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Search for heavy resonances decaying into two Higgs bosons or into a Higgs boson and a W or Z boson in proton-proton collisions at 13

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Abstract

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A search is presented for massive narrow resonances decaying either into two Higgs bosons, or into a Higgs boson and a W or Z boson. The decay channels considered are $HH \rightarrow b\bar{b}\tau^+\tau^-$ and $VH \rightarrow qq\tau^+\tau^-$, where H denotes the Higgs boson, and V denotes the W or Z boson. This analysis is based on a data sample of proton-proton collisions collected at a center-of-mass energy of 13 TeV by the CMS Collaboration, corresponding to an integrated luminosity of 35.9 fb^{-1} . For the TeV-scale mass resonances considered, substructure techniques provide ways to differentiate among the hadronization products from vector boson decays to quarks, Higgs boson decays to bottom quarks, and quark- or gluon-induced jets. Reconstruction techniques are used that have been specifically optimized to select events in which the tau lepton pair is highly boosted. The observed data are consistent with standard model expectations and upper limits are set at 95% confidence level on the product of cross section and branching fraction for resonance masses between 0.9 and 4.0 TeV. Exclusion limits are set in the context of bulk radion and graviton models: spin-0 radion resonances are excluded below a mass of 2.7 TeV at 95% confidence level. In the spin-1 heavy vector triplet framework, mass-degenerate W' and Z' resonances with dominant couplings to the standard model gauge bosons are excluded below a mass of 2.8 TeV at 95% confidence level. These are the first limits for massive resonances at the TeV scale with these decay channels at $\sqrt{s}=13 \text{ TeV}$. [Figure not available: see fulltext.] © 2019, The Author(s).

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