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 <u>2004-02-11</u> to <u>2004-03-01</u> Title of Research in Japan: "KamLAND Onsite Operations"

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Please write a research report of one or more pages and submit it with this cover to your host researcher till the end of this March.

Report on KamLAND Operations Work February 11, 2004 – March 1, 2004 Brian Kurt Fujikawa Lawrence Berkeley National Laboratory

KamLAND is a Japan-US one-kiloton liquid scintillator neutrino detector currently operating at the former site of the Kamiokande experiment in Kamioka, Japan. The KamLAND collaboration consists of about ninety physicists from the Tohoku University in Japan; the California Institute of Technology, Drexel University, Louisiana State University, Stanford University, Triangle Universities Nuclear Laboratory, University of Alabama, University of California Lawrence Berkeley National Laboratory, University of Hawaii, University of New Mexico, and University of Tennessee in the US; and from the Institute for High Energy Physics in China. The spokesperson for KamLAND is Professor Atsuto Suzuki from the Tohoku University. The primary mission of KamLAND is to test for neutrino oscillations, in particular for the disappearance of electron anti-neutrinos, where the electron anti-neutrino source are commercial nuclear power stations located in Japan. The long baseline (180 km flux averaged) combined with low anti-neutrino energies (about 2-6.5 MeV) gave KamLAND the ability to access, for the first time with artificial neutrino sources, the large mixing angle (LMA) solution of the solar neutrino problem. The LMA solution to the solar neutrino problem was confirmed by KamLAND in 2001. Recently, KamLAND has set a very restrictive upper bound on the flux of electron anti-neutrinos from the sun that could arise from exotic processes. KamLAND is currently in the process of measuring the neutrino oscillation parameter Δm_{12}^2 .

The KamLAND experiment is currently operating twenty four hours per day, seven days per week where it is necessary to monitor the experiment to insure the data quality, perform regular detector maintenance, and to check for unusual occurances that could damage the experiment. The burden of operating KamLAND is shared equally among the collaborating institutions. During my February trip to the KamLAND site of this year, I assumed responsibility for two consecutive KamLAND detector shifts each of 8 days duration. Shift duties included checking KamLAND data for problems, making sure that the detector and its peripherals were working properly, and communicating abnormal running conditions to other onsite workers and the onsite coordinators. High quality data was taken during my shift period and detector down time was minimized.

Radioactive source standards are periodically introduced into KamLAND to calibrate and to monitor the overall health of the detector. These calibration sources are deployed into the KamLAND detector through a clean glove box system at the top of the detector. The present source deployment system is a simple device that deploys sources only along the central axis of the detector. Although this device has been very reliable and sources can be deployed with the minimal introduction of backgrounds, this deployment system is unable to sample the majority of the KamLAND detector volume. This limits the amount of detector volume that can be confidently used for data analysis. A new and more sophisticated calibration source deployment device (known as the "417" calibration source deployment device) is currently under development and construction at LBNL. During my trip to the KamLAND site in February, I assisted with the preparation of the overall calibration system for the installation of this new device.

I would like to take this opportunity to thank Professor Atsuto Suzuki of the Tohoku University for inviting me to participate in the Center of Excellence short-term foreign researchers program and the Japanese government's Ministry of Education, Culture, Sports, Science, and Technology for its generous support during my stay at the KamLAND site.