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## Search for a heavy resonance decaying to a top quark and a vector-like top quark in the lepton plus jets final state in pp collisions at root s=13 TeV

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### Abstract

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 pp collisions at a centre-of-mass energy of 13 TeV corresponding to an integrated luminosity of 35.9 fb<sup>-1</sup> 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, Ht, Zt). 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, tT, T, Ht, Zt, Wb 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, tT, tHt. In a benchmark model with extra dimensions, invoking a heavy spin-1 resonance G\*, masses of the G\* between 1.5 and 2.3 TeV and between 2.0 and 2.4 TeV are excluded for T masses of 1.2 and 1.5 TeV, respectively.

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