CEBAF EXPERIMENT 93-030

Measurement of the Structure Functions for Kaon Electroproduction

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CEBAF Experiment 93-030 will measure the four structure functions, $\sigma_T, \sigma_L, \sigma_{TT} and \sigma_{TL}$ which describe kaon electroproduction over the range Q^2 from 1. to 2.5 GeV^2/c^2 and W from threshold (1.62 GeV) to 2.2 GeV. The small amount of data which exists for these reactions was taken at Cornell and at DESY in the 1970's. These two-spectrometer experiments were only able to measure well the unpolarized structure function, σ_T. The unique capabilities of the CLAS detector will allow detection of the K^+ over practically the entire solid angle, making it possible to measure all four structure functions.

Kaon electroproduction data will be complementary to pion data because s quarks are not present as valence quarks within the nucleon and thus certain quark diagrams are suppressed. Also, for the ΔK^+ final state, the fact that $\Delta's$ are isoscalar means that Δ*'s cannot contribute as S-channel intermediate states, simplifying the calculations. In fact, a selection of $\Delta or \Sigma$ as the recoiling hyperon yields a clear isospin separation of contributing amplitudes.

We mention several items of interest which this experiment will address:

1) determine the σ_{TT} interference term, which is a measure of the dependence of the amplitudes upon the transverse polarization of the virtual photon. The interest here is to see how this term changes with Q^2 and t as the form factor of the kaon causes the dominant t channel term to diminish.

2) measure the ratio σ_L / σ_T. This ratio is sensitive to the spin and transverse momentum of the object which absorbs the virtual photon, being large for spin zero objects, such as mesons, or for spin 1/2 objects (quarks) with large perpendicular momentum. For small values of t, σ_L is sensitive to the kaon form factor, while for large t (backward going kaons) a large value for the σ_L / σ_T ratio might be indicative of anomalies in the baryon form factor due to, for instance, processes in which a pre-existing diquark in the proton is struck.

3) measure the production ratio of the various hyperons, $\Delta, \Sigma, \Delta(1405), \Sigma(1385),$ and $\Delta(1520)$ as a function of Q^2. If these are simple quark states differing only by spin and orbital angular momentum orientation, then we would expect similar Q^2 dependence for their production amplitudes. Previous data already indicate that the electroproduction ratio of $\Sigma to \Delta$ differs markedly from the photoproduction value and also shows a large Q^2 dependence.

4) study the polarization of the produced $s\bar{s}$ pair by measuring the polarization of the outgoing Δ. Large effects have been observed previously but the explanation is still not settled.

5) search for missing N^* resonances which decay to K^+ hyperon final states. This experiment could detect, for instance, orbitally excited N^* resonances which decay readily to L=1 hyperons such as the $\Delta(1405)$ but which have very small branching ratios to $N\pi$ and $\Delta\pi$ modes.