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Calibration and tests of multichannel photodetection modules for the JEM-EUSO stratospheric and orbital missions

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The JEM-EUSO (Joint Exploratory Missions towards an Extreme Universe Space Observatory) collaboration is developing a series of balloon and orbital telescopes to detect fluorescent UV emission from the Earth atmosphere, with the primary aim to study ultrahigh energy cosmic rays (UHECRs) from space.

The detectors have a wide field-of-view, high temporal resolution (1-2.5 μ s) and single photon sensitivity. Currently one of these detectors (Mini-EUSO) is operating onboard the ISS. The last stratospheric balloon mission (EUSO-SPB2) was launched in May 2023. The next generation detectors are in preparation, namely the stratospheric balloon EUSO-SPB3/PBR and orbital space-based detectors K-EUSO and POEMMA. These projects use the same photo-detection modules (PDMs) composed of 36 multi-anode photomultiplier tubes (MAPMTs) with 2304 channels in total. Mini-EUSO uses one PDM, EUSO-SPB2 three, and EUSO-SPB3/PBR uses 4 PDMs. Big space projects such as K-EUSO and POEMMA will use dozens of PDMs.

A new method was developed to characterize the performance of the PDMs and provide absolute calibration of the MAPMTs used in the different JEM-EUSO missions. The characterization includes the photodetection efficiency of each pixel (including sub-pixel structures), their actual surface area, and the double pulse resolution. The method and its application to the EUSO-SPB2 PDMs in different modes of operation will be presented.

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