

# Search for flavour violating MSSM

## Search for SUSY top squarks in final states with a hadronically decaying $t$ , $c$ and large $E_T^{miss}$



#FIRST\_ANALYSIS\_AT\_THE\_LHC  
WITH THIS SIGNATURE  
ATLAS-CONF-2023-058

### MOTIVATION

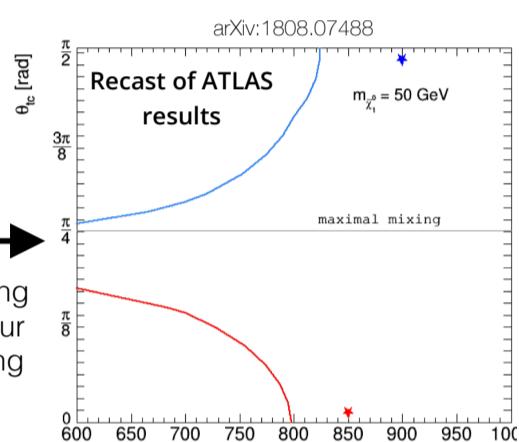
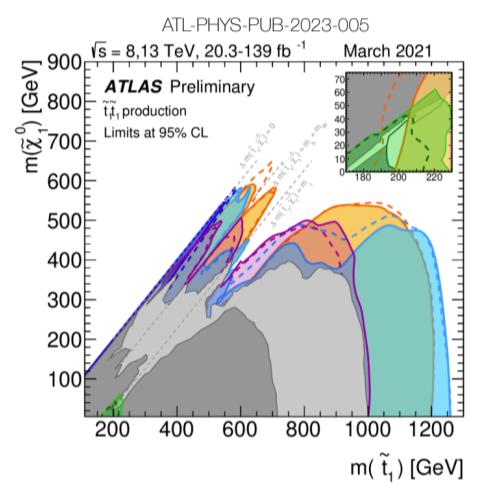
Several aspects of nature remain **unexplained** despite the success of the Standard Model (SM) e.g :

- The dark matter abundance
- The Higgs mass problem

### SUSY might be the answer

- Loop corrections from SUSY particles **canceling SM contributions** to the Higgs mass
- Lightest SUSY particle  $\tilde{\chi}_1^0$  is a viable **candidate for a DM particle**

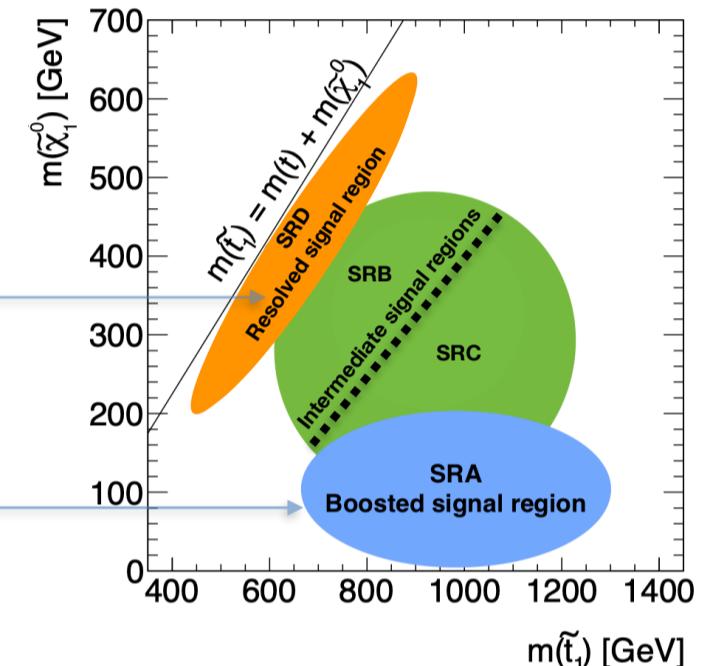
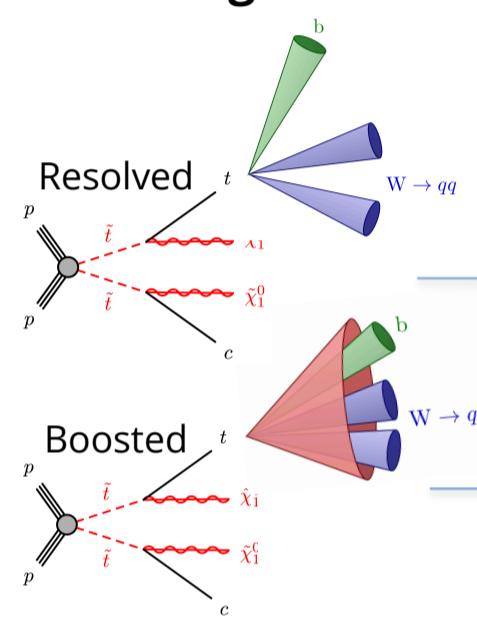
### Why flavour violation ?



