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Ground Calibration of MAPMT and SiPM for JEM-EUSO

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In order to unveil the mystery of ultra-high energy cosmic rays (UHECRs), JEM-EUSO (Extreme Universe Space Observatory on-board Japanese Experiment Module) will observe extensive air showers induced by UHECRs from the International Space Station (ISS) orbit with a huge acceptance. The telescope will consist of Fresnel optics and a focal surface detector with 5,000 multi-anode photomultiplier tubes (MAPMTs) - 300,000 channels in total. In order to discuss the origin of UHECRs precisely with the observed results, it is essential to calibrate the detector pre-flight with utmost precision.

With several pathfinder missions the technical readiness level of JEM-EUSO is demonstrated, e.g. EUSO-Balloon, EUSO-TA and Mini-EUSO. These pathfinder missions also provide the perfect environment to investigate the capability of new state of the art photosensors based on Geiger mode avalanche photo diodes (G-APDs), so called silicon photomultipliers (SiPMs).

In order to absolutely calibrate and characterize different types of photosensors, an universal calibration and test setup was built at the Karlsruhe Institute of Technology (KIT). It consists of a photon shielding dark box (1.5m x 1m x 1m), a diffuse uniform light source with a calibrated optical output and several readout electronics for MAPMTs and SiPMs. The light source can be used in single-photon mode (pulsed light) and other modes, ranging from a few tens of photons to continuous light. The spectral output is around 377±6 nm. Further wavelengths will be implemented with respect to the emission lines of the nitrogen fluorescence spectrum.

Former measurements with SiPMs have shown a temperature dependence of dark count and gain. Therefore, a temperature control has been implemented into the setup. With this the photo detection efficiency of various photosensors can be measured for different wavelengths and temperatures. The present status of the calibration and test setup will be reported.

Collaboration

JEM-EUSO

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