Search for single production of a vector-like T' quark decaying to tZ with CMS at √s = 13TeV

Yu Taozhe
on behalf of the CMS Collaboration
Institute of High Energy Physics and Chinese Academy of Science

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 $Z \rightarrow \nu \bar{\nu}$ 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

**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
- Number of midum b jet

**Partially merged category**
- Variable | SR | ttbar CR
- minΦ(MET,jet) > 0.6

**Fully merged category**
- Variable | SR | W+jets CR | ttbar CR
- Lepton veto
- Top jet 1 b-subjet 0 b-subjet 1 b-subjet

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

**Event Selection**
- In order to improve the sensitivity of the analysis, the following selection is applied:

**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:
  - Fully reconstructed 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

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- 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

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