$$\begin{pmatrix} \tilde{t}_1 \\ \tilde{t}_2 \end{pmatrix} = \begin{pmatrix} \cos \theta_{tc} & \sin \theta_{tc} \\ -\sin \theta_{tc} & \cos \theta_{tc} \end{pmatrix} \begin{pmatrix} \tilde{\chi}_R^0 \\ \tilde{\chi}_L^0 \end{pmatrix}$$

- Many SUSY searches looked into symmetrical final states covering a wide range of the phase space
- Extensions of the MSSM propose scenarios where flavour is **not conserved** have much looser constraints on the  $\tilde{t}_1$  mass

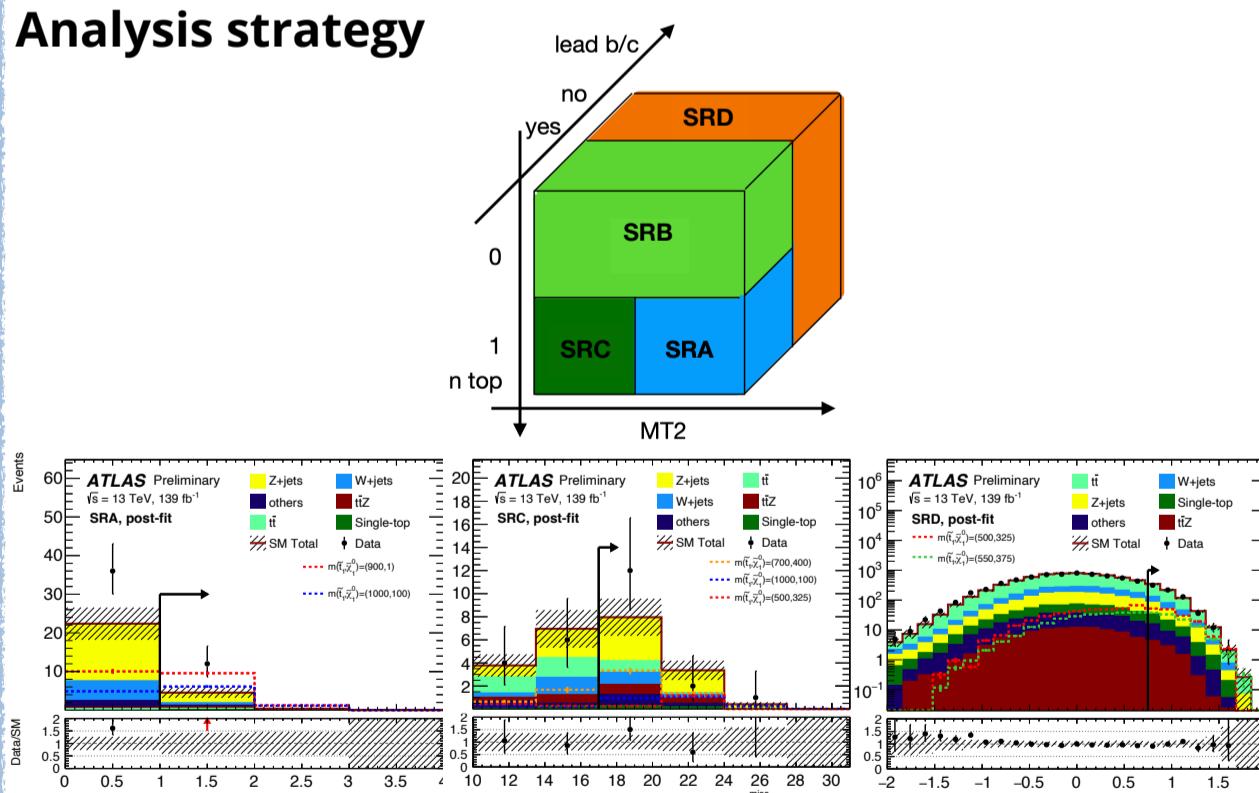
### Search regions



3 different topologies are targeted depending on the mass of  $\tilde{t}_1$  and  $\tilde{\chi}_1^0$ :

- **Boosted** :  $\Delta m(\tilde{t}_1, \tilde{\chi}_1^0) \gg m_t$
- **Intermediate** :  $\Delta m(\tilde{t}_1, \tilde{\chi}_1^0) > m_t$
- **Resolved** :  $\Delta m(\tilde{t}_1, \tilde{\chi}_1^0) \simeq m_t$

