Polarization observables from the photoproduction of ω-mesons using Linearly Polarized Photons

We shall report on the photon beam asymmetry, Σ, of the ω meson using a beam of linearly polarized photons in the photon energy region of $1.1 < E_\gamma < 2.1$ GeV. These preliminary results are from the summer 2005 g8b dataset, which were collected with the CLAS detector in Hall B of Jefferson Lab.

Polarization observables are necessary for delineating the underlying processes in the photoproduction of ω mesons. The angular distributions of the ω mesons and, in turn, the angular distributions of the daughter pions from ω decay give critical information on constraining the production mechanisms. By measuring the photon asymmetry parameter as functions of the Mandelstam variables s and t ($\Sigma = \Sigma(s,t)$), we can constrain the underlying production mechanisms. For example, in the forward or diffractive region, linear polarization provides a reference plane for describing the in- or out-of-plane distributions of the pions resulting from ω decay. And consequently serves as a parity filter for understanding the nature of the t-channel exchange, i.e. whether the exchange is from either pseudoscalar or scalar mesons or even perhaps a combination thereof. In the more central regions, other processes are expected to dominate. Since the ω is an isoscalar, it may only couple to N^* states, i.e. $I = \frac{1}{2}$. This eliminates Δ resonance production and makes for cleaner data samples. We expect that a precise measurement of the photon asymmetry parameter for $\vec{\gamma}p \rightarrow \omega p$ will shed light on the spin-parity of the underlying baryon resonances and will further help in disentangling the overlapping N*s.

The photon asymmetry parameter can be decomposed into several spin-density matrix elements (SDMEs) and as such set constraints on these SDMEs. SDMEs are formed of bilinear combinations of the helicity amplitudes, which are the physics of the production mechanisms. These SDMEs, therefore, are the matching point between theory and experiment. Our objective is to ultimately extract the SDMEs, and measuring $\Sigma = \Sigma(s,t)$ is the necessary first step in the analysis chain for this reaction.