

Baryon Resonance Electroproduction at High Momentum Transfer

The inelastic nucleon transition amplitudes to the $\Delta(1232)$ and $S_{11}(1535)$ baryon resonances, via the reactions $p(e, e'p)\pi^0$ and $p(e, e'p)\eta$ respectively will be measured at the previously inaccessible momentum transfer $Q^2 = 7.5 \text{ GeV}^2/c^2$. This experiment is an extension of experiment 94-014, which measured the same reactions in the momentum transfer range $Q^2 = 2.8$ and $4 \text{ GeV}^2/c^2$. Results of experiment 94-014 were published in refs. [Fr-99] and [Ar-99].

The physics goals of this experiment are to assess the relevant degrees of freedom appropriate to describe high momentum exclusive reactions, and in particular baryon excitation as $t \sim Q^2$ varies beyond the validity of the constituent quark model (CQM), to search for evidence of PQCD, and to learn about the transverse momentum (k_\perp) distribution by application of the generalized parton distribution formalism (GPD) to high t exclusive reactions. In the case of the $\Delta(1232)$ the breakdown of the (CQM) is signaled by a significant departure of the ratio E_{1+}/M_{1+} from 0, and the evolution toward PQCD by $E_{1+}/M_{1+} \rightarrow +1$. For the $S_{11}(1535)$ the appropriate signature is the approach to constituent scaling, ie. $A_{1/2} \rightarrow 1/Q^3$. The evolution of the k_\perp is directly related to the t dependence of the appropriate transition form factors. For the $N \rightarrow \Delta$ the relationship by

$$G_M^* = \int_{-1}^1 \sum_q H_M^q(\xi, x, t) dx \quad G_E^* = \int_{-1}^1 \sum_q H_E^q(\xi, x, t) dx \quad G_C^* = \int_{-1}^1 \sum_q H_C^q(\xi, x, t) dx$$

where G_M^* , G_E^* and G_C^* are magnetic, electric and Coulomb transition form factors, and H_M^q , H_E^q , and H_C^q are axial (isovector) GPD's. Similar relationships can be obtained for the $N \rightarrow S_{11}$ transition.

The experiment will be performed in Hall C. The electron beam will be fixed at the highest available energy ($\sim 5.75 \text{ GeV}$), at a current of $\sim 90 \mu\text{A}$. As in experiment 94-014 the scattered electrons will be detected by SOS in coincidence with recoil protons detected by HMS. The SOS central momentum and angle will be fixed at $1.6 \text{ GeV}^2/c^2$ and $\sim 50^\circ$ throughout the experiment, while the HMS momentum and angle will be varied to cover the resonance decay cone and outgoing proton momentum range. The maximum HMS momentum setting will be $5.1 \text{ GeV}^2/c^2$, and the minimum angle will be $\sim 13^\circ$.

References:

Ar-99 C.S. Armstrong et al., Phys. Rev. , **D60**, 052004-1 (1999)

Be-97 V. Frolov et al., Phys. Rev. Lett., **82**, 45 (1999)