# Helicity-Dependent Angular Distributions in Three-Body Photodisintegration of $^3$He

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**Abstract.** The photodisintegration $\vec{\gamma}^3\mathrm{He} \rightarrow ppn$ has been studied at Jefferson Lab Hall B using a circularly polarized tagged photon beam in the energy range between 0.35 GeV and 1.55 GeV. Beam-helicity-dependent angular distributions of the final-state particles were measured. Clear helicity asymmetries have been found in the angular distributions.

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Three-body mechanisms have recently been studied in the photodisintegration of $^3$He for photon energies between 0.35 and 1.55 GeV at Jefferson Lab with the CEBAF Large Acceptance Spectrometer (CLAS) [1]. The study of polarization phenomena is a natural extension of this investigation of the unpolarized cross section. It provides additional information on details of the underlying nuclear Hamiltonian not available in unpolarized reactions; see *e.g.* [2]. In this paper we study for the first time the beam-helicity asymmetry in the $\vec{\gamma}^3\mathrm{He} \rightarrow ppn$ reaction with circularly polarized photons. We used the data of [1] where the final-state protons have been detected and the neutron was reconstructed by missing mass.

Following the analysis procedure of [3] we constructed the asymmetry observable $A = \frac{1}{P_\gamma}\frac{N^+ - N^-}{N^+ + N^-}$ where $P_\gamma$ is the degree of circular polarization and $N^\pm$ are the normalized yields for the two different helicity states. The degree of circular polarization varied as a function of photon-beam energy between about 0.15 and 0.60. A schematic view of the reaction, together with angle definitions, is shown in Fig. 1.

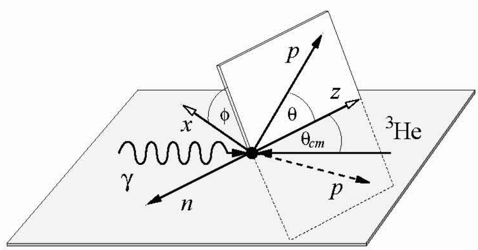


**FIGURE 1.** Angular definitions for the circularly polarized real-photon reaction $\vec{\gamma}^3\mathrm{He} \rightarrow ppn$ in the center of mass frame.

The asymmetry $A$ is particularly interesting in the study of three-body mechanisms as it vanishes for two-body reactions. Therefore, to insure that the final-state neutron was not a spectator in the reaction, we only include events with neutron momenta

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$p^{\mathrm{lab}} \geq 250$ MeV/c in the analysis. Owing to the large angular acceptance of the CLAS, complete azimuthal angular distributions of the asymmetries were observed. Figure 2 shows the preliminary data of the $A$ distribution integrated over the CLAS acceptance for various photon-energy bins. The asymmetries are odd functions of $\phi$ as expected from parity conservation. They are moreover symmetric about 90° because of the two identical protons in the final state. Both symmetries are seen in Fig. 2. We observe a maximum asymmetry in the $A(\phi)$ distribution in the energy range of $0.6 - 1.0$ GeV and no asymmetry for lower or higher photon energies.

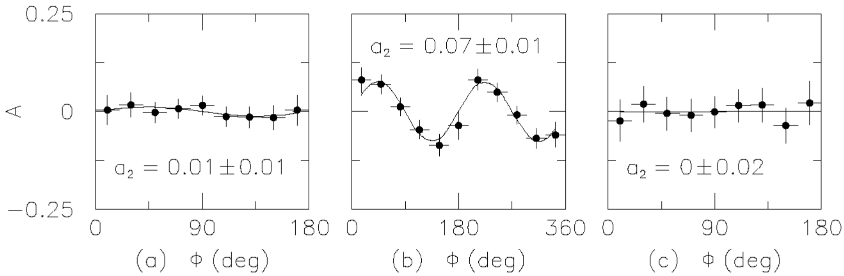


**FIGURE 2.** Preliminary angular distributions of $A(\phi)$ (a) for photon energies between 0.35 and 0.6 GeV, (b) for photon energies between 0.6 and 1.0 GeV, and (c) for photon energies between 1.0 and 1.55 GeV. The solid lines indicate fits of the lowest-order non-vanishing Fourier term, $a_2 \sin(2\phi)$, to the data.

In our preliminary analysis we have for the first time observed helicity asymmetries in the $\vec{\gamma}^3He \rightarrow ppn$ channel. Model calculations are now needed for a detailed interpretation of these data.

## REFERENCES

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