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Detecting Special Nuclear Material With Muon Scattering Tomography

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We present a novel approach to the detection of special nuclear material using cosmic rays. Muon Scattering Tomography (MST) is a method for using cosmic muons to scan cargo con- tainers and vehicles for special nuclear material. Cosmic muons are abundant, highly penetrating, not harmful for organic tissue, cannot be screened against, and can easily be detected, which makes them highly suited to the use of cargo scanning. Muons undergo multiple Coulomb scattering when passing through material, and the amount of scattering is roughly proportional to the square of the atomic number Z of the material. By reconstructing incoming and outgoing tracks, we can obtain variables to identify high-Z material. In a real life application, this has to happen on a timescale of 1 min and thus with small numbers of muons. We have built a detector system using resistive plate chambers (RPCs): 12 layers of RPCs allow for the readout of 6 x and 6 y positions, by which we can reconstruct incoming and outgoing tracks. We also present the performance of an algorithm by which we separate high-Z targets from low-Z background, both for real data from our prototype setup and for MC simulation of a cargo container-sized setup.

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