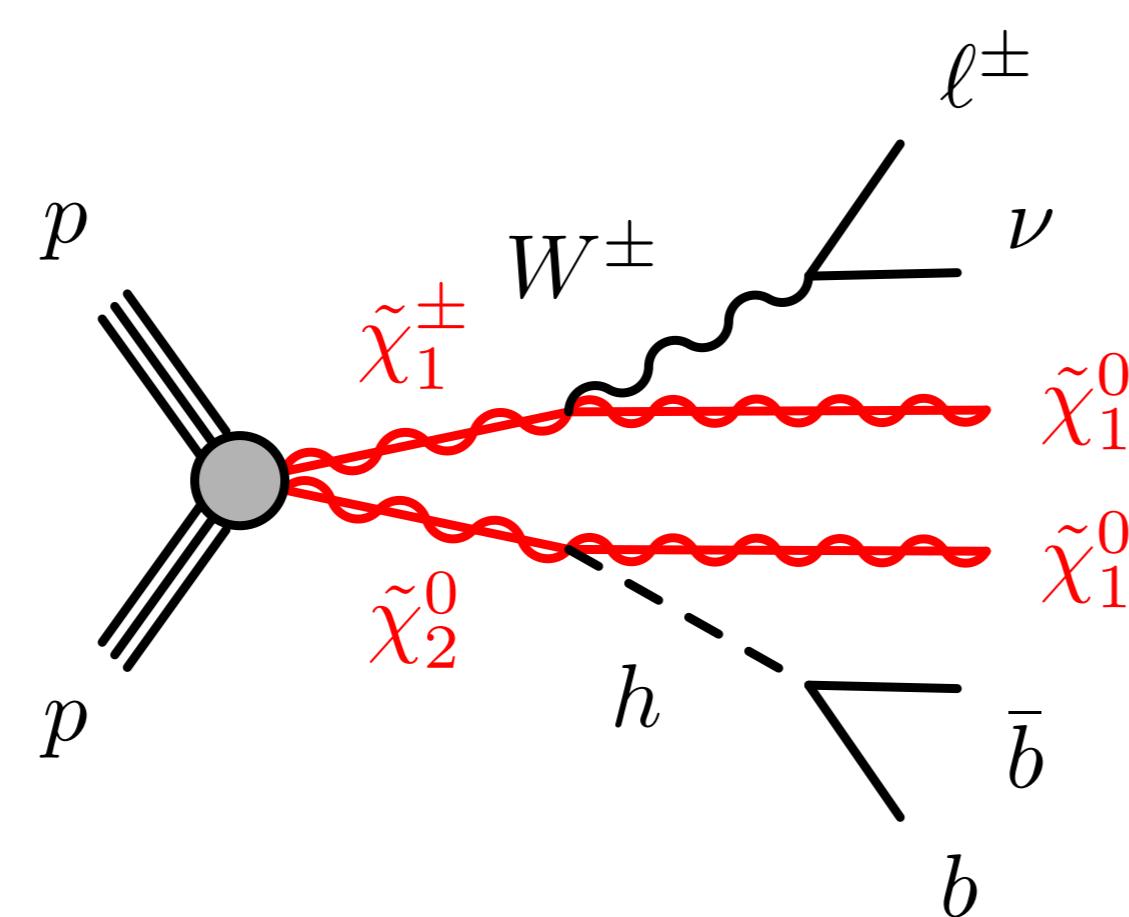


Introduction

Search for direct pair production of charginos ($\tilde{\chi}_1^\pm$) and next-to-lightest neutralinos ($\tilde{\chi}_2^0$) using 139 fb^{-1} of data recorded at $\sqrt{s} = 13 \text{ TeV}$ [1].

