# Searches for the supersymmetric partner of the top quark

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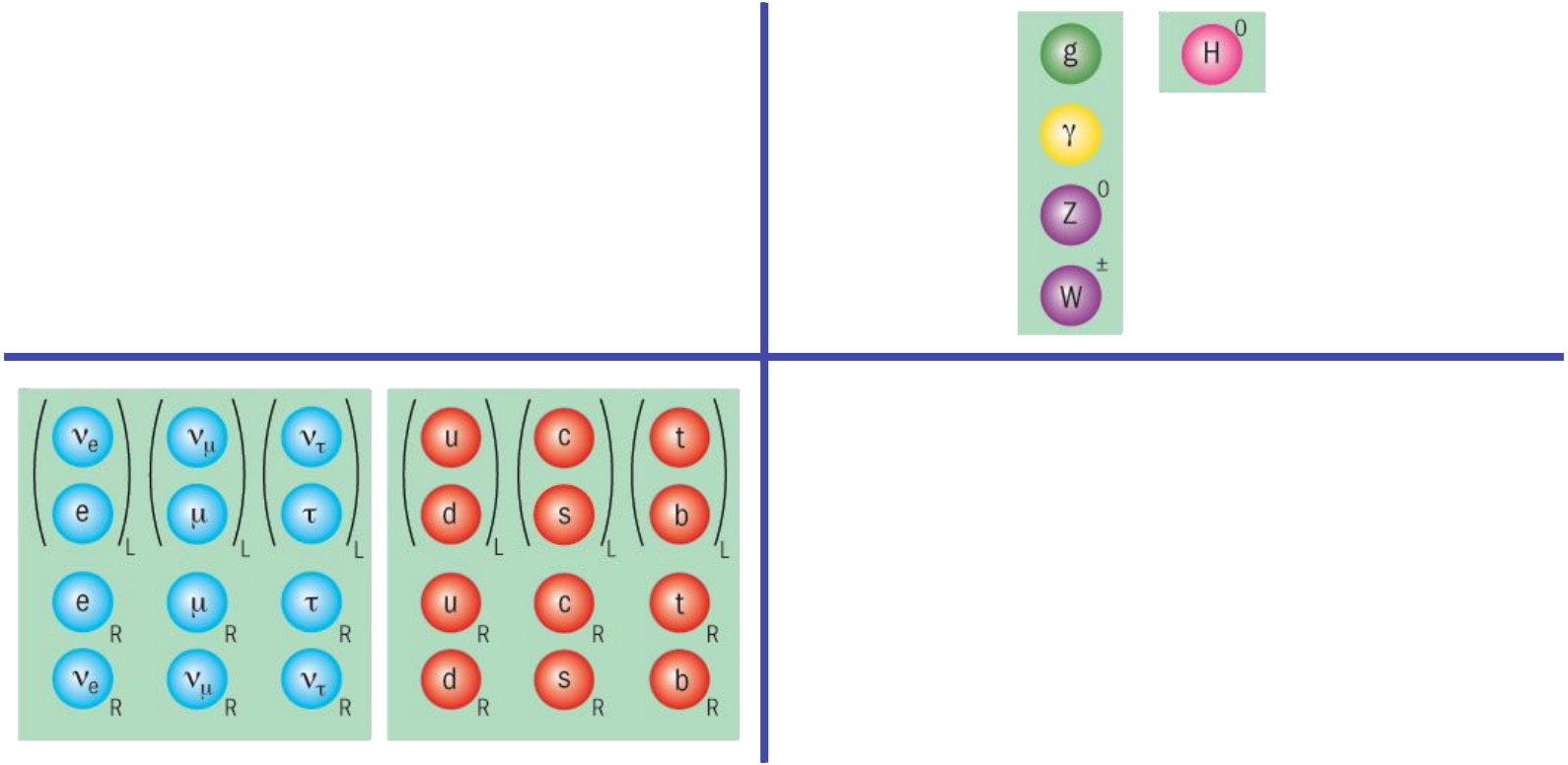
LABORATÓRIO DE INSTRUMENTAÇÃO
E FÍSICA EXPERIMENTAL DE PARTÍCULAS

# Good old Standard Model

matter: fermions (s=½)

