International Journal of Modern Physics: Conference Series

$K_S\Lambda$ PHOTOPRODUCTION ON THE NEUTRON WITHIN THE RESONANCE REGION

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Received 03 August 2013

We report some preliminary differential cross section results for the $\gamma\mathrm{d} \rightarrow K_S\Lambda(p)$ reaction using a circularly-polarized photon beam and an unpolarized LD_2 target. The data was collected at the CEBAF Large Acceptance Spectrometer (CLAS) at Jefferson Lab. For this study the photon energy ranged from 1.3 to 2.53 GeV, which covers from the reaction threshold through the nucleon resonance regimes. The acceptance- and flux-corrected yields show peaks at the center-of mass energies $W = 1.7$ and $W = 1.9$ GeV. These first-time results will aid in unraveling the spectrum of non-strange excited baryons.

Keywords: photoproduction; baryon reconstruction; cross section.

1. Introduction

The study of the neutral kaon channels is essential in our understanding of the baryon N* (I = 1/2) states. While the $\gamma\mathrm{d} \rightarrow K_S\Sigma^0(p)$ and $\gamma\mathrm{d} \rightarrow K^+\Sigma^-(p)$ channels also couple to the Δ^* (I = 3/2) states, making their theoretical interpretation somewhat more difficult, only the N(1650)$1/2^-$, N(1710)$1/2^+$, and N(1720)$3/2^+$ resonances are expected to contribute to the Λ channel at low center-of-mass energy[1]. We expect the measurement of the $\gamma\mathrm{d} \rightarrow K_S\Lambda(p)$ channel to be sensitive to the N(1900)$3/2^+$ resonance, similar to what is seen in the K^+ channels. As can be seen from fig.1, the K^+ channel models and SAPHIR's data are in close agreement. However for the $K_S\Lambda$ channel the two models are different by an order of magnitude. Prior to this study there has been no measurement of the $K_S\Lambda$ photoproduction cross section.

2. The g13 Experiment

For this analysis, the $\gamma\mathrm{d} \rightarrow K_S\Lambda(p)$ differential cross section was developed using the g13 dataset. This experiment produced data for both circulary (g13a) and linearly (g13b) polarized photons. The linearly polarized data was highly collimated and not ideal for the development of cross sections. Therefore the g13a data was used. The circularly polarized photons were produced from 1.99 and 2.65 GeV electrons

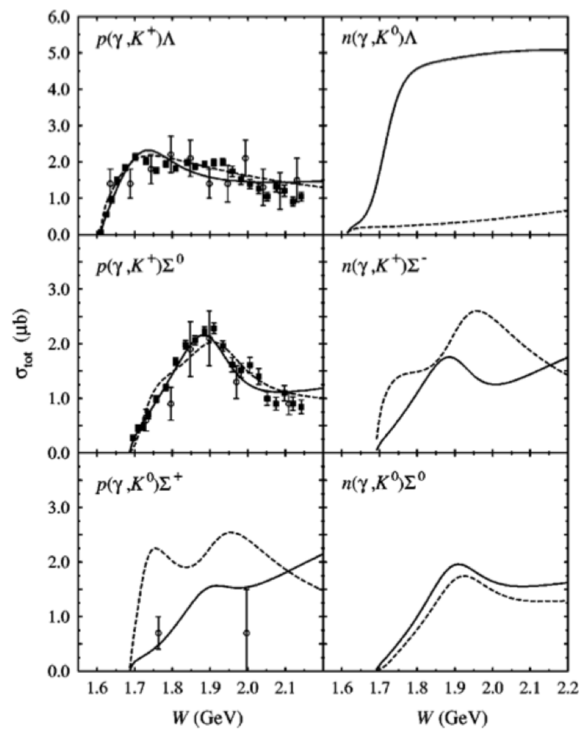

Fig. 1. Some of the possible kaon photoproduction channels compared to new experimental data (figure was taken from H. Yamamura, et al.[2]). The solid curve is is the later 1999 model and the older 1997 model[4] is presented by the dashed line. SAPHIR's data is plotted as the solid squares, while the older data is denoted with dots.

interacting with a thin gold foil. The 40-cm long LD_2 target provided the necessary luminosity for the measurement of the $K_S\Lambda$ cross section.

