

Decay of the $\Lambda(1405)$ to $\Sigma^0 \pi^0$ measured at GlueX

Friday, 1 July 2022 11:00 (20 minutes)

Among the light baryons, the $J^P = \frac{1}{2}^-$ $\Lambda(1405)$ baryon is an important special case by sitting just below the $\bar{K}N$ threshold and decaying almost exclusively to $\Sigma\pi$. It has long been hypothesized to be either a molecular bound state or a continuum resonance, or that it is a simple quark-model resonance, the P -wave companion of the $\Lambda(1520)$. In recent years chiral unitary models have suggested^a that there are two isospin zero poles present in this mass region, and that the “line shape” of the $\Lambda(1405)$ depends to what extent each of the two poles are stimulated in a given reaction. Evidence for this interpretation was reported by the CLAS collaboration^b in elementary photoproduction, albeit with limited statistics. Below the $N\bar{K}$ threshold, the $\Lambda(1405)$ decays to the three $\Sigma\pi$ charge combinations, but the $\Sigma^0\pi^0$ mode is purely $I = 0$, uncontaminated by complications arising from $I = 1$ scattering processes contributing to the reaction mechanism in the $\Sigma^+\pi^-$ and $\Sigma^-\pi^+$ decays, nor from production and decay of the nearby $\Sigma^0(1385)$ hyperon.

The GlueX experiment at Jefferson Lab has been used to study the $\Lambda(1405) \rightarrow \Sigma^0\pi^0$ decay mode with a photon beam in the energy range 6.5 - 11.6 GeV incident on a liquid hydrogen target and using a large acceptance charged particle tracking and electromagnetic calorimeter system. We focus on the preliminary results of $d\sigma/dM_{\Sigma^0\pi^0}$ in the $-(t - t_{min})$ range 0 - 1.5 GeV² from analyzing the reaction $\gamma p \rightarrow K^+\Lambda^*$ using the data collected during the first phase of the GlueX experiment.

Simultaneous fits were done to the hyperon line shapes for $\gamma p \rightarrow K^+\Sigma^0\pi^0$ and $\gamma p \rightarrow K^+K^-p$, where the latter reaction is used as a source of events above $N\bar{K}$ threshold. The $\Lambda(1405)$ appears with a highly distorted line shape that can be decomposed into a set of coherent Breit-Wigner amplitudes interfering with each other and with the nearby $\Lambda(1520)$. We include the effect of the Flatté-type distortions evident at the $\bar{K}N$ threshold, where unitarity and analyticity affect the line shapes, including data from the above-threshold decay $\Lambda(1405) \rightarrow K^-p$.

^acf. recent review: M. Mai, U-G, Meissner, Eur. Phys. J. A 51, 30 (2015)

^bK. Moriya et al.(CLAS Collaboration), Phys. Rev. C 87, 035206 (2013)

Primary authors: WICKRAMAARACHCHI, Nilanga (The Catholic University of America); SCHUMACHER, Reinhard (Carnegie Mellon University); KALICY, Grzegorz (The Catholic University of America)

Presenter: WICKRAMAARACHCHI, Nilanga (The Catholic University of America)

Session Classification: 5; Fri-II