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Exotic mesons in a holographic approach to QCD

Since quarks interact with each other through the exchange of colored self-interacting gluons, QCD predicts the existence of hybrid configurations, composed by a quark, an antiquark and an excited gluon. This structure gives rise to hybrid mesons, whose J^{PC} quantum numbers can be either ordinary or exotic. In the former case hybrid configurations are not easily observable because they mix with standard quark-antiquark states having the same ordinary quantum numbers. Conversely, mesons with exotic quantum numbers cannot be represented as quark-antiquark pairs, so their detection would point out the existence of non-standard structures comprising gluons as constituents. Several QCD models indicate the hybrid meson with quantum numbers $J^{PC} = 1^{-+}$ as the lowest-lying exotic state.
We explore the properties of such configuration by means of holographic QCD, a phenomenological approach inspired by the gauge/gravity correspondence. This technique has been used to evaluate relevant physical quantities, such as the mass spectrum and the decay constants of 1^{-+} hybrid mesons. The computed masses, compared to the experimental values of the 1^{-+} candidates $\pi_1(1400)$, $\pi_1(1600)$ and $\pi_1(2015)$, favour $\pi_1(1400)$ as the lightest hybrid exotic state. The behaviour of 1^{-+} hybrid mesons at finite temperature has been studied through the calculation of the spectral function. This analysis has shown that dissociation occurs at a lower temperature than for light vector and scalar mesons, and scalar glueballs. Our result can be interpreted as an indication that hybrid quark-gluon configurations, although present in the meson spectrum, suffer of larger instabilities with respect to other kind of states.
Moreover, the relatively low melting temperature could explain why it is difficult to detect hybrid mesons in experiments.

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