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DETERMINATION OF THE ENERGY OF HIGH-ENERGY PROTONS (1 TEV AND HIGHER) BY THE LFM METHOD

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Calorimetric methods are currently practically the only way to directly measure the characteristics of high energy (TeV and higher) cosmic nuclei. The primary particle, interacting with the substance of the calorimeter, gives rise to a cascade of secondary particles in it. To measure the characteristics of the cascade, the dense matter is interbedded with special detectors. Based on the measurements of signals from these detectors, a cascade curve is formed. If the cascade curve has reached a maximum in the calorimeter, then the primary energy is reconstructed quite accurately. However, to measure the maximum of the cascade, the calorimeter must have a sufficiently large thickness (and so large weight). When using thin calorimeters, the primary energy is determined with a large error (30-70 percent when measuring hadronic cascades) due to significant fluctuations in the development of the cascade curve. In this regard, the energy spectrum of cosmic rays for energies of 1-100 TeV is currently poorly understood, since different experimental groups present different spectra of cosmic rays.

In this paper, to solve this problem, it is proposed to use the Lessening Fluctuation Method (LFM) based on correlation curves. In this method, instead of cascade curves, correlation curves of the dependence of the cascade size on the rate of cascade development are used. The cascade development rate is understood as a quantity equal to the difference in the cascade sizes at two measurement levels, divided by the thickness of the calorimeter, during the passage of which this change in the cascade size occurred. The rate of cascade development depends on the primary energy and therefore it can be used as an additional quantity to improve the accuracy of primary energy reconstruction. The correlation curves almost do not fluctuate and make it possible to determine the energy of cascades that have not reached a maximum. To test the LFM, we simulated the passage of cascades formed by protons with energies of 1-10 TeV through the PAMELA collaboration calorimeter. Based on the simulation, it was shown that the correlation curves almost do not fluctuate. This makes it possible to significantly reduce measurement errors (up to ˜10 percent when measuring hadron cascades). Moreover, LFMs make it possible to correctly determine the energy of cascades that have not reached their maximum. This makes it possible to solve the problem of the large weight of the calorimeter.

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The speaker is a student or young scientist

Yes

Section

1. Neutrino physics and nuclear astrophysics

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