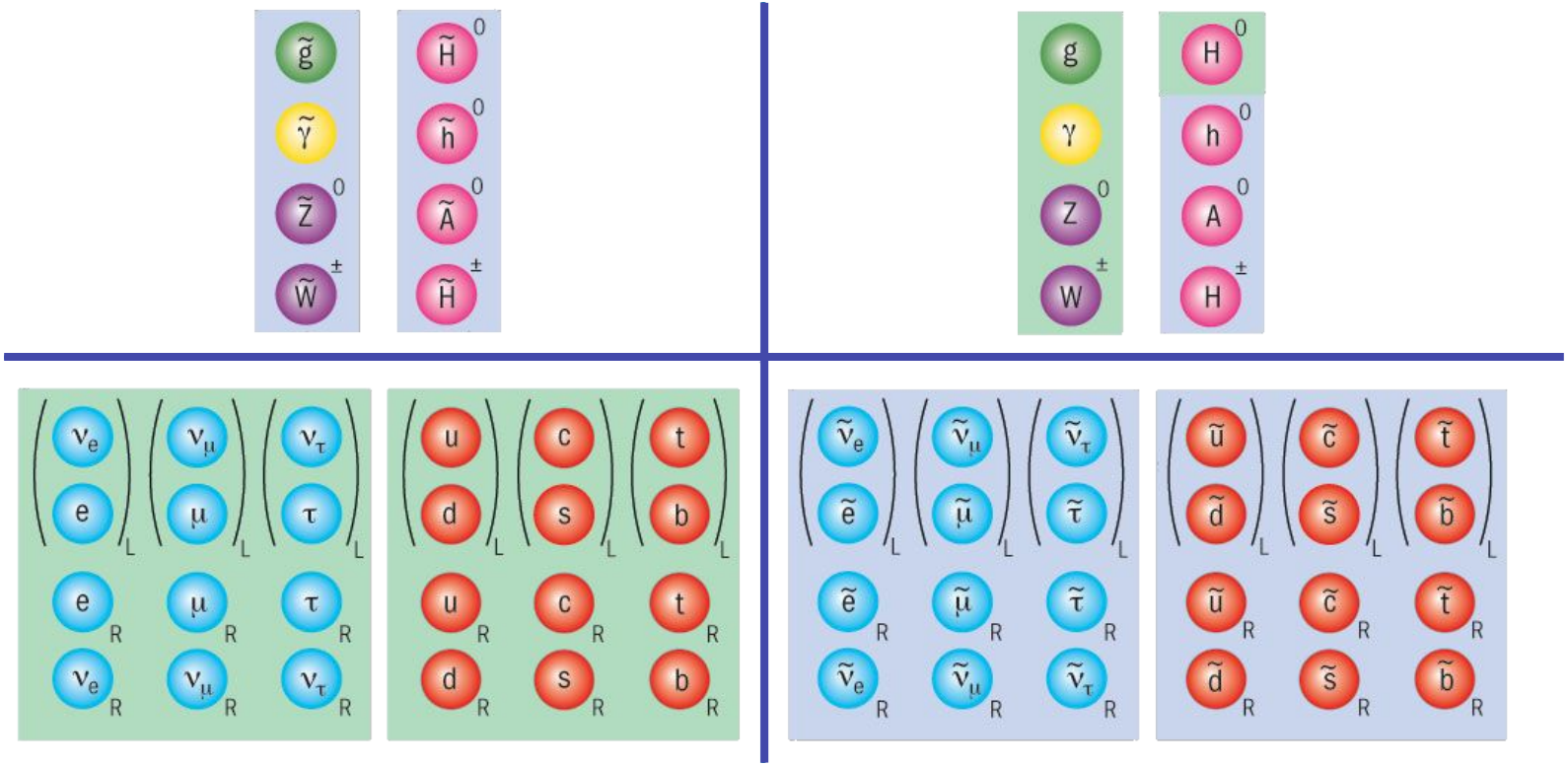
interactions: bosons (s=1 or s=0)



# Meet SUSY!

matter: fermions (s=½)

