Study of the ηN scattering amplitude through the associated photoproduction of Φ- and η-mesons

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The $\gamma p \to \Phi\eta p$ reaction is studied in the kinematic region where the ηp final state originates dominantly from the decay of the $N*(1535)$ resonance. The threshold laboratory photon energy for this reaction (at the peak of the $S11$ resonance) is $E_\gamma^{Lab} = 3\,GeV$. We will discuss it somewhat above threshold, at $E_\gamma^{Lab} \simeq 4-\ GeV$, in order to reach lower (absolute) values of the squared 4-momentum transfer from the initial photon to the final Φ-meson. In these conditions, we expect the t-channel π^0- and η-meson exchanges to drive the dynamics underlying the $\gamma p \to \Phi\eta p$ process. The initial photon dissociates into the final Φ-meson and a virtual pseudoscalar meson (π^0 or η). The virtual pseudoscalar meson scatters from the proton target to produce the final ηp state. The $\pi^0 p \to \eta p$ and $\eta p \to \eta p$ amplitudes are derived in the framework of a coupled-channel effective field theory of meson-baryon scattering. We found the η-meson exchange to be largely dominant. The $\eta - \pi^0$ interference is of the order of 20-30%. The sign of this term is not known and has a significant influence on the results. The $\pi N \to \eta N$ amplitude being largely determined by data on the $\pi^- p \to \eta n$ reaction, we found that the $\gamma p \to \Phi\eta p$ reaction cross section is rather directly related to the η-nucleon scattering amplitude in the $N*(1535)$ resonance region. Accurate data on the $\gamma p \to \Phi\eta p$ process would therefore put additional constraints on this still poorly known amplitude.

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[2] M.F.M. Lutz, Gy. Wolf, B. Friman, Nucl. Phys. A 706 (2002) 431; ERRATUM-ibid A 765 (2006) 495.

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