Abstract

The purpose of J-PARC KOTO experiment is to search for the rare decay "$K_L \to \pi^0\nu\overline{\nu}$".

One of the main background sources is neutrons interacting with CsI calorimeter, misidentified as photons. To suppress the background, we will measure the interaction depths of neutrons and γ's in the calorimeter. To measure the depth, we will attach silicon photon detectors (MPPCs) on the upstream surface of CsI calorimeter and measure the timing difference between the MPPCs and the PMTs on the downstream surface of CsI crystals (hereinafter, this is called Δt).

With cosmic rays, I confirmed that there is a linear correlation between Δt and the cosmic ray hit positions. The timing resolution of Δt was 1.2 ns. Also, by using neutron and γ beam, I demonstrated that we can discriminate between neutrons and γ's with Δt. I also investigate the behavior of scintillation photon in the calorimeter by simulation and cosmic ray test.

With a Geant4-based simulation, I confirmed that the neutron background is suppressed to (5.4±0.2)% while keeping 90% of the $K_L \to \pi^0\nu\overline{\nu}$ signal events.

The new readout system with MPPCs thus works to suppress the neutron-induced background.