Development of cosmic muon calibration methods for the longitudinal segmented sampling lead/scintillator hadron calorimeter at the NA61/SHINE, CBM, BM@N and MPD experiments

N. Karpushkin, D. Finogeef, M. Golubeva, F. Guber, A. Ivashkin, S. Morozov

Institute for Nuclear Research, Moscow, Russia

Forward hadron calorimeter tasks

To determine the global event characteristics in nucleus-nucleus collisions - the centrality of the collision, which is related to the number of participating nucleons, and orientation of the reaction plane, the forward hadron calorimeters are used in NA61/SHINE, CBM, BM@N and MPD experiments.

The event-by-event determination of the centrality and reaction plane orientation in heavy-ion interactions is one of important tasks in these experiments and is necessary to study the collective flow of identified particles, particle multiplicities and fluctuations and other observables.

Waveform fitting

Advantages of the fitting procedure:
• More correct determination of signal charge
• Working with small signals near the noise level
• Pick-up and pile-up identification
• True signal recovery

Energy calibration approach

Adjusted charge is calculated taking into account the thickness of the scintillator material traversed by the cosmic muon track.

Conclusions

• A new method of waveform fitting is developed
• The fit QA is used to reject noise and pick-ups.
• Since the muon beam is absent in major part of the experiments, the energy calibration of the hadron calorimeter sections is possible only with cosmic muons.
• The presence of longitudinal segmentation of the calorimeter modules made it possible to use a new approach to the cosmic muon calibration, adjusting the energy deposition in calorimeter sections by the thickness of the scintillator traversed.
• The corrected energy deposition distribution has a more clearly defined maximum resulting in a more accurate energy calibration.

Acknowledgements

This work was partially supported by RFBR grants 18-02-40081 and 18-02-40065.