

Photoproduction of η and η' Mesons from Deuterium

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Differential cross sections for photoproduction on deuterium of η and η' mesons will be measured using the Hall B Bremsstrahlung Photon Tagger and the CEBAF Large Acceptance Spectrometer. Tagged photons of energies from 0.60 to 1.52 GeV will be incident on a liquid deuterium target. The measurements to be made are of great interest for many reasons, among which are:

- Published data on coherent and incoherent photoproduction from deuterium are limited to a few non-zero data points near threshold with large uncertainties.
- Existing theories of the mechanisms believed responsible for photoproduction of η mesons on deuterium are grossly inconsistent with the sparse measured cross sections.
- Data on the photoproduction of η' mesons from the deuteron are non-existent.
- Deuterium η and η' photoproduction measurements are a critically needed complement to studies of the photoproduction of these mesons on the proton and on heavier nuclei.
- Models of isoscalar nucleon resonances can be subjected to stringent tests by data obtained from coherent and incoherent photoproduction of η and η' mesons from deuterium.

The cross sections provided by this experiment for η photoproduction will be of much greater precision than existing measurements and will greatly extend coverage to regions presently unmeasured and inaccessible at other facilities. At the same time, the first extensive cross sections for η' photoproduction will be measured. The simultaneous measurement of both coherent and incoherent processes for η and η' photoproduction will help elucidate the isospin structure of the electromagnetic transition densities, and, as a complement to a previously approved study of photoproduction on the proton, will facilitate specific determination of the amplitudes for photoproduction on the neutron.

This experiment represents an important component of a series of related initial studies of the photoproduction of eta mesons and their interactions with nucleons. The opportunity to fully investigate phenomena associated with eta photoproduction, to extend such studies to greater solid angle coverage, to investigate other resonances (such as the $P_{11}(1710)$) in the baryon resonance spectrum, and the entire field of η' photoproduction must await the capabilities of Hall B and GRAAL. These measurements will be critical to resolving important questions related to our understanding of the structure of the nucleons, the structure of the mesons themselves, and the interactions of nucleons and these mesons with each other.