

Small- x Helicity Evolution: First Study on the Impact of Polarized pp Scattering Data

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We perform a phenomenological study of helicity-dependent parton distribution functions (hPDFs) using the KPS-CTT small- x helicity evolution equations. Specifically, this new work presents the first study of the influence of polarized proton-proton (pp) scattering data whilst simultaneously analyzing inclusive and semi-inclusive deep-inelastic scattering data, all at $x < 0.1$. Polarized pp data in this analysis is limited to double-longitudinal spin asymmetries in single-inclusive jet production, for which we approximate it via the polarized small- x pure-gluon calculation of $pp \rightarrow gX$. We use a variant of the large- N_c evolution equations by taking the large- N_c & N_f KPS-CTT evolution equations and setting $N_f = 0$ to replicate a pure-gluon limit that retains external quark flavor dependence for the spinor field operators. We observe that the pp data have a substantial impact on the helicity PDFs at small x , leading to reduced uncertainties and an updated total quark and gluon helicity contribution to the proton for $x < 0.1$ of -0.04 ± 0.23 . Comparing our analysis with a recent JAM analysis of world polarized data, including data at $x > 0.1$, we estimate a total parton helicity contribution for $x > 10^{-7}$ of between 0.02 and 0.51.

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