

Novel pentaquark picture of single-heavy baryons in chiral effective model

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We propose a new type of structure of single-heavy baryons made of one heavy and four light quarks, namely $Qq\bar{q}q$ state, in addition to the conventional Qqq state. It is proven that the inclusion of $Qq\bar{q}q$ state is inevitable to explain the observed mass spectrum of heavy-quark spin-singlet and flavor-antisymmetric single-heavy baryons. Based on chiral symmetry of the light quarks inside the baryons, we find $\Lambda_c(2765)$ and $\Xi_c(2967)$ are mostly $Qq\bar{q}q$ state while $\Lambda_c(2286)$ and $\Xi_c(2470)$ are mostly Qqq state. In addition, the mass of negative-parity single-heavy baryons are predicted. We also derive a sum rule and the Goldberger-Treiman-like relation for which the masses of single-heavy baryons satisfy. Our findings provide useful information for not only future experiments on heavy baryons but also future lattice simulations on diquarks.

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