The 21-Century COE Project
Exploring New Science by Bridging Particle-Matter Hierarchy

Short-term Foreign Researchers
Research Report

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Your Stay Period in Japan: From Feb 9 2004 to Feb 21 2004
Title of Research in Japan: Neutrino Physics

Report:

For the first week of this visit I attended the NOON04 conference in Tokyo. This conference highlights recent work in neutrino physics, attracting researchers from around the world. It is an important meeting in neutrino physics. I presented a talk on the KamLAND experiment. The KamLAND collaboration mostly involves scientists from Japan and the United States (recently small groups from China and Europe joined the collaboration). The experiment is located underground at the Kamioka mine in the cavity that originally housed the Kamiokande detector. KamLAND's main goal was to search for anti-neutrino disappearance. The experiment monitors the observed reactor anti neutrino flux from reactors in Japan and Korea. By comparing the measured flux with the flux predicted from the known reactor power KamLAND has discovered a deficiency in the observed flux if one simply assumes a $1/r^2$ falloff. KamLAND reported this discovery last year. More recently we published results from a search for electron antineutrinos from the Sun. The limits are an order of magnitude better than previous experiments. Since then the statistical precision of KamLAND for the reactor neutrino experiment has increased significantly but no new results were reported at NOON. It is expected that an update on KamLAND will happen later in the year.

NOON04 was a stimulating and interesting conference. New results from SuperKamiokande from an analysis of neutrino oscillations by focusing on the L/E dependence of the observed atmospheric neutrino flux seems to show the behavior expected from neutrino oscillations. The outlook from this conference was an optimistic view of the possibities and opportunities in neutrino physics.

The second part of my visit was spent at the experimental site for KamLAND. An improved calibration system for KamLAND is being prepared and this trip supported the installation process. This calibration system will significantly improve the reliability of KamLAND's conclusions. The new calibration system has the capability of deploying radioactive sources anywhere within the KamLAND fiducial volume. At present we can only deploy sources along the z-axis of the detector. This new capability of the "four-pi" deployment device will significantly increase the reliability of KamLAND's conclusions about reactor neutrinos. The new calibration will allow KamLAND to make more reliable spectral measurements, which should add more confidence to conclusions about the distortion of the reactor neutrino spectrum that is expected with neutrino oscillations. The installation of this new system is challenging. During this trip we formalized the final plans for the preparations for installation of the new system.

The time spent in at the experiment provided an opportunity to interact with my collaborators and to discuss the ongoing analysis of the KamLAND data. I am very grateful to the JSPS for supporting this visit.

Stuart Freedman