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Resolving the left-hand-cut problem in lattice studies of the doubly-charmed tetraquark

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The recently discovered I = 0, JP = 1+ doubly-charmed tetraquark Tcc(3875) is an exotic meson that is a candidate for a DD*molecule. In nature, it decays to DDπ, since the D* is unstable. It has been studied on the lattice for heavier-than-physical quark masses for which the D*is stable, so that two-particle methods can be used. However, a major drawback of this methodology is that the tentative position of the (virtual) bound state lies very close to, or even below, the left-hand cut, which is the subthreshold energy below which the two-body formalism breaks down. We present a method to overcome this limitation, in which we apply the three-particle formalism to the DDπ system and incorporate the D* as a bound state in the p-wave Dπ subsystem. Using this formalism below the three-particle threshold allows us to study the Tcc while incorporating the physics responsible for the left-hand cut. The new approach has the additional advantage of remaining valid when the quark masses are reduced into the regime where the D decays to Dπ, so that the Tcc becomes a resonance with a three-body decay.

Topical area

Hadronic and Nuclear Spectrum and Interactions

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