Contribution ID: **691** Type: **Parallel**

Hamiltonian approach to Parton Distribution Functions in the Schwinger model

Friday 11 July 2025 09:55 (17 minutes)

Parton distribution functions (PDFs) describe universal properties of hadrons. They provide insights into the non-perturbative internal structure of bound states and are highly significant for experiments. Calculating PDFs involves evaluating matrix elements with a Wilson line in a light-cone direction. This poses significant challenges for Monte Carlo methods in Euclidean formulation of lattice gauge theory, where the light cone cannot be directly accessed. In contrast, the PDF can, in principle, be calculated directly from light-cone matrix elements in the Hamiltonian formalism. This seems particularly appealing since recent developments in quantum computing and tensor network approaches allow for an efficient treatment of states in Hilbert space. Using the quantum-inspired tensor network ansatz, we introduce a new strategy to obtain the PDFs directly in the Minkowski formalism, and apply it to the Schwinger model. We present the PDF for different fermion masses in the continuum limit. This shows the feasibility of tensor networks for dynamical calculations in gauge theories and represents a first step towards such computations for QCD. The approach can also be implemented in quantum simulations and with quantum computers in the future.

Secondary track

T05 - QCD and Hadronic Physics

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Session Classification: T15

Track Classification: T15 - Quantum technologies in HEP (special topic 2025)