### Analysis strategy



#### Boosted regions :

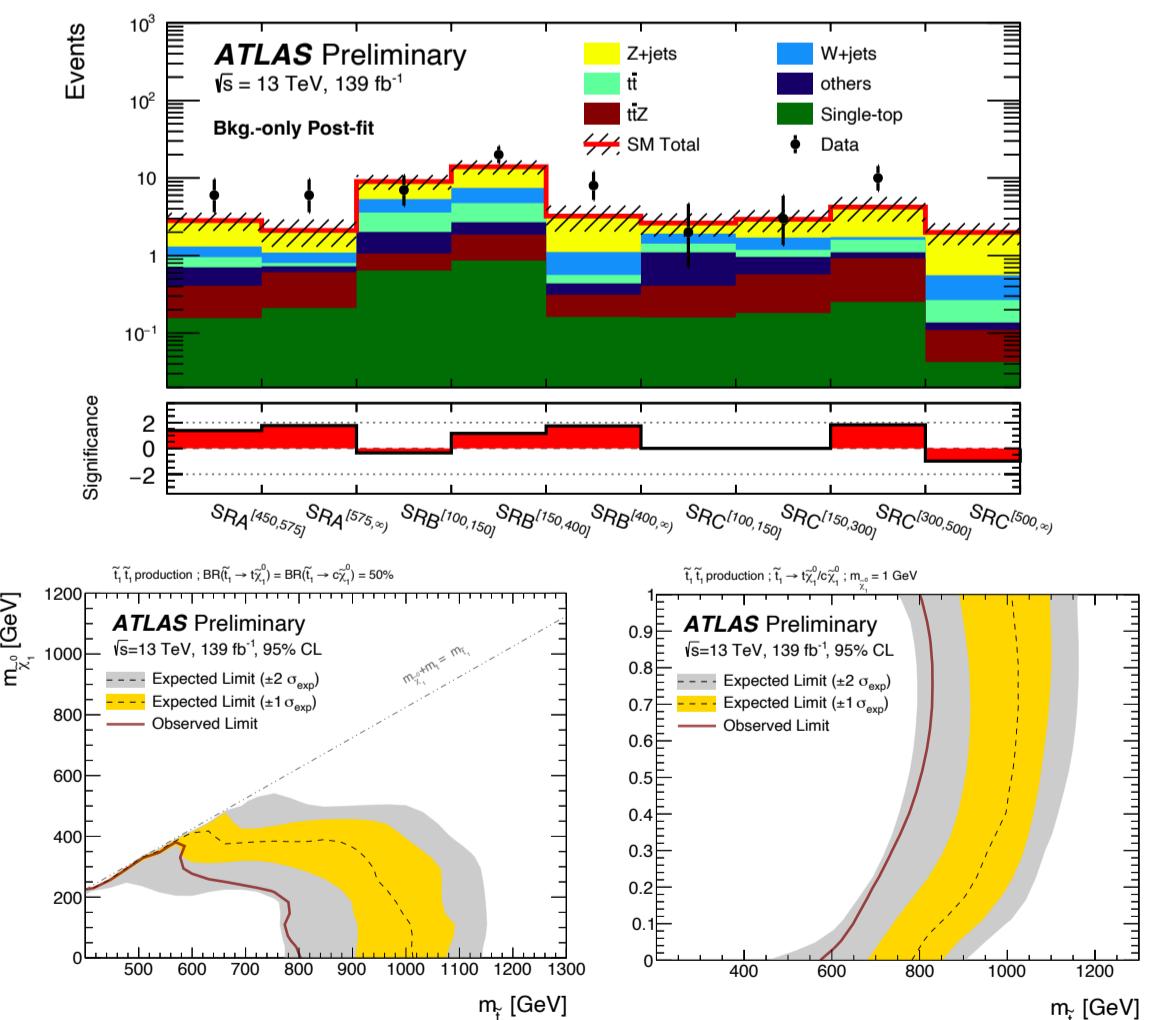
- Using discriminant variables :  $E_T^{miss}$  significance and the number of top-tagged jets

#### Resolved region :

- Using a neural network to discriminate between signal and dominant backgrounds  $t\bar{t}$  and Z+jets

- **Control regions** and **validation regions** are defined to validate the background modeling

### Results



- **Mild excesses** observed around  $2\sigma$  in boosted regions
- Weak observed limit reach due to the observed excesses
- Looking forward to **RUN III data**