Simplified model:

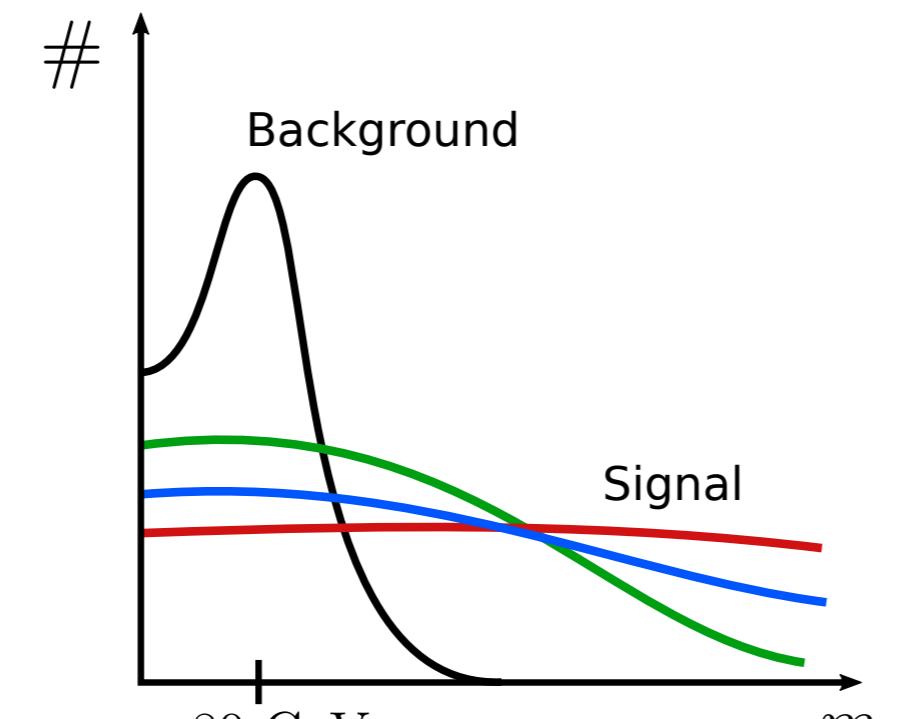
- Lightest neutralino ($\tilde{\chi}_1^0$) is a bino-like lightest supersymmetric particle (LSP).
- $\tilde{\chi}_1^\pm$ and $\tilde{\chi}_2^0$ are wino-like and mass-degenerate.
- Higgs boson decay: $h \rightarrow b\bar{b}$ with Standard Model (SM) Higgs branching ratio.



Main discriminating observables

Missing transverse momentum (E_T^{miss}):

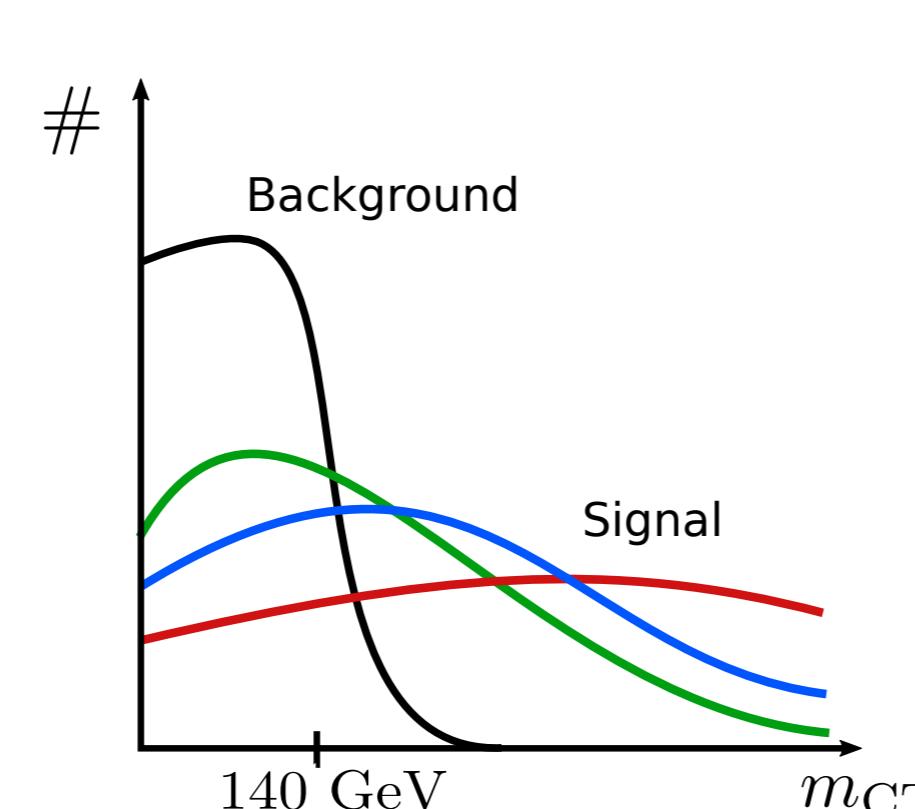
Signal events tend to have high E_T^{miss} because LSPs escape the detector.



