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3D Volcano Imaging Using Transmission Muography

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Muography is a recent technique in particle physics where atmospheric muons are used to study the interior of large targets such as volcanoes. In the case of transmission muography, a detector is used to count and track muons that survive after propagation through the target. To a first approximation, the number of muons that survive after propagation through the target depends directly on the amount of integrated matter along their path. The 2D map of the number of muons
needs to be converted into a 2D map of density. To do this, the number of muons measured with the detector in each direction is compared to the expected number of muons for different target models by varying the density. For each direction, the simulated density that best reproduces the data is chosen. To estimate the muon survival probability, many experiments use an analytical approximation called CSDA (Continuous Slow Down Approximation) giving the range of matter a particle may cross for a given energy. In the MIM (Muon IMaging) experiment, we use a Monte-Carlo treatment. Using the CSDA approximation, thus neglecting the stochastic character of the high-energy interactions of the particles with matter, underestimates their survival probability and thus induces systematics on the reconstructed density. In the range of kilometer of standard rock, the effect is about 3%.

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