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Evaluation of Hadronic Interaction Models Through Muon Multiplicity Distributions in Extensive Air Showers at the GRAPES-3 Experiment

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The GRAPES-3 experiment, located in Ooty, India, consists of a densely packed array of 400 plastic scintillator detectors and a large area ($560m^2$) muon telescope. The muons produced in extensive air showers (EAS) are key observables for analyzing the primary cosmic ray composition. The GRAPES-3 muon telescope (G3MT) measures the muonic component in the EAS by counting the reconstructed muon tracks based on the proportional counter hit information. A detailed simulation of the EASs is needed to reconstruct the properties of the primary particles. However, the persistent discrepancies among the hadronic interaction models and experimental data at higher energies highlight the need for further analysis and examination of the current models in use. Our comparative analysis of muon multiplicity predictions from 100 TeV to 1 PeV monoenergetic vertical showers, considering proton, helium, nitrogen, aluminum, and iron primaries, shows that the percentage difference among QGSJET II-04, SIBYLL 2.3c, and EPOS-LHC models is within 5% at 100 TeV and decreases at higher energies. Further, in this contribution, we compare the muon multiplicity distributions (MMDs) from experimental data with the predictions of these three hadronic interaction models, reconstructed by assuming the GST composition model. These comparisons are important for testing the hadronic interaction models and improving their predictive accuracy in simulating high-energy cosmic ray interactions.

Collaboration(s)

GRAPES-3

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