

Hidden-charm $P_{\psi s}^\Lambda$ pentaquarks in a constituent quark model calculation

The discovery of pentaquark states by the LHCb [1] revolutionized Hadron Physics, expanding the usual qqq structure to four quarks and an antiquark. The first observations, detected in the $J/\psi p$ mass spectrum, showed two resonances, dubbed $P_c(4380)^+$ and $P_c(4450)^+$, close to $D^{(*)}N$ thresholds, which suggested a baryon-meson molecular nature in contrast to a compact pentaquark core. The existence of such pentaquarks, with minimum $\bar{c}cuud$ quark content, anticipated similar hidden-charm structures with strangeness, i.e., with $\bar{c}cuds$, which were recently confirmed with the discovery of the so-called $P_{cs}(4459)^0$ [2], now called $P_{\psi s}^\Lambda(4459)^0$.

In this work, we provide a theoretical description of the $P_{\psi s}^\Lambda(4459)^0$ and $P_{\psi s}^\Lambda(4338)$ resonances as $\bar{D}^{(*)}\Xi_c^{(\prime)(*)}$ molecular states in the framework of a constituent quark model that has been extensively used to describe hadron phenomenology [3], in particular exotic states in the baryon spectrum as meson-baryon molecules [4,5]. Such $P_{\psi s}^\Lambda$ states are found in the $J^P = \frac{1}{2}^-$ channel with masses and widths compatible with the experimental measurements in a coupled-channels calculation with all the parameters constrained from previous studies. Other candidates are explored in the $J^P = \frac{3}{2}^-$ and $\frac{5}{2}^-$ channels. Additionally, $P_{\psi ss}^N$ pentaquark states are predicted as $\bar{D}_s\Xi_c$ molecules.

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