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Development of Hybrid Photo-Detector for the Hyper-Kamiokande Project

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A hybrid photo-detector (HPD) is being developed for the Hyper-Kamiokande experiment, a next-generation underground water Cherenkov detector designed to study a wide range of topics in physics and astronomy. To establish the feasibility of HPDs for Hyper-Kamiokande, we plan to study their long-term stability and determine their neutrino detection performance. The HPD is a hybridization of a photomultiplier tube and an avalanche diode (AD), in which photoelectrons are amplified in 2 steps: bombardment from the photocathode to the AD surface under high voltage ($\sim 8\text{kV}$) and from the internal AD avalanche. For this reason, the HPD is expected to achieve higher single photon sensitivity and better timing resolution at a lower mass production cost than the conventional PMTs used in the baseline design of Hyper-Kamiokande. Implementation of HPDs in Hyper-Kamiokande could therefore improve its physics sensitivity.

As part of our RD we will evaluate the performance of a water Cherenkov detector using small size, 8-inch HPDs in 200-ton water tank before developing a 20-inch HPD for Hyper-Kamiokande.

As a preparation for validation studies in 200-ton tank. The basic performance of an 8-inch HPD was measured such as single photon sensitivity, timing resolution, uniformity of response, thermal and magnetic dependence and so on. Also we operated it in small water tank to guarantee safe and stable operation. These results and status will be presented.

quote your primary experiment

HyperKamiokande HPD neutrino

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