Contribution ID: **679** Type: **Poster**

New readout system for the KOTO CsI calorimeter upgrade

Friday, July 6, 2018 8:15 PM (15 minutes)

The purpose of J-PARC KOTO experiment is to search for a rare Kaon decay, $K_L \to \pi^0\nu\bar{\nu}$. This decay violates CP symmetry and is highly suppressed in the Standard Model (SM). The SM predicts its branching ratio as $BR = (3.0 \pm 0.3) \times 10^{-11}$, and the deviation of the measured BR from the prediction signifies the existence of new physics.

The KOTO detector consists of a CsI calorimeter, and veto detectors to suppress backgrounds. The signature of the signal is 2 γs originated from π^0 detected in CsI calorimeter. One of the backgrounds is beam halo neutrons hitting the CsI creating photon-like clusters. These background events are rejected by 2-orders of magnitude based on waveforms and shower shapes of the clusters, but another order of magnitude reduction is needed in order to reach the SM sensitivity.

We have developed a new readout system utilizing MPPCs (Multi Pixel Photon Counter) to discriminate neutrons and γs in the CsI calorimeter.
MPPCs will be installed on the upstream side of the CsI in addition to the PMTs currently used on the opposite side. With timing difference between the MPPC and PMT, we can identify background neutrons because their interaction depths are deeper than those of γs.

We will present the performance of this system measured with e^+ beam at the Tohoku University.

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Session Classification: POSTER

Track Classification: Detector: R&D for Present and Future Facilities