

The nature of the orbitally excited charmed-strange mesons through nonleptonic $B \rightarrow D^{(*)}D_{sJ}^{(*)}$ decays

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The nature of the P -wave charmed-strange mesons $D_{s0}^*(2317)$, $D_{s1}(2460)$, $D_{s1}(2536)$ and $D_{s2}^*(2573)$ is far from being entirely understood. Assuming Heavy Quark Symmetry (HQS) the $D_{s0}^*(2317)$ and $D_{s1}(2460)$ mesons belong to the $j_q^P = \frac{1}{2}^+$ doublet but they have surprisingly light masses which cannot be explained neither by naive quark models nor by Lattice QCD calculations. This fact has stimulated a fruitful line of research suggesting a richer structure than a simple $q\bar{q}$ picture. The $D_{s1}(2536)$ and $D_{s2}^*(2573)$ mesons constitute the $j_q^P = \frac{3}{2}^+$ doublet.

Nonleptonic $B \rightarrow D^{(*)}D_{sJ}^{(*)}$ can provide extra information on the structure of these mesons. The Belle Collaboration has recently reported [1] a study of the decays $B \rightarrow D_{s1}(2536)^+ \bar{D}^{(*)}$ providing also estimates of relevant ratios between branching fractions of decays $B \rightarrow D^{(*)}D_{sJ}^{(*)}$. The disagreement between experimental data and Heavy Quark Symmetry predictions [2] has been used as an indication that $D_{s0}^*(2317)$ and $D_{s1}(2460)$ mesons could have a more complex structure than the canonical $c\bar{s}$ one. However, simple estimates of the $1/m_Q$ corrections to the heavy quark limit implies large contributions to various quantities describing $B \rightarrow D^{**}$ transitions [3] and we expect they could also play an important role in this case.

In order to analyze these effects we calculate the ratios measured by the Belle Collaboration using the factorization approximation and within the framework of the constituent quark model of Ref. [4] supplemented by one-loop gluon exchange corrections. The model is able to reproduce the mass spectrum of the D_s mesons except for the $D_{s1}(2460)$ meson which needs the coupling with a tetraquark structure to obtain the physical mass [5].

As anticipated, $1/m_Q$ corrections are significant and, when properly included, the calculated ratios agree better with the experiment except for the $D_{s1}(2460)$ meson. This reinforces the idea that the meson $D_{s1}(2460)$ may have non- $q\bar{q}$ components, whereas the $D_{s0}^*(2317)$ and $D_{s1}(2536)$ mesons seem to be $q\bar{q}$ structures.

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