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Contribution ID: 3900 Type: **Oral Competition (Graduate Student) / Compétition orale (Étudiant(e) du 2e ou 3e cycle)**

(G*) Predicting Muon Fluxes and Seasonal Variations in Underground and Underwater Labs Using MUTE

Wednesday 21 June 2023 11:00 (15 minutes)

MUTE (MUon inTensity code) is a Python program (<https://github.com/wjwoodley/mute>) that combines two state-of-the-art codes, MCEq and PROPOSAL, to calculate muon intensities and spectra in deep underground and underwater laboratories. We have previously shown that, using these tools, MUTE can provide forward predictions while accurately characterising the uncertainties arising from hadron production models. In this new study, we expand our analysis by calculating total muon fluxes, and comparing with the current experimental data. The results are in very good agreement with the data, implying MUTE can be a powerful tool for Dark Matter and neutrino experiments to estimate muon-induced backgrounds for future generation detectors. As we have previously shown that the uncertainties on the underground data are smaller than the current theoretical uncertainties, we will discuss the suitability of this data in constraining high-energy neutrino flux calculations. Additionally, we predict the seasonal variations in labs located under flat earth and mountains using topographic maps of the overburdens, which can be of particular interest in studying the annual modulation of Dark Matter candidates. Lastly, MUTE can provide accurate underground angular distributions, which can be compared against experimental data. This can be used as a cross-check to identify any issues in data analyses, such as event misreconstructions or issues with the position of the detector in the mountain map.

Keyword-1

Muons

Keyword-2

Cosmic rays

Keyword-3

Dark Matter

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