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Quantum computing for parton fragmentation functions

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Fragmentation functions are indispensable for understanding processes of hadron production ubiquitously existing in high-energy collisions, but their first principle determination has never been realized due to the NP-hard nature in traditional lattice calculation. We propose a framework that makes a first step for exploiting quantum computing to evaluate the Parton fragmentation function. The key subroutine is to construct a hadron projector for filtering out hadrons of desired types in a collection of particles encoded in the quantum state. Remarkably, We show that the hadron projector can be constructed efficiently with a variational quantum algorithm. We illustrate the framework by elaborating on the Nambu–Jona-Lasinio model with numeral simulations. Moreover, we develop error mitigation techniques tailed for accurately calculating the fragmentation functions in the presence of quantum noises. Our work opens a new avenue for investigating fragmentation on near-term quantum computers.

session

C. Hadron Structure

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