Transverse mass (m_T):

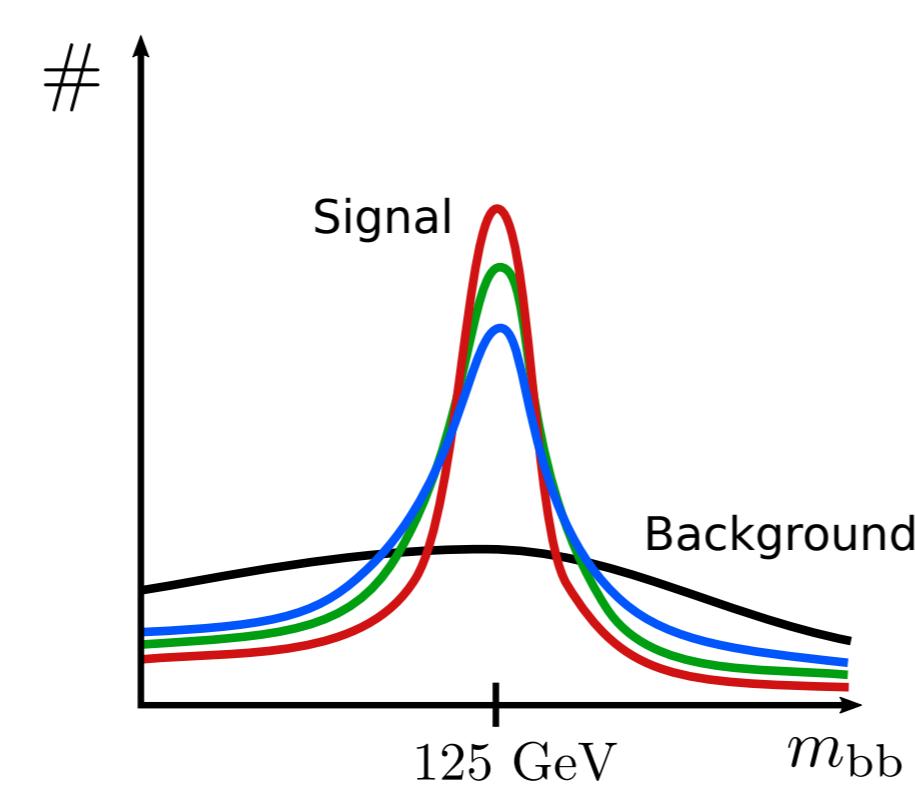
Reduces $W+\text{jets}$ and $t\bar{t}$ backgrounds.

$$m_T = \sqrt{2p_T^\ell E_T^{\text{miss}} (1 - \cos [\Delta\phi(p_T^\ell, p_T^{\text{miss}})])}$$



Invariant mass of leading b-jets (m_{bb}):

Selection criterion for jet pairs to be considered as Higgs boson candidates.



Event selection

Basic selection:

Events recorded using the E_T^{miss} -trigger. Must contain:

