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Spin-splittings in heavy quarkonium hybrids

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The unambiguous establishment of a gluonic spectroscopy (glueballs and quark-gluon hybrids) will change the way we think the matter is constructed: gluons participate at the same level than quarks in building it. This feature is unique in quantum chromodynamics (QCD) and can be traced back to the self-interaction capacity of gluons. It is difficult to single out which states of the hadronic spectrum are glueballs due to the (expected) strong mixing between them and conventional mesons. However, valence gluonic degrees of freedom increase the quantum numbers that are available to quark-antiquark systems and thus they cannot be confused. The Born-Oppenheimer effective field theory has been designed to describe quark-gluon hybrids containing heavy quarks. The charmonium- and bottomonium-hybrid multiplets within this approach were presented elsewhere and compare nicely with the most recent lattice results for ccg mesons (no lattice simulations of the same multiplets have been performed for the bottomonium hybrids since the full treatment of the b-quark on the lattice seems to be tricky). We focus now on the computation of spin-dependent splittings of charmonium hybrids that belong to the lowest multiplets. This involves nonperturbative contributions that should be fitted attending to Lattice results. We naturally extend our study to the bottomonium sector and thus present a novel prediction of the low-lying bottomonium hybrids which is QCD-based, model independent and systematically improvable.

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