

Proposal: PR12-06-122

Title: Measurement of neutron asymmetry A_1^n in the valence quark region using 8.8 and 6.6 GeV beam energies in hall A.

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Motivation: The goal of this proposal is to measure the Neutron Spin Asymmetry A_1^n (virtual photon asymmetry) in the valence quark region (extending Jlab data at much larger x values, and covering the range from 0.3 to around up to 0.71 with a finer binning and comparable precision). This x region is uniquely covered at the Jefferson Laboratory, thanks to the high luminosity achieved. The important physics case is related to the nucleon spin structure and tests of the constituent quark models in the DIS regime, as well as the test of Helicity conservation in pQCD predictions (with in particular the tantalizing role of Orbital Angular Momentum between quarks). The beam energies necessary are obtained with the 11 GeV gradients. This observable is also measured simultaneously in the resonance region due to the large acceptance of the spectrometer (BigBite) that is used. The choice of the kinematics of this measurement should allow exploring possible Q^2 dependence of A_1^n , especially when combined with the results of the proposal PR12-06-110 in Hall C. The two experiments will provide the same observable via a similar measurement.

Measurement and Feasibility: The measurement is to be performed in Hall A, with different beam energies (2.2, 6.6 and 8.8 GeV obtained in 1, 3 or 4 passes with the LINAC 11 GeV gradient). The key experimental devices required by this experiment are already in use with the 6 GeV beams. The scattered electrons are detected in the BigBite spectrometer. The polarized neutrons are obtained from a polarized ^3He gas target. The electron beam is polarized (80%) and the intensities of 10 μA requested are limited by the target operation. The BigBite spectrometer will be located at 30° , at a single field setting (1.2 T) and placed at 1.55 m from the target (covering a solid angle of 50 msr, when averaged over a 30 cm length of the target). This experimental configuration has been designed from GEANT simulations and previous data taking, and will be checked in experiments scheduled in the coming years. New features should be implemented in the detection package (gas Cherenkov, distance between Multi-Wire Drift Chambers) for this experiment. Asymmetry data recorded with HRS, although with smaller statistics, can be used as a crosschecks and systematic errors estimates. The procedures concerning studies of systematic errors as well as the extraction of A_1^n from measured data have been already tested in previous (successful) measurements at 6 GeV. Beam and target polarization, as well as other systematic errors, are checked with the measurement of elastic scattering and transverse asymmetry in Δ production with a beam of lower energy (2.2 GeV, 1 pass) and using the HRS spectrometer. In this experiment, the charged pion background will be rejected by means of PID (gas Cherenkov and lead glass counter), whereas the contribution of pair production (e^+e^- , from photons produced in π^0 decay) will be corrected for by measurements with reverse spectrometers polarity.

Issues: Some concerns raised by the Technical Advisory Committee have not appeared as showstoppers for the measurement; although pion backgrounds should be checked at the early stage of the Hall A commissioning due the open geometry of the Bigbite spectrometer. The first data taking should also set limits and feasibility for the extension of the program at larger Q^2 either in Hall A or in Hall C as proposed in the companion proposal PR12- 06-110.

Recommendation: Approval