

# **Stony Brook University The Graduate School**

## **Doctoral Defense Announcement**

### **Abstract**

**Measurement of Cross section and Double longitudinal asymmetries in  $\pi^+$  production  
to constrain the Gluon Polarization's contribution to the Proton's Spin**

**By**

**Sook Hyun Lee**

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  $\sim 25\%$  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  $\Delta g$ . 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  $\pi^0$ 's at PHENIX and jets at STAR have been mainly used to constrain  $\Delta G$ , the first moment of  $\Delta g$ , other channels providing complementary information on  $\Delta G$  are crucial.

Due to its isospin symmetry with other  $\pi$  species, charged pion measurement is key to determining the sign of  $\Delta G$  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  $\pi^+$ , and achieved  $>98\%$  purity in  $\pi^+$  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  $\pi^+$  is a promising channel to extract information on  $\Delta G$  with further constrained charge-separated fragmentation functions.

**Date:** April 8th, 2013

**Time:** 2:00 PM

**Place:** Physics Bldg, C120

**Program:** Physics

**Dissertation Advisor:** Abhay Deshpande