

A New Upper Limit for the Tau-Neutrino Magnetic Moment

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Abstract

The tau-neutrino enriched neutrino beam in the Fermilab experiment E872 (DONUT) provides a unique opportunity to study tau neutrino properties. A non-vanishing tau-neutrino magnetic moment is consistent with the recent observation of neutrino mass and gives rise to electromagnetic interactions between neutrinos and charged particles. The resulting increase in the neutrino-electron scattering cross-section can be detected experimentally.

This thesis presents a search for an excess of neutrino-electron scattering events in the DONUT data set. The analysis of 6,000,000 recorded triggers yielded two candidate events with 4.4 expected background events from Standard Model processes. No evidence for non-Standard Model interactions has therefore been found, and the new upper limit for the tau-neutrino magnetic moment is $\mu_{\nu_\tau} \leq 4.2 \times 10^{-7} \mu_B$.

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Dedication

This thesis is dedicated to my wife, Jan.