

Constraining the gluon helicity at STAR

The STAR Collaboration

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Abstract

How do quarks and gluons conspire to provide the total spin of proton is a long-standing puzzle in quantum chromodynamics (QCD). Decades of experimental and theoretical work have revealed that the quark spin contributes about one-third of the proton's total spin, with the remaining spin coming from the gluon spin and the orbital angular momentum of partons inside it.

The unique capability of RHIC, that can provide the longitudinally polarized $p + p$ collisions at both $\sqrt{s} = 200$ GeV and $\sqrt{s} = 510$ GeV, provided crucial insights into the gluon helicity prior to the EIC era. The 2009 STAR inclusive jet measurement of the longitudinal double-spin asymmetry, A_{LL} , provided the first evidence of positive gluon polarization at partonic momentum fraction of $x > 0.05$. Subsequent measurements using 2012, 2013, and 2015 data at both 200 GeV and 510 GeV confirmed these findings, placing tighter constraints on the previously unexplored ($x < 0.05$) region. Moreover, dijet analyses further refined the x dependent behavior of $\Delta g(x)$, ruling out the negative gluon polarization scenario proposed by the JAM Collaboration.

In this talk, an overview of recent results on the gluon helicity measurements from STAR as well as their impact on global analysis will be presented.