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Constraining the Gluon Polarization Distribution with Jet, Dijet, and Neutral Pion Probes at STAR

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A major goal of the proton spin physics program at the Relativistic Heavy Ion Collider (RHIC) is to constrain the gluon polarization distribution $\Delta g(x)$ and thus determine the contribution of gluons to the spin of the proton. Measurements of spin asymmetries with jets and neutral pions at central pseudorapidities at STAR and PHENIX have been critical to this effort. Recent global analyses have demonstrated a positive contribution to the spin of the proton from mid-to-high x gluons (e.g. $x > 0.05$). But, the gluon polarization remains poorly constrained at low x. A variety of measurements at STAR have been recently completed, or are now underway, to better constrain the gluon polarization distribution. The STAR detector is well suited for a campaign of spin asymmetry measurements featuring full azimuthal coverage and a range of detector capabilities. Specifically, we will present measurements of the doubly-longitudinal spin asymmetry, A_{LL}. STAR has excellent tracking in the mid-rapidity ($|\eta| < 1.3$) region, useful for jet measurements, while mid-rapidity ($|\eta| < 1.0$) and intermediate-rapidity calorimetry ($1.09 < \eta < 2.00$) contribute to jet measurements and both of these calorimeters and a forward system ($2.65 < \eta < 4.0$) allow measurements with neutral pions. Inclusive jet measurements at mid-rapidity remain a core part of the STAR program while measurements with correlated observables like dijets provide more precise information about the initial-state parton kinematics. Moving to forward pseudorapidities allows us to probe lower partonic momenta, as does moving to higher center-of-mass energy. We will present the status of a variety of asymmetry measurements and the results of others using jet, dijet and neutral pion probes with longitudinally polarized $p + p$ datasets at $\sqrt{s} = 200$ GeV (25 pb^{-1}) and $\sqrt{s} = 510$ GeV (382 pb^{-1}).

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