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Optical calibration design for the Hyper-Kamiokande Outer Detector

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Hyper-Kamiokande will be the next generation water Cherenkov detector, an order of magnitude larger than Super-Kamiokande, capable of studying proton decay, atmospheric neutrinos, and detecting neutrinos from astronomical sources with far greater precision than its predecessor. It will also serve as the far detector for long baseline neutrino beams produced at J-PARC.
The detector will consist of both inner (ID) and outer (OD) detectors filled with ultrapure water. The ID will be instrumented with photomultiplier tubes (PMTs) facing inwards to detect Cherenkov light produced in neutrino interactions and potential nucleon decays, with 40% photocoverage. The OD will have PMTs on the OD inner wall facing outwards, with a photocoverage of 1%, and has the primary purpose of vetoing background events originating outside of the detector, as well as determining whether or not events occurring in the ID are fully contained.
An LED optical calibration system has been designed for the Hyper-Kamiokande ID and deployed for testing in Super-Kamiokande, incorporating narrow and diffuse beams of light. A similar system is intended for use in the OD, with light being delivered by optical fibres around the outside wall of the detector. A specific challenge of this design arises due to the geometry of the OD and sensor support structures within it, necessitating many light injection points to illuminate all PMTs to the required intensity, as well as allowing sufficient redundancy should any sources become non-functional, all while minimising the final number of injection points to mitigate costs. The initial results of simulated studies of this system using the WCSim software suite will be presented in this talk.

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