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Machine learning in heavy ions properties and ultra-central nuclear collisions

Unlike the earlier paradigm in physics, recent advancements in machine learning focus on uncovering physical law through data-driven approaches. In this talk, we leverage well-trained feedback neural networks (FNNs), combined with phenomenological models and reliable nuclear mass data from AME2020 and AME2016, to predict atomic masses with exceptional accuracy and extrapolation capabilities, surpassing traditional theoretical predictions. Using this framework, we accurately determine the masses of superheavy nuclei. Additionally, we also employ Generative Adversarial Networks (GANs), which can handle noisy input data by training the generator and discriminator against each other, to obtain the relationship between the initial condition features (ϵ_n) of quark-gluon plasma and final-state momentum distribution (v_n) under ultra-central collisions of identical heavy ions, as derived from transport and/or hydrodynamic model simulations and low-energy deformation data. Accounting for initial state fluctuations and hadronic evolution, we use ϵ_n and v_n as independent variables to infer the deformation characteristics of the two colliding nuclei. Our GAN model effectively recovers physical information lost during blinded process, providing a novel approach to learn heavy-ion collisions.

Category

Theory

Collaboration (if applicable)

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