KamLAND Offline Analysis

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US DATA ANALYSIS SOFTWARE

The KamLAND offline analysis software and the analysis algorithms were developed in the past year. The software is written in C++ and is tightly integrated with the ROOT framework[1]. The KamLAND offline software includes algorithms to perform the full analysis chain, starting from the raw data up to mini-DSTs. There are algorithms for waveform signal processing and for extracting pulses from the waveforms. The extracted pulses are used as inputs for energy reconstruction, event vertex fitting and muon track fitting.

The software framework and DST output format is very flexible. For instance, the framework provides methods to let several different algorithms reconstructing the same quantity (e.g. vertex fitting) be run simultaneously and written to DST for later comparison.

Integrated into the KamLAND offline analysis software are also methods to transparently access information stored in the database, read and write the event data in several file formats that the collaboration uses and a number of event displays.

LBNL is responsible for the full analysis framework, including the definition of file-formats and data storage classes. On the algorithmic side, LBNL has made many important contributions to the signal processing and pulse extraction. LBNL has also developed a new muon track fitter; the muon track fitter is essential in vetoing correlated backgrounds. These can mimic the neutrino signal and are the most important background contribution in KamLAND. This software is used by the full US KamLAND collaboration.

KAMLAND MONTE-CARLO SOFTWARE

The KamLAND simulation software is maintained jointly by the Japanese and the US collaborations. The software is written in C++ and uses the GEANT4[2] simulation package for particle transport. The KamLAND Monte-Carlo simulation software has a full description of the detector geometry and provides a shell environment for interactive simulation analysis.

The LBNL group has worked on including a more realistic simulation of the PMT response and on integrating the MC into the US offline data analysis framework. The group has further studied how to improve the simulation of muons in the detector. This is an important task for the muon track reconstruction effort.

[1] http://root.cern.ch. ROOT is a Nuclear and Particle physics software framework developed at CERN.
[2] http://geant4.web.cern.ch/geant4