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Extraction of Beam Spin Asymmetry in the $\vec{\gamma}d \to pp\pi^-$ Reaction[1]

WEIZHI XIONG, YORDANKA ILIEVA, University of South Carolina — Here we present a new method to estimate the polarization observable beam spin asymmetry (Sigma) from experimental data on nuclear reactions initiated by linearly polarized photon beam. We use the Maximum Log-Likelihood (LL) method to determine the estimator for Sigma and its uncertainty. We construct the probability density function (p.d.f.) of the azimuthal angle (ϕ) according to the physics dependence of the cross section of a nuclear reaction on ϕ, in which Sigma is a parameter. In order to test our estimator, we applied it to randomly generated events similar to real data from the $\vec{\gamma}d \to pp\pi^-$ reaction occurring when a photon strikes a deuterium target. We analyzed samples generated with, and without, detector acceptance folded in the p.d.f., where we extract the functional dependence of the detector acceptance from data taken with the CLAS detector at Jefferson Lab. We find that the value of Sigma estimated from the LL method is consistent with the true value and our estimator is unbiased. We show that the LL method yields an estimate for Sigma that has a smaller uncertainty than estimates obtained from fits to azimuthal distributions. Ours is a new and original study which supports the rich N* physics program based on polarization observables that is currently being run in Hall B at JLab.

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