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ENERGY THRESHOLD DETERMINATION FOR AMIGA MUON COUNTERS VIA GEANT4 SIMULATION

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One of the first improvements of the Pierre Auger Observatory is the Auger Muons and Infill for the Ground Array (AMIGA) detector, in order to measure the cosmic ray spectrum and the chemical composition in the energy range from 10^{17} eV. The muon detectors of the AMIGA *infill* count muons from extensive air showers observed by Auger Observatory, which are then reconstructed by the surface and fluorescence detectors. Muons with energy greater than or equivalent to 1 GeV propagating in the soil are able to reach the muon detector. Although the air shower muonic component is attenuated much less than the electromagnetic component, the shielding of approximately 2.25 m of soil adds 540 g/cm² of vertical mass (approximately 60% more than the atmosphere above the Pierre Auger Observatory). Thus, in order to better understand attenuation mechanisms (shielding effects) of muons, a Monte Carlo simulation with Geant4 was made to determine the muon energy threshold, i.e., the minimum kinetic energy the muon should have to go through the 2.25 m of soil and produce a signal in the AMIGA counters. The energy threshold is determined by taking into account the primary particle as well as the secondary particles produced in the soil above the detector. The information on the energy threshold is important to understand the process of data analysis. This threshold can be used to test the Geant4 simulation program, since the muon energy threshold is well calculated via the Bethe-Bloch formula. From the energy thresholds and the energy distribution at ground level for different particles from extensive air showers, the contribution of those particles to the data recorded by the detectors can be calculated. This contribution is crucial to correctly determine the number of muons in an extensive air shower, which is one of the main aims of the AMIGA enhancement.

Keywords: AMIGA detectors, Geant4 simulation, muons, energy threshold, Bethe-Bloch formula.

Collaboration

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