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Extracting properties of the Tcc(3875) state from lattice QCD

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Exploring the light-quark mass dependence of near-threshold exotic states provides insights into their internal structure. In this talk, we introduce a novel approach based on chiral effective field theory to extract the properties of such states from lattice energy levels [1]. This approach benefits from the incorporation of left-hand cuts originating from long-range interactions, thereby extending beyond the well-known Lüscher method. Also, the presence of the left-hand cuts in the vicinity of the threshold restricts the effective range expansion, commonly used for analyzing infinite volume phase shifts, to a very narrow energy range [2].

The proposed approach is applied to systematically extract, for the first time, the properties of the Tcc state, particularly the pole position and the low-energy parameters, from recent lattice data for DD* scattering at mpi=280 MeV [3], accounting for the left-hand cut contribution from the one-pion exchange [1]. The one-pion exchange is shown to have a significant impact on S-wave and P-wave phase shifts as well as the Tcc pole position. Consequences for the structure of the Tcc are discussed.

[1] L.~Meng, V.~Baru, E.~Epelbaum, A.~A.~Filin and A.~M.~Gasparyan, "Solving the left-hand cut problem in lattice QCD: $T_{cc}(3875)^+$ from finite volume energy levels," [arXiv:2312.01930 [hep-lat]], accepted for publication in Physics Review D (letter).

[2] M.~L.~Du, A.~Filin, V.~Baru, X.~K.~Dong, E.~Epelbaum, F.~K.~Guo, C.~Hanhart, A.~Nefediev, J.~Nieves and Q.~Wang,

"Role of Left-Hand Cut Contributions on Pole Extractions from Lattice Data: Case Study for Tcc(3875)+," Phys. Rev. Lett. \textbf{131} (2023), 131903

[3] M.~Padmanath and S.~Prelovsek, "Signature of a Doubly Charm Tetraquark Pole in DD* Scattering on the Lattice," Phys. Rev. Lett. \textbf{129} (2022), 032002

session

B. Hadron Spectroscopy

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