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Muon counting with the Underground Muon Detector of The Pierre Auger Observatory

The Pierre Auger Observatory was designed to answer the key questions about the origin and composition of ultra-high energy cosmic rays. As part of the Observatory's upgrade, AugerPrime, a new detection system has been conceived to have direct access to the muon component of the air showers above $10^{16.5}$ eV up to the ankle-region of the energy spectrum. The Underground Muon Detector (UMD) consists of 30 m^2 buried devices based on plastic-scintillators that measure muons with energy greater than ~ 1 GeV and are deployed in a triangular array over an area of 23.5 km^2. To estimate the number of particles the UMD works in two complementary ways dubbed as counting and integrated modes. The first, relying on the amplitude of the signals in the detector, is optimized for low particle densities while the latter, based on the signal charge, is better suited for high densities close to the shower core.

In this work, we will present an overview of the final design of the Underground Muon Detector and its reconstruction techniques alongside the observations obtained during the engineering array phase. First results are compatible with a muon deficit that current hadronic interaction models have at energies between 2 x 10^{17} eV and 2 x 10^{18} eV.

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