3. Measurement of the Cross Section

After the event selection process, the missing mass for the p$\pi^-\pi^-\pi^+$ final state has two surviving distributions (see fig.2). The proton peak corresponds to the $K_S\Lambda$ channel and the "proton + γ" peak is mostly from the $K_S\Sigma^0$ channel. For both the γd $\rightarrow K_S\Lambda(p)$ and γd $\rightarrow K_S\Sigma^0(p)$ reactions, the intermediate kaon and hyperons (Λ and Σ^0) are neutral and short-lived, making them difficult to directly detect in CLAS. Therefore they are reconstructed through their primary decays: $K_S \rightarrow \pi^+\pi^-$, $\Lambda \rightarrow p\pi^-$ and $\Sigma^0 \rightarrow \Lambda\gamma \rightarrow p\pi^-(\gamma)$. Once the events with the correct final state are identified, their tracks are paired to reconstruct the possible K_S and Λ particles. Initially, we cannot be certain which decay process the two π^- belong to, so both combinations are introduced into the data. Invariant mass and track momentum cuts removed nearly all of the combinatoric background.

Two $cos(\theta_{Ks})$ bins of the differential cross section are shown in Fig.3 as a

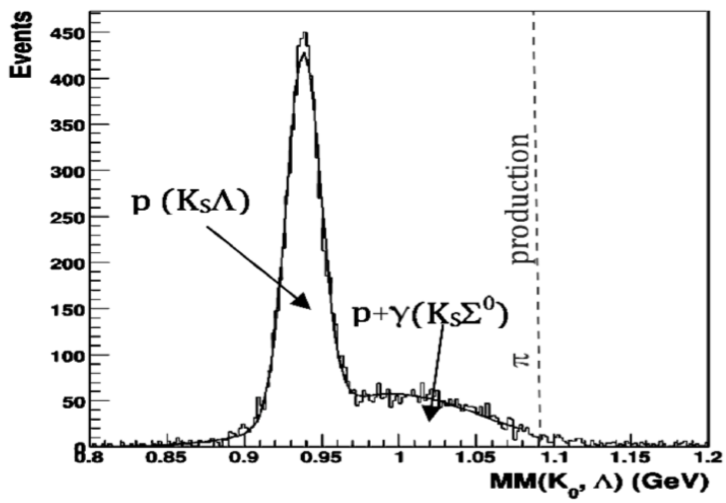

Fig. 2. Missing mass distribution of the proton from $K^+\Lambda$ and with the distribution from the proton plus photon associated with the $K_S\Sigma^0$. Because of the missing momentum cut (MMom < 1.5 GeV) used in the code, events with Σ^* do not survive.

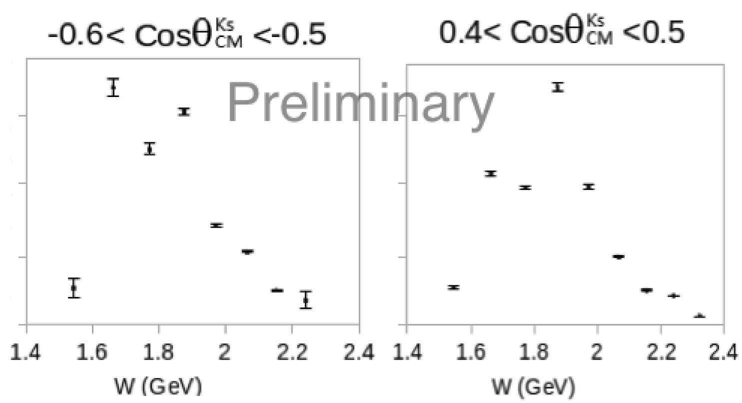

Fig. 3. Two of the $cos(\theta_{Ks})$ bins for the preliminary differential cross section for the γd $\rightarrow$ $K_S\Lambda(p)$. These cross sections were developed from the acceptance-corrected yields and energy dependent photon flux. Some peak structures can be seen with CM energy as low as 1.7 GeV and again at 1.9 GeV. Both systematic and statistical uncertainties are shown. The magnitude is temporarily excluded pending verification checks.

function of the center-of-mass energy. The general distribution is similar to what is seen in the $K^+\Lambda$ channel[5,6]. Both the $K^+\Lambda$ and $K_S\Lambda$ channels show the expected peak at 1.9 GeV. In the preliminary results, the $K_S\Lambda$ channel also has a peak at 1.7 GeV. This is near the $K_S\Lambda$ threshold and will require further study. The differential cross section quickly decreases with increasing energy. Finer energy binning is being used for the next iterations of these cross sections.

4. Conclusion

Here we presented a sample of the preliminary differential cross sections for the γd $\rightarrow K_S\Lambda(p)$ reaction. Initial results look very promising for the N* resonances. The well established[5,6] N(1900)$3/2^+$ resonance is evident in our results and there is some evidence for the N(1650)$1/2^-$, N(1710)$1/2^+$, and N(1720)$3/2^+$ resonances. The final differential cross sections will prove valuable in the refinement of the theoretical models for the $K_S\Lambda$ channel.

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