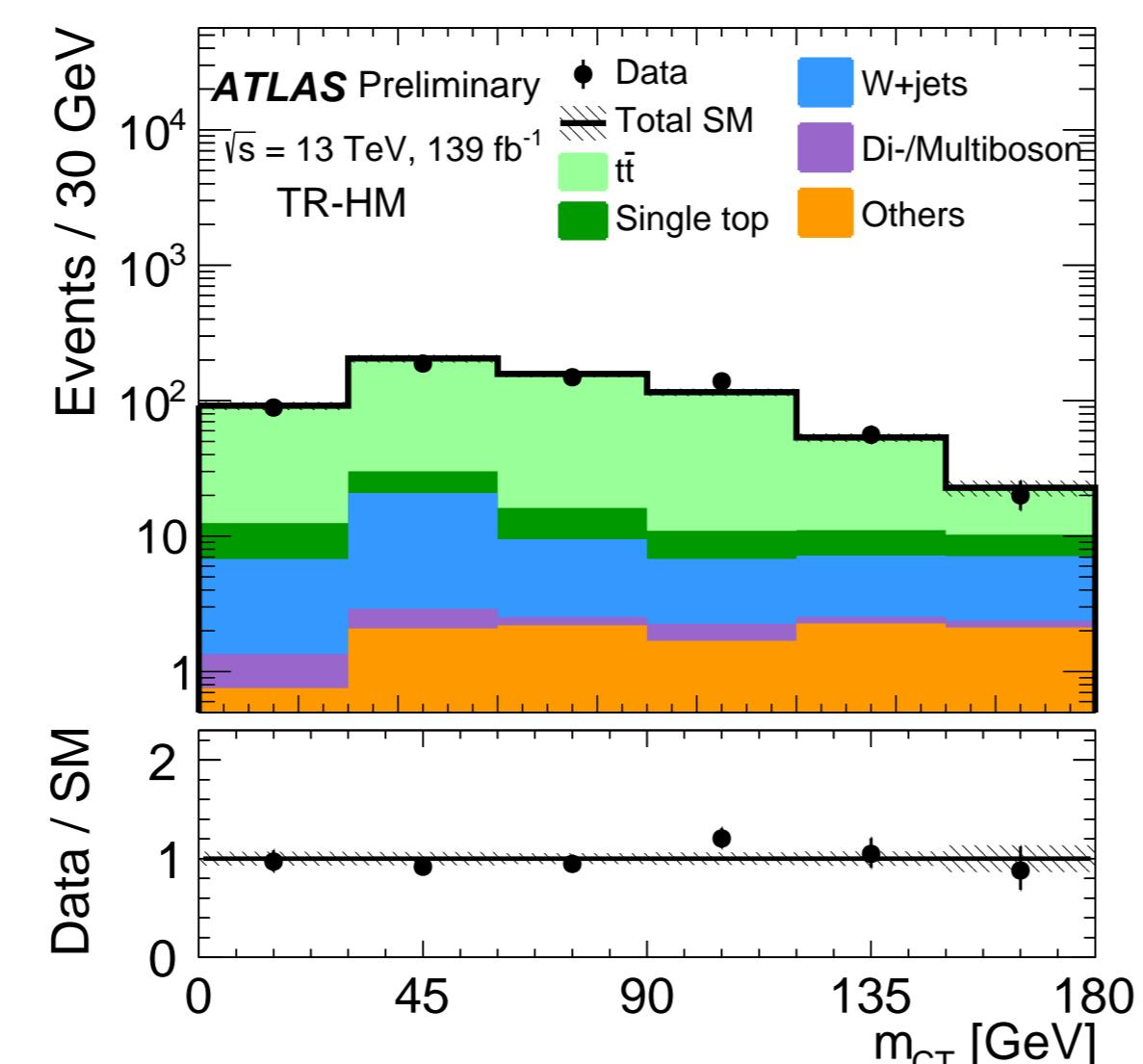
- exactly one electron (muon) with $p_T > 7 \text{ GeV}$ ($p_T > 6 \text{ GeV}$),
- two or three jets with $p_T > 30 \text{ GeV}$, two of which are b -tagged.

Signal regions (SRs):

- Orthogonal through requirement on m_T and m_{CT} .
- Statistical combination in simultaneous likelihood fit.

⇒ 2D shape-fit in m_T and m_{CT} .

