Contribution ID: 44   Type: **Talk in workshop 1 "Non-perturbative approaches for hadron structure from low to high energy"**

x-dependence of hadron GPDs at physical pion mass from the lattice

Wednesday 29 October 2025 17:10 (25 minutes)

Generalized Parton Distributions (GPDs) provide a unified framework for exploring the three-dimensional structure of hadrons, encoding correlations between spatial and momentum distributions as well as spin and orbital angular momenta of quarks and gluons. Lattice QCD offers a first-principles approach to access these nonperturbative quantities, but long-standing challenges have limited calculations to low moments. Recent developments in large-momentum effective theory (LaMET) and related approaches have enabled direct studies of the full Bjorken-x dependence of parton distributions, opening new opportunities for lattice inputs to global analyses.

In this talk, I will review the progress of lattice QCD calculations of parton distributions, with an emphasis on generalized parton distributions. I will highlight results on pion and nucleon GPDs at the physical pion mass and discuss recent advances in renormalization and matching, as well as systematic effects and strategies for controlling them. Together, these developments mark an exciting era where lattice QCD inputs can play a decisive role in unraveling the three-dimensional structure of hadrons.

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Session Classification: Parallel Workshop 1