Contribution ID: **289** Type: **Contributed Talk**

Precision Measurement of the Neutron Asymmetry A1n at Large Bjorken x at 12 GeV JLab

Tuesday, 24 March 2020 12:40 (20 minutes)

The virtual photon asymmetry A_1 is one of the fundamental quantities that provide information on the spin structure of the nucleon. The value of A1 at high x_{Bj} is of particular interest because valence quark dominate in this region, which makes it a relatively clean region to study the nucleon spin structure. There are several theoretical calculations that apply to the high x valence quark region, and here we will focus on the neutron A_1^n. The neutron A_1^n is predited to be 0 in the naive SU(6) quark model, while both relativistic constituent quark model (RCQM) and perturbative QCD (pQCD) predict A_1^n to be 1 at x=1. Predictions for the quark polarization in the nucleon also exist: $\Delta d/d$ is predicted to approach $+1$ in pQCD while RCQM prediction remains negative at the $x \to 1$ limit. The A_1^n experiment during the 6 GeV JLab era showed that a_1^n indeed turns positive at $x \sim 0.5$, while $\Delta d/d < 0$ at $x = 0.61$. Subsequent theoretical studies based on our 6 GeV results claimed that quark orbital angular momentum or non-perturbative nature of the strong interaction plays a significant role in the valence quark region.

With the 12 GeV upgrade of JLab, a new experiment on A_1^n is being carried out using a 10.4 GeV beam, a polarized ^{3}He target, and the HMS and the Super-HMS (spectrometers) in Hall C. This measurement will reach a deeper valence quark region: $x \sim 0.75$. And once combined with expected data from the upgraded CLAS12 experiment on the proton A_1^p, we will finally be able to reveal whether $\Delta d/d$ turns positive (as in pQCD) or remain negative at high x (as in RCQM).

We will present the physics of A_1^n and review the running status of the experiment. Performance of an upgraded polarized ^{3}He target will be presented.

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Session Classification: Spin Physics

Track Classification: Spin Physics