

Front-end circuits for MPPCs for the KOTO CsI calorimeter upgrade

Tuesday, 27 November 2018 18:30 (2 minutes)

The purpose of the J-PARC KOTO experiment is to search for new physics beyond the standard model(SM) with the rare kaon decay $K_L \rightarrow \pi^0 \nu \bar{\nu}$.

The branching ratio of this decay was predicted to be $BR = 3.0 \times 10^{-11}$ in the SM.

The KOTO detector consists of an electromagnetic calorimeter made of undoped Cesium Iodide(CsI) crystals, and hermetic veto counters.

To reach the sensitivity predicted in the SM, we need to suppress the halo-neutron backgrounds by a factor of ten.

We are now installing 4096 Multi Pixel Photon Counters (MPPCs) on the upstream side of the crystals to discriminate neutrons and gammas.

In the KOTO detector, the MPPCs will be exposed to 1.5×10^9 $n_{1\text{MeV}}/\text{cm}^2$ doses. We confirmed that radiation damage did not affect MPPC's performance: breakdown voltage and photon detection.

For the updated calorimeter, we developed front-end circuits including MPPC connection, summing amplifier circuit for the signal, and control system.

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Session Classification: Poster session