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Contribution ID : 114

Type : **Poster**

Testing methods for 20-inches PMTs of the JUNO experiment

Tuesday, 28 February 2017 17:00 (1:00)

Content

The 20kt Liquid Scintillator (LS) JUNO detector is under construction by the International Collaboration in China with the primary goal to address the question of neutrino mass ordering (hierarchy). The main JUNO challenge is to achieve a record energy resolution, $\sim 3\%$ at 1MeV of energy released in the LS, which is required to perform the neutrino mass hierarchy determination. About 20'000 large 20" PMTs with high Photon Detection Efficiency (PDE) and good photocathode uniformity ensure about 80% surface coverage of JUNO detector. The JUNO collaboration is preparing equipment for the mass tests of all PMTs using 4 dedicated containers. Each container consists of 36 drawers. Each drawer will test a single PMT. This approach allows us to test 144 PMTs in parallel. The basic measurement in the container will be the PMT response during illumination of its photocathode by the uniform light of a small intensity. All of the 20000 PMTs will undergo the container test. For sampled tests of PMTs also a dedicated scanning system was constructed that allows us to study a variation of the PDE over the whole PMT photocathode surface. Recently a sophisticated laboratory for the PMT testing was built. It has a dark room where the scanning station is housed. The core of the scanning station is a rotating frame with 6 LED sources of calibrated short light flashes that are placed along the photocathode surface covering zenith angles from the top of a PMT to its equator. It allows testing of individual PMTs in all relevant aspects by scanning the photocathode and identifying any potential problem. The collection efficiency of a large PMT is known to be very sensitive to the Earth Magnetic Field (EMF), therefore, understanding the necessary level of EMF suppression is crucial for the JUNO Experiment. A dark room with Helmholtz coils compensating the EMF components is available for these tests as a JUNO facility. Hamamatsu R12860 20" PMT is a candidate for the JUNO experiment. In this talk the container design and mass-testing method, the scanning setup and scanning method are described and preliminary results for performance test of this PMT are reported.

Summary

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Session Classification : Posters

Track Classification : Instrumentation for Astroparticle and Neutrino physics