K^+ Photoproduction with LEPS at BL33LEP

There are many nucleon resonances, N* and Δ*, which have been predicted by theoretical calculations, but have not been observed in πN and N(γ, π) reactions. These nucleon resonances are called 'missing resonances.' It has been realized that intermediate resonances to be studied in pionic reactions are limited [1]. Quark model studies suggest that a part of these missing resonances may couple to strangeness channels, such as KΛ and KΣ channels [1].

Measurements of the total cross section for the $\gamma p \rightarrow K^+ \Lambda$ reaction at ELSA/SAPHIR [2] and JLAB/CLAS [3] showed a new resonance-like structure around W = 1900 MeV (E_γ = 1.5 GeV) [4]. However, only cross section data are insufficient for establishing the missing resonances. There still remains a controversy in the theoretical description of the cross sections [5,6]. Additional observables are necessary for further studies. Photon beam asymmetry is useful to pin down the model to be used. Furthermore, there remains a significant discrepancy between the SAPHIR and CLAS data, particularly at forward angles [3]. Therefore, new cross section data are important for solving this discrepancy.

The LEPS experiment has been carried out using linear-polarized photons and a liquid hydrogen target at beamline **BL33LEP**. Photon beam asymmetries and differential cross sections of the $\gamma p \rightarrow K^+ \Lambda$ and $\gamma p \rightarrow K^+ \Sigma^0$ reactions have been measured in the photon energy range from 1.5 GeV to 2.4 GeV at forward angles of $0^o < \Theta^{K+}{}_{cm} < 60^o$. The produced kaons were detected and identified using a magnetic spectrometer in an experimental hutch. The Λ and Σ^0 hyperons are identified using the missing mass calculation.

Figure 1 shows the experimental results of the photon beam asymmetries as a function of $\cos\Theta^{K+}{}_{cm}$ for the $\gamma p \rightarrow K^+ \Lambda$ and $\gamma p \rightarrow K^+ \Sigma^0$ reactions, respectively. The statistical and systematic errors are included in the error bars in the data plots. The signs

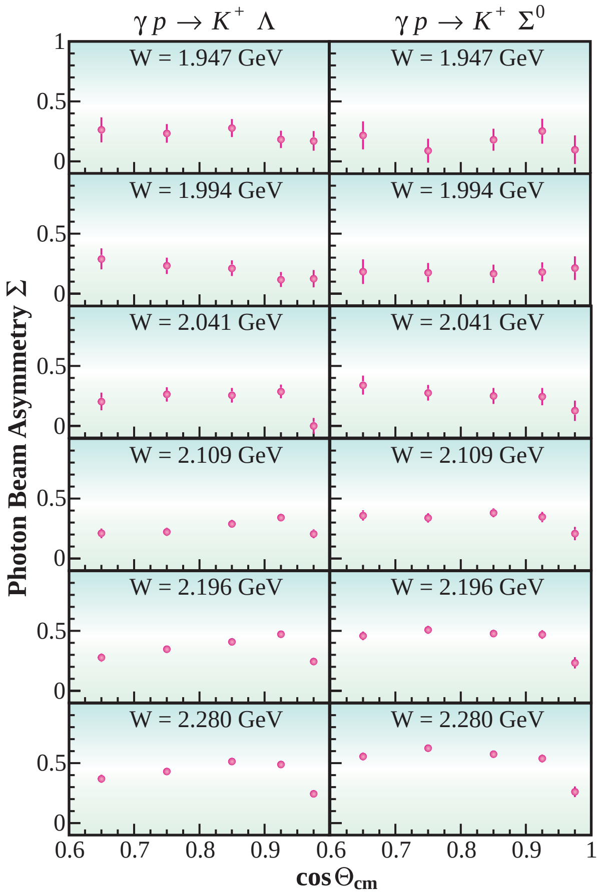

Fig. 1. Angular dependence of photon beam asymmetries for the $\gamma p \rightarrow K^+ \Lambda$ **(a)** and $\gamma p \rightarrow K^+ \Sigma^0$ **(b)** reactions. W is the total energy in GeV.

