

CEBAF EXPERIMENT 89-012

**Two-Body Photodisintegration of the Deuteron at  
Forward Angles and Photon Energies  
between 1.5 and 4.0 GeV**

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We propose to measure the energy dependence of the cross section for the  $\gamma d \rightarrow pn$  reaction throughout the photon energy range 1.5 to 4.0 GeV and that for the  $\gamma d \rightarrow \pi^0 d$  reaction in the range 1.5 to 3.0 GeV. This experiment represents the natural extension of work at SLAC, where it was discovered that the energy dependence of the cross section between 1.4 and 2.8 GeV at  $\theta_{c.m.} = 90^\circ$  is consistent with that expected from the constituent counting rules. The purpose of the present work is to extend the SLAC measurements up to the highest energy feasible in order to determine whether or not the simple energy dependence persists throughout a larger energy range and at smaller reaction angles.

Presently, an important issue in nuclear physics is whether there exist nuclear processes which require the explicit inclusion of quark-gluon degrees of freedom in the reaction dynamics in order to be understood. A guiding principle in this search is to perform experiments with high energy electromagnetic probes of the simplest nucleus, the deuteron, a system which is particularly amenable to theoretical interpretation. It has long been recognized that the constituent counting rules seem to apply for electron elastic scattering from the pion and nucleon, but unfortunately, this dimensional scaling region has not been reached for electron-deuteron elastic scattering because of the very small cross section at high momentum transfer. The results from experiment NE8 and NE17 at SLAC indicate that the  ${}^2\text{H}(\gamma, p)n$  reaction cross sections are consistent with the constituent counting rules above  $E_\gamma = 1.4$  GeV and at  $\theta_{c.m.} = 90^\circ$ . The key issue is whether or not asymptotic scaling has been achieved as suggested by these results. It is essential to extend these measurements to the highest energy practicable in order to determine whether this trend continues and whether the trend is observed at smaller angles and high energies as well.

A second fundamental exclusive process involving a photon and deuteron in the initial state is the  $\gamma d \rightarrow d\pi^0$  reaction. Here, according to the constituent counting rules, the cross section at a fixed center-of-mass angle should have an  $s^{-13}$  dependence in the asymptotic scaling region.

This experiment will make use of bremsstrahlung photons produced from the CEBAF electron beam. The bremsstrahlung photons will irradiate a deuterium target, and photoprotons from the  $D(\gamma, p)n$  and photodeuterons from the  $D(\gamma, d)\pi^0$  reaction will be detected in the HMS spectrometer in Hall C.

