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Neural network application to event-wise estimates of the impact parameter

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Evaluation of the impact parameter in a single event is crucial for correct and efficient data processing in collision-based nuclear and particle physics experiments. Real-time estimates of the impact parameter allows experimentalists to preselect the most informative events at the data acquisition stage, before any processing. Here we consider a number of model setups to check whether a neural network can evaluate the impact parameter from the spacial and time-of-flight data collected in real time by a set of inexpensive microchannel plate ring detectors.
We evaluate several detector geometries, including the geometries considered for SPD detector [1] at NICA, and several neural network architectures.

We have shown that even low spacial resolution detectors in realistic geometry would make it possible to separate low — less than 6 fm — impact parameter events from other collisions with 84% probability.
The analysis of the full 4π geometry would rise the probability of the low impact parameter collision identification to 97%. Appropriate usage of the time of flight information is crucial to obtain these results. Without time information the quality of identification of low impact parameter events does not exceed 64%, with especially high contamination from high — greater than 12 fm — impact parameters.

The presented computational experiments prove application of neural network techniques for direct impact parameter evaluation useful for future experimental setups.

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1. V.M. Abazov et al., arXiv:2102.00442v2 (2021).

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