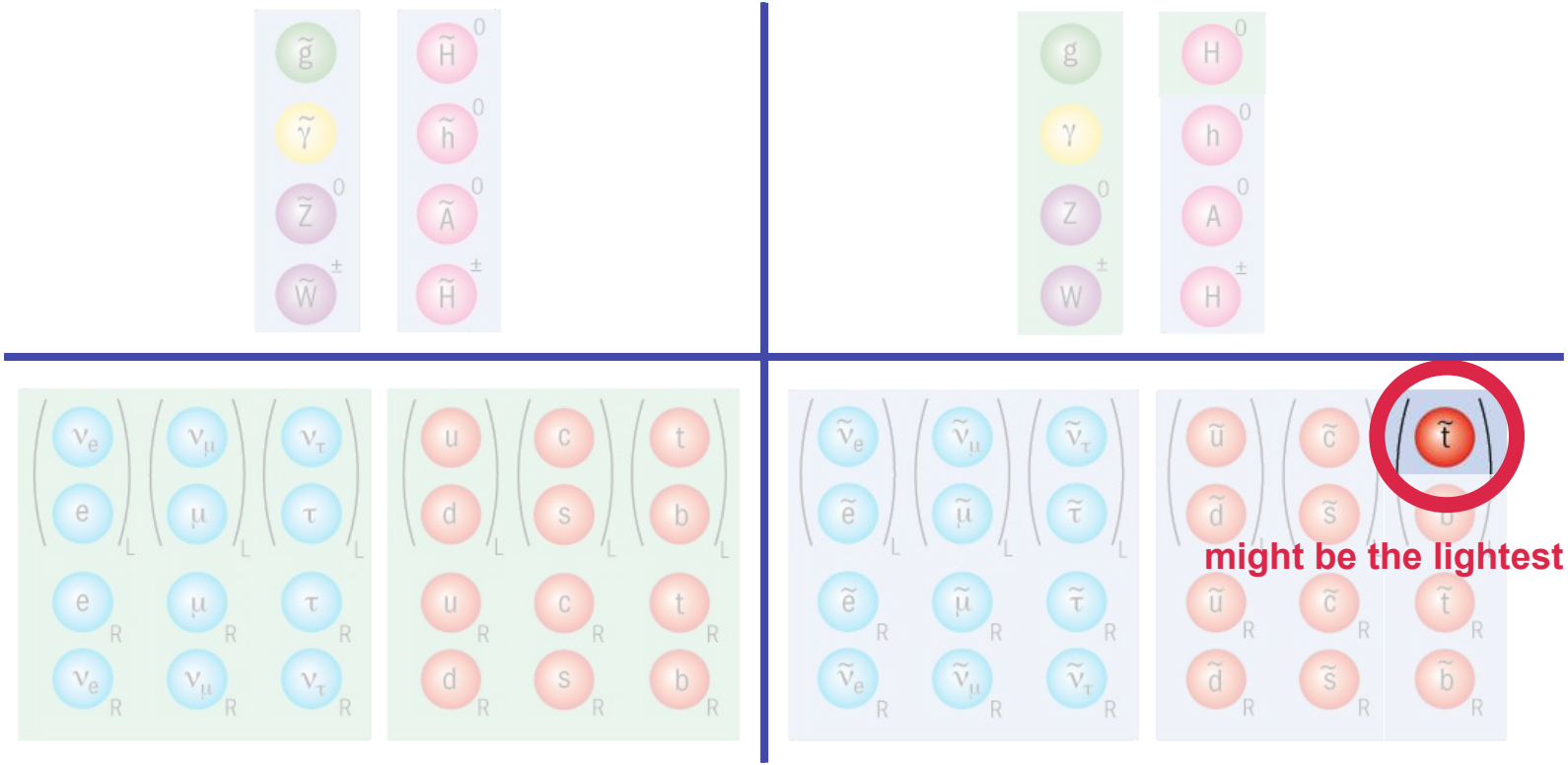
interactions: bosons (s=1 or s=0)



