KamLAND-Kamioka Liquid Scintillator Anti-Neutrino Detector*

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KamLAND is the world's longest baseline reactor neutrino experiment, located in the Kamioka mine under Mt. Ikenoyama near Mozumi, Japan. The primary goal of KamLAND is a search for neutrino oscillations using Japanese and western Asian nuclear power reactors as sources of electron anti-neutrinos. Most of the reactors are distributed between 140 and 200 kilometers from the mine site. The traditional and robust inverse beta-decay signal, consisting of a prompt positron and a delayed neutron capture allows KamLAND to detect the expected signal level of about one event a day with very little background.

The construction of KamLAND was completed last year. The detector consists of 1000 tons of active liquid scintillator viewed by 1839 20"-diameter photomultiplier tubes. The front-end electronics was produced at LBNL and installed early in FY01. Data taking began on January 22, 2002. The data from 145 days of running was analyzed by the Fall FY03. The first results of KamLAND were published in January 17, 2003 edition of the Physical Review Letters.

The first data from KamLAND indicates a clear signal of anti-neutrino disappearance at the 99.05% CL. The ratio of the observed detection rate relative to that expected from a simple $1/r^2$ of the anti-neutrino flux is 0.611 +/-0.085 +/-0.041. Under the assumption of CPT invariance this result is consistent with the effect expected from the Large-Mixing-Angle solution of the solar neutrino problem.

The data from KamLAND does not yet establish the shape distortion that is suggested by the most favored parameters for neutrino oscillations. Hopefully continued running will provide adequate statistics. The LNBL group is focused on reducing the systematic error by extending the calibration to the full volume of the detector.

Footnotes and References

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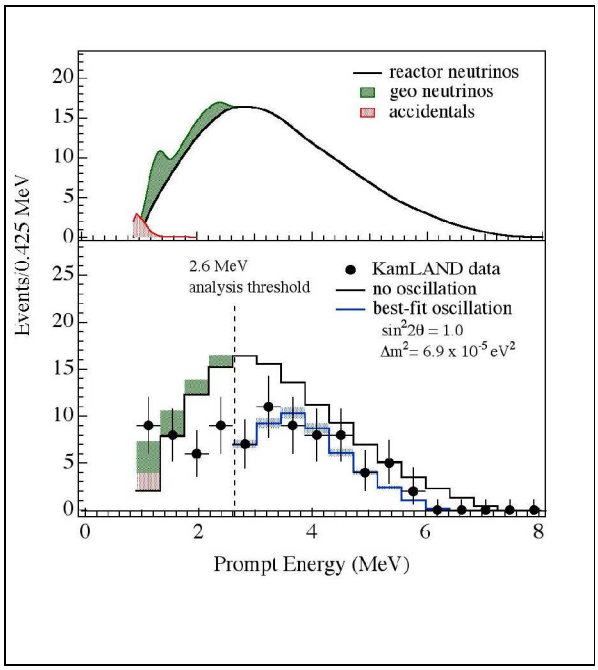

Fig. 1. Upper panel: Expected reactor electron anti-neutrino energy spectrum along with a model for geo-neutrinos from radioactivity in the earth, and background. Lower panel: Energy spectrum of the observed prompt events are the solid circles. The histogram is the expectation with no neutrino oscillations reflected in the upper panel spectrum. The blue histogram is a best fit above 2.6 MeV including the effects of neutrino oscillations. The best-fit parameters are indicated in the figure.