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Study of neutrons associated with neutrino interactions in water with the IWCD detector

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The Hyper-Kamiokande (HK) experiment, a next generation underground experiment in Japan, will have a broad physics program, including long-baseline neutrino oscillation measurements using an upgraded 1.3 MW beam produced at J-PARC accelerator, following the successful T2K experiment. To achieve the designed goal, an accurate prediction of neutrino interaction rates on the water target at the HK far detector is vital. For this aim, the Intermediate Water Cherenkov Detector (IWCD), which can vertically move changing the angle between the average beam direction and the direction of neutrinos impinging the detector, is planned as one of HK's near detector. By measuring neutrino interaction rates at various vertical positions, IWCD will measure neutrino interactions' dependence on neutrino energy. It is also planned to operate the detector with $Gd_2(SO_4)_3$ loading, enabling the measurement of neutrons associated with neutrino interactions in water. Since information about these neutrons will be utilized to improve various physics analyses at the HK far detector, the measurement at IWCD will be used to reduce uncertainties on the modeling of neutron production. This talk will present an overview of the IWCD detector design and its measurement program, and discuss the challenges associated with the measurement of neutron multiplicities, including reconstruction of neutron signal and backgrounds in the measurement.

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