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Mass composition study with machine learning on KASCADE archival data (Remote)

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Despite many experiments in the 1–100 PeV range, accurately measuring mass component spectra in this energy region remains challenging. Discrepancies between experiments are attributed to factors including the choice of the hadronic interaction model used.
In this study, we present a reanalysis of archival data from the KASCADE experiment, which recorded extensive air showers from 1996 to 2013. This analysis uses a novel approach to measure the energy spectra of five mass components (protons, helium, carbon, silicon, and iron), based on event-by-event mass-type reconstruction using a convolutional neural network.
The systematic uncertainties, which were lower than in the last original KASCADE study, as well as the corresponding uncertainties of the IceTop and TALE experiments, were also investigated. Furthermore, the uncertainties associated with the use of different post-LHC hadronic interaction models (QGSJet-II.04, EPOS-LHC, Sibyll 2.3c) were examined.
Our findings show a marked excess of the proton component flux compared to the latest original KASCADE results. We demonstrate, with the highest statistical significance, a knee in the proton (~4.4 PeV) and helium (~11 PeV) components. Additionally, we observe a hint of hardening (~4.5 PeV) in the iron spectrum, which can be interpreted as analogous to the proton hardening (~166 TeV) observed in the GRAPES-3 experiment.

Type of Contribution

talk

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