1 - 9 $\Lambda(1520)$ and $\Sigma(1385)$ Photoproductions Based on the New CLAS Data*

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The study of nucleon resonance is an important topic in hadron physics. The most important way to study the nucleon resonances is the collision of the photon and nucleon. Up to now, the knowledge about the nucleon resonances around 2 GeV is still scarce. Recently, the CLAS Collaboration at Jefferson National Accelerator Facility released their exclusive photoproduction cross sections for the $\Lambda(1520)$, $\Sigma^0(1385)$ and $\Lambda(1405)$ for energies from near threshold up to a center of mass energy W of 2.85 GeV with large range of the K production angle[1]. Since the threshold for the photoproduction of $\Lambda(1520)$ is about 2.01 GeV, the new experimental data with high precision released by the CLAS Collaboration provide an opportunity to study the nucleon resonances above 2 GeV.

The new experimental data of the $\Lambda(1520)$ and $\Sigma(1385)$ photoproductions are analyzed in a Regge-plus-resonance approach combined with the input from the constituent quark model[3]. As shown in Figs. 1 and 2, the differential cross sections for both photoproductions are well reproduced in our model. The result suggests that the contact terms are dominant in the photoproductions of $\Lambda(1520)$ and $\Sigma(1385)$. The Regge trajectory is found to be essential for reproducing the experimental data at forward angles, especially at high energies. To describe the behavior of the differential cross section at backward angles, the Λ intermediate u channel contribution should be included.

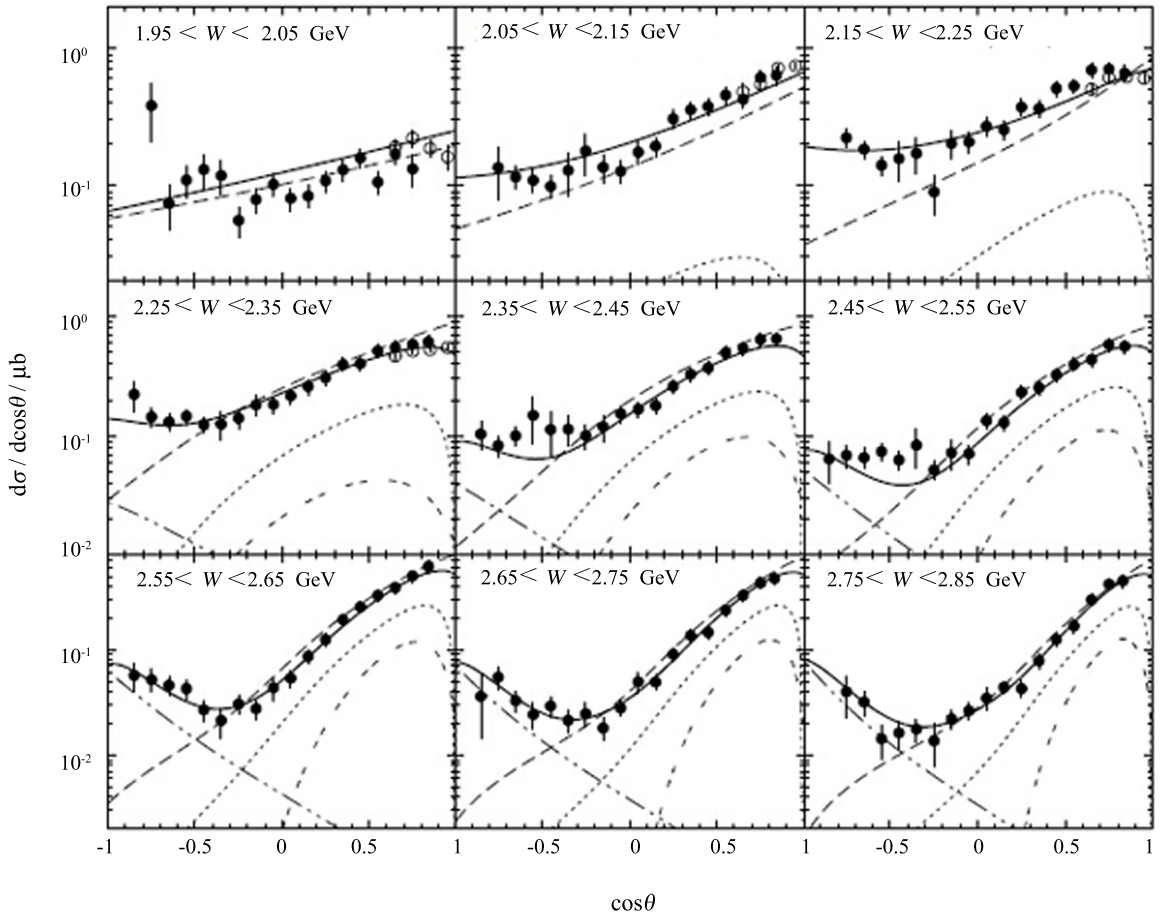

Fig. 1 (color online) The differential cross section $d\sigma/d\cos\theta$ with variation of $\cos\theta$. The full (black), dashed (red), dotted (blue), dash-dot-dotted(brown), dash-dashed (magenta) and dash-dotted (darkgreen) lines are for full model, contact term, K exchange t channel, u channel, K* exchange t channel and N(2120). The full circle (red) and open circle (blue) are for CLAS13 data [1] and LEPS10 data [2].

