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Using new methods for systematic study of nuclear structure in high-energy collisions to probe the effect of short-range correlations

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There is increasing interest in using high-energy collisions to probe the structure of nuclei, in particular with the high-precision data made possible by collisions performed with pairs of isobaric species. A systematic study requires a variation of parameters representing nuclear properties such as radius, skin thickness, angular deformation, and short-range correlations, to determine the sensitivity of the various observables on each of these properties. In this work we propose a method for efficiently carrying out such study, based on the shifting of positions of nucleons in Monte-Carlo samples. We show that by using this method, statistical demands can be dramatically reduced — potentially reducing the required number of simulated events by orders of magnitude — paving the way for systematic study of nuclear structure in high-energy collisions.

As an application, we perform a systematic study of short-range nucleon-nucleon correlations and their effects on heavy-ion observables. Using our methods these effects, though small, can be precisely studied without the need for large numbers of simulations. In particular, we illustrate the limitations of a simple exclusion radius as a proxy for realistic nucleon-nucleon correlation functions.

Reference: arXiv:2302.14026

Category

Theory

Collaboration (if applicable)

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