JEFFERSON LAB EXPERIMENT 94-110

Measurement Of $R = \sigma_L/\sigma_T$ In The Nucleon Resonance Region

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The ratio of longitudinal to transverse electron scattering off the proton is a fundamental quantity that should be measured with the best possible accuracy. Measurements have been made to extract the ratio $R = \sigma_L/\sigma_T$ from deep inelastic cross sections measured at momentum transfers as high as $Q^2 = 50$ (GeV/c)^2. The small values of R measured in deep inelastic electron-proton scattering are interpreted to be a consequence of the spin-$\frac{1}{2}$ property of the charged partons involved in the quasi-free lepton-quark scattering process. L/T separations have been performed on precision electron-proton elastic cross sections out to $Q^2 = 8.83$ (GeV/c)^2. These elastic separations allow the direct measurement of the proton electric and magnetic form factors, $G_{Ep}(Q^2)$ and $G_{Mp}(Q^2)$.

In contrast to both the elastic and the deep inelastic, there exist few separation measurements of the ratio R in the resonance region at moderate or high momentum transfers. In a resonance excitation probed at moderate momentum transfer the partons are not free, and the arguments applied to the deep inelastic scaling data are not necessarily applicable. We intend to measure inclusive nucleon resonance electroproduction cross sections throughout the region $1 < W^2 < 4$ GeV^2 and spanning the four-momentum transfer range $0.75 < Q^2 < 7.5$ (GeV/c)^2. The cross sections will be used to perform Rosenbluth separations to extract the ratio R. We intend to measure R to approximately 10%, a substantial improvement over the current errors on R which are greater than 100%.

Precision measurements of R will greatly aid efforts to develop reliable global descriptions of existing inclusive electroproduction data at moderate to high Q^2. These global models are necessary for electron-nucleon scattering model development and for accurate radiative correction calculations. The proposed measurements will be useful in the extraction of resonance form factors and spin-dependent structure functions from inclusive electron scattering experiments.

An observed scaling relationship between resonance electroproduction and deep inelastic scattering, termed Bloom-Gilman duality, suggests a common origin for both kinematic regimes. A fundamental quark description for both properties of electroproduction may become possible by studying duality with new resonance electroproduction data and better measurements of R. Theoretical models indicate that both the σ_L and the σ_T structure functions should manifest Bloom-Gilman duality. These models of duality can be tested for the first time with the proposed measurements of R.

CEBAF EXPERIMENT 94-110

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