

**Stony Brook University  
The Graduate School**

Doctoral Defense Announcement

**Abstract**

Tau Neutrino Appearance in the Atmospheric Neutrinos with Super-Kamiokande

By

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Neutrinos are elementary particles, which have been considered to be massless in the Standard Model of particle physics. In the last decade, however, neutrino oscillations, which would not occur without neutrino mass, have been observed and confirmed by several neutrino experiments. In particular, Super-Kamiokande has reported the evidence for the zenith angle dependent deficit of muon neutrinos and for the sinusoidal signature of muon neutrino disappearance from the atmospheric neutrino flux. All of the experimental observations favor  $\nu_\mu \leftrightarrow \nu_\tau$  oscillation hypothesis and rely largely on the disappearance of muon neutrinos from the atmospheric neutrino flux with no explicit observation of tau neutrino appearance from the oscillations. Thus, an observation of tau neutrino appearance would be an unambiguous confirmation for  $\nu_\mu \leftrightarrow \nu_\tau$  oscillations.

This dissertation describes the tau neutrino appearance analysis using the atmospheric neutrino data obtained by the Super-Kamiokande detector. A tau neutrino enriched sample is selected using the event topologies of the decay of tau-leptons produced in charged-current  $\nu_\tau$  interactions. The zenith angle distribution of the selected sample is compared with the expected tau neutrino signals resulting from oscillations and the predicted atmospheric neutrino background events including oscillations. The results show that the Super-Kamiokande atmospheric neutrino data are consistent with the expected tau neutrino appearance from  $\nu_\mu \leftrightarrow \nu_\tau$  oscillations.

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