“XMASS: a large single-phase liquid-xenon detector”

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Abstract:

The XMASS program is designed for multiple physics goals such as direct dark matter search, low energy solar neutrino observation, and neutrinoless double beta decay, using a large single-phase liquid-xenon scintillator located underground (2,700 m water equivalent) at the Kamioka Observatory in Japan. As the first stage of the XMASS project (XMASS-I), the detector with 832 kg of liquid-xenon is currently under operation. The liquid-xenon volume is viewed by 642 photomultiplier tubes. The signals from each PMT are recorded by waveform digitizers with 1 GS/s sampling rate and 10-bit resolution.

The scintillation light response is calibrated by inserting various calibration sources such as \textsuperscript{55}Fe, \textsuperscript{109}Cd, \textsuperscript{241}Am, and \textsuperscript{57}Co. The scintillation light yield is regularly monitored by the \textsuperscript{57}Co source. We achieved a high photoelectron (PE) yield of \textasciitilde14 PE/keV for 122 keV gamma-rays. The time profile of scintillation is also important for particle identification and vertex reconstruction. Recently, we published the results of the measurement of scintillation time profile induced by gamma-rays. The decay time constant increased from 27.9 ns to 37.0 ns as the gamma-ray energy increased from 5.9 keV to 122 keV. The Energy dependency of the scintillation decay time was studied as a function of the kinetic energy of electrons induced by gamma-rays. Furthermore, a fast decay time component with $\tau\sim2$ ns was necessary to reproduce data.

In this talk, an overview of the experiment, the experimental apparatus and its performance will be presented. Especially, we will focus on recent results from scintillation time profile measurement for low energy gamma-ray induced events. Prospects for particle identification using scintillation pulse shape will also be discussed.