CEBAF EXPERIMENT 89-017

Electroexcitation of the Δ(1232) in Nuclei

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This proposal addresses questions about the properties of the first excited state of the nucleon, the Δ(1232), when the production and propagation of the Δ take place in a nucleus. The Δ is well understood when it is produced from a free nucleon, especially the proton, but the nuclear environment is expected to modify the Δ production process. The modifications can be both fundamental and "trivial." For example, it is not known whether the Δ-nucleon force is the same as the nucleon-nucleon force. A difference would shift the Δ production peak from the position expected. Another fundamental modification would be a change in the Δ radius, observed through the momentum transfer dependence of the cross section. Such effects have been proposed for the nucleon to explain quasielastic scattering data. A "trivial" modification is broadening of the Δ production peak due to the motion of the nucleons within the nucleus, Fermi motion. But Fermi motion is not the only influence on the peak width because the nuclear environment allows additional decay modes. Another "trivial" modification is due to interactions between the Δ and surrounding nucleons, final state interactions. If all these modifications can be distinguished from one another, the resulting understanding of Δ–nucleus interactions will in turn lead to a better understanding of baryon-baryon interactions.

Past studies of Δ electroproduction in nuclei have been almost entirely inclusive measurements. These studies showed that to first order the cross section is just the atomic number times the cross section for a free nucleon. A comprehensive study [1] that covered the full range of atomic number and a wide range in momentum transfer showed that the observed position of the Δ peak shifts to higher invariant mass as momentum transfer increases. Also the peak width is greater than can be explained by Fermi motion alone. The limited data available from coincidence measurements indicates that in the Δ region there is significant contribution from quasielastic scattering and two-body absorption. These processes cause uncertainty in interpreting the inclusive data for Δ electroproduction.

Experiment 89-017 is meant to provide the first extensive set of data in which all outgoing reaction products are identified. The CLAS detector will be used to detect these particles with a large solid angle. This will allow the various competing reaction mechanisms to be stripped away from the Δ production mechanism so that it may be studied by itself. Data will be taken over the entire range of atomic number and for the full momentum transfer range for which the Δ can be separated from background. Isolated from other effects, Δ electroproduction data should allow extraction of a Δ-nucleus potential and may show clear indications of a radius change or new reaction mechanisms.

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[1] R.M. Sealock, et al., Phys. Rev. Lett 62, 1350 (1989)