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Nature of Tcc with effective field theory

The exotic hadrons have a different internal structure from the ordinary hadrons with qqq or $q\bar{q}$. T_{cc}, observed by the LHCb Collaboration last year, is considered as the exotic state with $cc\bar{u}\bar{d}$ [1]. One of the possible internal structures of the exotic hadron is the hadronic molecule state which is a weakly bound state of hadrons. The weight of the hadronic molecule component in a hadron wavefunction is quantitatively expressed as the compositeness [2]. We discuss the internal structure of T_{cc} by calculating the compositeness with the effective field theory.

We construct a model to reproduce the mass of T_{cc} with the scattering of D^0D^{*+} coupled with the compact four-quark state. The model parameters are the cutoff Λ, coupling constant g_0 and energy of the compact four-quark state ν_0 measured from the threshold of the D^0D^{*+} scattering. We employ $\Lambda = 0.14$ [GeV] based on the pion exchange interaction. The relation between g_0 and ν_0 is obtained from the bound-state condition with the binding energy $B = 0.36$ [MeV] of T_{cc}. We vary ν_0 in the region $-B \leq \nu_0 \leq \Lambda^2/(2\mu)$ which is the allowed region in this model. We show that T_{cc} is hadronic molecule dominant for almost all region of ν_0 even without D^0D^{*+} direct interactions.

[1] R. Aaij et al. [LHCb], Nature Phys 18 (2022) no.7, 751-754; Nature Commun. 13, no.1, 3351 (2022).
[2] T. Kinugawa and T. Hyodo, Phys. Rev. C 106, 015205 (2022).

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