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A method for reconstructing the muon lateral distribution with an array of segmented counters with time resolution

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Although the nature of ultra high energy cosmic rays is still largely unknown, significant progress has been achieved in last decades with the construction of the large arrays that are currently taking data. One of the most important pieces of information comes from the chemical composition of primary particles. It is well known that the muon content of air showers generated by the interaction of cosmic rays with the atmosphere is rather sensitive to primary mass. Therefore, the measurement of the number of muons at ground level is an essential ingredient to infer the cosmic ray mass composition. The energy range from 3×10^{17} eV to 10^{20} eV is considered using two triangular arrays spaced at 750 m and 1500 m respectively. We introduce here a novel method for reconstructing the muon lateral distribution function with an array of segmented counters. The reconstruction builds on a previous method we recently presented by considering the time resolution of the detectors. We show that the new method improves the statistical uncertainty of the measured number of muons with respect to the previous alternative. The new reconstruction has also the additional advantage of estimating uncertainties in the number of muons without bias. These improvements make a difference in composition analyses. While the increased resolution allows for a better separation between different primary masses, correct uncertainties are required for a meaningful classification of cosmic rays on an event-by-event basis.

Collaboration

– not specified –

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