Physics Advisory Committee

December 8-10, 2005

Comments and Recommendations

*P-954 SciBooNE (Nakaya/Wascko) K2K **Sci**Bar detector at FNAL **Boo**ster **N**eutrino **E**xperiment*

The SciBooNE collaboration presented their proposal to install the K2K SciBar detector in the Booster Neutrino Beamline. The proposed experiment would enable measurements of low-energy neutrino cross-sections of particular importance to the T2K neutrino oscillation program. Information on these lower energy cross sections would be complementary to the higher energy data to be obtained by MINERνA, and the high granularity and low-energy threshold of the SciBar detector would enable higher precision studies to complement those of MiniBooNE. The cross sections measured by SciBooNE should also be beneficial for understanding MiniBooNE data, and SciBooNE would enable an independent determination of the ν_μ contamination in the Booster antineutrino beam.

The on-axis Booster neutrino beam at Fermilab has a peak energy quite similar to the T2K off-axis neutrino beam. The primary impact of the proposed SciBooNE measurements would be to improve the sensitivity of T2K to ν_e appearance. In addition, the determination of oscillation parameters in ν_μ disappearance by T2K would benefit from SciBooNE data.

The SciBar detector already exists and has been used in the previous K2K experiment. It would be used in a modified form for the proposed measurements at Fermilab. The live detector/target is 15T of extruded scintillator which is followed by an electromagnetic calorimeter (EC) and a muon range detector (MRD). The detector/target and EC would be shipped from Japan to Fermilab, and a new MRD would be constructed from existing components at Fermilab. The on-axis location in the Booster Neutrino Beamline is chosen to match the peak energy of the T2K off-axis neutrino beam and to maximize the event rate, and requires a detector enclosure to be excavated.

The Committee believes that the proposed SciBooNE measurements would be valuable, and finds the proposed program and cost-effective use of the existing detector to be attractive. This experiment would also have the benefit of establishing a new international collaboration at Fermilab in neutrino physics. The time constraints associated with future commitments of detector components and collaborators imply that this experimental run would need to be complete before March 2008. The proponents have requested $2\text{x}10^{20}$ protons on target. The cost to Fermilab of the excavation of the enclosure and assembly of the detector and the incremental cost of running the beam for this experiment are relatively modest. Nevertheless, proceeding with SciBooNE would imply foregoing other opportunities. Thus the Committee urges the Laboratory Directorate and the collaboration to explore ways

of minimizing the cost to Fermilab. Assuming that sufficient resources can be identified to perform this experiment, the Committee recommends approval.

Collider Program

The Committee heard presentations about accelerator operations, the Tevatron experiments, CMS, and ILC detector R&D.

Since the June 2005 PAC meeting, the Tevatron has broken new luminosity records. The peak luminosity has reached nearly 1.7×10^{32} cm^{-2} s^{-1}, and the integrated luminosity delivered in Run II has exceeded 1.4 fb^{-1}. The last months have seen the successful commissioning and operation of pbar electron cooling in the Recycler. Efforts are now concentrating on increasing the pbar stacking rate. The luminosity projections to the end of 2009 range from 4fb^{-1} (base) to 8 fb^{-1} (design), depending on the achieved stacking rate. The Committee congratulates the Accelerator Division on these spectacular achievements.

CDF and D0 presented the status of the experiments, as well as their plans for maintaining the necessary strength of the collaborations in the future. Both experiments have over 1 fb^{-1} of integrated luminosity on tape, and are taking data with efficiencies in the 85-90% range. The detectors are performing very well, and most of the upgrade projects have been completed. There is a wealth of physics results pouring out of the experiments, which in most cases improve significantly on existing results world-wide. Thanks to the remarkable machine luminosity profile, to the detailed understanding of the detectors' performance, and to the growing maturity of the analysis techniques, the prospects for precision measurements (some of which are unique to the Tevatron) and for discoveries are bright. Both collaborations are presently developing trigger tables to cope with peak luminosities as high as 3×10^{32} cm^{-2} s^{-1}. The Committee congratulates the experiments on their success, and looks forward to even more exciting physics results.

A dedicated Tevatron Collider Task Force has addressed the problem of maintaining the strength of the collaborations as the LHC era approaches, and made several recommendations. The experiments are making efforts to optimize the available human resources, in particular to cover the key physics studies and to optimize the analysis tools. Although the matching between the needed and available resources seems to be roughly adequate, continuous monitoring of this crucial aspect will be needed to fully exploit the experiments' potential and reach the ultimate physics capabilities of the Tevatron.

The Fermilab contribution to the CMS construction is completed for the HCAL and Muon chambers, close to completion for the Silicon tracker outer barrel, where the emphasis is now shifting to assembly and integration, and at the start of production for the forward pixel detector. The FNAL Tier1 computing capacity is growing fast, and Grid operation within OSG and LCG has started. The LHC Physics Center (LPC) is building up its role of support center for US CMS analysis activities, organizing, among other initiatives, a rich program of tutorials, lectures, and mini-workshops. The Committee believes that the LPC can help foster

a smooth transition of US physicists from the Tevatron to the LHC and an optimum sharing of human resources during the transition phase.

The Committee thinks that detector R&D, in parallel with accelerator R&D, is necessary to promote Fermilab as a possible host lab for the ILC. The Committee is therefore pleased to note that efforts at Fermilab on ILC detector R&D are gaining momentum. The current activities cover design of tracking devices (both mechanics and electronics), high-granularity calorimetry, muon detection and high field solenoid. The Committee appreciates that these R&D efforts build on existing expertise, strengths, and facilities in the Laboratory (in particular from the Tevatron, BTeV, and CMS experiments). Given the limited human and financial resources, the Committee encourages the Laboratory to focus on a few R&D efforts, where it has strong expertise and therefore can play a leading role in the international community. The Committee feels that, as the ILC activity grows, more effort should be put into simulation of global detector aspects. This is an important ingredient to enhance the Laboratory's role in the international detector design activities. As the US national laboratory aiming at hosting the ILC, Fermilab should strengthen the synergies and work in a coordinated way with other US Universities and institutes involved in ILC detector R&D. The Committee strongly encourages Fermilab to continue to secure adequate resources for ILC detector R&D.

In conclusion, the Committee believes that the Laboratory's Collider program is well balanced and highly motivated. Fermilab is running the present facility at the world's energy frontier; has been and is providing a most significant contribution to the construction, software development, computing infrastructure and physics preparation of the CMS experiment at the LHC; and is intensifying its participation in ILC detector R&D as a necessary ingredient of the Laboratory's strategy toward hosting the ILC.

The Committee appreciates the challenges that the Laboratory has to face to secure enough human and financial resources for these ambitious activities, and to ensure a smooth transition from the Tevatron to the LHC and ILC era. The Committee supports Fermilab's efforts and strategy in this direction.