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# Neural network domain adaptation for addressing the generator-dependence problem in impact parameter estimation

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This study addresses the challenge associated with estimating the impact parameter of heavy-ion collisions using data from microchannel plate detectors for future NICA experiments [1-3]. The primary issue arises from the dependence of algorithms quality on the choice of event generator model, specifically QGSM [4], EPOS [5], and PHQMD [6], which were investigated in our work.

To resolve this model-induced bias, we evaluated multiple data analysis methodologies. Initially we employed classical techniques, such as dimensionality reduction via principal component analysis (PCA) and naive training on mixed datasets. Then we focused on advanced domain adaptation strategies. The most robust performance was achieved using a deep reconstruction neural network (DRNN) [7]. Algorithms trained via this approach demonstrated accuracy approaching that of models trained on single-generator datasets, while significantly outperforming naive mixed-data training.

The results highlight that the domain adaptation can be utilized in mitigating generator-specific biases, offering a step toward generalized algorithms for impact parameter estimation. These findings are prominent for advancing the analysis of event generator properties and the development of generalized algorithms better suited for future experimental data.

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