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First Lattice QCD Study of Gluonic Transversity

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We present the first lattice QCD study of the double-helicity-flip leading-twist gluonic structure function $\Delta(x,Q2)$. In particular, we calculate its leading moment in a φ meson and find a robust signal. This quantity is particularly interesting since, unlike the unpolarised and helicity gluon distributions, the double-helicity-flip density is a clean measure of gluonic degrees of freedom as it only mixes with quark distributions at higher twist.

We also explore the gluon structure of the φ meson in more general terms, including the first investigation of the direct gluonic analogue of the Soffer bound for transversity which relates the helicity flip and non-flip gluon distributions. We find that the first moment of this bound in a φ meson (at the unphysical light quark masses used in this work and subject to caveats regarding renormalisation and the continuum limit) is saturated to approximately

the same extent as the first moment of the isovector quark Soffer bound for the nucleon as determined in a previous lattice simulation.

This constitutes a proof-of-feasibility of lattice QCD calculations of complicated aspects of the gluon structure of hadrons. Our investigations can be extended to light nuclei where $\Delta(x,Q2)$ provides a measure of 'exotic glue' (gluons in the nucleus not associated with individual nucleons), as well as to off-forward gluon transversity matrix elements in the nucleon.

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