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Water Cherenkov Detector for Study of Wavelength Shifting Plates

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The Hyper-Kamiokande experiment [1] aims for a search for CP violation in neutrino oscillations, proton decay, measurements of solar and atmospheric neutrinos, and other neutrino physics using a large water Cherenkov detector. The outer veto Chrenkov detector will use about 4000 optical modules based on PMT's and wavelength-shifting (WLS) plates [2], which enhances light collection efficiency and improves particle identification.

This report describes the prototype of water Cherenkov detector constructed to evaluate the characteristics of WLS plates under conditions of Hyper-Kamiokande. The prototype features a scaled-down water tank and an outer detector module consisting of a 3-inch Hamamatsu R14374 photomultiplier tube (PMT) [3] and a 30 × 30 cm, 7 mm thick WLS plate. The water purification system of this detector has currently achieved a resistivity of approximately 8 MΩ·cm. Parameters of WLS plates were measured using cosmic-ray muons. It was obtained that such a module (PMT plus WLS plate) increases light collection (the number of collected photons) by more than 2 times compared to the light collection of a bare PMT.

Future work will focus on upgrading the water purification system to achieve characteristics approaching those of ultrapure water. Acquiring data to create a Monte Carlo model of the WLS plates' optical characteristics is also a part of the future plans.

Key words: Hyper-Kamiokande outer detector, Water Cherenkov detector, Water purification system, Wavelength-shifting (WLS) plates, Hamamatsu R14374 photomultiplier tube (PMT), PMT coupling, Cherenkov light

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