Measurement of the photon beam asymmetries for the $\gamma p \to \eta p$ reaction

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The study of nuclear resonances is one of the approaches for understanding the quantum chromo dynamics in the non-perturbative region. However, observed resonances with the high angular momenta are still scarce. Recently, ELSA/CB has reported a new resonance $D_{15}(2070)$ by the $\gamma p \to \pi^0 p$[1] and $\gamma p \to \eta p$[2] reactions. These data were taken using a non-polarized photon beam and the resonances were obtained by the partial wave analysis method. If the incident beam is linearly polarized, one could obtain the new observable "photon beam asymmetry(Σ)" and may provide more information for nuclear resonances. This is defined by the asymmetry of the azimuthal angle between the plane of linearly polarized beam and the reaction plane. This asymmetry occurs when there is an interference between two resonance states excited by right and left circularly polarized parts in the linearly polarized beam, respectively.

ESRF/GRAAL can use a linearly polarized photon beam with the energy up to 1.5 GeV and has provided the photon beam asymmetry data for the $\gamma p \to \eta p$ reaction from the η threshold[3][4]. In this report, we present preliminary results of the $\gamma p \to \eta p$ reaction with a CH_2 target at the SPring-8/LEPS beam line with the energy from 1.5 to 2.4 GeV. These energies correspond to $\sqrt{s}$ =1.92 and 2.32 GeV/c^2, respectively, so our experiment is suitable for studying over the suggested new resonance $D_{15}(2070)$. The experiment was performed using the Forward(FG) and Backward(BG) gamma detectors to detect 2γs decaying from η. They covered the polar angle of 3-15 deg and 30-100 deg with the full azimuthal angles, respectively[5].

In this analysis, 1γ was detected by FG and BG each from decay η. The recoil proton was detected by BG and identified by the E-ΔE technique. The coplanar cut has also been applied for the protons assuming the $\gamma p \to \eta p$ process. Figure 1(a) shows a 2γ invariant mass and (b) is the missing mass assuming protons in carbon nuclei in the CH_2 target are at rest. The events of 0.8-1.1 GeV/c^2 in (b) were selected in (a). Figure 2 is the result of the photon beam asymmetries. They seems to have a tendency of a forward peaking shape and large asymmetry values. Further analysis is underway.

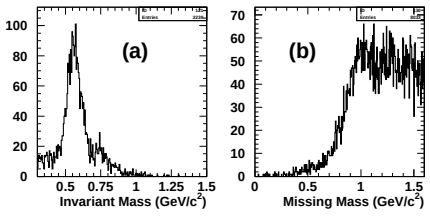

Figure 1: (a)Invariant Mass of 2γs. (b)Missing mass assuming the protons are at rest. Both are CH_2 target data.

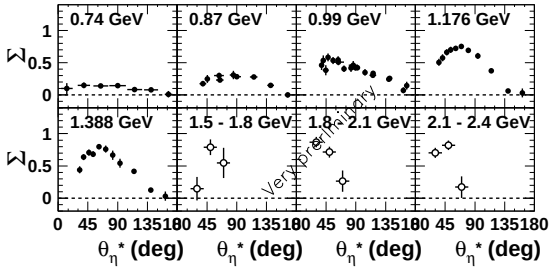

Figure 2: Obtained photon beam asymmetries(Σ). Open circles are the present results with a CH_2 target. Error bars are statistical only. Closed circles are the data by GRAAL[3][4].

References

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