Measurement of the photon beam asymmetries for the $\gamma N \to \pi^0 N$ reaction at the forward angle

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In the 60s and 70s, many single π photoproduction experiments had been performed using multi GeV energy photons. These were mainly aimed at the investigation of exchanged mesons by the aid of the Regge theory[1] and nuclear resonances. If the incident photon is linearly polarized, one could obtain the observable "photon beam asymmetry" which is defined by the asymmetry of the azimuthal angle between the plane of linearly polarized beam and the reaction plane. The observation of this asymmetry is a useful tool to study the parity of exchanged particles. The absence of the contribution from pions is a feature of the π^0 measurement. There is no exchange of a charged pion by the charge conservation and the C-parity conservation forbids the exchange of a neutral pion. However, no data for the photon beam asymmetry at the forward angle have been obtained.

Now a days, the Laser Electron Photon(LEP) is available, which has good properties that the photons concentrate in a small angle and it can become linearly(circularly) polarized with a high degree. In this report, we present preliminary results of the photon beam asymmetry for the $\gamma N \to \pi^0 N$ reaction at the SPring-8/LEPS beam line using LEP with the energy from 1.5 to 2.4 GeV. The experiment was performed using the Forward(FG) and Backward(BG) gamma detectors. LEP was bombarded on a carbon target. FG and BG covered the polar angle of 3-15 deg and 30-100 deg with the full azimuthal angles, respectively[2].

We used events which FG detected both of 2γs from decay π^0 and neither FG nor BG did a charged particle. Figure 1(a) shows an example of 2γ invariant mass distribution. The missing mass assuming the nucleons in the carbon target are at rest is shown in fig.1(b) on the π^0 events in (a). A clear peak at the nucleon mass is seen, which means the quasi-free production of a single π^0. Closed circles in Fig. 2 show one of the preliminary results of the photon beam asymmetry with the carbon target. The obtained value is close to +1 and this suggests that the exchanged particles are dominated by natural parity particles. The candidate is the ω/ρ exchange. The detail analysis is underway.

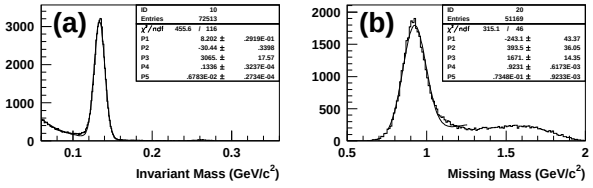

Figure 1: (a)Invariant mass of 2γs detected by FG. (b)Missing mass assuming the nucleons in the carbon target are at rest.

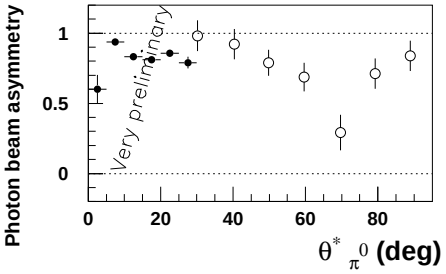

Figure 2: Closed circles are the present results at E_γ =2.0-2.2 GeV with the carbon target. Open circles are the data at E_γ =2.1 GeV for the $\gamma p \to \pi^0 p$ measurement[3]. Horizontal axis is the π^0 polar angle in the CM system.

References

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