; the TeraGrid is being expanded, and the Open Science Grid and TeraGrid are planning to work together.
- FACET, a plasma wakefield program at SLAC, and BELLA, a laser wakefield program at LBNL, will be built in the United States with gradients of 10 to 100 gigavolts per meter with high power-use efficiency, small beam-energy spread, and small emittance.
- The PASAG has reviewed its charge and is collecting information.
- The Astronomy and Astrophysics Decadal Survey (Astro2010) will include external expert reviews of the cost, readiness, and risks of proposed projects.
- CERN, DESY, Fermilab, and SLAC are creating INSPIRE, the new high-energy-physics information system, based on the Invenio software to help manage the increasing interdisciplinary nature of HEP, the growing complexity of the literature, and the major advances that have been made in information-system software.

There being no further business, the meeting was adjourned at 11:53 a.m.

Respectfully submitted,
F. M. O'Hara, Jr.
HEPAP Recording Secretary
June 6, 2009

Corrected by
Melvyn Shochet
HEPAP Chairman
August 16, 2009

The minutes of the High Energy Physics Advisory Panel meeting held at the Palomar Hotel, Washington, D.C., on May 21-22, 2009, are certified to be an accurate representation of what occurred.

Signed by Melvyn Shochet, Chair of the High Energy Physics Advisory Panel on August 16, 2009.

Melvyn J Shochet