Abstract

We propose to measure cross section and recoil polarization angular distributions for η electroproduction at $Q^2 = 0.5$ (GeV/c)^2 near the $S_{11}(1535)$ resonance. Measurements will be made on both sides of $\mathbf{q}$ covering the full range of c.m. angle in steps of 30°, allowing the response functions R_{LT}, R_{LT}^N, $R_{LT}^{\prime L}$, $R_{LT}^{\prime S}$, $R_{TT}^{\prime L}$, and $R_{TT}^{\prime S}$ to be separated with high precision.

These proposed measurements will be complete enough for multipole analysis. The $R_{TT}^{\prime S}$ response function is shown to provide a relatively model-independent measurement of $|E_{0+}|^2$. The unpolarized transverse response function, R_T, may receive important contributions from the $P_{11}(1440)$ resonance, but those contributions are highly model dependent because neither the electroexcitation form factors nor the ηN branching ratio for that resonance are known well. By contrast, P_{11} resonances do not contribute in first-order to $R_{TT}^{\prime S}$ and the d-wave and nonresonant contributions are also very small. Furthermore, the d-wave contribution to $R_{TT}^{\prime S}$ can be separated based upon the angular distribution for its contribution to $R_{TT}^{\prime L}$. Once $|E_{0+}|^2$ is known, the P_{11} contribution to R_T can be inferred. The d-wave resonances dominate R_{LT}. Information about the longitudinal couplings for the S_{11} and the nondominant resonances can be obtained from the structure of the LT and LT' response functions.

We will also exploit the symmetry $R_{TT}^{\prime L} = \pm R_T$ for parallel (antiparallel) kinematics to separate the longitudinal and transverse response functions without using the Rosenbluth method. We expect to be able to measure the ratio $\mathcal{R}_\pm = R_L/R_T$, which is practically unknown for this reaction, to a precision of $\delta\mathcal{R}_\pm \sim 0.02$ by this recoil-polarization technique.

Requirements

Beam energy	: 3.2 GeV
Beam polarization	: $\sim 75\%$
Beam current	: $\leq 75\ \mu$A
Target	: 10 cm LH_2
Luminosity	: 2×10^{38} cm^2 s^{-1}
Detectors	: HRS^2 + FPP
Beam time	: 624 hours