Stony Brook University
The Graduate School

Doctoral Defense Announcement

Abstract

Measurement of Cross section and Double longitudinal asymmetries in π^+ production

to constrain the Gluon Polarization's contribution to the Proton's Spin

By

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The spin of the proton is known to be $\frac{1}{2}\hbar$. Although its angular momentum sum rule in terms of constituent quarks' and gluons' components has been established, its detailed decomposition is poorly known. Dedicated experiments in the past few decades have measured the sum of the quark and anti-quark spins' contribution to account for only ~25% of the proton's spin, whereas separating the sea-quark polarizations (spin) or constraining the gluon polarization's contribution is still a subject of active experimental research.

The Relativistic Heavy Ion Collider (RHIC) is a unique facility that provides collisions between polarized protons and thereby excellent tools to study the gluons' role in the protons' spin. The double longitudinal asymmetry A_{LL} of single inclusive production allows access to the polarized gluon distribution Δg. It does so when the asymmetry measurements are incorporated into the so-called global analysis where polarized parton distribution functions and fragmentation functions are simultaneously fitted to best describe various measurements from different experiments. While π^0's at PHENIX and jets at STAR have been mainly used to constrain ΔG, the first moment of Δg, other channels providing complementary information on ΔG are crucial.

Due to its isospin symmetry with other π species, charged pion measurement is key to determining the sign of ΔG even without global analysis involved. High p_T charged pion produced at mid-rapidity in polarized p+p collisions at $\sqrt{s}$ = 200 GeV has been analyzed towards this end. In this work, We developed a new analysis including the Hadron Blind Detector, a gas-based Cerenkov detector, to overcome the major challenge, a large fraction of electrons misidentified with π^+, and achieved >98% purity in π^+ sample. Along with A_{LL}, invariant differential cross section has been measured for different charges separately to validate the current perturbative Quantum Chromo-dynamics framework. Through these first successful measurements, we demonstrated π^+ is a promising channel to extract information on ΔG with further constrained charge-separated fragmentation functions.

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