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Dear Robin and Judith:

I am writing to summarize the meeting of the High Energy Physics Advisory Panel (HEPAP) held in Washington on March 3-4. This was the first meeting of HEPAP since the membership was substantially changed. The agenda was extremely full because a number of subpanel reports had been completed after the previous HEPAP meeting in July.

We were very pleased that Ray Orbach, Director of the DOE Office of Science, John Marburger, Director of the President's Office of Science and Technology Policy, and Arden Bement, Director of the National Science Foundation, were able to speak to HEPAP. Their comments were very valuable and timely in light of the American Competitiveness Initiative announced by President Bush during his State of the Union Address.

Ray Orbach noted that the President's proposed FY07 14.1% increase in the Office of Science budget puts it on the path toward doubling over the next ten years. This creates a major opportunity to strengthen physical science training and research in the United States. HEPAP is very pleased with the 8.1% increase in the high-energy physics budget which will provide needed additional support for our most important projects. In particular, the increase in R&D for the International Linear Collider (ILC), from $30M this year to the proposed $60M in FY07, will allow a more rapid determination of the cost of building ILC components in industry.

John Marburger gave HEPAP his perspective of the American Competitiveness Initiative (ACI) and physical science funding more broadly. He presented a sobering but realistic assessment of the Administration's Initiative. He noted that the NIH spent more on physical sciences research in FY02 than did the NSF. It became clear to the Administration that for the long term health of the nation, additional resources were needed in the agencies that traditionally fund the physical sciences. However the focus of the ACI is support of those fields most likely to make significant contributions to the future economic competitiveness of the United States. High energy physics

is not a targeted area, but it will benefit from the general increase in physical sciences funding. To obtain funding for a major new accelerator such as the ILC, the high energy physics community will have to make its case to the public. Both *Quantum Universe* and *Discovering the Quantum Universe* set the right tone for this discussion.

Arden Bement reviewed the role of the NSF and the impact of a budget doubling over the next decade. He noted the importance of high energy physics not only in the big scientific questions it addresses but also in creating innovative technology and contributing to a skilled technological workforce. HEPAP was pleased to hear that the President's FY07 NSF budget includes a $15M increase in funding for university investigators, which will increase with the general budget growth in future years. Arden reminded HEPAP of the importance to NSF of both education and diversity.

The details of the proposed FY07 DOE HEP budget were presented by Robin Staffin. The overall 8.1% increase would allow for progress in many areas. There would be full utilization of the Tevatron Collider and SLAC B Factory. As LHC detector construction comes to an end, additional needed funds would be made available to the LHC Research Program for operations and computing in preparation for LHC turn-on next year. Two new initiatives would be started to investigate neutrino oscillations: an electron neutrino appearance experiment at Fermilab and a reactor neutrino experiment. Increases in R&D for future projects would include $5M for long-term accelerator R&D, $10M for dark energy experiments, and of course the $30M increase in ILC R&D noted above. The core research programs in the universities would be increased by 6%. HEPAP applauds this budget proposal which stands in startling contrast to the stagnant budgets of the past decade.

Joe Dehmer presented an overview of the NSF Division of Physics. A priority, which HEPAP applauds, is keeping the core program strong by expending more than 50% of the Division's funds on the investigator grants program. HEPAP is also very pleased with the significant 6.6% increase in the proposed FY07 Physics budget. Joe reviewed the history of the Deep Underground Science and Engineering Lab (DUSEL) and the importance of its science potential to the NSF.

The first of the subpanel reports was presented by Hitoshi Murayama for the Large Hadron Collider – Linear Collider Subpanel. They produced *Discovering the Quantum Universe* (DQU), a document that explains to a non-technical audience the synergy between the Large Hadron Collider (LHC) and the proposed International Linear Collider (ILC). The report describes the exciting scientific questions that can be answered at the TeV energy scale, questions that are of the highest priority in elementary particle physics. DQU then shows that, for each of many possible discoveries at the LHC, detailed investigation at the ILC will be needed in order to decipher the new phenomenon. HEPAP feels that *Discovering the Quantum Universe* will be very helpful in explaining the importance of the ILC to the public. HEPAP unanimously approved the report.

