PROCEEDINGS OF SCIENCE

Search for Muon Neutrino Disappearance in a Short-Baseline Accelerator Neutrino Beam

Yasuhiro Nakajima*
†
Kyoto University
E-mail: nakajima@scphys.kyoto-u.ac.jp

Neutrino oscillations have been observed and confirmed at $\Delta m^2 \sim 10^{-3}$ and 10^{-5} eV^2 with various experiments. While oscillations at other mass splittings are prohibited by the current standard model, the LSND experiment observed an excess of electron antineutrinos in a muon antineutrino beam, indicating a possible oscillation at $\Delta m^2 \sim 1$ eV^2. To test the oscillation at $\Delta m^2 \sim 1$ eV^2, we search for muon neutrino disappearance using the Fermilab Booster Neutrino beamline and two experiments, SciBooNE and MiniBooNE. The neutrino fluxes are measured in the SciBooNE and MiniBooNE detectors, located at 100 m and 540 m downstream from the neutrino production target, respectively. We collected beam data from June 2007 through August 2008 with SciBooNE, and over a five year period with MiniBooNE. A preliminary sensitivity for a joint ν_μ disappearance search is presented.

35th International Conference of High Energy Physics
July 22-28, 2010
Paris, France

*Speaker.

†The author was supported by Japan Society for the Promotion of Science, and by the Grant-in-Aid for the Global COE Program "The Next Generation of Physics, Spun from Universality and Emergence" from the MEXT of Japan.

PoS(ICHEP 2010)328

An observation of a data excess of $\overline{\nu}_e$ in a $\overline{\nu}_\mu$ beam by the LSND experiment [1] initiated interests of a possible neutrino oscillation at $\Delta m^2 \sim 1$ eV^2. In this paper, we discuss a search for ν_μ disappearance at $\Delta m^2 \sim 1$ eV^2 using data from both the SciBooNE [2] and the MiniBooNE [3] experiments, where the SciBooNE detector is used to constrain flux and cross-section uncertainties.

The experiments use the Booster Neutrino Beam (BNB) at Fermilab [4]. An intense muon neutrino beam with mean energy of ~0.8 GeV are produced and detected at the SciBooNE and MiniBooNE detectors. The SciBooNE detector is located 100 m downstream from the neutrino production target. The main component of the detector complex is a fully active fine grained scintillator tracker, SciBar. The detector itself is the neutrino target (CH) and its fiducial volume is 10.6 tons. The MiniBooNE detector is located 440 m downstream from the SciBooNE detector, and is a 12 m diameter spherical tank filled with 800 tons of mineral oil (CH_2).

First, we measure energy dependent ν_μ inclusive charged current (CC) interaction rates (product of flux and cross section) by fitting muon kinematics using SciBooNE data [2]. Then, we use the result of the CC interaction measurement to tune the ν_μ interaction rate at MiniBooNE. Systematic uncertainties are carefully estimated by evaluating the correlation between SciBooNE and MiniBooNE data. Finally, we test the oscillation hypothesis assuming the mixing between 2 neutrino flavors; ν_μ and ν_x. Figure 1 shows the 90% CL. sensitivity for the ν_μ disappearance. We find that the expected sensitivity directly supersedes the MiniBooNE only ν_μ disappearance result [3], as substantial flux and cross section uncertainties have been reduced. The results of this analysis will be released soon.

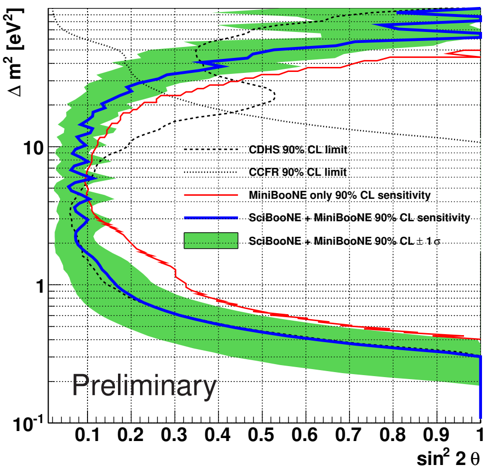

Figure 1: The expected sensitivity for ν_μ disappearance. The dotted curve shows the 90% CL limits from CDHS [5] and CCFR [6] experiments. The thin solid curve is the MiniBooNE-only 90% CL sensitivity. The thick solid curve and the filled region are the 90% CL sensitivity and $\pm 1\sigma$ band from SciBooNE-MiniBooNE joint analysis, respectively.

References

[1] A. Aguilar *et al.*, Phys. Rev. D **64** (2001) 112007.

[2] Y. Nakajima *et al.* (SciBooNE Collaboration), arXiv:1011.2131.

[3] A. A. Aguilar-Arevalo *et al.* (MiniBooNE Collaboration), Phys. Rev. Lett. **103** (2009) 061802.

[4] A. A. Aguilar-Arevalo *et al.* (MiniBooNE Collaboration), Phys. Rev. D **79** (2009) 072002.

[5] F. Dydak *et al.*, Phys. Lett. **B134** (1984) 281.

[6] I. E. Stockdale *et al.*, Phys. Rev. Lett. **52** (1984) 1384.

PoS(ICHEP 2010)328