

How the $Z_c(3900)$ Reveals the Spectra of Quarkonium Hybrid and Tetraquark Mesons

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Flavor-exotic tetraquark mesons have recently been observed in the heavy-quark pair sectors of QCD, including two isospin multiplets in the $b\bar{b}$ sector, $Z_b(10610)$ and $Z_b(10650)$, and one isospin multiplet in the $c\bar{c}$ sector, $Z_c(3900)$. We identify Z_b and Z_c as tetraquark mesons that are analogs of quarkonium hybrids with the gluon field replaced by an isospin-1 excitation of the light-quark fields. Given the identification of $Y(4260)$ and $Z_c(3900)$ as a ground-state charmonium hybrid and tetraquark, respectively, lattice QCD calculations of the charmonium spectrum can be used to estimate the masses of the lowest four spin-symmetry multiplets of charmonium hybrids and tetraquarks. The $Z_b(10610)$ and $Z_b(10650)$ can be assigned to excited-state multiplets of bottomonium tetraquarks, resulting in estimates of the masses of the ground-state multiplets of bottomonium hybrids and tetraquarks.

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