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Empowering JUNO physics by means of an ancillary photodetection system

JUNO is a liquid scintillator detector currently under construction in the south of China. JUNO aims to detect the disappearance of reactor antineutrinos at an average baseline of 53 km, with the primary goal of determining the neutrino mass ordering and performing a sub-percent measurement of three of the neutrino oscillation parameters. This physics program is rooted in the detector's unprecedented capability to detect 1200 photoelectrons (PEs) per MeV of deposited energy, yielding a 3% energy resolution at 1 MeV. The main photodetection system comprises 18000 20-inch "large"photomultipliers (LPMTs), each of which experiences an illumination varying over two orders of magnitude. To help calibrating the LPMT response in such a demanding environment, JUNO will be instrumented with additional 25600 custom-made 3-inch "small"photomultipliers (SPMTs). They will operate in photon-counting regime by detecting at most 1 PE per neutrino interaction, hence providing a complementary energy estimator. In addition, the SPMT system is designed to provide a semi-independent measurement of the "solar"oscillation parameters, to aid the measurement of supernova neutrinos, and to improve the muon track reconstruction, whose performance is pivotal for background rejection. The SPMTs, together with their power and readout systems, will have to operate under water for over 20 years, posing challenging constraints on the design, reliability and implementation of this major subsystem of JUNO. In this talk, we will present the innovative design of the JUNO SPMT system, its impact on physics, and the current status of SPMT production and testing.

Working group

WG6

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