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Composite models for 750 GeV diphoton excess at the LHC

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The diphoton excess at 750 GeV would make a definite signal of new physics beyond the Standard Model, if it is confirmed. We consider a possibility that the excess is due to a composite (pseudo)scalar boson, whose constituents are either new vector-like quarks ($Q\overline{Q}$) or scalar quarks
($\widetilde{Q}\widetilde{Q}^\dagger$) which feel new QCD-like vectorlike confining force
with confinement scale Λ_h.
Assuming $m_Q(m_{\widetilde{Q}}) \gg \Lambda_h$, the observed 750 GeV excess could be
either $Q\overline{Q}(^1S_0)$ state with $J^{PC} = 0^{-+}$ or
$\widetilde{Q}\widetilde{Q}^\dagger(^1S_0)$ state with $J^{PC} = 0^{++}$.
For the $Q\bar{Q}$ scenario, there will be a spin-triplet partner ψ_Q which is slightly
heavier that η_Q because of the hyper fine interactions mediated by h-gluon exchange.
We consider productions and decays of $\eta_Q, \eta_{\widetilde{Q}}$ and ψ_Q using
the nonrelativistic QCD methods, and identify the parameter regions which can explain
the observed diphoton excess. We discuss how to test these scenarios using the Drell-Yan process for ψ_Q case, and the dijet azimuthal angular distributions to determine the
J^{PC} quantum number of the diphoton excess. This model predicts a new bound state, which is color-singlet in the new QCD, but color-octet in ordinary QCD. We estimate the production cross section of the color-octet bound state at the LHC, which would be a new signal at the LHC.

Summary

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