A study of the contribution from non-perturbative effects to di-jet yields at forward rapidity

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The STAR Collaboration has proposed to upgrade its forward calorimetry in order to perform a range of polarized proton and *p*+A studies in the 2020+ time frame [1]. One anticipated measurement will investigate the double-longitudinal spin asymmetry, A_{LL}, for forward di-jet production in *pp* collisions at $\sqrt{s}$ = 500 GeV to constrain the gluon polarization in the proton at very low *x*. Next-to-leading-order perturbative QCD calculations indicate that forward di-jets with transverse momenta $p_{T,1}$ > 8 GeV/*c* and $p_{T,2}$ > 5 GeV/*c* would provide very good sensitivity for gluons with $x \sim 10^{-3}$ [1], where existing data provide essentially no constraints [2,3]. However, the NLO pQCD calculations do not include possible background contributions from initial-state radiation, underlying event effects, and beam remnants that can create additional particles which appear as jets in the detector.

A PYTHIA study was performed to estimate the size of the background contributions that were absent in the NLO pQCD calculation. It found that, for ~20% of the di-jets that satisfy a back-to-back requirement ($|\Delta\varphi-\pi| < 1$), one or both of the observed jets arose from the various background effects. However, the background contributions end up nearly uncorrelated in $\Delta\varphi$. Thus, if the trigger is designed to accept di-jet events over a wide $\Delta\varphi$ range, for example $\Delta\varphi > \pi/2$, a simple subtraction will provide a clean di-jet sample suitable to determine the gluon polarization.

[1] E.C. Aschenauer *et al*., "The RHIC Cold QCD Plan for 2017 to 2023: A Portal to the EIC", arXiv:1602.03922.
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[3] E.R. Nocera *et al*. (NNPDF Collaboration), Nucl. Phys. **B887**, 276 (2014).