



Professor Melvyn Shochet
Chair of HEPAP

June 23, 2006

Dear Mel:

This letter to HEPAP provides the P5 recommendation regarding the running of the SLAC B-factory for FY2008. Following the plan elaborated approximately six months ago by P5 and endorsed by HEPAP, we have evaluated the importance of B-factory running in FY2008 in the context of a longer-term roadmap for the field. To make such a roadmap, which we anticipate will be complete around September 2006, P5 has had four meetings and a number of phone conferences to discuss and evaluate the science opportunities before us. In addition, during the last six months, we have received the reports from the Neutrino Scientific Assessment Group and the Dark Energy Task Force, helping to guide some of our deliberations, and the EPP2010 report, which lays out a vision for the future for particle physics research in the U.S. We are enthusiastic and excited by the vision provided by the EPP2010 report, which has guided our planning. We have also discussed various issues with some of the authors of these three reports as well as leaders of some of the experiments proposed for the future in order to better understand the scientific goals of these experiments.

To produce a roadmap we have adopted a number of planning guidelines. We enumerate these guidelines below. They have been developed with the recommendations of the EPP2010 committee in mind, our view of the present science opportunities for the field, and specific conservative budgetary numbers furnished by the funding agencies.

Planning Guidelines:

- 1) The LHC program is our most important near term project given its broad science agenda and potential for discovery. It will be important to support the physics analysis, computing, maintenance and operations, upgrade R&D and necessary travel to make the U.S. LHC

program a success. The level of support for this program should not be allowed to erode through inflation.

- 2) Our highest priority for investments toward the future is the ILC based on our present understanding of its potential for breakthrough science. We need to participate vigorously in the international R&D program for this machine as well as accomplish the preparatory work required if the U.S. is to bid to host this accelerator.
- 3) Investment in a phased program to study dark matter, dark energy, and neutrino interactions is essential for answering some of the most interesting science questions before us. This will allow complementary discoveries to those expected at the ILC and provide nearer term projects that, along with the LHC, will train the next generation of students in particle physics. A phased program will allow time for progress in our understanding of the physics as well as the development of additional innovative techniques for making the key measurements.
- 4) In cases where new techniques are under development our recommendations will include rough dates for reviewing technical progress in order to select the most promising directions for new ambitious experiments.
- 5) In making a plan, we have arrived at a budget split for new investments of about 60% toward the ILC and 40% toward the new projects in dark matter, dark energy, and neutrinos through 2012. This excludes NSF funds made available through NSF investments in MREFC projects, which may include particle physics as part of an interdisciplinary program involving astronomy, biology, engineering or earth sciences. The budget plan expresses our priority for developing the ILC but also allows significant progress in the other areas. We feel the investments in dark matter, dark energy, and neutrino science in our plan are the minimum for a healthy program.
- 6) The projects recommended for a construction start in dark matter, dark energy, and neutrino science should complete construction by approximately the end of 2012. This will allow maximum flexibility for decisions on future investments to be made toward the beginning of the next decade in the light of new science results, progress in new technologies, better definition of interagency contributions and plans, and progress on the ILC.
- 7) Recommendations for construction starts on the longer-term elements of the particle physics roadmap should be made around the end of this decade by a new P5 panel, after thorough review of new physics

results from the LHC and other experiments. A final decision regarding possible upgrade construction for the LHC, which will likely be a high priority, should also be made at that time. We have, however, included the LHC upgrade construction (starting in FY2011) in our budget plan to be sure that funding for this can be available. In evaluating this we have kept to our funding guideline that 60% of new investment be available for the ILC. The LHC upgrade construction would fit into the remaining 40%, while still allowing significant funds for investment in next-generation dark matter, dark energy and neutrino experiments.

- 8) Among a range of funding options for the future provided to us, we have made our recommendations within a conservative funding plan. Significant additional discovery physics, more rapid progress on exciting projects in dark energy, as well as more rapid progress on ILC R&D would be possible with additional resources.

