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The role of charged exotic states in e+e- to psi(2S) pi+ pi-

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Abstract

In this work, we use the dispersion theory to provide a physical description of recent BESIII data on the reaction $ e^+ e^- \to \psi (2S) \, \pi^+ \, \pi^-$. Taking into account explicitly the effects of charged exotic intermediate states in the t- and u-channels as well as the two-pion final state interaction, we describe the invariant mass distribution for four different $e^+ e^-$ center-of-mass energies. The effects of the $\pi\pi$ rescattering are accounted for within a model-independent single channel approach which is found to explain the $\pi \pi$-invariant mass distributions at all $e^+ e^-$ center-of-mass energies. For $q= 4.226$ GeV and $q= 4.258$ GeV the already established charged exotic state $Z_c(3900)$ is considered as the intermediate state, whereas for $q= 4.358$ GeV the rescattering of pions dominates the fits. For the highest energy, $q= 4.416$ GeV, a heavier charged exotic state with mass $m_{Z_c} = 4.016(4)$ GeV and width $\Gamma_{Z_c} = 52(10)$ MeV is essential to describe the experimental data. Although the mass of this state is consistent with the established $Z_c(4020)$, its width is significantly larger.