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Pole determination of $P^{\Lambda}_{\psi s}(4338)$ and possible $P^{\Lambda}_{\psi s}(4254)$ in $B^- \to J/\psi\Lambda\bar{p}$

First hidden-charm pentaquark candidate with strangeness, $P^{\Lambda}_{\psi s}(4338)$, was recently discovered in $B^- \to J/\psi\Lambda\bar{p}$ by the LHCb Collaboration. $P^{\Lambda}_{\psi s}(4338)$ shows up as a bump at the $\Xi_c\bar{D}$ threshold in the $J/\psi\Lambda$ invariant mass ($M_{J/\psi\Lambda}$) distribution. The $M_{J/\psi\Lambda}$ distribution also shows a large fluctuation at the $\Lambda_c\bar{D}_s$ threshold, hinting the existence of a possible $P^{\Lambda}_{\psi s}(4254)$. In this work, we determine the $P^{\Lambda}_{\psi s}(4338)$ and $P^{\Lambda}_{\psi s}(4254)$ pole positions for the first time. For this purpose, we fit a $B^- \to J/\psi\Lambda\bar{p}$ model to the $M_{J/\psi\Lambda}$, $M_{J/\psi\bar{p}}$, $M_{\Lambda\bar{p}}$, and $\cos\theta_{K^*}$ distributions from the LHCb simultaneously; $\chi^2/\mathrm{ndf} \sim 1.29$. Then we extract $P^{\Lambda}_{\psi s}$ poles from a unitary $\Xi_c\bar{D}$-$\Lambda_c\bar{D}_s$ coupled-channel scattering amplitude built in the model. The $P^{\Lambda}_{\psi s}(4338)$ pole is found at $(4339.2 \pm 1.6) - (0.9 \pm 0.4)\,i$˜MeV while the $P^{\Lambda}_{\psi s}(4254)$ pole at 4254.4 ± 0.9˜MeV. Without the coupled-channels, $P^{\Lambda}_{\psi s}(4338)$ is a bound $\Xi_c^+ D^-$-virtual $\Xi_0^+ \bar{D}^0$ state while $P^{\Lambda}_{\psi s}(4254)$ is a $\Lambda_c\bar{D}_s$ virtual state. The data disfavors a hypothesis of $P^{\Lambda}_{\psi s}(4338)$ as merely a kinematical effect. This pole determination, which is important in its own right, sets a primary basis to study the nature of the $P^{\Lambda}_{\psi s}$ states.

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