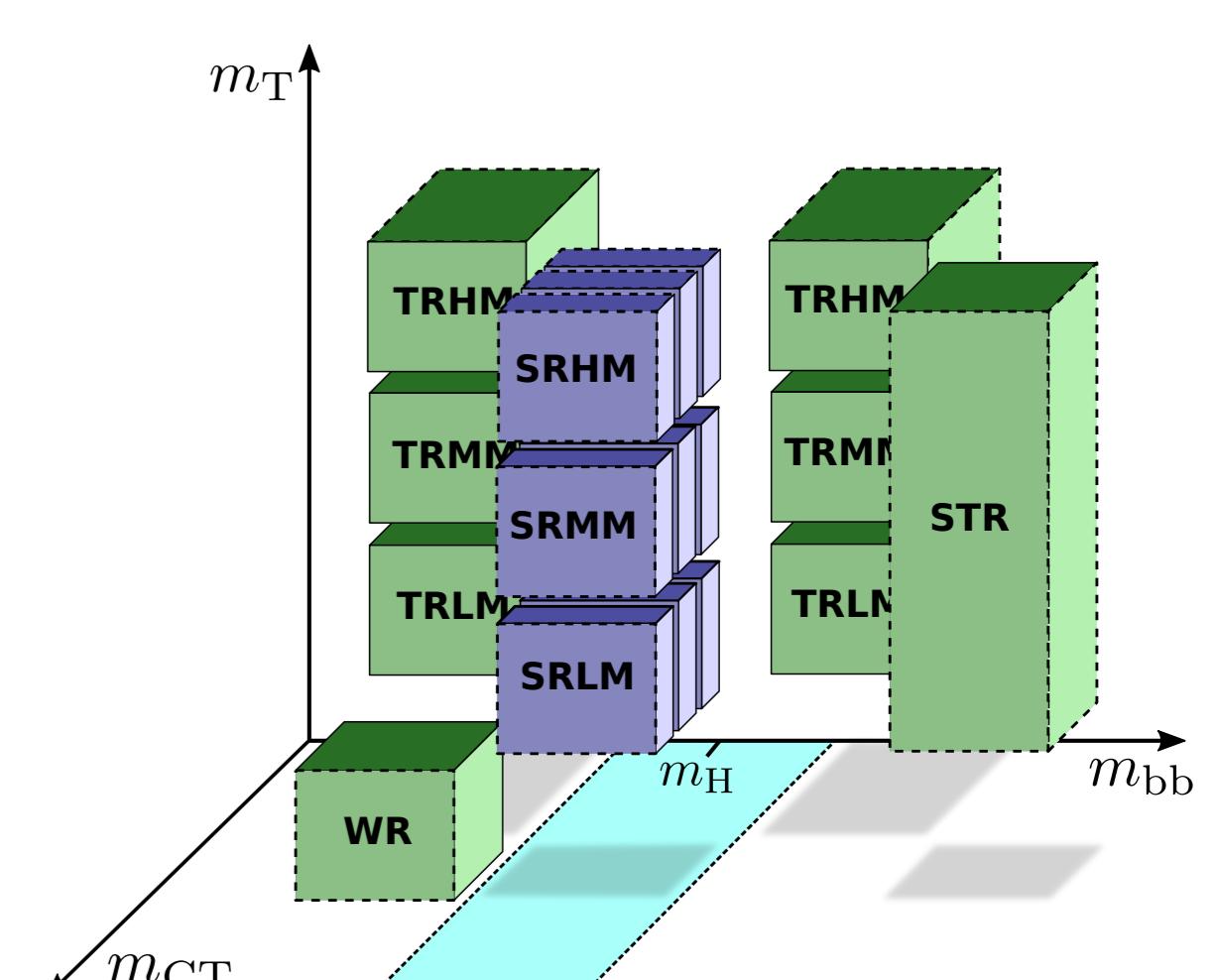
	SR-LM	SR-MM	SR-HM
N_{lepton}		= 1	
$p_T^\ell \text{ [GeV]}$	> 7(6) for $e(\mu)$		
N_{jet}	= 2 or 3		
$N_{b\text{-jet}}$	= 2		
$E_T^{\text{miss}} \text{ [GeV]}$	> 240		
$m_{bb} \text{ [GeV]}$	$\in [100, 140]$		
$m(\ell, b_1) \text{ [GeV]}$	–	–	> 120
$m_T \text{ [GeV]} \text{ (excl.)}$	$\in [100, 160]$	$\in [160, 240]$	> 240
$m_{CT} \text{ [GeV]} \text{ (excl.)}$	$\in [180, 230], \in [230, 280], > 280$		
$m_T \text{ [GeV]} \text{ (disc.)}$	> 100	> 160	> 240
$m_{CT} \text{ [GeV]} \text{ (disc.)}$		> 180	



