APR13-2012-000036

Abstract for an Invited Paper
for the APR13 Meeting of
the American Physical Society

Henry Primakoff Award Talk: Tests of Lorentz and CPT violation with neutrinos

TEPPEI KATORI, Massachusetts Institute of Technology

Lorentz violation is a predicted phenomenon from the Planck scale physics. Although the three active massive neutrino framework with the Standard Model (SM), so-called the neutrino Standard Model (νSM), is successful, series of signals not understood within the νSM suggest neutrino physics may be the first place to see the physics beyond the SM, such as Lorentz violation. Especially, neutrino oscillations are the natural interferometer and they are sensitive to the Lorentz violation with comparable sensitivity with precise optical experiments. The LSND oscillation signal was analyzed under the Standard Model Extension (SME) framework, and it was found that the oscillation data was consistent with no Lorentz violation, but data cannot reject Lorentz violation hypothesis with order $\sim 10^{-17}$. By assuming LSND signal was due to the Lorentz violation, a global phenomenological model was made to describe all known oscillation data including the LSND signal. The model also predicted the signal for MiniBooNE at the low energy region. Later, MiniBooNE announced an event excess at the low energy region. However, the oscillation candidate signals from MiniBooNE were consistent with no Lorentz violation. The limit obtained by MiniBooNE and MINOS on the $e-\mu$ sector reject the simple scenario to explain LSND signal with Lorentz violation. Meantime, MINOS and IceCube set tight limits on the $\mu-\tau$ sector Lorentz violation. The last untested channel, the $e-\tau$ Lorentz violating mixing, was tested using reactor disappearance data from Double Chooz. However, Double Chooz data was consistent with flat, and sidereal time dependent Lorentz violation hypothesis is rejected. Combinations of all oscillation data from LSND, MiniBooNE, MINOS, IceCube, and Double Chooz provide very tight constraint for a possible Lorentz violation in the neutrino sector in terrestrial level.