of the photon beam asymmetries are positive for both reactions in the measured kinematical region. The positive sign means that K^+ particles are emitted preferentially in the orthogonal direction to the photon polarization. The photon beam asymmetry for the both reactions increases as the photon energy increases. Figure 2 shows the differential cross sections as a function of $\cos\Theta^{K^+}_{cm}$ for the $\gamma p \rightarrow K^+ \Lambda$ and $\gamma p \rightarrow K^+ \Sigma^0$ reactions. The measured differential cross sections agree with the data measured by the CLAS collaboration at $\cos\Theta_{cm} < 0.9$ within the experimental uncertainties, but the discrepancy with the SAPHIR data for the $K^+ \Lambda$ reaction is large at $\cos\Theta_{cm} > 0.9$. In the $K^+ \Lambda$ reaction, the resonance-like structure found in the CLAS and SAPHIR data at W =1.96 GeV is seem. The differential cross sections at forward angles suggest a strong K-exchange contribution in the t-channel for the $K^+ \Lambda$ reaction, but not for the $K^+ \Sigma^0$ reaction.

None of theoretical models can reproduce the present data. The data will help develop the theoretical models.

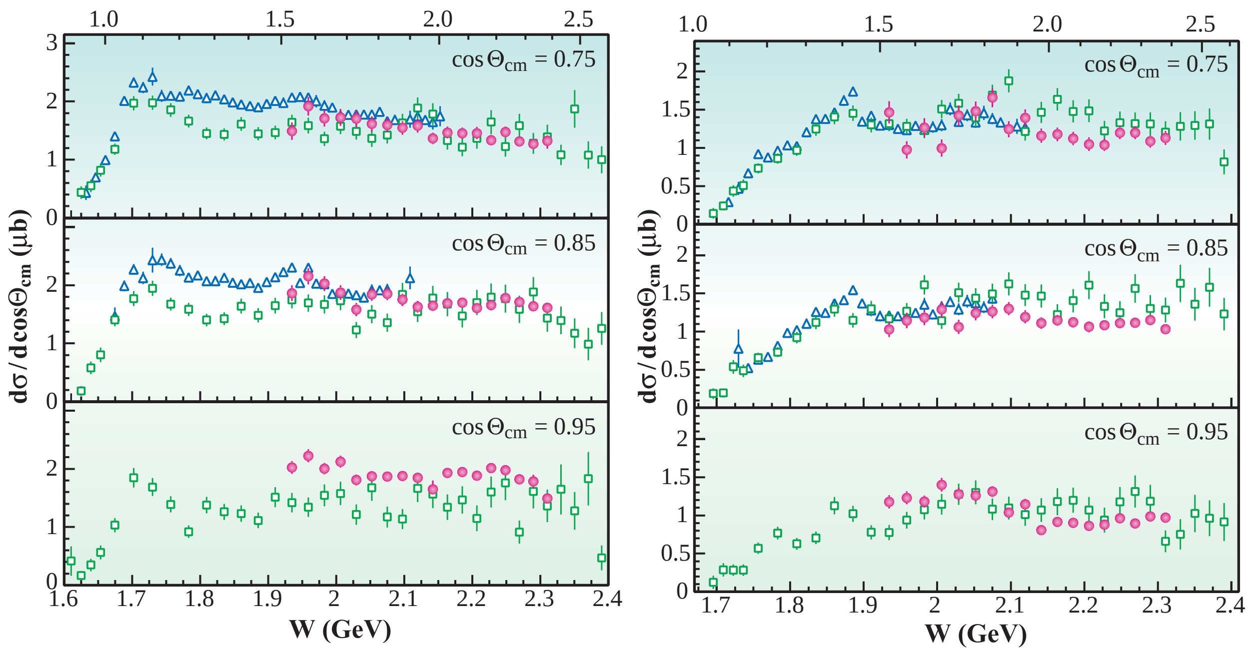

Fig. 2. Energy dependence of differential cross sections for the $\gamma p \rightarrow K^+ \Lambda$ **(a)** and $\gamma p \rightarrow K^+ \Sigma^0$ **(b)** reactions. The closed circles are the present results. The open squares and triangles are the data measured by the SAPHIR [2] and the CLAS [3] collaborations, respectively. Errors are only statistical one.

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References

[1] S. Capstick and W. Roberts: Phys. Rev. D **49** (1994) 4570; Phys. Rev. D **58** (1998) 074011.
[2] M.Q. Tran *et al.*: Phys. Lett. B **445** (1998) 20.
[3] R.A. Schumacher: Nucl. Phys. A **663-664** (2000) 440, nucl-ex/0305028 (2003).
[4] T. Mart and C. Bennhold: Phys. Rev. C **61** (1999) 012201.
[5] S. Janssen *et al.*: Phys. Rev. C **65** (2002) 015201.
[6] B. Saghai: nucl-th/0105001 (2001).