



Search for single production of a vector-like T' quark decaying to tZ with CMS at $\sqrt{s} = 13\text{TeV}$

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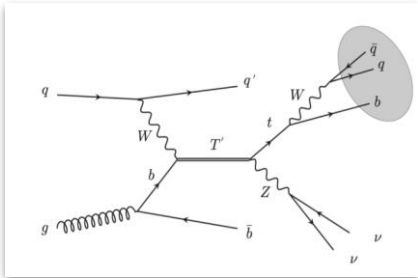
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A search is presented for single production of a vector-like quark of electric charge $+2/3$ in the decay channel featuring a top quark and a Z boson, with the top quark decaying hadronically and the Z boson decaying to neutrinos. The search uses data collected by the CMS experiment in proton-proton collisions at a center-of-mass energy of 13 TeV recorded at the CERN LHC in 2016-2018, corresponding to an integrated luminosity of 136 fb^{-1} . The search is sensitive to a T' quark mass between 0.6 and 1.8 TeV with decay widths ranging from narrow up to 30% of the T' quark mass.

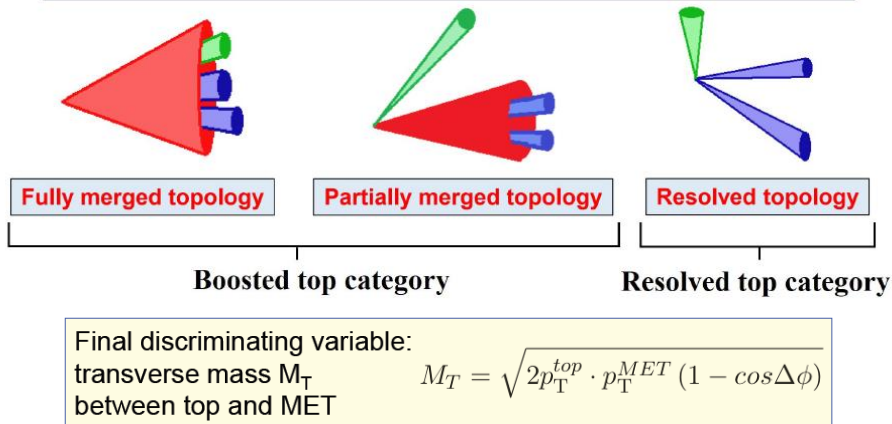
Introduction

- Discovery of Higgs boson motivates search for new physics
- Theories predict existence of **heavy vector-like quarks** (VLQ)
- VLQ T' with a charge of $+2/3$ has three different decay channels into SM particles by the assumption of the model: bW , tZ and tH
- We search for a T' quark decays to a Z boson and a top quark, with **Z to $\nu\bar{\nu}$** and **top quark to hadrons** ($t \rightarrow bW \rightarrow bqq'$).
- T' quark width hypothesis are studied: negligible, 10%, 20% and 30% of the T' mass



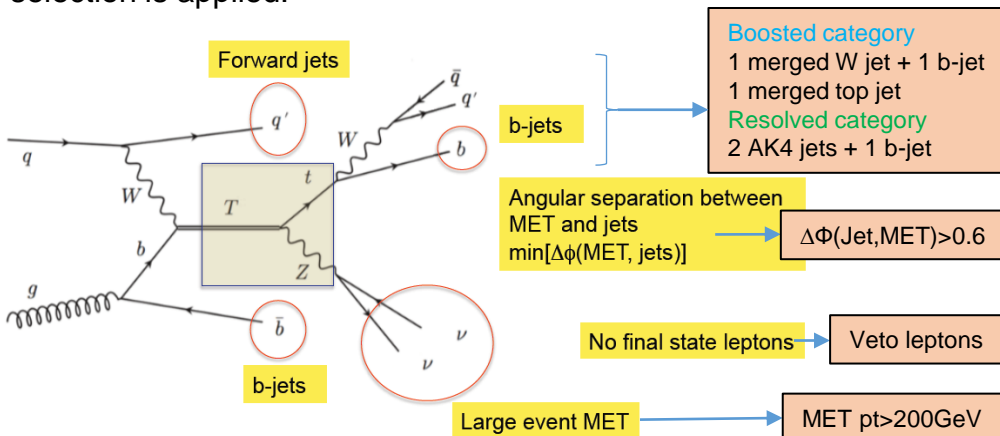
Analysis strategy

- Forward jets: define two categories with enhanced sensitivity
 - ✓ No forward jets
 - ✓ At least 1 forward jet
- The top quark identified in three different scenarios:
 - **Three reconstruction algorithms** to have good sensitivity in all mass range
 - ✓ **Fully merged topology**: top candidate is a top-jet
 - ✓ **Partially merged topology**: top candidate given by one W-jet and one ak4 jet
 - ✓ **Resolved topology**: top candidate given by three ak4 jets



