Test the two-pole structure of the $\Xi(1820)$ state

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Content

We present a new interpretation for the observed $\Xi(1820)$ resonance in the recent BESIII measurement of the $K^-\Lambda$ mass distribution in the$\psi(3686) \to K^-\Lambda\bar{\Xi}^+$ decay. We recall that the chiral unitary approach for the interaction of pseudoscalar mesons with the baryons of the decuplet predicts two states for the $\Xi(1820)$ resonance, one around 1824 MeV and narrow, and another one around 1875 MeV and wide. We show how the consideration of the two $\Xi(1820)$ states provides a natural explanation to the BESIII data. Furthermore, we propose the reactions $\psi(3686) \to \bar{\Xi}^+\bar{K}^0\Sigma^{*-}$, $\Omega_c \to \pi^+(\pi^0,\eta)\pi\Xi^*$ and $\Omega_c \to \pi^+(\pi^0,\eta)\bar{K}\Sigma^*$ in order to show evidence for the existence of two $\Xi(1820)$ states. For the $\psi(3686) \to \bar{\Xi}^+\bar{K}^0\Sigma^{*-}$ decay, the phase space for $\bar{K}^0\Sigma^{*-}$ production reduces the effect of the lower mass resonance, magnifying the effect of the higher mass resonance that shows clearly over the phase space. When the $\Omega_c \to \pi^+(\pi^0,\eta)\bar{K}\Sigma^*$ reactions are studied, both peaks for the two $\Xi(1820)$ states are observed in the $\bar{K}\Sigma^*$ mass distributions. For the $\Omega_c \to \pi^+(\pi^0,\eta)\pi\Xi^*$ decays, the $\pi\Xi^*$ mass distributions obtained in the different reactions studied are quite different. The lower mass resonance is clearly seen as a sharp peak, but the higher mass resonance manifests itself through an interference with the lower one that leads to a dip in the mass distribution around $1850\,\mathrm{MeV}$. Its observation in coming upgrades of present facilities will shed light on the existence of two $\Xi(1820)$ states and their nature.

Reference

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