Near-Threshold Doubly Heavy Tetraquark States

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1 Abstract

The structure of exotic hadrons remains one of the major unsolved problems in particle physics. While advances in high energy experiments have provided compelling evidence for the existence of a variety of exotic states, no consistent theoretical description of these states has emerged. This paper focuses on tetraquark states which contain two heavy quarks or one heavy quark and one heavy anti-quark, and for which only one quantum state exists, in connection to recently discovered particles such as the $X(3872)$ which are thought to contain a $c\bar{c}$ pair. We present a description of these states as a two-body problem in quantum mechanics. By parameterizing the mass of the heavy quark, we showed that the weakly bound property of such states is a direct consequence of mass scale separation in the semi-classical limit of quantum chromodynamics.