Contribution ID: **15** Type: **Oral**

Large Area Photo-Detection System using 3-inch PMTs for the Hyper-Kamiokande Outer Detector

Thursday, 29 November 2018 14:20 (20 minutes)

Hyper-Kamiokande, scheduled to begin construction as soon as 2020, is a next generation underground water Cherenkov detector, based on the highly successful Super-Kamiokande experiment. It will serve as a far detector, 295 km away, of a long baseline neutrino experiment for the upgraded J-PARC beam in Japan. It will also be a detector capable of observing — far beyond the sensitivity of the Super-Kamiokande detector — proton decay, atmospheric neutrinos, and neutrinos from astronomical sources.

An Outer Detector (OD) consisting of PMTs mounted behind the inner detector PMTs and facing outwards to view the outer shell of the cylindrical tank, it would provide topological information to identify interactions originating from particles outside the inner detector. Any optimization would lead to a significant improvement for the physics goals of the experiment, which are the measurement of the CP leptonic phase and the determination of the neutrino mass hierarchy.

An original setup using small 3" PMTs is being designed for the Hyper-K OD. They would give better redundancy, spatial, and angular resolution, as they would be twice or three times more photo-sensors that the original 8" design proposal of the experiment, and for a reduce cost. In this presentation, I will show the characterization of several 3" PMTs candidates considered for the Hyper-K OD, tested at Queen Mary University London. Moreover, I will carefully assessed the measurement stand performances, and evaluation of the systematics. I will show how we are minimizing those by working with state-of-the-art software and DAQ.

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Session Classification: Thursday afternoon