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Measurement of single and multiple horizontal cosmic muons at high altitudes with the MEV telescope

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The study of very inclined (nearly horizontal) cosmic muons is of special interest for several reasons. Due to the Earth atmosphere the quantitative effect of the mechanisms leading to the formation of extensive air showers is different with respect to vertical showers, with strong suppression of some components in the shower, and a different energy distribution of the particles.
The investigation of muon bundles in cosmic ray showers, especially at large zenithal angles, is also an important benchmark for hadronic shower calculations. The role of nearly horizontal muons has also been discussed in the context of upward τ air showers generated by τ neutrino conversion in the Earth crust. Nearly horizontal, but downward going muons from the opposite side would represent a background when searching for these events. In such a case the presence of a close mountain could act as muon absorber, eliminating a large fraction of muons from one of the two sides, thus allowing to reduce the background.
An experimental investigation of single and two muon tracks events detected by the MEV cosmic ray telescope [1] has been carried out during a commissioning phase of the project. The MEV telescope, which is based on three 1x1 m2 tracking planes segmented into scintillation strips with wavelength fibers and multianode PMT readout, has been installed at an altitude of about 3100 m a.s.l. in front of the North-East Etna crater (Sicily) since the summer of 2017. The main aim of this facility is to provide a detailed muography of the crater interior. An additional analysis of a first sample of data, taken during a period of approximately two months in 2017 has been undertaken to measure the abundance and topology of nearly horizontal multiple cosmic muons. A small sample of multiple track events was identified and typical rates for such events in front of a solid mountain were estimated.

[1] D.Lo Presti et al., Nuclear Instruments and Methods in Physics Research A904(2018)196.

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