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## Search for a heavy resonance decaying to a top quark and a vector-like top quark in the lepton + jets final state in pp collisions at $\sqrt{s}=13\text{TeV}$ (Article)

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### Abstract

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A search is presented for a heavy spin-1 resonance  $Z'$  decaying to a top quark and a vector-like top quark partner  $T$  in the lepton + jets final state. The search is performed using a data set of  $p p$  collisions at a centre-of-mass energy of  $13\text{TeV}$  corresponding to an integrated luminosity of  $35.9\text{fb}^{-1}$  as recorded by the CMS experiment at the CERN LHC in the year 2016. The analysis is optimised for final states arising from the  $T$  decay modes to a top quark and a Higgs or  $Z$  boson ( $T \rightarrow H t, Z t$ ). The event selection makes use of resolved and merged top quark decay products, as well as decays of boosted Higgs bosons and  $Z$  and  $W$  bosons using jet substructure techniques. No significant deviation from the standard model background expectation is observed. Exclusion limits on the product of the cross section and branching fraction for  $Z' \rightarrow t T, T \rightarrow H t, Z t, W b$  are presented for various combinations of the  $Z'$  resonance mass and the vector-like  $T$  quark mass. These results represent the most stringent limits to date for the decay mode  $Z' \rightarrow t T \rightarrow t H t$ . In a benchmark model with extra dimensions, invoking a heavy spin-1 resonance  $G^*$ , masses of the  $G^*$  between 1.5 and  $2.3\text{TeV}$  and between 2.0 and  $2.4\text{TeV}$  are excluded for  $T$  masses of 1.2 and  $1.5\text{TeV}$ , respectively. © 2019, CERN for the benefit of the CMS Collaboration.

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