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Detector setup optimization based on training artificial neural-networks

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We apply artificial neural networks (ANN) to event-wise analysis of simulated data from a microchannel plate detector (MCP)[1] being considered for installation in future experiments on NICA collider [2]. We have demonstrated, that neural networks can estimate the parameters of the collision not only from spatial distribution of particles, but also benefit from high resolution time-of-flight distributions that can be obtained from MCP. From this data we estimate the impact parameter and the collision point of an event. We have performed the analysis based on several Monte-Carlo models of the event. Even though the quality of the existing event models is not sufficient for a reliable model-independent estimation of the event parameters, the proposed parameter reconstruction procedure allows us to evaluate - and to optimize - the technical characteristics of the detector. These characteristics include the geometry of the device, its placement, the number of sensors, and the time resolution.

In [3, 4, 5] we have demonstrated that - subject to the detector geometry - the collision point and the impact parameter of each event can be estimated quite accurately only from the raw detector data. Our approach exploits Monte-Carlo models of high energy collisions. As we have demonstrated in [3, 4, 5], the data from QGSM generator[6] allows us to estimate the impact parameter within an uncertainty of about 1 fm, and to reconstruct the collision point with uncertainty about 1 cm. This result, however, is model-dependent, and processing data from alternative generators [7, 8] leads to different ANN parameters. Despite this model dependence of the ANNs, the detector parameters providing the best reconstruction of the event parameters do not depend on the Monte-Carlo model of the event.

We report the results of ANN training and suggest the optimal MCP configuration which is model-independent and, thus, can be used in future detector specification.

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Section

Design of new experimental facilities

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