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Doubly heavy exotics

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Recent discoveries by Belle and BESIII of charged exotic quarkonium-like resonances provide fresh impetus for study of heavy exotic hadrons. In the limit $N_c \rightarrow \infty$, $M_Q \rightarrow \infty$, the $(\bar{Q} Q q \bar{q}')$ tetraquarks (TQ-s) are expected to be narrow and slightly below or above the $(\bar{Q} q')$ and $(Q \bar{q})$ two-meson threshold. The isoscalar TQ-s manifest themselves by decay to $(\bar{Q} Q) \pi \pi$, and the ~ 30 MeV heavier charged isotriplet TQ-s by decays into $(\bar{Q} Q) \pi$. The new data strongly suggest that the real world with $N_c=3$, $Q=c,b$ and $q,q' = u,d$ is qualitatively described by the above limit. We discuss the relevant theoretical estimates and suggest new signatures for TQ-s in light of the recent discoveries. We also consider “baryon-like” states $(Q Q' \bar{q} \bar{q}')$, which if found will be direct evidence not just for near-threshold binding of two heavy mesons, but for genuine tetraquarks with novel color networks. We stress the importance of experimental search for doubly-heavy baryons in this context.

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