Background estimation

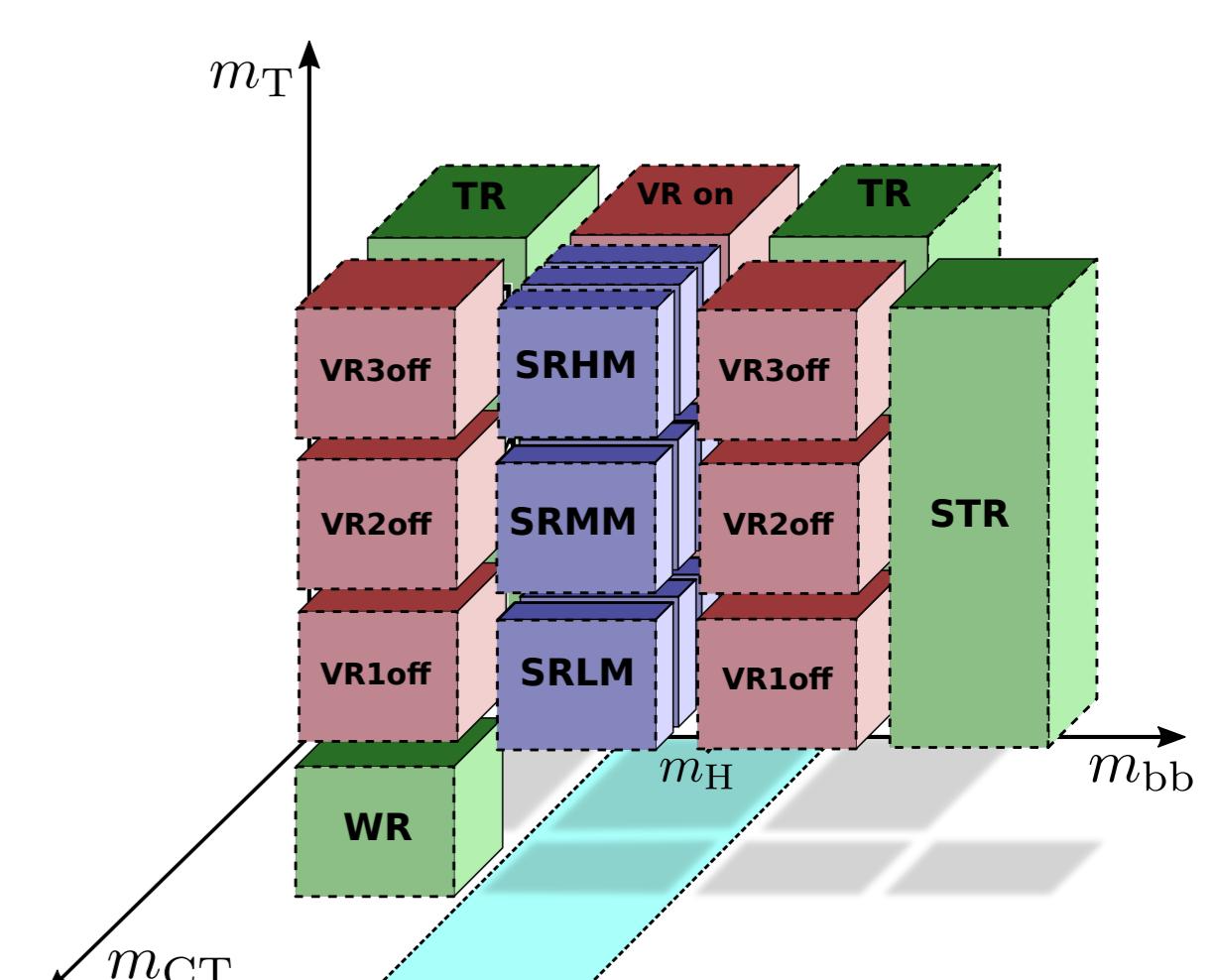
Control regions (CRs):

- Major backgrounds** ($t\bar{t}$, Wt and $W+\text{jets}$): estimated from Monte Carlo (MC) simulation but normalised to data in dedicated CRs.
- Minor backgrounds**: estimated directly from MC simulation.



