



Contribution ID: 353

Type: Talk

Constructing Nucleon Operators on a Lattice for Form Factors with High Momentum Transfer

Monday, July 25, 2016 3:55 PM (20 minutes)

In typical nucleon structure calculations on a lattice, the interpolating fields are optimized to overlap with the nucleon ground state at rest, which in practice limits the momentum transfer in form factors to $Q^2 \leq 1 \text{ GeV}^2$. There is great interest in studying nucleon form factors up to few tens of GeV^2 . New experiments at the JLab 12-GeV upgrade will measure nucleon form factors with momentum transfers up to 18 GeV^2 in an attempt to reach the regime of perturbative QCD scaling and investigate further the pattern in the GE/GM ratio in the proton. With current lattice QCD techniques, one can achieve momenta of several GeV^2 without risk of overwhelming discretization effects. In a boosted nucleon, however, excited state admixtures will become even more problematic to control than at rest, and will require computing nucleon correlators to high statistical precision. I will present some initial results from a lattice study of nucleon structure optimized for boosted nucleon initial and final states with the method recently adopted by the Regensburg collaboration. These methods will also be essential for the recently proposed novel method to compute parton distributions directly on a lattice.

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Session Classification: Hadron Structure

Track Classification: Hadron Structure