Photon beam asymmetries for the K^+ photoproduction at SPring8/LEPS

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Considerably large number of nucleon resonances, N^* and Δ^*, are predicted by theoretical calculations than ones observed in the πN and $N(\gamma,\pi)$ reactions. These nucleon resonances are called 'missing resonances'. It has been realized that intermediate resonances are limited in the pionic reactions[1]. Quark model studies suggest that a part of these missing resonances may couple to strangeness channels, such as $K\Lambda$ and $K\Sigma$ channels[1].

Recently, indications of new resonance contributions were seen around $E_\gamma = 1.5$ GeV (W = 1.9 GeV in total energy) in the cross section data of the $p(\gamma,K^+)\Lambda$ reaction measured by the SAPHIR[2] and CLAS[3] collaborations. To reproduce the experimental data, missing resonances like $D_{13}(1960)$ were included in several theoretical calculations[4, 5]. However, only cross section data was used for this study. There still remains a controversy in the theoretical description of the cross sections[5, 6]. Therefore, additional observables are necessary for further studies. The photon beam asymmetry is one of good candidates for the studies because the observable is quite sensitive to model differences.

The experiment has been carried out using the linear-polarized photons and the liquid hydrogen target from December 2000 to June 2001 at SPring8/LEPS facility. The photon beam asymmetries of the $p(\vec{\gamma},K^+)\Lambda(1116)$ and $p(\vec{\gamma},K^+)\Sigma^0(1193)$ reactions have been measured for the first time in the photon energy range from 1.5 GeV to 2.4 GeV at forward angles, $0^\circ < \Theta^{K^+}_{cm} < 60^\circ$. Fig. 1 and Fig. 2 show the experimental results of the photon beam asymmetries as a function of $\cos\Theta^{K^+}_{cm}$ for the $p(\vec{\gamma},K^+)\Lambda$ and $p(\vec{\gamma},K^+)\Sigma^0$ reactions, respectively. The statistical and systematic errors are included in the error bars in the data plots. The signs of the photon beam asymmetries are positive for both reactions in the measured kinematical region. The photon beam asymmetry for the both reactions increases as the photon energy increases. The solid and dashed lines in Fig. 1 show the results of the theoretical calculations with and without the $D_{13}(1960)$ missing resonance, respectively, by Mart and Bennhold [4]. Both models result in the positive sign which is the same as our data. The solid line reproduces our data better than the dashed line at $E_\gamma = 1.75$ GeV. None of the present models can reproduce our data of the photon asymmetries perfectly since theoretical models of the

K^+ photoproduction are not fixed due to the lack of data. Our data of the photon beam asymmetries will stimulate the further development of the theoretical models.

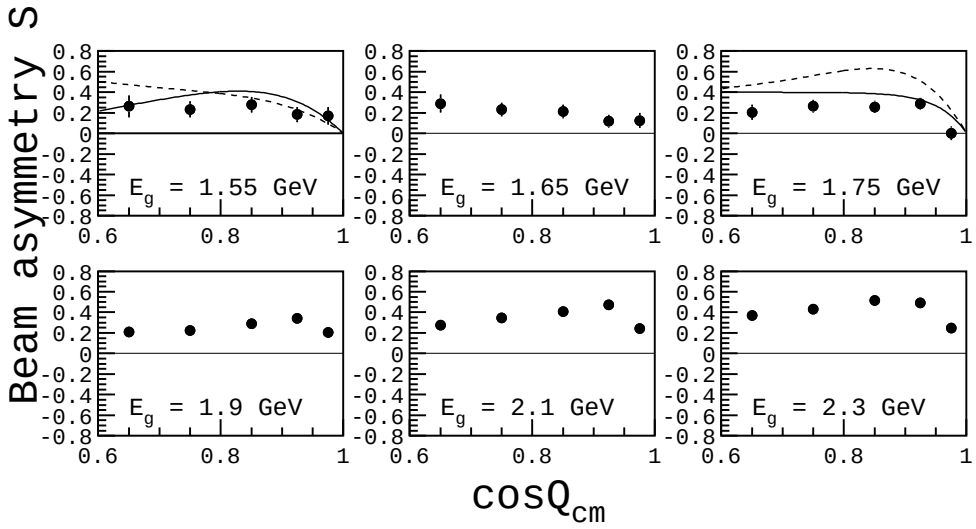

Figure 1: Photon beam asymmetries for the $p(\vec{\gamma},K^+)\Lambda$ reaction. The filled circles are the present data. The lines are theoretical predictions[4].

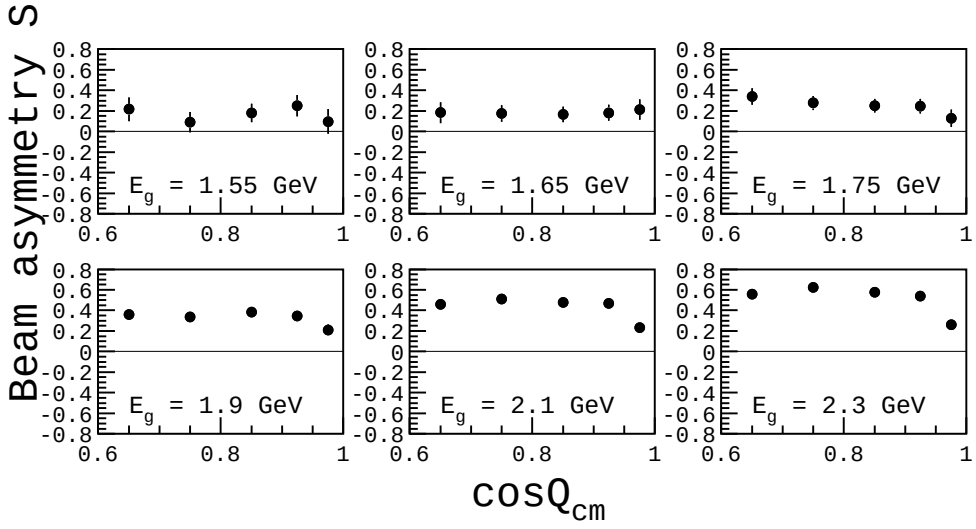

Figure 2: Photon beam asymmetries for the $p(\vec{\gamma},K^+)\Sigma^0$ reaction. The filled circles are the present data.

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