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Production of New Hadron States in Effective Field Theory

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Abstract : In the past decade, a growing number of new hadron states have been observed, which are dubbed as XYZ states in the heavy quarkonium mass regions. In this work, we present our study on the production of some new hadron states. In particular, we investigate the processes Y(5S,6S)→ Zb (10610)/Zb (10650)π, Bc→ Zc (3900)/Zc (4020)π and Λb→ Pc (4312)/Pc (4440)/Pc (4457)K. (1) For the production of Zb (10610)/Zb (10650) from Y(5S,6S) decay, two types of bottom-meson loops were discussed within a nonrelativistic effective field theory. We found that the loop contributions with all intermediate states being the S-wave ground state bottom mesons are negligible, while the loops with one bottom meson being the broad B_0* or B_1' resonance could provide the dominant contributions to the Y(5S)→ $Zb^{(1)}$ π. (2) For the production of Zc (3900)/Zc (4020) from Bc decay, the branching ratios of Bc^+→ $Z(3900)^+$ π^0 and Bc^+→ $Zc(4020)^+$ π^0 are estimated to be of order of $10^{(-4)}$ and $10^{(-7)}$ in an effective Lagrangian approach. The large production rate of Zc (3900) could provide an important source of the production of Zc (3900) from the semi-exclusive decay of b-flavored hadrons reported by D0 Collaboration, which can be tested by the exclusive measurements in LHCb. (3) For the production of Pc (4312), Pc (4440) and Pc (4457) from Λb decay, the ratio of the branching fraction of Λb→ Pc K was predicted in a molecular scenario by using an effective Lagrangian approach, which is weakly dependent on our model parameter. We also find the ratios of the productions of the branching fractions of Λb→ Pc K and Pc→ J/ψ p can be well interpreted in the molecular scenario. Moreover, the estimated branching fractions of Λb→ Pc K are of order $10^{(-6)}$, which could be tested by further measurements in LHCb Collaboration.

Keywords : effective Lagrangian approach, hadron loops, molecular states, new hadron states
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