Measurements of p_T-differential cross section and transverse single-spin asymmetry of Z^0 bosons in p+p collisions at STAR

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Abstract

We present preliminary results on cross section and transverse single-spin asymmetry (TSSA) of Z^0 bosons measured by the STAR experiment at RHIC in p+p collisions at $\sqrt{s}$ = 500 and 510 GeV. Accessing the Sivers function in p+p collisions through the measurement of the TSSA amplitude, A_N, in weak boson production is an effective way to test the fundamental QCD prediction of its change of sign (non-universality) with respect to e+p processes. Furthermore, it also provides a test of the evolution of transverse-momentum dependent parton distributions. Z^0 production in particular complements $W^{\pm}$ in having direct experimental reconstruction of the produced boson's kinematics and negligible background. Our new preliminary A_N measurement in Z^0 production is based on RHIC run 2017 data ($\sim$ 350 pb^{-1}). This dataset brings a significant improvement in statistical precision over STAR's published result, which is based on run 2011 ($\sim$ 25 pb^{-1}). The differential Z^0 cross section, measured as a function of the boson's p_T, provides important constraints on the scale dependence of unpolarized transverse momentum distributions of partons inside the proton. The probed x range ($0.1 < x < 0.3$) covered by our data naturally complements the phase space accessed at the LHC, providing a critical input to global fits. Our new $d\sigma/dp_T$ preliminary result combines data from run 2017 with data from 2011, 2012, and 2013, corresponding to an integrated luminosity of 700 pb^{-1}, nearly twice that of previously released STAR preliminary measurement.