ABSTRACT OF DISSERTATION

The University of Alabama Graduate School

Degree: Doctor of Philosophy **Major Subject:** Physics

Name of Candidate: Kevin Scott McKinny

Title of Dissertation: A Search for Astrophysical Electron Anti-Neutrinos at KamLAND

A search has been carried out using 149 days of data taken between March, 2003, and December, 2003, at the KamLAND detector for a flux of astrophysical anti-neutrinos due to Supernova Relic Neutrinos (SRN), and solar $\bar{\nu}_e$ resulting from the transformation of ^{8}B ν_e's into $\bar{\nu}_e$'s through the process of Spin Flavor Precession (SFP) or neutrino decay. A search for the SRN $\bar{\nu}_e$ flux in the range of 16.2 - 30 MeV yielded zero candidates, where $1.72 \pm .12$ are expected from background. An upper limit is placed on the flux of SRN $\bar{\nu}_e$ of 74 cm^{-2} s^{-1} in the energy range of 16.2 - 30 MeV. This limit does not compete with the current limit of 1.2 cm^{-2} s^{-1} reported by the Super-Kamiokande Experiment. The search for solar $\bar{\nu}_e$'s resulted in one candidate event in the energy range of 8.0 - 16 MeV, where the signal from background is expected to $0.94 \pm .45$ events. The results are consistent with no signal, and an upper limit on the solar $\bar{\nu}_e$ flux between 8.0 and 16.2 MeV is found to be 9.4×10^2 cm^{-2} s^{-1}, which corresponds to a transition probability of 0.00077 for $\nu_e \rightarrow \bar{\nu}_e$, assuming no spectral deformation. This value improves by a factor of 10 on the previous limit of 0.008 obtained by the Super-Kamiokande Experiment. The new

limit is used to further improve on the current limits for the product of the neutrino magnetic moment with the transverse solar magnetic field, and the neutrino lifetime for non-radiative decays.

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