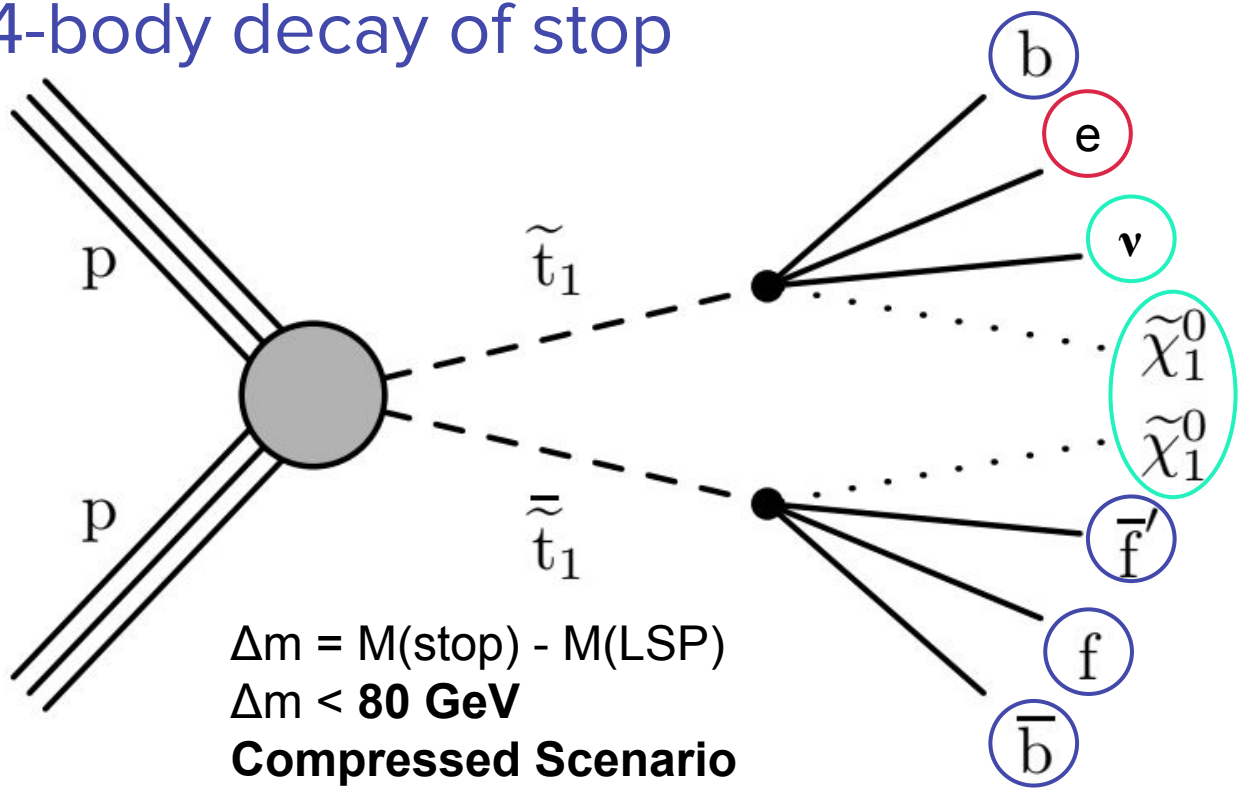
# STOP

matter: fermions (s=½)

interactions: bosons (s=1 or s=0)



