Strangeness photoproduction with CLAS at Jefferson Lab

Reinhard A. Schumacher (for the CLAS Collaboration)
Department of Physics, Carnegie Mellon University, Pittsburgh, PA 15213, USA

The CEBAF Large Acceptance Spectrometer (CLAS) [1] at Jefferson Lab has been used to measure the elementary photoproduction of kaons and hyperons in the energy range of the nucleon resonances. Data have been obtained for the reactions

$$\gamma + p \to K^+ + \{\Lambda,\ \Sigma^\circ, \Lambda(1405)/\Sigma(1385),\ \Lambda(1520)\}\,. \tag{1}$$

These channels test our understanding of pseudoscalar meson photoproduction, and may extend our knowledge of the spectrum of non-strange baryons which decay to strangeness-containing final states.

We report preliminary results from the first photoproduction run of CLAS, which yielded approximately 100 million events, out of which 210,000 strangeness-containing final states were reconstructed. Bremsstrahlung photons were tagged and covered the energy range from Λ threshold at 0.911 GeV up to 2.4 GeV. CLAS was triggered on a coincidence of hits in the photon tagger and scintillators that signaled at least one charged track coming from the LH2 target. Kaons with momenta up to 2 GeV/c were identified using momentum and time-of-flight measurements, with an average signal-to-noise ratio with respect to pions of about 4:1. Sideband subtraction of the pion background resulted in a hyperon missing mass spectrum shown in Fig. 1, which shows cleanly separated Λ and Σ° samples, as well is several well-known excited hyperons.

Analysis is in progress to extract the Λ and Σ° total and differential cross sections, the hyperon recoil polarizations, and beam-recoil polarization observables. Here we report preliminary results for the total cross section for Λ and Σ° hyperon photoproduction. Kaon events were normalized using the integrated photon flux, and corrected using Monte Carlo techniques for acceptance and in-flight decay. Total cross sections were obtained from Legendre polynomial fits to the angular distributions at each photon energy. Fig. 2 shows σ_{tot} compared to several previous calculations [2]. There is considerable disagreement among the calculations and the data; calculations [4,5,6] were primarily designed to fit the near-threshold energies below 1.5 GeV, not the higher energy region, and do not preserve unitarity. The calculations of Ref [3] were fitted to the data of Ref [8] by the inclusion of hadronic form factors.

A suggestion exists [7], based on comparing a recent model for Λ photoproduction to data [8], that there may be evidence in the total cross section for a non-strange resonance near $W = 1.9$ GeV which couples with significant strength to both the photon and the hyperons, but only weakly to πN. Our preliminary result shows a bump in the Λ total cross section at $E_\gamma = 1525$ MeV, or $W = 1.93$ GeV, which tends to support this claim. Studies of the experimental angular distributions and of the systematic uncertainties are in progress to evaluate the strength and stability of this signal. Definite evidence for such

a state would tend to support a recent quark-model analysis which predicted a baryon resonance with strong strangeness coupling near this mass [9]; a strong pionic coupling for that state was also predicted, however, so interpretation of this possible experimental signal remains open for the present.

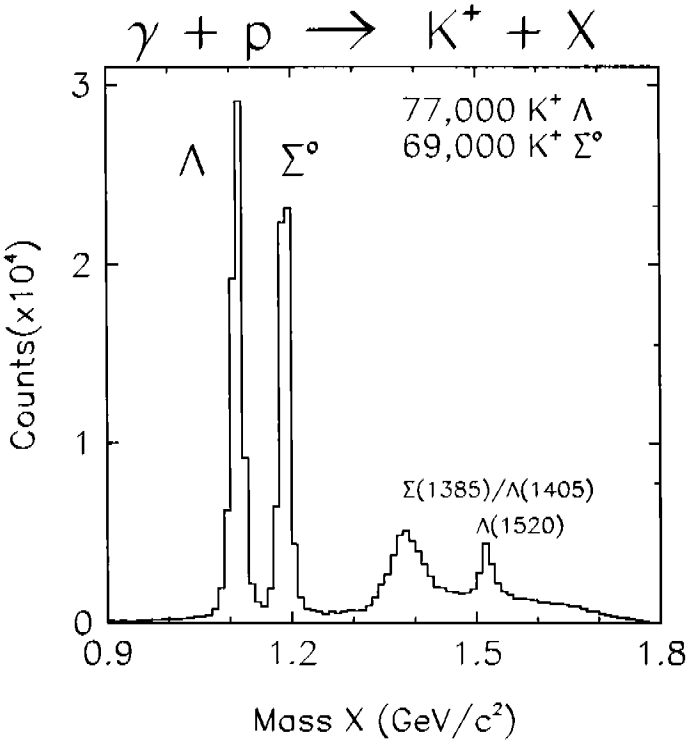

Figure 1. Missing mass spectrum for the reaction $\gamma + p \rightarrow K^+ + X$ for $W > 1.6$ GeV. The events cover the entire CLAS detector in angle and momentum. Background pions misidentified as kaons have been subtracted using a sideband technique.

