

Molecular components in $D_{s0}^*(2317)$ and $D_{s1}(2460)$ mesons

Thursday, 2 June 2016 18:15 (0:20)

Collaboration

Abstract content

Results obtained by various experiments show that the $D_{s0}^*(2317)$ and $D_{s1}(2460)$ mesons are very narrow states located, respectively, below the DK and D^*K thresholds. This has led much attention because it is markedly in contrast with the expectations from naive quark models and heavy quark symmetry [1]. Early lattice QCD studies found D_{s0}^* and D_{s1} energy levels in line with quark model expectations (see, for instance, Ref. [2]).

Motivated by a recent lattice study [3, 4] which addresses the mass shifts of the $c\bar{s}$ ground states with quantum numbers $J^P = 0^+$ ($D_{s0}^*(2317)$) and $J^P = 1^+$ ($D_{s1}(2460)$) due to their coupling with S -wave DK and D^*K thresholds, we perform a similar analysis within a nonrelativistic constituent quark model in which quark-antiquark and meson-meson degrees of freedom are incorporated. The quark model has been applied to a wide range of hadronic observables and thus the model parameters are completely constrained (see references [5, 6] for reviews). The coupling between quark-antiquark and meson-meson Fock components is done using a 3P_0 model in which its only free parameter γ has been elucidated performing a global fit to the decay widths of mesons that belong to different quark sectors [7].

We observe that the S -wave coupling of the 0^+ (1^+) meson sector to the DK (D^*K) threshold is a key feature in lowering the masses of the corresponding $D_{s0}^*(2317)$ and $D_{s1}(2460)$ states predicted by the naive quark model, but also in describing the $D_{s1}(2536)$ meson as the 1^+ state of the $j_q^P = 3/2^+$ doublet predicted by heavy quark symmetry and thus reproducing its strong decay properties. Two features of our formalism cannot be address nowadays by lattice computations: the coupling of the D -wave D^*K threshold in the $J^P = 1^+$ channel and the computation of the probabilities associated with different Fock components in the physical state.

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Session Classification : Parallel Session A2