# 4-body decay of stop




$\Delta m = M(stop) - M(LSP)$
$\Delta m <$ **80 GeV**
**Compressed Scenario**

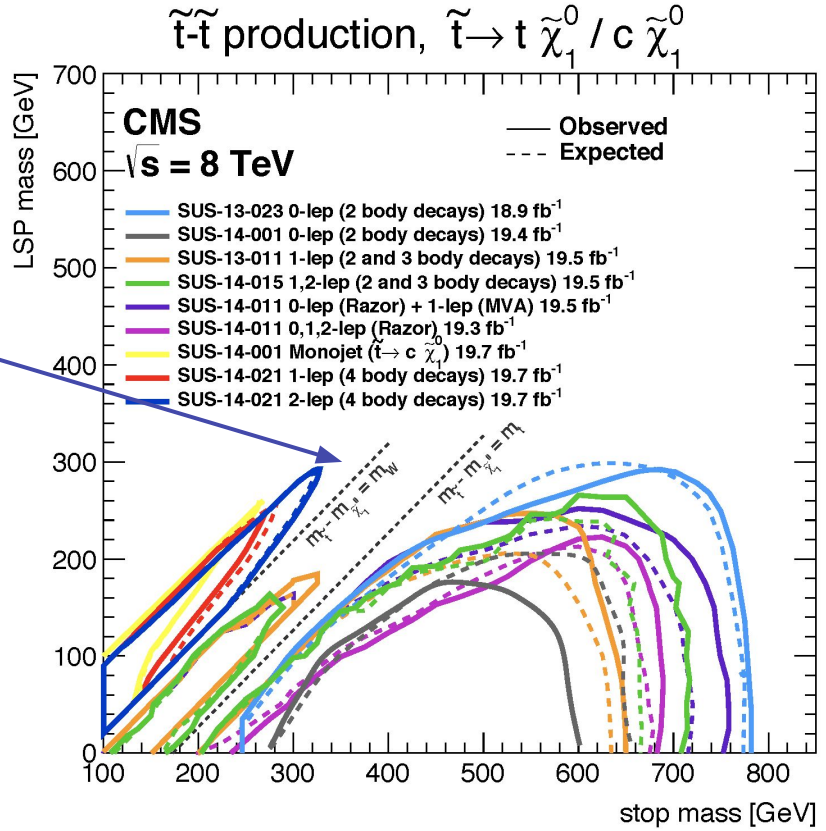
Final state:
jets
1 lepton
MET

MET: Energy not detected carried by particles that interact weakly ➔ neutrinos or BSM particles

$\tilde{\chi}_1^0$ - Neutralino : Supersymmetric neutral particle. The **Lightest Stable Particle** in many SUSY models

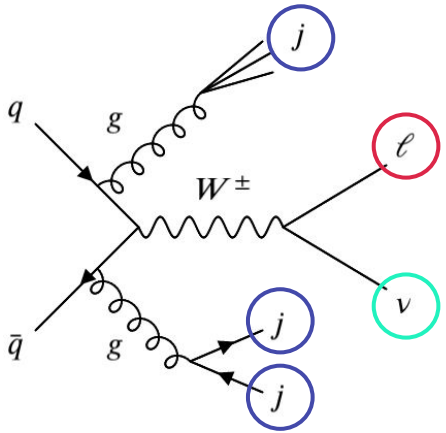
# Completing the picture: the compressed scenario