REFERENCES

1. W. K. Brooks, CLAS spectrometer; these Proceedings.
2. Calculations using code by T. Mart (private communication) for models of Refs [3-6].
3. H. Haberzettl, C. Bennhold, T. Mart, and T. Feuster, Phys. Rev. **C58** (1998) R40.
4. R. Williams, C. R. Ji, and S. R. Cotanch Phys. Rev. **C46** (1992) 1617.
5. R. A. Adelseck and B. Saghai, Phys. Rev. **C42** (1990) 108.
6. R. A. Adelseck and L. E. Wright, Phys. Rev. **C38** (1988) 1965; C. Bennhold, Phys. Rev. **C39** (1989) 1944.
7. T. Mart and C. Bennhold, *nucl-th 9906096*; C. Bennhold *et al*, *nucl-th/9901066.*
8. M. Q. Tran *et al*, Phys. Lett. **B445** (1998) 20.
9. S. Capstick and W. Roberts, Phys. Rev. **D58** (1998) 1.

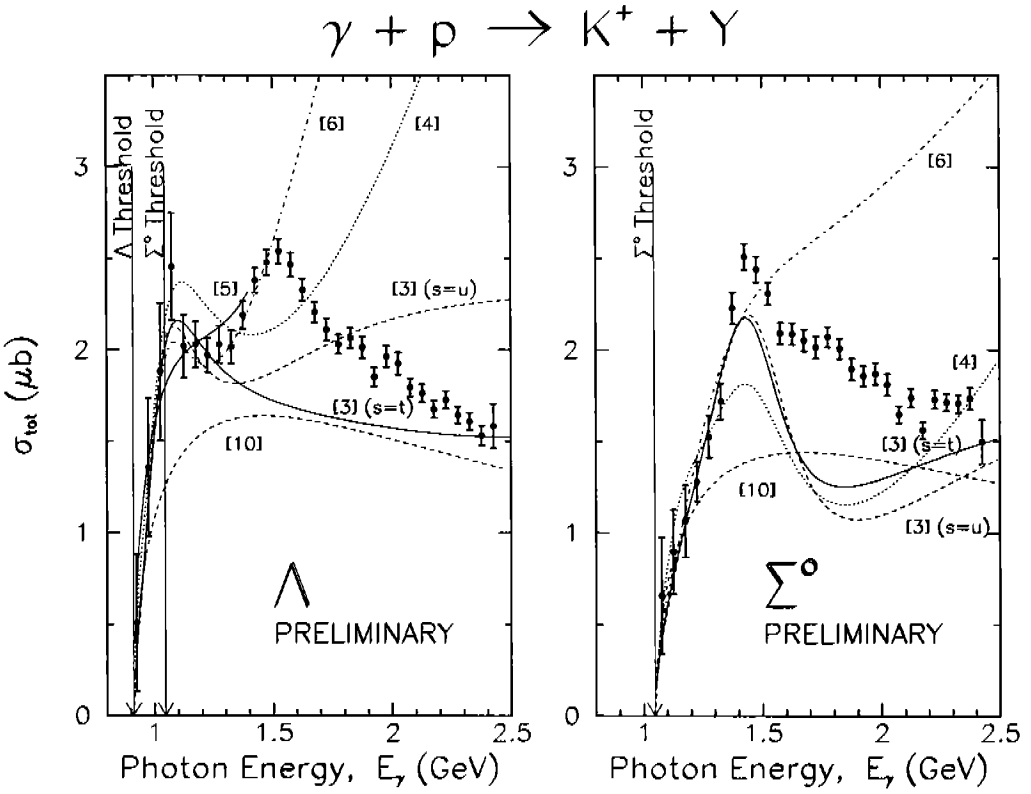

Figure 2. Preliminary total cross sections for $\gamma + p \rightarrow K^+ + Y$. The data were acceptance corrected; uncertainties are statistical only, and do not reflect a $\pm 20\%$ systematic uncertainty. Dashed line [10] is a phase space curve.