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Calorimeter upgrade of the KOTO experiment with both-end readout of CsI crystals using MPPCs

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We are searching for the decay $K_L \rightarrow \pi^0 \nu \bar{\nu}$ in the KOTO experiment at J-PARC. The signal is identified by detecting two photons from the π^0 decay with a calorimeter composed of undoped CsI crystals. The main background “hadron cluster background” comes from neutrons generating two clusters in the calorimeter: a neutron in the beam halo hits the calorimeter to generate the first cluster, and a secondary neutron escaping the first cluster generates the second separated cluster. In order to reduce this background, we upgraded the calorimeter to have both-end readout by attaching MPPCs on the upstream face of each CsI crystal on top of the original PMT attached on the downstream face. The background can be rejected exploiting the timing difference between the MPPC and PMT, since neutrons tend to interact deeper inside the crystals. We installed the MPPCs in 2018, and evaluated the performance with data taken in 2019. I will present the newly developed technologies and the performance of the background rejection with the upgraded calorimeter.

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