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Revealing the puzzle of the dynamical nature of two $\bar{3}_1^* \bar{3}^*$ states from an analysis of LQCD results

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We perform an analysis of LQCD light - charmed (pseudoscalar) meson scattering data with UChPT for pion masses ranging from $m_\pi \simeq 230$ -MeV till the SU(3) limit, $m_\pi \simeq 700$ -MeV. We find two poles in the non-strange isospin $I = 1/2$ sector that can be related to the experimental $D_0(2300)$ resonance. At the physical pion mass, the poles are located at $\sqrt{s_0} = 2094(7)(1) - i111(7)(13)$ MeV, and $2463(60)(30) - i108(14)(12)$ -MeV. While the first pole, named here $D_0^*(2100)$, is always a resonance in $D\pi$ within the 1σ region, the second pole can be a resonance or virtual state close to the $D\eta, D_s\bar{K}$ thresholds. For the first time, the pion mass dependence on different chiral trajectories including SU(3) LQCD data are investigated for these poles. We find that in the $m_s = m_{s,\text{phy}}$ trajectory, the $D_0^*(2100)$ resonance pole behaves similarly as the σ resonance in $\pi\pi$ scattering, splitting into two poles, connected to the $\bar{\mathbf{3}}$ representation. Moreover, we found that the higher pole related to the experimental $D_0^*(2300)$ can be related to the $\mathbf{6}$ representation. We highlight that since this pole couples strongly to channels with hidden strangeness, its mass is fairly constant in the $\text{Tr}[M] = C$ trajectory, what can be tested in future LQCD simulations. The compositeness of the $D_0^*(2100)$ state at the SU(3) limit is evaluated. Finally, other sectors are also discussed.

Primary author(s) : ZHUANG, Zejian (University of Valencia)

Presenter(s) : ZHUANG, Zejian (University of Valencia)

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