Exploring gluon polarization with NNPDF and STAR

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The NNPDF group uses neutral networks to obtain parton distribution functions (PDFs). The use of neutral nets allows them to make no assumptions regarding the Bjorken-*x* dependence of the PDFs at their input scale, in contrast to other groups performing PDF fitting. Recently, they published their first polarized PDF set, NNPDFpol1.0 [1], which they obtained from a global analysis of polarized deep-inelastic electron and muon scattering measurements. In addition to their best fit, NNPDF has posted 100 "replica" PDF sets, each of which they consider to be equally probable given their input data.

The NNPDF group has developed a reweighting method [2,3] to include new experimental data into an existing PDF set without the need to repeat the entire fitting process. The method involves calculating weighted averages over the 100 replicas, with the weight for each replica derived from the χ^2 probability for the replica to describe the new data. We have implemented this method to produce a modified NNPDF fit that includes the 2006 and 2009 STAR inclusive jet A_{LL} results. When calculating the χ^2 probabilities for the jet asymmetries, we included both the statistical and systematic uncertainties and their correlations.

We find that the jet data have a negligible impact on the polarized quark and anti-quark distributions, but a significant impact on the polarized gluon distribution. Fig. 1 shows the original NNPDF polarized gluon distribution as a function of *x* at $Q^2 = 10$ GeV^2, as well as the modified fit that

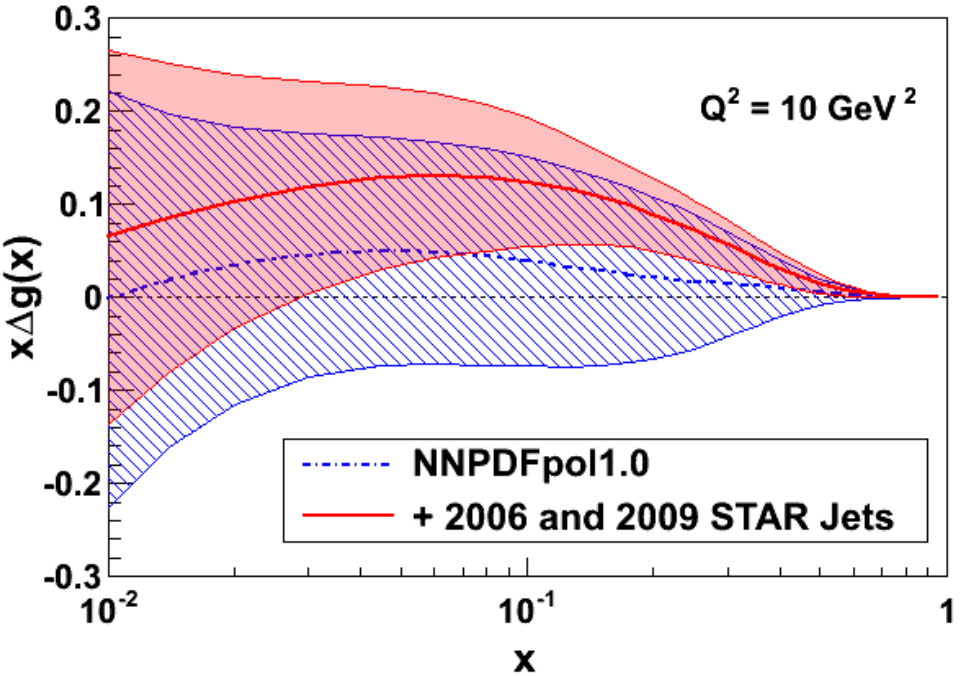

FIG. 1. Gluon polarizations from NNPDF (blue dot-dashed curve, hatched uncertainty band) [1], and from a modified version of NNPDF that we obtain when including the 2006 and 2009 STAR inclusive jet A_{LL} results through reweighting (red solid curve and uncertainty band).

includes the 2006 and 2009 STAR data. The integral of $\Delta g(x,Q^2=10\ \mathrm{GeV}^2)$ over the range $0.05 < x < 0.5$ is 0.06 ± 0.18 for the original NNPDF fit and 0.21 ± 0.10 when the fit is reweighted using the STAR jet data. The inclusion of the STAR jet data results in a substantial reduction in the uncertainty for the gluon polarization in the region $x > 0.05$ and indicates a preference for the gluon helicity contribution to be positive in the RHIC kinematic range.

[1] R.D. Ball *et al*. (NNPDF Collaboration), Nucl. Phys. **B874**, 36 (2013).

[2] R.D. Ball *et al*. (NNPDF Collaboration), Nucl. Phys. **B849**, 112 (2011). [*Errata*: **B854**, 926 (2012); **B855**, 927 (2012).]

[3] R.D. Ball *et al*. (NNPDF Collaboration), Nucl. Phys. **B855**, 608 (2012).