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Doubly heavy tetraquark bound and resonant states in the quark model

In 2021, the LHCb Collaboration discovered the first doubly charmed tetraquark state $T_{cc}(3875)^+$, which may open a new chapter for the discovery of other doubly heavy exotic states in the future. We investigate the S-wave doubly heavy tetraquark systems, including the $QQ^{(\prime)}\bar{q}\bar{q}$, $QQ^{(\prime)}\bar{s}\bar{q}$, and $QQ^{(\prime)}\bar{s}\bar{s}$ ($Q^{(\prime)} = b, c$ and $q = u, d$) systems, within the constituent quark model. Besides the D^*D molecular bound state as a candidate of $T_{cc}(3875)^+$, we also obtain a series of other bound and resonant states with various configurations, including meson molecules, compact diquark-antidiquark tetraquarks, compact even tetraquarks (QCD analog of hydrogen molecule) and compact diquark-centered tetraquarks (QCD analog of helium atom). The classifications of tetraquarks based on their color-spatial configurations help unravel the rich internal structures and various forming mechanisms of tetraquark states.

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