Spin and low-*x* physics with STAR at RHIC

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During the past year, our primary focus has been on the analysis of inclusive jet data from longitudinally polarized p+p collisions to determine the contribution that gluons make to the proton spin. A long polarized proton run occurred in 2005. STAR devoted nearly the entire p+p run to longitudinally polarized proton collisions, with a mix of triggers that was designed to maximize our acceptance for high-p_T jets. Since then, there has been a major effort within the STAR Spin PWG to extract the longitudinal double-spin asymmetry A_{LL} for inclusive jet production. Our group has played a major role in this effort. Initially, we identified a set of event and jet cuts that reduced our sensitivity to apparent false asymmetries. This led to the preliminary result shown in Fig. 1 [1]. These new results imply that the gluon polarization in the nucleon can't be much larger than the GRSV-std polarized parton distribution fit.

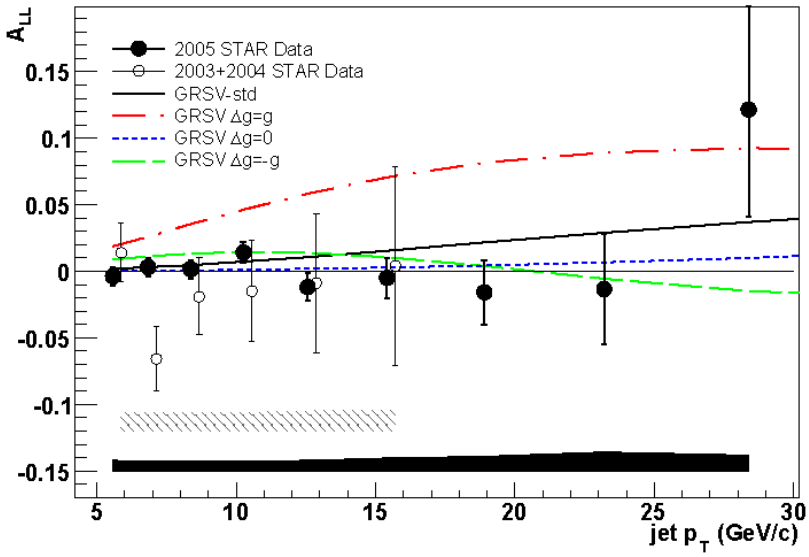

Figure 1. Preliminary STAR measurement of A_{LL} for inclusive jets from data recorded in 2005 [1], compared to previous STAR results from 2003-04 [2].

More recently, we have repeated many parts of the analysis. We repeated the run QA studies, which allowed us to increase the jet statistics by ~20%. We also identified a problem with the relative luminosity study that had been performed by a post-doc from Caltech. Correcting that problem led to a significant reduction in the systematic uncertainties associated with relative luminosity and potential false asymmetries. These reduced uncertainties then motivated us to explore a new analysis procedure that involves a partial unfolding of instrumental effects to minimize jet reconstruction and trigger bias effects. The new analysis, which has been done in collaboration with R. Fatemi of MIT, has reduced the corresponding systematic uncertainty by a factor of 2 or more. It also allows us to make a quantitative

confidence level comparison between our data and the GRSV parameterization in a way that accounts properly for systematic uncertainties that are correlated across jet p_T bins. The results of this analysis are currently being written up for publication. M. Sarsour will be one of the principal authors of the paper.

In parallel, we have begun to analyze the inclusive jet data that STAR recorded during 2006. Improvements in detector acceptance, integrated luminosity, and beam polarization are expected to lead to a factor of 3 or more reduction in the statistical uncertainties for A_{LL} at high p_T, when compared to the 2005 results. The initial indications are very promising.

The STAR investigation of forward π^0 production in p+p and d+Au collisions was published this past year [3]. One of us (CAG) was a principal author of this paper.

This past year, we completed our study of similarities and differences in mid-rapidity jet and di-jet production in p+p and d+Au collisions at RHIC energies, based on data that STAR recorded during 2003. Good agreement is found between Pythia+GEANT and data for the longitudinal (z) and transverse (j_T) jet shapes. The rms j_T is found to be 612±12±30 MeV/c for p+p collisions and 630±13±30 MeV/c in d+Au collisions. A new procedure has been developed to determine the intrinsic and nuclear k_T. We find the k_T Gaussian sigma is 2.08±0.12±0.13 GeV/c in p+p collisions. The additional nuclear k_T in d+Au collisions is consistent with zero to within 0.5 GeV/c. T. Henry received his Ph.D. for this work in December, 2006.

The STAR Forward Meson Spectrometer (FMS) is a new addition to the STAR electromagnetic calorimetry, providing complete coverage over the pseudorapidity region $2.5 < \eta < 4$, which is the deuteron forward direction when RHIC studies d+A collisions, and nearly complete EMC coverage over the range $-1 < \eta < +4$. The FMS will enable STAR to search for mono-jet production in d+Au collisions. It will also facilitate measurements of gluon polarization in the proton at low-x and detailed studies of the dynamics that underlie the significant single-spin asymmetries that have been seen in forward π^0 production at RHIC. This past year members of the group participated in the construction of the FMS and analysis of data that were taken during 2006 with the FPD++, an engineering prototype for the FMS.

We also carry administrative responsibilities related to STAR and RHIC. This past year, Dr. Gagliardi served as Deputy Spokesperson of the STAR Collaboration and co-chair, with A. Frawley of Florida State, of the RHIC II White Paper writing committee. Dr. Gagliardi also served on the STAR Advisory and Trigger Boards, and Drs. Gagliardi and Tribble participated on several STAR god-parent committees.

[1] M. Sarsour (for the STAR Collaboration), hep-ex/0612065.
[2] B.I. Abelev *et al*. (STAR Collaboration), Phys. Rev. Lett. **97**, 252001 (2006).
[3] J. Adams *et al*. (STAR Collaboration), Phys. Rev. Lett. **97**, 152302 (2006).