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

Short-term Foreign Researchers

Research Report

Name: Kam-Biu Luk

Affiliation: University of California, Berkeley

Host Researcher in Tohoku University: Atsuto Suzuki

Your Stay Period in Japan: From 5 Jan, 2004 to 16 Jan, 2004

Title of Research in Japan: KamLAND - reactor-based long baseline neutrino-oscillation experiment

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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.

KamLAND is a long baseline experiment designed to study neutrino oscillation using electron antineutrinos from nuclear reactors. The KamLAND detector consists of one thousand tonnes of liquid scinillator contained in a thin transparent balloon which is surrounded by 2-m-thick mineral oil. About 2000 photomultiplier tubes viewing the liquid scintillator are mounted on panels outside of the mineral oil. The liquid scintillator and the mineral oil are shielded from radiations coming from the wall of the cavern with a water jacket which is also served as a water Cherenkov counter for vetoing cosmic-ray muons. In ensure proper operation of the detector many sensors are installed inside and outside the detector to monitor the temperature, pressure, and liquid levels. The operating voltage of all the photomultiplier tubes and the temperature of the crates in the electronic hut are also monitored.

KamLAND has been taking data since January 22, 2002. There are three shifts in a day. For this round, I took the third shift between 11:30 pm and 8:00 am in the KamLAND office in Mozumi for nine consecutive days. The status of data taking is monitored remotely from the Mozumi office since we are not allowed to work alone in the mine between 10 pm and 7 am, and without a shifter who is fluent in Japanese. During the shift, I would make sure data taking was running smoothly. This required me to check the run log of the data acquisition system. In addition, I monitored data taking by watching the real-time displays of the rates and distributions of various triggers. However, this is not sufficient to ensure that we are collecting the highest-quality data. Hence, I had to review the HV alarm, the temperature and the DC voltages of the crates for the front-end electronic modules, as well as the hit distribution of the channels. I would record any channels that were either getting too few hits or too many in the shift-check list. Besides baby-sitting data collection, I took time to review the water level, the levels of the liquid scintillator and the buffer oil as well as the difference between them, and the tension acting on the balloon. This was particularly important because we had imbalance between the oil levels in this period. The problem was due to the commissioning of the 20” photomultiplier tubes that generated excessive amount of heat which was not being removed by the water circulation system fast enough, leading to a rise in temperature near the top of the detector. As a result, some oil was expelled into the overflow tank due to thermal expansion. By the time we increased the water flow to cool off the top of the detector, the oil levels were no longer the same as before. Therefore, watching the

readings of sensors for these elements was essential to make sure the detector was in good shape. The alarms of some these elements went off a few times during my nine-day shift; fortunately, none of them was serious. While we were taking data, we also compressed the raw data on disk before writing them to tapes that are then shipped to Tohoku University as well as to the States for analysis. I also assisted the task of copying data to tapes a couple time. Towards the end of my shift, we started to upgrade the HV system that required us to stop data taking for several days. During this down period, I only monitored the ‘health’ of the detector.

Before I left Mozumi, I also shipped a small amount of the KamLAND liquid scintiillator to Berkeley for studying its response to light of different frequencies. Hopefully, this would allow us to understand the energy calibration of the detector better.