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Prediction of a narrow exotic hadronic state with quantum numbers J^{PC}=0^{−}

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Lots of charmonium-like structures have been observed. Most of them share the same quantum numbers with conventional charmonium states, with exceptions of those with an electric charge and/or strangeness. We show that a neutral and zero-strangeness charmonium-like exotic state with quantum numbers $J^{PC} = 0^{--}$, denoted as $\psi_0(4360)$, is a robust prediction in the hadronic molecular scenario, where the $\psi(4230)$, $\psi(4360)$ and $\psi(4415)$ are identified as $D\bar{D}_1$, $D^*\bar{D}_1$ and $D^*\bar{D}_2^*$ bound states, respectively; the mass and width are predicted to be (4366 ± 18)˜MeV and less than 10˜MeV, espectively. The interactions are calculated by the t-channel vector and pseudoscalar meson exchanges assisted by heavy quark spin symmetry. The coupled-channel effects and the u-channel pion exchange including full 3-body effects of the $D^*\bar{D}^*\pi$ intermediate states are carefully examined. The $\psi_0(4360)$ is significant in two folds: no 0^{--} hadron has been observed so far, and a study of this state will enlighten the understanding of the mysterious vector mesons between 4.2 and 4.5˜GeV. We propose that such an exotic state can be searched for in $e^+e^- \to \eta\psi_0(4360)$ and uniquely identified by measuring the angular distribution of the outgoing η meson.

Category

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