Contribution ID : **258** Type : **Oral talk**

APPLICATION OF UNIVERSALITY IN CASCADE DEVELOPMENT FOR THE STUDY OF HIGH-ENERGY COSMIC RAYS IN SPACE EXPERIMENTS

Friday, 30 October 2026 18:00 (15)

Most energy measurement methods used in modern experiments are based on the cascade curve, i.e., the dependence of the cascade size (typically expressed as the logarithm of the energy deposition, log q, in a given calorimeter layer) on the penetration depth (d) of the cascade into that layer. If the cascade curve reaches its maximum within the calorimeter, the primary energy can be reconstructed with relatively high accuracy. However, to measure the cascade maximum, the calorimeter must have sufficient thickness; moreover, the higher the primary energy, the thicker the calorimeter needs to be. Cascade curves exhibit significant fluctuations. A cascade may start developing in the first measurement layer, for example, or in the tenth layer. Accordingly, the total energy deposition in the calorimeter for these two cascades will differ substantially. In addition, since the primary energy is determined using the total energy deposition, large fluctuations in the latter lead to large uncertainties in the reconstruction of the primary energy.

In this work, a method for reducing fluctuations (LFM) is presented to improve energy reconstruction for data obtained with thin calorimeters. The proposed method is based on the use of so-called correlation curves, i.e., the dependence of the cascade size (S = log q) on the cascade development rate (R). The cascade development rate is defined as the difference between cascade sizes at two measurement levels divided by the calorimeter thickness over which this change occurs:

$R = (S_1 - S_2) / (d_1 - d_2)$, where d_1 and d_2 are the penetration depths corresponding to these two measurement layers. The size–rate curves exhibit minimal fluctuations. They coincide for cascades that start developing in the first measurement layer and for those that begin in the tenth measurement layer. As a result, the energy resolution achieved with this approach is superior to that obtained using conventional cascade curves.

This method is based on the assumption of the universality of cascade development for particles with the same energy and charge. Cascades differ significantly in the parameters of the first interaction, which leads to large fluctuations at the initial stage of the cascade curve.

However, fluctuations become small once a large number of secondary particles are produced in the cascade.

Using this method, the primary energy is reconstructed near the beginning of the cascade development. Thus, with increasing energy, there is no need to increase the thickness of the calorimeter. The proposed method is universal for a wide range of energies and different nuclei.

Primary author(s) : FEDOSSIMOVA, Anastassiya (Institute of Physics and Technology)

Presenter(s) : FEDOSSIMOVA, Anastassiya (Institute of Physics and Technology)

Session Classification : Astroparticle physics

Track Classification : Astroparticle physics