Abstract Submitted
for the APR21 Meeting of
The American Physical Society

A first lattice calculation of quark spin-orbit correlations in the proton MICHAEL ENGELHARDT, NMSU, JEREMY GREEN, CERN, NESREEN HASAN, Universität Wuppertal, TAKU IZUBUCHI, BNL, CHRISTOS KALLIDONIS, JLab, STEFAN KRIEG, Universität Wuppertal, SIMONETTA LIUTI, University of Virginia, STEFAN MEINEL, University of Arizona, JOHN NEGELE, ANDREW POCHINSKY, MIT, ABHA RAJAN, Old Dominion University, GIORGIO SILVI, Universität Wuppertal, SERGEY SYRITSYN, Stony Brook University — Generalized transverse momentum-dependent parton distributions (GTMDs) provide a comprehensive framework for imaging the internal structure of the proton. In particular, by encoding the simultaneous distribution of quark transverse positions and momenta, they allow one to directly access longitudinal quark orbital angular momentum (OAM), and, moreover, to correlate it with the quark helicity. The relevant GTMD is evaluated through a lattice calculation of a proton matrix element of a quark bilocal operator (the separation in which is Fourier conjugate to the quark momentum) featuring a momentum transfer (which is Fourier conjugate to the quark position), as well as the Dirac structure appropriate for capturing the quark helicity. The weighting by quark transverse position requires a derivative with respect to momentum transfer, which is obtained in unbiased fashion using a direct derivative method. The lattice calculation is performed directly at the physical pion mass, using domain wall fermions to mitigate operator mixing effects. Both the Jaffe-Manohar as well as the Ji quark spin-orbit correlations are extracted.

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Date submitted: 08 Jan 2021 Electronic form version 1.4