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R&D and Status of the LED System for Hyper-K's LED-mPMT Module

The Hyper-Kamiokande (Hyper-K) main detector is under construction and is planned to begin operation in 2027. The detector will consist of a cylindrical water tank measuring 68 metres in diameter and 72 metres in height, instrumented with 20,000 inward-facing 50-cm photomultiplier tubes (PMTs). To enhance calibration capabilities, 800 of the conventional PMTs will be replaced by multi-PMT (mPMT) modules: 600 regular mPMTs, each equipped with 19 8-cm fast PMTs, and 200 LED-mPMT modules, each equipped with 14 8-cm fast PMTs and five UV-light sources pointing in different directions. Each LED system in the LED-mPMT modules includes three diffuse and four collimated UV-light sources at different wavelengths. The combination of these UV-light sources with the fast timing resolution of the mPMTs will allow us to address two critical calibration needs for Hyper-K: (1) calibrating the diffused light source at the opposite wall to improve understanding of the angular response of the 50-cm PMTs and water-attenuation effects, and (2) calibrating the collimated light source to measure water quality in the tank by analyzing light transmission, including position-dependent scattering effects such as those caused by bacteria. In this presentation, I will talk about the research and development of the LED system for the LED-mPMT module and give an update on its production status. I will then describe the development of experimental test stands to measure both collimated and diffuse light output and to assert the quality and consistency of the devices. Together, these efforts ensure readiness for Hyper-K's start of operation and support its goal of achieving unprecedented precision in neutrino measurements and related physics analyses.

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