

Reconstruction of the muon production longitudinal profiles in extensive air showers

Muons produced in extensive air showers have large decay lengths and small radiative energy losses, enabling a large fraction of them to reach surface and underground detector arrays while keeping relevant information about the hadronic interactions that occurred high in the atmosphere. We can relate a muon's arrival time and position at the detector to its production distance/depth. The total delay of muons with respect to the shower plane is primarily due to their geometric path and energy, which we call the geometric and kinematic delays, respectively. We are currently working on improving the current kinematic delay parameterizations using Deep Neural Networks for muons arriving at surface and underground detector arrays. We aim to reconstruct the longitudinal profile of muons for future arrays of buried scintillator detectors at energies from around the second knee to the ankle of the cosmic ray spectrum, where there is an overlap with the nominal energies at the LHC. Given the low zenith angle acceptance of scintillator detectors and the richness of the forward physics near the shower core, we aim at applying a radial cut of 200 m instead of the usual 1000 m used in previous works.

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