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Refurbishment of KamLAND outer detector

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The Kamioka Liquid-scintillator Anti-Neutrino Detector (KamLAND) at Kamioka-mine in Japan, witch has been taking data since Jan 2002, has detected reactor neutrinos and geo-neutrinos using 1,000ton ultra-pure liquid scintillator. The Outer Detector (OD) is a 3,200ton water Cherenkov detector with 225 20-inch photo-multiplier tubes (PMTs). The OD is a cosmic ray-muon veto counter and suppresses muon-induced neutrons to enter the liquid scintillator inner detector (ID).

The muon tagging efficiency of the OD had gradually decreased since 2010, which was caused by gradual failure of 20-inch PMTs. To prevent increasing neutron backgrounds, we launched on OD refurbishment in Jan 2016. The 225 20-inch PMTs that were reuse of the Kamiokande-PMTs were replaced with 140 new 20-inch PMTs. At the relatively low sensitive region, the photo-coverage was enhanced and high reflective tyvek sheets were added.

We present a report of OD refurbishment work and the latest data of the new OD.

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