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Generalized Parton Distribution Functions via Quantum Computing

Quantum simulation of quantum field theories offers a new way to investigate properties of the fundamental constituents of matter. We develop quantum simulation algorithms based on the light-front formulation of relativistic field theories. The process of quantizing the system in light-cone coordinates will be explained for a Hamiltonian formulation, which becomes block diagonal, each block approximating the Fock space with a certain harmonic resolution K. We analyze a QCD theory in 2+1D. We compute the analogue of parton distribution functions, the generalized parton distribution functions for hadrons in these theories. In particular, we look at the generalized parton distribution functions for a π^0 meson as well as a baryon in a quark-diquark model.

Significance

This work builds upon the groundwork produced by the Tufts quantum information group to develop a formalism to simulate quantum field theories on a quantum computer via light cone coordinates. This work to be presented is the first attempt at calculating GPDs on a quantum computer. GPDs are important non-perturbative distribution functions that relay information about the 3D structure of hadrons.

References

https://arxiv.org/abs/2211.07826

Experiment context, if any

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