Stony Brook University  
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Doctoral Defense Announcement  

Abstract  

Observation of $\nu_e$ appearance from an off-axis $\nu_\mu$ beam utilizing neutrino energy spectrum

By

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T2K (Tokai to Kamiokande) is a long baseline neutrino experiment located in Japan. It uses a 30 GeV proton beam at the J-PARC accelerator in Tokai to produce an intense off-axis muon neutrino beam that travels 295 km through the Earth to Super-Kamiokande. One of its primary goals is to measure neutrino oscillation parameters by directly detecting $\nu_e$ at Super-Kamiokande that have oscillated from the $\nu_\mu$ beam. The measurement of $\nu_\mu \to \nu_e$ oscillations are of a particular interest because this mode is sensitive to both mixing angle $\theta_{13}$ and CP phase $\delta_{CP}$ of the PMNS matrix. Precision measurement of $\nu_\mu \to \nu_e$ allows us to explore the possibility of CP violation in the lepton sector.

This dissertation will describe the recent 2013 $\nu_e$ appearance oscillation analysis using the reconstructed neutrino energy spectrum by means of a maximum likelihood fit. The data used for this analysis corresponds to $6.57 \times 10^{20}$ POT. A total of 28 $\nu_e$ candidate events were observed, corresponding to a 7.2 $\sigma$ significance of $\nu_e$ appearance by non-zero $\theta_{13}$. These results are then combined with the world average value of $\theta_{13}$ from reactor experiments and some values of $\delta_{CP}$ are disfavored at the 90% CL.

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