Peter Meyers presented the report of the Neutrino Scientific Advisory Group (NuSAG) on reactor- and accelerator-based neutrino oscillation experiments. The report on neutrino-less double-beta decay had been approved at a previous meeting. NuSAG recommends that the U.S. be a leader in a program of important experiments within the world-wide context to establish whether the $\theta_{13}$ mixing angle is large enough for CP violation to be observed and the neutrino

mass hierarchy to be determined. It endorses the NOvA experiment at Fermilab, which would measure neutrino oscillations off of the neutrino beam axis. In future phases, NOvA and the T2K experiment in Japan would be considerably more powerful than either experiment alone in resolving neutrino parameter ambiguities because of the difference in baseline and NOvA's sensitivity to the neutrino mass hierarchy. NuSAG also recommends a reactor neutrino experiment that would have sensitivity to $\sin^2 2\theta_{13}$ down to 0.01 without ambiguity. It supports continued U.S. participation in the Japanese neutrino oscillation program and the Double Chooz reactor experiment in France, the latter at a lower priority.

There was considerable discussion of the NuSAG report, followed by its unanimous approval by HEPAP. HEPAP feels it is important that the Particle Physics Project Prioritization Panel (P5) view NOvA in the context of the long-term program in neutrino physics. A cap on NOvA's total cost should also be considered to avoid cost escalation that could endanger other important parts of the program. Robert Svoboda from Louisiana State University, representing the U.S. members of the Double Chooz collaboration, requested support for $4.8M of construction funds spread over a few years for a reactor experiment in France. The sense of HEPAP is that this is a good opportunity to quickly extend the explored range of $\sin^2 2\theta_{13}$ at a relatively low cost that should be supported.

Abraham Seiden presented the P5 report on the running of the Tevatron and PEP-II. The current plan has PEP-II ceasing operation at the end of FY08 followed by the completion of Tevatron running at the end of FY09. The detectors at both laboratories are working well and producing high quality results. A significant increase in integrated luminosity is expected in the next few years which will improve the sensitivity to new physics processes at both facilities. With the information P5 currently has, it sees no reason to terminate operations at either facility earlier than planned. However it will revisit the last year of running at both accelerators in the context of the full roadmap for the field so that opportunity costs can be evaluated. For PEP-II, this will be done in spring, 2006, and for the Tevatron, it will be carried out a year later.

Closely connected with the P5 assessment of the PEP-II and Tevatron programs is the concern about physicist resources, whether the field has sufficient personnel to successfully carry out the experiments to which the U.S. program is committed through the end of the decade. James Whitmore presented the report of the Physicist Resource Working Group (PRWG) which collected and analyzed the demographics. It concluded that maximizing the physics output from the currently operating experiments while preparing newer projects will tax the available physicist resources. This is especially so for CDF and D0, since many of their collaborators are also working on LHC experiments. PRWG recommends active coordination among collaboration leadership, laboratory management, and the funding agencies.

Joel Butler reported on the response from Fermilab, CDF, and D0. A task force was established to assess the needs for both operations and data analysis and to recommend solutions to any apparent shortfall. A bottom-up evaluation of the needs showed that the previous estimates had been too large. A solution was found involving both collaboration physicists and laboratory technical staff. However there is not much margin and thus considerable risk remains.

HEPAP unanimously approved both the P5 report and the Physicist Resource report. It encourages Fermilab, collaboration leaders, and the funding agencies to work together to manage the personnel shortfall risk.

HEPAP discussed three new subpanel charges. P5 will now develop a roadmap for the field in which the most compelling opportunities in elementary particle physics are prioritized in the context of a realistic budget profile that will be provided by the funding agencies. A new subpanel, the Dark Matter Scientific Advisory Group, will advise on priorities and strategies for direct detection and study of dark matter. NuSAG will have a new charge, this one concerning detector configurations for use with a megawatt-class neutrino beam.

Robert Cahn and Gary Bernstein presented an interim report from the Dark Energy Task Force. They described the four major techniques for measuring the cosmological parameters associated with dark energy. The techniques have different dependences on the cosmological parameters and different sources of systematic uncertainty. Consequently, multiple techniques should be pursued in order to best understand the origin and properties of dark energy. A report with the task force's recommendations should be completed before HEPAP meets again.

The next HEPAP meeting is scheduled for July. At that time we expect to hear the final reports from the Dark Energy Task Force, the Advanced Accelerator R&D Subpanel, as well as the EPP2010 report from the National Academies.

Sincerely,

Melvyn J. Shochet
HEPAP Chair