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The XY-Scanner for Absolute End-to-End Calibration of Fluorescence Detectors

The precise determination of the energy scale is a key part of experiments in astroparticle physics. At the Pierre Auger Observatory, the energy scale is set by the calorimetric measurement of extensive air showers with fluorescence detectors. Thus, the absolute end-to-end calibration of the fluorescence detectors is of utmost importance. In the past, this calibration was performed by illuminating the whole optical system of a fluorescence telescope with a large-scale extended uniform light source of the same diameter as the telescope aperture. However, handling difficulties, excessive manpower requirements, and degradation of such a source led to the need for a different approach for the absolute end-to-end calibration. The fundamental idea of the novel approach is to significantly reduce the geometrical size of the calibration light source, which is a near-UV LED source implemented in a portable integrating sphere with specifically designed interior. This light source is moved over the aperture by a rail mechanism with two independent linear stages named the XY-Scanner. Calibration data are evaluated from a series of light source positions instead of illuminating the entire aperture at once. The absolute photometric determination of the light source emission intensity is performed in a dedicated laboratory setup with a measurement uncertainty of 3.5 %. The XY-Scanner mechanics installed at the aperture gives also the opportunity to install other, devices for instance a narrow, collimated beam source to investigate local impurities of the telescopes. This contribution gives an overview of this novel XY-Scanner calibration method and presents preliminary results and discusses plans for the future.

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