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Estimation of the contribution of Muon Forward Scattering to the signal registered by the MuTe detector

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Muography is a technique that allows us to estimate the distribution of matter in the inner structure of geophysical formations like volcanoes. This technique is based on the measurement of the absorption of atmospheric muons that go through the structure, so that with a hodoscope instrument it is possible to build a map of density of matter, similar to a medical X-ray image. The MuTe (Muon-Telecope) collaboration, from *Universidad Industrial de Santander*, has designed and deployed a hybrid detector, with the same name. This detector consists of both a hodoscope and a water Cherenkov detector (WCD), and it has been conceived with two scientific aims in mind: applying Muography to study volcanic structures in Colombia, and working as a muon counting detector. In Muography, one source of noise is the Muon Forward Scattering (MFS) phenomenon, i.e. muons coming from the ground after a deflection caused by processes such as Coulomb interactions, that can be erroneously interpreted as muons that have crossed the structure of interest, when they actually have not. In this work, we quantify this effect using Monte Carlo simulations via the Geant4 toolkit, where we modeled the ground as standard rock. Thus, as a main result, we have estimated the MFS effect on the MuTe signal using an array of computer simulations: CORSIKA, to generate a realistic background of muons and other particles created in extensive air showers from cosmic rays; MAGNETOCOSMICS, to account for the effect that Earth's magnetic field has on the trajectories of primary cosmic rays; and a model of MuTe in Geant4, to estimate the superposition of the signal from MFS over the signal produced by the background of particles.

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