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FLUKA simulations of neutrino-induced effective dose at a Muon Collider

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The International Muon Collider Collaboration (IMCC) is in charge of assessing the performance and feasibility of an underground circular accelerator colliding TeV-scale muons. During the operation of a muon collider, the decay of circulating muons produces a narrow disk of high-energy neutrinos emitted radially in the collider plane and emerging on the Earth's surface at several km. The goal is to ensure that neutrino interactions do not entail any noticeable addition to natural radioactivity, such that the environmental impact of the muon collider is negligible. To do so, dedicated studies of the expected neutrino and secondary-particle fluxes are performed. This work presents a set of FLUKA Monte Carlo simulations that characterize the radiation showers generated by the interaction in soil of high-energy neutrinos from muon decays. The results are presented as the effective dose in soil at different distances from the muon decay, quantifying the peak dose and the width of the radiation cone, for beam energies of 1.5 TeV and 5 TeV. The implications of the results for realistic muon collider scenarios are discussed, along with possible methods to mitigate the local neutrino flux.

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Primary author: LERNER, Giuseppe (European Organization for Nuclear Research)

Co-authors: FRASCA, Alessandro (European Organization for Nuclear Research); LECHNER, Anton (European Organization for Nuclear Research); CARLI, Christian (European Organization for Nuclear Research); AHDIDA, Claudia (European Organization for Nuclear Research); Dr MANCZAK, Jerzy (European Organization for Nuclear Research)

Presenter: FRASCA, Alessandro (European Organization for Nuclear Research)

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