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Application of the Prony least squares method for fitting signal waveforms measured by sampling ADC

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At present, new forward hadron lead/scintillator sampling calorimeters are constructed for the Compressed Baryonic Matter (CBM) experiment at the future Facility for Antiproton and Ion Research (FAIR) and the Multi Purpose Detector (MPD) at Nuclotron-based Ion Collider Facility (NICA). These calorimeters will be used for centrality and the reaction plane orientation measurements in heavy-ion collisions. A wide dynamic range requires reliable determination of the scintillation signal parameters. Digitizing of an analog signal with sampling ADC results in strong fluctuation of the measured charge. To improve the response, the new procedure of fitting signals based on the Prony least squares method has been proposed. This method represents waveform as a linear combination of exponential functions and allows to obtain the charge more accurately. Moreover, fitting the waveforms with the Prony method requires minimum machine time.
The procedure of fitting the waveforms of calorimeter signals using the Prony least squares method will be presented. The application of this method will be shown for the processing of signals, obtained in hadron calorimeter tests on cosmic muons and on hadron beams at CERN using sampling ADC board ADC64s2 (AFI Elecronics, Dubna). It will be shown that fitting of the signals with a known function allows to isolate weak signals comparable to the level of electronic noise, which is important for performing a muon calibration of calorimeter sections.

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