We are looking here

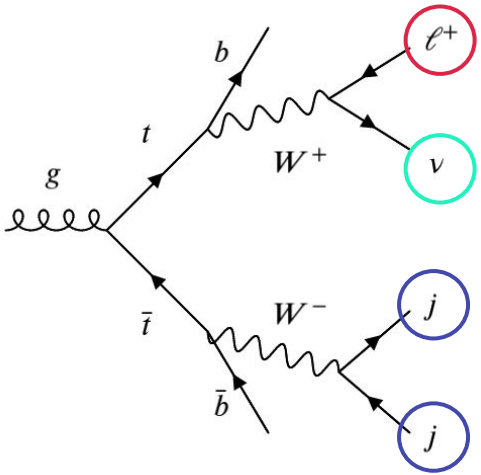


# Standard Model Background

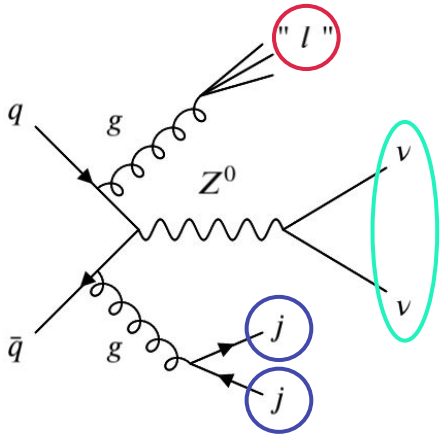
## W+Jets




## TTbar+Jets



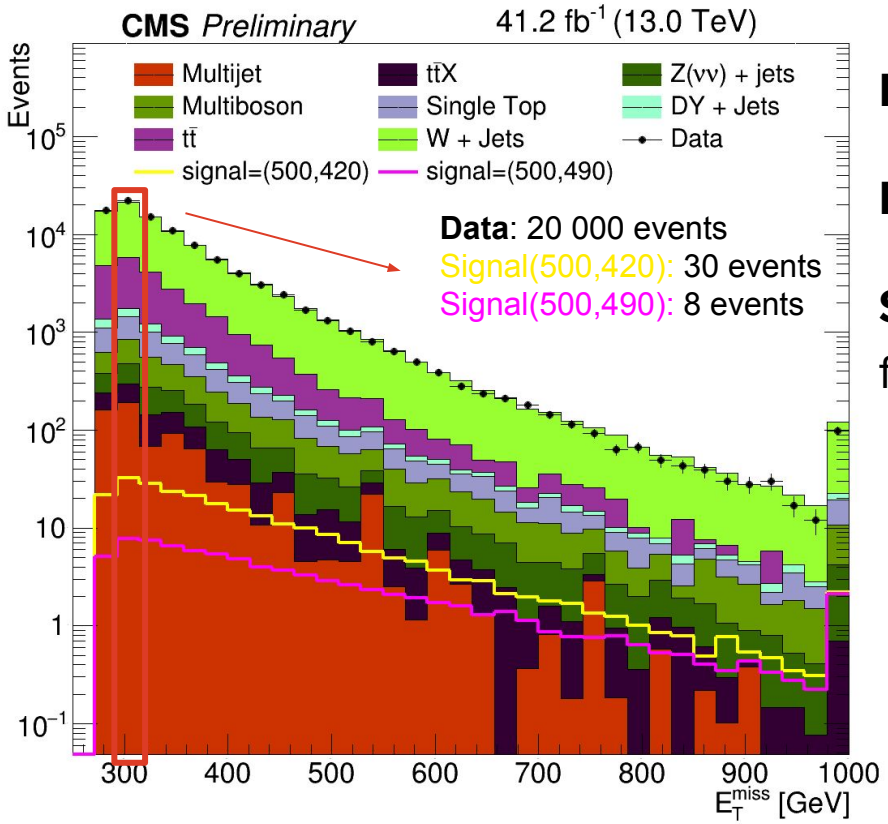

## ZtoNuNu+Jets




**Signature:** jets + 1ℓ + MET

**Other:** Drell-Yan+Jets; Single Top; Multiboson; TTbarX; QCD

# MET - 2017 Data and Monte Carlo samples



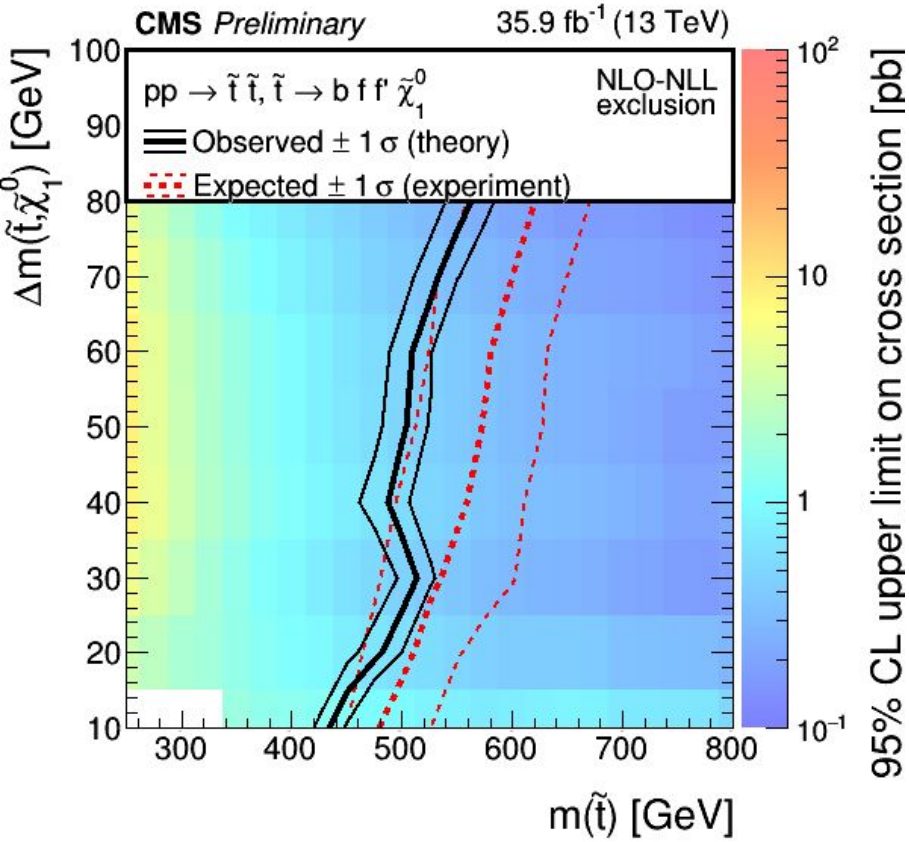

**Muon final state**: good Data/MC agreement

**Background**: SM Processes

**Signal**: depends on the mass of our initial and final SUSY particles - **stop**, **neutralino**

- M(stop)=500; M(neutralino)=420
- M(stop)=500; M(neutralino)=490

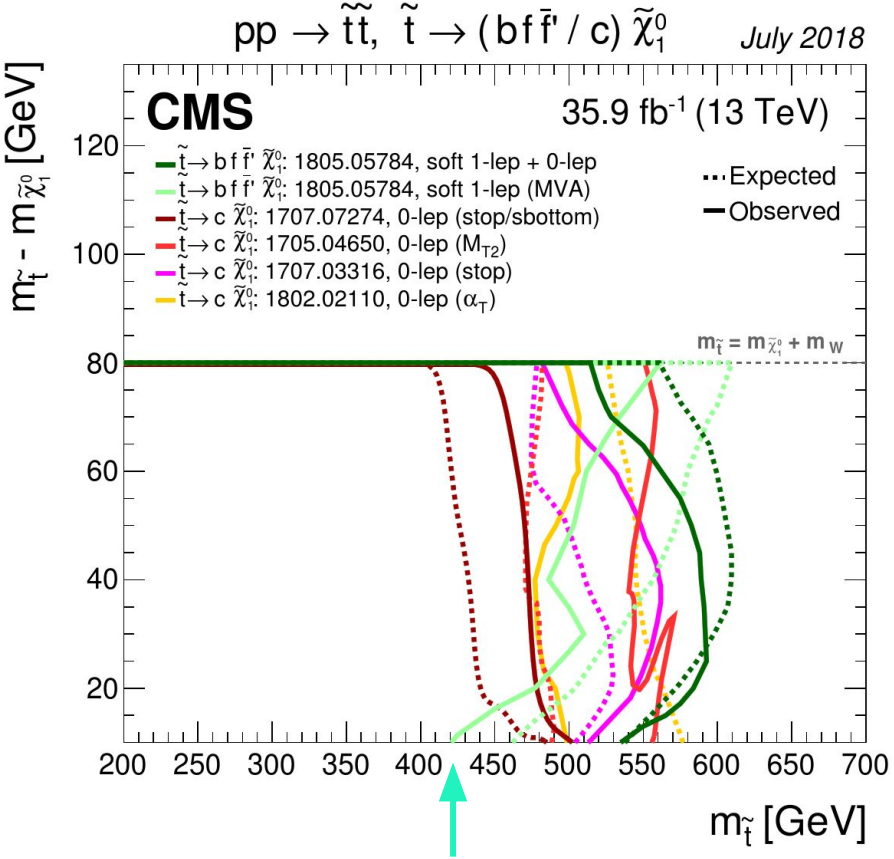
# Region excluded: 2018 publication




Final result of 2018 publication [JHEP 09 (2018) 065](): 

- Data collected only on 2016
- MVA: Boosted Decision Trees
- Low sensitivity at low and high Δm
- **No evidence** for direct stop production is observed
- My PhD builds on top of this analysis

# Summary




SUSY **is not** an excluded theory

AN-19-276

We are improving on top of the previous analysis

- **Better methods**
  - Object identification
  - Data driven background prediction methods
- **Neural networks**

  Better Background/Signal separation
- **Full RunII data**

  2016 Delivered Luminosity : 41.0 $fb^{-1}$

  2016+17+18 Delivered Lumi: **158,7 $fb^{-1}$**