Influence of a perturbing backward upward flux on the quality of muon tomography

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Density muon tomography of large volumes of rocks involves the measurement of tiny fluxes of muons that are blurred by particles coming from other directions. This is particularly the case of the huge open-sky flux that produces fortuitous events when independent particles simultaneously hit the detectors of the telescope and mimic a false track coming from the target to image. To get reliable data, this type of noise must be eliminated by using telescopes equipped with three or more detector matrices that make the probability for a false track negligible. The filtering is further improved by using clock with a 1 ns resolution as implemented in our telescopes.

Muon tomography of volcanoes constitutes a particular situation where the telescopes are installed on mountain flanks with their backward side oriented toward deep valleys. In such a case, a non negligible flux of muons coming from below the horizon may be produced by sub-horizontal atmospheric showers that continue to develop in the air volume below the horizontal plane located at the telescope altitude.

Such backward upward flux have been detected during experiments performed on La Soufrière of Guadeloupe and on Mount Etna in Sicily. We show how the high-resolution clock of our telescopes allows to determine the flight direction of the particles in order to detect an eventual upward flux and determine its intensity. We discuss the influence of such a noise on the quality of the density radiographies.