$K^*\Sigma$ photoproduction off the proton target with baryon resonances

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We studied on the K^* photoproduction off the proton target, i.e. $\gamma p \to (K^{*0}\Sigma^+, K^{*+}\Sigma^0)$. There have been two experimental data from the TAPS collaboration at CBELSA [1] and the CLAS collaboration at Jefferson laboratory [2]. We employ the effective Lagrangian method at the tree-level Born approximation, including the N^* and Δ^* resonance contributions, such as $D_{13}(2080)$, $G_{17}(2190)$, $D_{15}(2200)$, $S_{31}(2150)$, $G_{37}(2200)$, and $F_{37}(2390)$. The relevant Feynman diagrams preserving the gauge invariance are given in Fig. 1, in which N, Δ, K, κ, Σ, and Σ^* indicate the nucleon, $\Delta(1232)$, $K(496)$, $\kappa(800)$, $\Sigma(1190)$, and $\Sigma^*(1385)$, respectively.

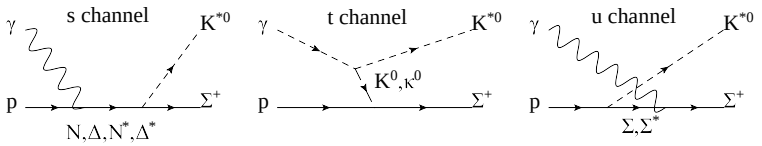

Figure 1: Relevant Feynman diagrams for $\gamma p \to K^*\Sigma$.

The scattering amplitude can be written with the phenomenological form factors that satisfy the Ward-Takahashi identity and the form factors are defined generically as

$$F_{\rm common} = F_p F_\Sigma - F_p - F_\Sigma, \qquad F_\Phi = \frac{\Lambda_\Phi^2 - M_\Phi^2}{\Lambda_\Phi^2 - p^2}, \qquad F_B = \frac{\Lambda_B^4}{\Lambda_B^4 + (p^2 - M_B^2)^2}, \tag{1}$$

where p, Λ_Φ and Λ_B stand for the momentum transfer, the cutoff masses for the meson-exchange and baryon-pole diagrams, respectively. For the details of the theoretical framework, readers can refer to [3].

The numerical results for the total cross sections are given in the left panel of Fig. 2 as functions of E_γ. The unpolarized production strengths for $K^{*0}\Sigma^+$ and $K^{*+}\Sigma^0$ photoproductions are negligibly affected by the resonance contributions. In other words, the total production rate is dominated by the Born diagrams such as the Δ-pole and t-channel exchanges, as far as we rely on the available experimental and theoretical information.

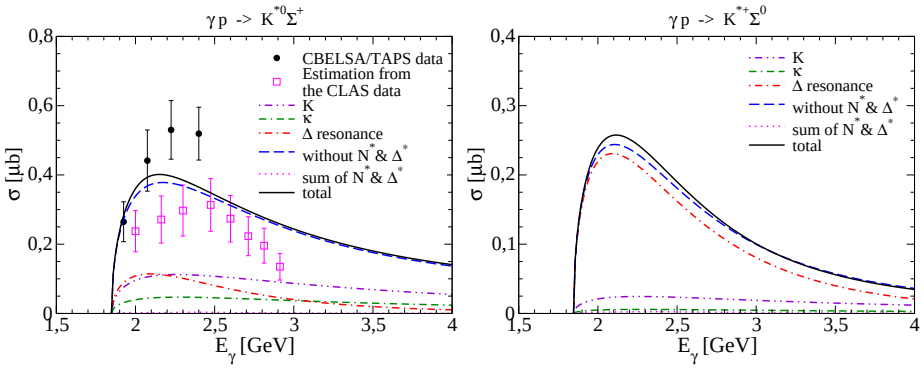

Figure 2: Total cross sections for $\gamma p \to K^{*0}\Sigma^+$ as functions of the photon energy E_γ in the left panel. The black circles denote the TAPS data [1], whereas the open squares represent the estimated values extracted from the CLAS data [2]. The Total cross sections for $\gamma p \to K^{*+}\Sigma^0$ are given in the right panel with the same notation.

References

[1] M. Nanova *et al.* [CBELSA/TAPS Collaboration], Eur. Phys. J. A **35**, 333 (2008).
[2] I. Hleiqawi *et al.* [CLAS Collaboration], Phys. Rev. C **75**, 042201 (2007).
[3] Y. Oh and H. Kim, Phys. Rev. C **74**, 015208 (2006).