Studying the Λ(1405) Hyperon Using Photoproduction at CLAS

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The nature of the Λ(1405) hyperon and where it belongs in the hierarchy of resonances is a longstanding mystery. Past experiments have observed the invariant mass spectrum (lineshape) to be distorted from a simple Breit-Wigner form, and this has lead to various speculations on the nature of this resonance and the dynamics involved in forming it.

Using the CLAS detector at Jefferson Lab, we have studied the Λ(1405) via photoproduction with unprecedented statistics from a proton target. This has allowed us to measure and compare the lineshapes and differential cross sections of all three decay modes $\Sigma^+\pi^-$, $\Sigma^0\pi^0$, and $\Sigma^-\pi^+$ from near the production threshold up to center-of-mass energies of 2.84 GeV. As predicted in chiral unitary models, the lineshapes and differential cross sections for each mode are indeed qualitatively different. This lends support to the idea that the Λ(1405) has strong dynamical components that distinguish it from other known resonances. Cross section comparisons of the nearby Σ(1385) and Λ(1520) will also be shown.

Another basic property of the Λ(1405) that has previously been experimentally unconfirmed is its spin and parity quantum numbers. Our spin-parity analysis shows for the first time that indeed the assignment of $½^-$ is correct.