CEBAF EXPERIMENT 93-028

Deformation of the Nucleon

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Spherically symmetric quark models have been quite successful in predicting a whole range of fundamental observables, such as the mass spectrum and the magnetic moments of baryons. Despite of this success, serious discrepancies have been found when calculating the G_A/G_V–coupling constant ratio, the SU(3) decay ratio (D+F)/(D–F) and the ratio $G_{\pi N\Delta}/G_{\pi NN}$ using the spherically symmetric quark model. Glashow and later Veneto, Baym and Jackson proposed that with a large D-state admixture in the nucleon wave function one can resolve the discrepancies encountered.

The presence of a deformed bag resulting in the addition of a D-state with angular momentum $L = 2$ is made plausible by several model predictions. For instance in potential quark models color magnetic effects from one-gluon exchange may lead to a mixing of S and D states.

Experimental evidence for such a D-state is not easily obtained for the nucleon as its spin is 1/2. However, measurements of the electromagnetic transition amplitudes from the nucleon to the delta resonance ($N(938) \rightarrow \Delta(1232)$) can provide direct evidence. In spherically symmetric quark models this transition is described by a pure magnetic dipole M1 spin-flip transition of one of the quarks. The presence of a D-state allows for non–vanishing $L = 2$ *longitudinal quadrupole* and *transverse quadrupole* amplitudes. These amplitudes are measurable experimentally, and test the fundamental assumption of a D-state contribution in the nucleon wave function.

An observable that is sensitive to the longitudinal $L = 2$ amplitude is the inclusive longitudinal-transverse asymmetry A_{TL} which we propose to measure. A_{TL} measures the interference term of the longitudinal and the transverse response which allows for a test of a small $L = 2$ contribution due to the enhancement by the dominant transverse term.

We plan to perform an inclusive measurement $\vec{H}(\vec{e}, e')$ of the asymmetry A_{TL} across the Δ-resonance in the Q^2 range of $0.2 - 1.4\ GeV/c^2$ with accuracies of order 0.015. The proposed measurements complement various exclusive measurements of the transition amplitudes. We plan to carry out the measurements in Hall C and use the apparatus that is <u>*identical*</u> to the one discussed in the proposal of our collaboration to measure G_{en} via $\vec{d}(\vec{e}, e'n)$ 93–026. In particular we plan to use the polarized $^{15}NH_3$ target that has been built by the Basel/UVa collaboration and has been used successfully in experiment E143 at SLAC.

The systematic errors of the measurements are the accuracy of beam and target polarization of ±3% and ±5% respectively. The proposed measurements will provide an important measurement of A_{TL} in inclusive $\vec{H}(\vec{e}, e')$ - –which is sensitive to the longitudinal quadrupole contribution of the $N - \Delta$ transition– using polarized beam and target.