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MUTE: Calculations for Cosmic-Ray Muons in Deep Underground Laboratories

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MUTE (MUon inTensity codE) is a Python program that performs calculations for cosmic-ray muons underground and underwater. It combines two state-of-the-art programs, DAEMONFLUX and PROPOSAL, to provide comprehensive calculations for muon intensities, total muon fluxes, energy and angular spectra, and mean muon energies at the surface, in deep underground laboratories —under both flat overburdens and mountains —and underwater. For precise modelling, the program takes into account rock densities and chemical compositions for various underground labs as well as topographic map profiles of mountainous overburdens. Our results show excellent agreement with available experimental data for most underground sites. Additionally, our model predicts the amplitude of seasonal variations in the atmospheric muon flux to a high degree of precision. MUTE is an open-source, publicly available program, providing a solid framework for accurate muon flux predictions in various underground environments, essential for applications in cosmic ray physics and dark matter searches.

Collaboration you are representing

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