**Charmonium absorption by nucleons in the meson-exchange model**

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We have reanalyzed and improved the meson-exchange model for J/ψ-nucleon reaction [1]. We find that vector-meson dominance and charm vector-current conservation lead to the universality of the J/ψ meson couplings, which can drastically change the ratio $R_{D/D^*}$ of the cross sections of $J/\psi+N\rightarrow D+\Lambda_c$ and $J/\psi+N\rightarrow D^*+\Lambda_c$. It is also found that this ratio is sensitive to the relative strengths of the coupling constants $g_{DN\Lambda c}$ and $g_{D^*N\Lambda c}$ as well as to the tensor couplings $\kappa_{\psi\Lambda c\Lambda c}$ and $\kappa_{D^*N\Lambda c}$. We further find that the Vector Meson Dominance (VDM) and vector-current conservation lead to a large value of $R_{D/D^*}$. This value can be further enhanced by the $\psi\Lambda_c\Lambda_c$ tensor interaction. But the $D^*N\Lambda_c$ tensor interaction has the opposite role by decreasing $R_{D/D^*}$. To match the quark-interchange model predictions of Ref.[2] with those from our effective Lagrangian approach leads us to conclude that $g_{DN\Lambda c}$ must be larger than $g_{D^*N\Lambda c}$ and $\kappa_{D^*N\Lambda c}$ must be small. The first condition contradicts with the QCD sum-rule predictions of Ref.[3] that prefers a similar strength for the two couplings. Instead, the SU(4) symmetry relations satisfy this condition. However, SU(4) symmetry gives a large value for $\kappa_{D^*N\Lambda c}$, and thus does not fulfill the second condition. Since SU(4) symmetry must be broken by the heavy charm quark mass, it would be interesting to see how badly the SU(4) symmetry relations for $g_{DN\Lambda c}$, $g_{D^*N\Lambda c}$, and $\kappa_{D^*N\Lambda c}$ are broken. Therefore, more rigorous studies on these couplings are required, which will eventually help to reconcile the predictions of the quark model and of the meson-exchange model. Nevertheless, the constraints used in our study, VMD and charm vector-current conservation, are found to have a nontrivial role to fill the gap between the quark-interchange model and meson-exchange model predictions to some extent.

[1] Y. Oh, W. Liu, and C. M. Ko, Phys. Rev. C **75**, 064903 (2007).
[2] J. P. Hilbert, N. Black, T. Barnes, and E. S. Swanson, nucl-th/0701087.
[3] F. O. Duraes, F.S. Navarra, and M. Nielsen, Phys. Lett. B **498**, 169 (2001).