

Transversely Polarized Proton Spin Measurements in $p^\uparrow+p$ Collisions with the PHENIX detector

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The Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Lab is a truly unique and flexible collider, capable of colliding a wide range of heavy ion species as well as protons in both transversely and longitudinally polarized modes. Early measurements of double longitudinal asymmetries at RHIC have shown that the contribution to the proton's spin from gluon spin is not very large[1,2,3] and perhaps could be much less than the 70% of the proton's spin that is unknown. Any remaining contribution to the proton's spin must come from quark or gluon orbital angular momentum.

Recently, transverse spin physics has enjoyed a renaissance experimentally, with hints from the Hermes detector for asymmetries from the Sivers and Collins effects[4], a measurement of the Collins fragmentation function in Belle[5], and the observation of large asymmetries in hadron production at forward rapidities in polarized proton collisions by the STAR and Brahm's collaboration[6,7]. These experimental discoveries have coincided with many new theoretical insights into transversely polarized proton structure. At RHIC, it is hoped that orbital angular momentum might be addressed by understanding quantitatively these myriad effects in transversely polarized proton collisions, in a regime where the theory in unpolarized collisions is well understood.

PHENIX is one of the two large detectors at RHIC and is capable of a wide variety of asymmetry measurements which can probe the possible effects in transversely polarized proton collisions, such as those from the Sivers function, or from transversity plus Collins and/or interference fragmentation, or from higher twist interactions. During the course of RHIC running PHENIX has accumulated a substantial transversely polarized data set, resulting for instance in the measurement of single inclusive asymmetries at mid-rapidity with the central arm detectors[8]. The latest RHIC polarized proton run has yielded an integrated luminosity of $\sim 2.7 \text{ pb}^{-1}$ at a $\sqrt{s} = 200 \text{ GeV}$ and $\sim 20 \text{ nb}^{-1}$ at a $\sqrt{s} = 62 \text{ GeV}$, both with an average beam polarization of $\sim 60\%$ and 50% , respectively. The larger statistics, along with a new electromagnetic calorimeter that was installed at forward rapidities, allows for more detailed studies of transverse spin effects. We present the status of the measurements made with the PHENIX detector in transversely polarized proton collisions, and summarize the insights towards a deeper understanding of proton structure that we hope to glean from our data.

1. S.S. Adler et al., Phys. Rev. Lett. **93** (2004) 202002.
2. S.S. Adler et al., Phys. Rev. D **73** (2006) 091102.
3. B.I. Abelev et al., Phys. Rev. Lett. **97** (2006) 252001.
4. A. Airapetian et al., Phys. Rev. Lett. **94** (2005) 012002.
5. R. Seidl et al., Phys. Rev. Lett. **96** (2006) 232002.
6. J. Adams et al., Phys. Rev. Lett. **92** (2004) 171801.
7. F. Videbaek et al., AIP Conf. Proc. **792** (2005) 993-996.
8. S.S. Adler et al., Phys. Rev. Lett. **95** (2005) 202001.