* Foundation item: Major State Basic Research Development Program of China (2014CB845405), National Natural Science Foundation of China (11275235, 11035006) and Knowledge Innovation Project of Chinese Academy of Sciences(KJCX2-EW-N01).

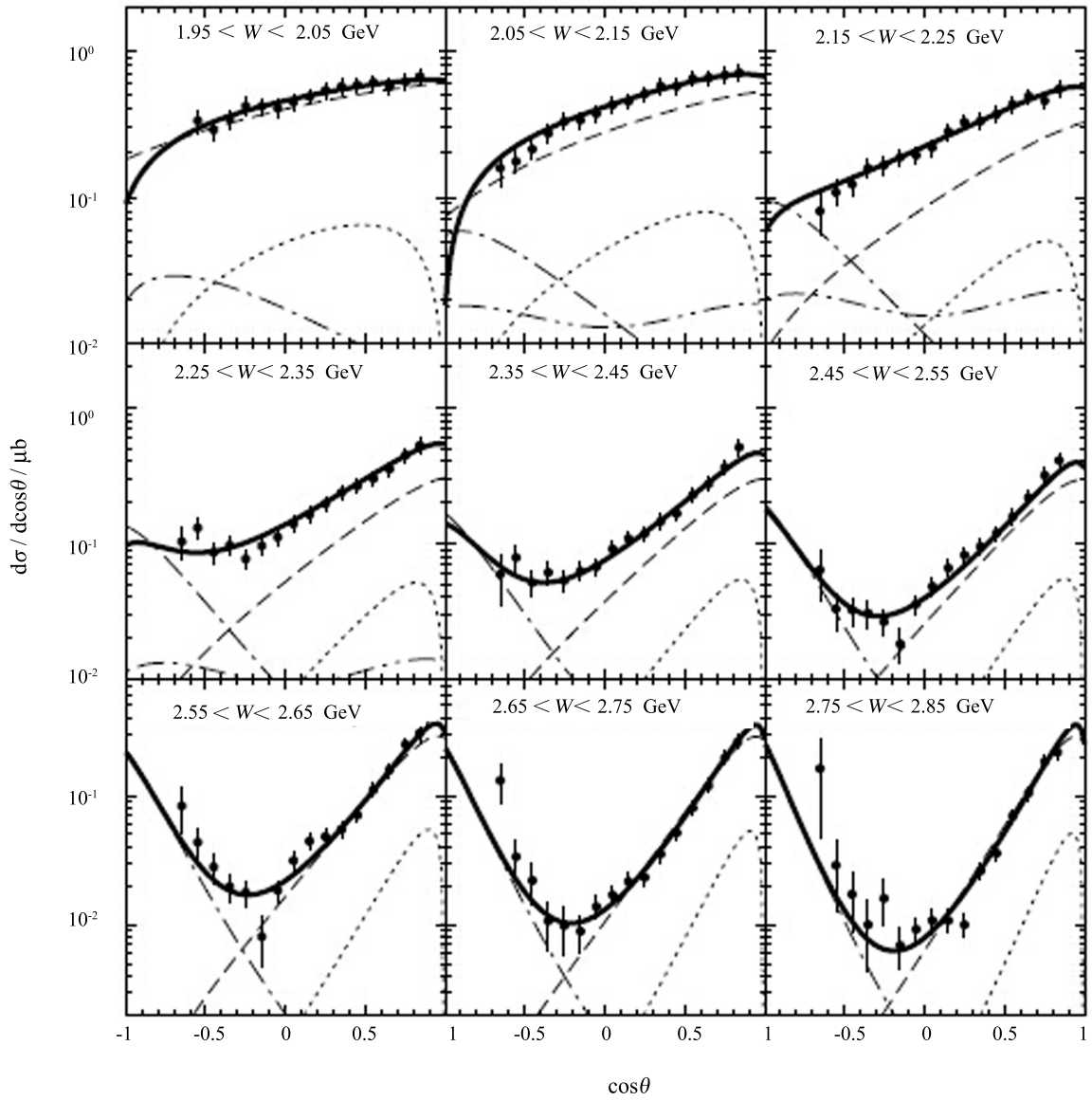

Fig. 2 (color online) The differential cross section $d\sigma/d\cos\theta$ for the $\Sigma(1385)$ photoproduction from proton as a function of $\cos\theta$. The full (black), dashed (red), dash-dotted (brown), dotted (blue) and dash-dot-dotted (green) lines are for the full model, the contact term, the u channel, the t channel and $\Delta(2000)$, respectively. The data are from[1].

The contributions of nucleon resonances are determined by the radiative and strong decay amplitudes predicted from the constituent quark model[4,5]. The results show that the contributions from nucleon resonances are small compared with the contact term, u and t channel contributions, but essential to reproduce the experimental data. In the $\Sigma(1835)$ photoproduction, the contribution from $\Delta(2000)$ is much more important than the contributions from other nucleon resonances, and the N(2120) is dominant in the $\Lambda(1520)$ photoproduction. The data indicate that the $\Delta(2000)$ and N(2120) are the third Δ state with spin-parity $5/2^+$ and the third nucleon state with spin-parity $3/2^-$ in constituent quark model, respectively. Other nucleon resonances are found to give negligible contributions in the channel considered in this work. The results are helpful to understand the internal structure of the nucleon resonance around 2 GeV and the "missing resonance" problem.

References

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