CEBAF EXPERIMENT 89-042

A Measurement of the Electron Asymmetry in $p(e,e'p)\pi^0$ and $p(e,e'\pi^+)n$ in the Mass Region of the $P_{33}(1232)$ for $Q2 \leq 2$ $(GeV/c)^2$

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This experiment, in conjunction with Experiment 89-042, is aimed at a precise determination of the electromagnetic multipole moments from the ground state nucleon to the first excited isospin 3/2 state $P_{33}(1232)$. Information about higher mass states will be gained simultaneously. The motivation for measurements to obtain a better understanding of the microscopic structure of the $\gamma N \rightarrow P_{33}(1232)$ transition is outlined in the description of Experiment 89-037. An important problem in the study of resonance transition is the separation of resonant and non-resonant contributions. The contributions from the multipoles E_{1+} and S_{1+} to the cross section in the $P_{33}(1232)$ region are very small, and precise knowledge of the non-resonant multipoles is needed for a model-independent determination of the resonant multipoles. This measurement is therefore aimed at obtaining a better understanding of the non-resonant contribution to E_{1+} and S_{1+} in single pion production.

The electron asymmetry for single pion production is given by:

$$A_e^{\pi} = \frac{\sigma_e(\uparrow) - \sigma_e(\downarrow)}{\sigma_e(\uparrow) + \sigma_e(\downarrow)},$$

where $\sigma_e(\uparrow)$ and $\sigma_e(\downarrow)$ are the differential cross sections for pion production with electrons polarized parallel or anti-parallel to the beam direction, respectively.

A_e^{π} is sensitive to interferences between resonant and non-resonant multipoles, and to their phases. The size of A_e^{π} in the $P_{33}(1232)$ mass region is expected to be 10% or less. Systematic uncertainties in event of the advantage of polarization measurements is that systematic uncertainties can be much more easily controlled than in absolute cross sectin measurements. experiments to be conducted for systematic uncertainties in the asymmetries are much more easily controlled than in absolute cross section measurements.