A Study of the Contribution from Non-Perturbative Effects to Di-jet Yields at Forward Rapidity

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It is well known that the spin of the proton is equal to $\hbar/2$, but the internal structure of the proton and the spin contributions made by its parton constituents, especially gluons, remains enigmatic. By studying asymmetric pairs of jets produced in polarized proton-proton collisions at forward rapidity, more information about the spin contribution of the gluon can be attained. Next to leading order perturbative quantum chromodynamics calculations indicate that measurements of a pair of jets at forward rapidity with transverse momenta ($p_T$) of 5 and 8 GeV/c can provide valuable additional information regarding the polarization of the gluons. However, these calculations do not include background contributions from initial-state radiation, underlying events, and beam remnants that can create additional particles, which appear in a detector as jets. In this study, PYTHIA simulations were used to analyze jets of stable final-state hadrons. A simple procedure is found to reject the background contributions. Most of the di-jets that remain can be matched to initial hard scattered partons with momentum fractions $x_2$ of the order $10^{-3}$, and $x_1$ of 0.4 or greater. These kinematics indicate that the remaining jet pairs will provide relevant information about the gluon’s contribution to the proton spin. The information provided by this simulation will help prepare the way for future experiments at RHIC that will provide us with a better understanding of the proton’s structure at the partonic level.