CEBAF EXPERIMENT 94-101

PRECISION MEASUREMENT OF THE NEUTRON ASYMMETRY A_1^n AT LARGE x_{Bj} USING CEBAF AT 6 GeV

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Z.-E. Meziani, P. Souder, Spokespersons

This experiment is designed to explore the fraction of neutron spin carried by the spin of valence quarks in a region where it is known that valence quarks carry a large fraction of the neutron momentum namely the high x and high Q^2 region. It is an inclusive electron-nucleus scattering experiment where the lepton beam and the target nucleus are polarized allowing to measure the rate asymmetry when the incoming lepton and target nucleon have their spin oriented parallel versus antiparallel to each other. The measurement consists of collecting data at one incident energy (E_i = 6 GeV) and one scattering angle ($\theta = 45°$) but for six spectrometer momentum settings to cover the range $0.25 \leq x \leq 0.63$ and $2.5 \leq Q^2 \leq 0.63$.

Of course at the present time no free polarized neutron target is available, and therefore, this study must be carried on a nucleus. Possible choices to study a quasifree polarized neutron are a polarized deuteron or a polarized ^{3}He target, we have chosen ^{3}He because of the technical feasibility of the experiment and the competitiveness of CEBAF over worldwide laboratories engaged in this type of studies.

The high energy (6 GeV and higher) high current electron beam at CEBAF combined with the wide angular positioning and overall acceptance of the Hall A spectrometers provide a unique opportunity for a precision determination of the photon-neutron spin asymmetry A_1^n in the high x region at large Q^2. The precision attainable at CEBAF will be unchallenged by the high energy facilities around the world engaged in the measurement of this quantity.

In the last two decades Quantum Chromodynamics (QCD) has emerged as the theory of strong interactions, although our experiment focuses on a finite aspect of the theory which corresponds to exploring the structure of the neutron it attempts to provide data crucial to understanding the link between perturbative and non perturbative regimes of the theory.

A precise determination of the shape of A_1^n in the large x region helps distinguish between the various QCD inspired nucleon models presently under investigation and therefore will provide insight into the behavior and interactions of the constituents. Moreover, as $x \to 1$ Perturbative QCD inspired nucleon models offer definite predictions for A_1^n (as $x \to 1$ we have $A_1^n \to 1$) and hence can be tested. It is well know that in the low x region A_1^n is negative and hence a change of sign is also expected at large x but not yet observed.

This experiment along with CERN, SLAC and future HERMES high precision measurements of the proton A_1^p and that of the ratio $R^{np} = F_2^n/F_2^p$ in the same kinematical region, that is, in the large x region is of paramount importance for a consistent understanding of the nucleon spin substructure.