FY2008 Roadmap and Recommendation on Running the B-factory:

We have tried to follow the guidelines enumerated above in making a FY2008 plan. The plan includes running of the Tevatron and the Fermilab neutrino program as presently foreseen. We congratulate the groups at the Tevatron on their recent discovery and precision measurement of B_s mixing and the groups providing the impressive first results from the Numi-MINOS program. We look forward to continued excellent physics from these programs. We also recommend strongly that FY2008 see continued improvement in support for the University program, as foreseen in the FY07 budget presently under consideration.

Within our roadmap, we recommend that the B-factory running continue in FY08, allowing completion of the BaBar physics data collection at close to 1000 fb^{-1} of integrated luminosity. The physics opportunities have been discussed in detail in our report of six months ago. The accelerator is running very well at present. The integrated luminosity through the summer of 2006 is expected to be about 415 fb^{-1} . The combined run in FY07 and FY08 would more than double this, allowing more incisive tests of the Standard Model and the search for new physics in channels where results are presently interesting but not definitive. The BaBar group continues to be very productive. Between January 1, 2006 and May 30, 2006 they have submitted 31 journal publications.

They have also submitted 151 abstracts to the 2006 International Conference on High Energy Physics.

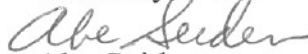
We also make the following recommendations for other elements of the FY08 program, which are aimed at implementation of the EPP2010 vision for the field. These follow the guidelines we have listed above and provide the context for our B-factory recommendation.

- 1) We recommend a strongly supported program at the energy-frontier through physics at the LHC and vigorous R&D for an ILC. We note that FY08 will likely be the first year of significant data collection at the LHC and the U.S. participants should be supported to vigorously engage in this first physics. We encourage international coordination of the ILC R&D to maximize progress toward the realization of this accelerator.
- 2) We recommend the start of construction on three smaller projects that have significant potential for important physics. These projects are:
 - a) The Dark Energy Survey, which combines measurements on baryon oscillations, cluster surveys, supernovae studies, and weak lensing to significantly improve our understanding of dark energy.
 - b) The next phase of the Cryogenic Dark Matter Search experiment, using a 25kg detector deep underground to significantly extend our sensitivity for direct detection of dark matter.
 - c) The Daya Bay reactor experiment, contingent on satisfactory review of the costs, the construction plan, the technique, and the ability to control systematic errors to the required level. This experiment will significantly extend the reach for measuring the critical third mixing angle of the neutrino-mixing matrix.
- 3) We recommend the start of construction on the NOvA neutrino oscillation experiment using the Numi beamline at Fermilab. This experiment is complementary to the other neutrino experiments on a worldwide basis and represents the next step for the U.S. in a phased international program aimed at measuring the remaining parameters of the neutrino oscillation matrix, determining the mass ordering among the neutrino mass eigenstates, and finding out whether neutrinos violate the CP symmetry.
- 4) Numerous studies have identified a Large Survey Telescope and a Dark Energy Space Mission as providing large steps forward in the

study of dark energy and tests of general relativity, our picture of inflationary cosmology, and measurement of cosmic distributions of dark matter. The particle physics community has been particularly active in developing candidates for each of these projects, which benefit from innovative work on detectors and data acquisition techniques developed in particle physics. These two projects, the Large Synoptic Survey Telescope (LSST) and the SuperNova Acceleration Probe (SNAP) are proposed as collaborative inter-agency projects. In the case of LSST, NSF has been the lead agency with DOE providing substantial resources as the partner agency. In the case of SNAP, DOE has been the lead agency with potential partners of either an international collaboration, which might include a foreign launch, or NASA, or perhaps both. We strongly re-affirm the compelling case for a Stage IV dark energy experiment (as described in the Dark Energy Task Force report). We recommend that both LSST and SNAP be supported to bring these projects to the "Preliminary Design Review Stage" in the case of NSF and LSST, "CD2 Stage" for the DOE parts of LSST, and "CD2 Stage" in the case of DOE and SNAP over the next two to three years (starting in FY07). This will allow sharpening of cost estimates, further interagency planning, further development of the collaborations, and continued work on the science potential as discussed in the Dark Energy Task Force report.

We place our highest priority on the new projects outlined above, which have been motivated by the EPP2010 vision. Should additional funds be available in FY08, compared to our planning model, our first priority among the several important uses for it would be to enable an even more ambitious start on ILC R&D.

Sincerely,



Abe Seiden

For the P5 Subpanel