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Search for pair production of vector-like partners of the top quark (T), with $T \rightarrow tH$, $H \rightarrow \gamma\gamma$

The recent discovery of a Higgs boson at the LHC sets strong constraints on a simple, sequential third generation of quarks. Still, the presence of new physics is necessary to stabilize the mass of the Higgs boson, if one wants to avoid an unnaturally high level of fine tuning of the theory. In supersymmetry, bosonic top quark partners would cancel the loops that induce this large instability. Similarly, fermionic top quark partner quarks can also serve this purpose. We present a search for a new T particle, which is a vector-like partner of the top quark, focusing on the T quark pair production. We use data collected with the CMS experiment during the year 2012, in proton-proton collisions at the LHC at a centre-of-mass energy of 8 TeV. Older searches for heavy vector-like-quarks focused separately either on the $T \rightarrow bW$ or $T \rightarrow tZ$ final states. The precise knowledge of the Higgs boson mass now allows to target the $T \rightarrow tH$ decay as well. Here we focus exclusively on events with at least one top partner undergoing the $T \rightarrow tH$ decay chain; in order to ensure a Higgs boson is actually present in the final state, we exploit the Higgs to diphoton final state.

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