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Longitudinal Spin Asymmetry Measurements at PHENIX

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Measurements of the gluon helicity distibution (Δg), or the gluon spin contribution to the proton spin, is under way in the PHENIX experiment. Δg is obtained from the double helicity asymmetry (A_{LL}) for inclusive particle production with longitudinally polarized proton collisions at RHIC. First results for A_{LL} at PHENIX have been obtained for inclusive neutral pion production at midrapidity and $\sqrt{s} = 200$ GeV. The neutral pion is sensitive to the Δg through a mixture of gluon-quark and gluon-gluon subprocesses. The rarer reaction, inclusive direct photon production, is a clean channel dominated by the gluon Compton process. By measuring A_{LL} of direct photons, Δg can be factored out in leading order. We have obtained the cross section of the direct photon, and will begin measurement of A_{LL} this year. It is important to also obtain the cross section for these processes, as a basis to describe the measured asymmetries using next-to-leading order perturbative-QCD (NLO pQCD) calculations. The NLO pQCD calculations have shown good agreement with the cross section measurements for both neutral pion and direct photon production. In addition, development for future measurements of heavy-flavor production and weak-boson production is in progress. Heavy-flavor production is dominated by the gluon fusion process and the asymmetry measurement probes Δg. Parity-violating weak boson production at $\sqrt{s} = 500$ GeV will be used to measure flavor-identified quark and anti-quark helicity distributions. By combining measurements of various channels at $\sqrt{s} = 200$ GeV and 500 GeV with a wide x coverage, we will be able to contribute to the understanding of the spin structure of the proton.