Event Selection

In order to improve the sensitivity of the analysis, the following selection is applied:



Background Estimation

- The main backgrounds in my analysis are : **Z+jets**, **W+jets**, **ttbar**
- Define signal and sideband region in different categories:

Resolved category

Variable	SR	Z+jets CR	W+jets CR	ttbar CR
lepton	veto	veto	≥ 1	≥ 1
Number of midum b jet	≥ 1	=0	=0	≥ 1

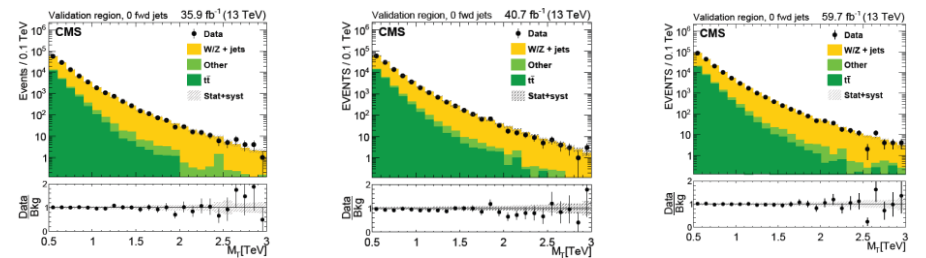
Partially merged category

Variable	SR	ttbar CR
minPhi(MET,jet)	> 0.6	< 0.6

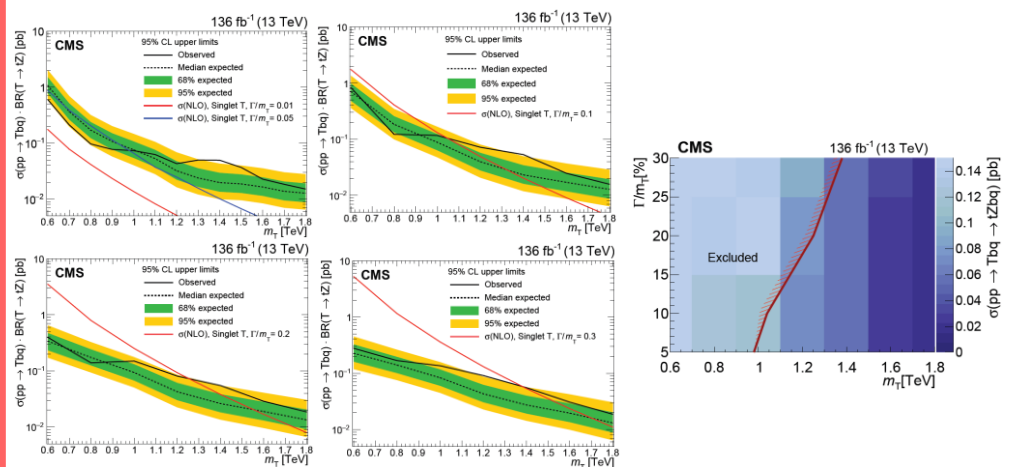
Fully merged category

Variable	SR	W/Z+jets CR	ttbar CR
Lepton	veto	veto	1 loose muon or electron
minPhi(MET,jet)	> 0.6	> 0.6	No cut
Top jet	1 b-subjet	0 b-subjet	1 b-subjet

- Using Data-driven method to get SF from control region in data.
- Show data and the predicted background in validation sample:



Results



	Upper limit	Cross section @95%CL	Mass @95%CL
Narrow width resonance		$>602-15\text{fb}$	$<0.98\text{TeV}(5\%)$
10-30% width resonance		$>836-16\text{fb}$	$<1.4\text{TeV}(30\%)$

- This is the **first result of MET +jets** final state in CMS
- This is the **first single-VLQ T'** paper with the **full Run-II**
- This is the **current best published result on single-VLQ T'** in the **$tZ(\nu\bar{\nu})$** decay channel