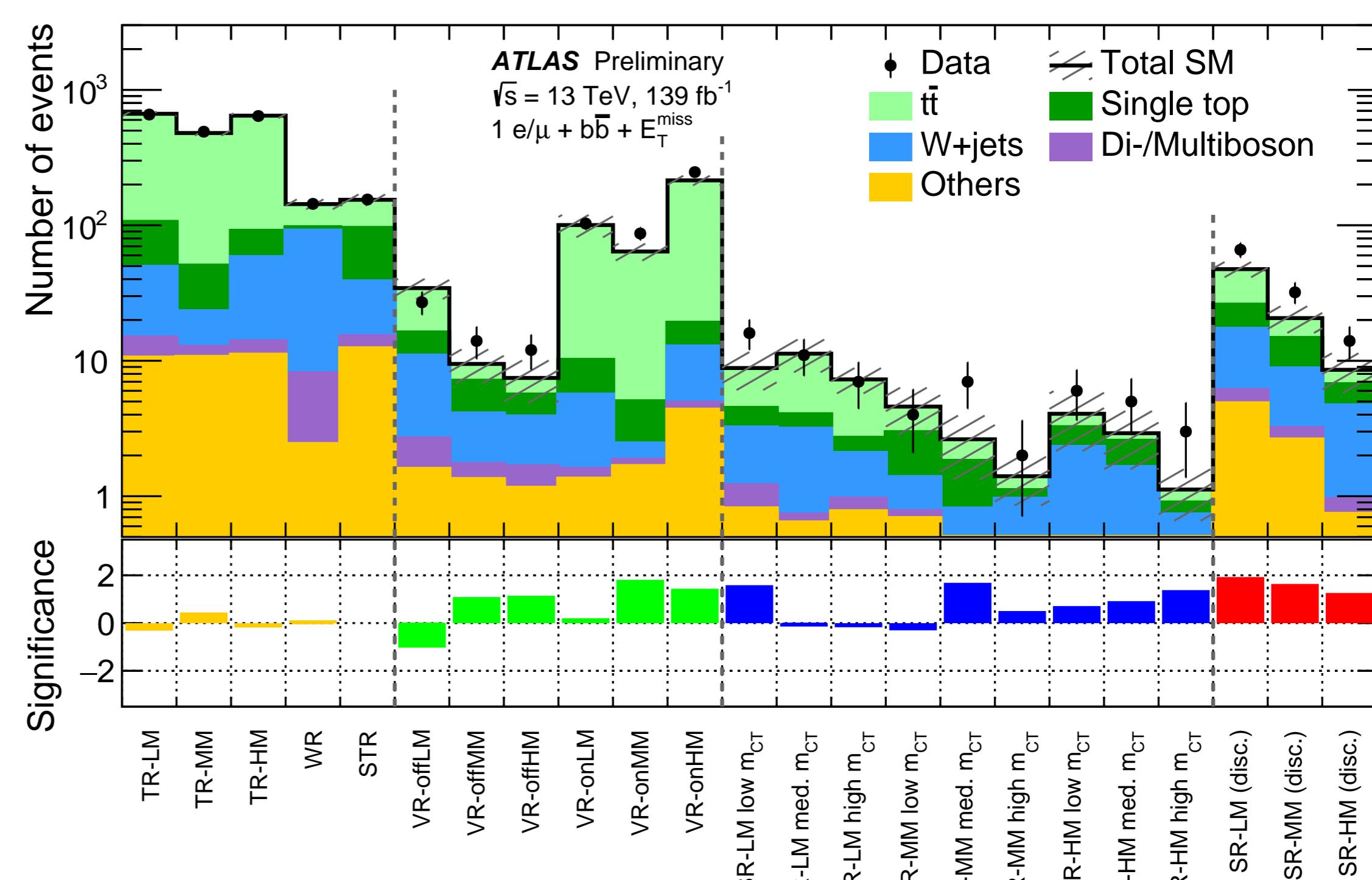
Validation regions (VRs):

- Validation of background predictions.
- Orthogonal to all other regions and placed between CRs and SRs for extrapolation validation.



Results

- No significant excess over SM expectation found in data after likelihood fit.

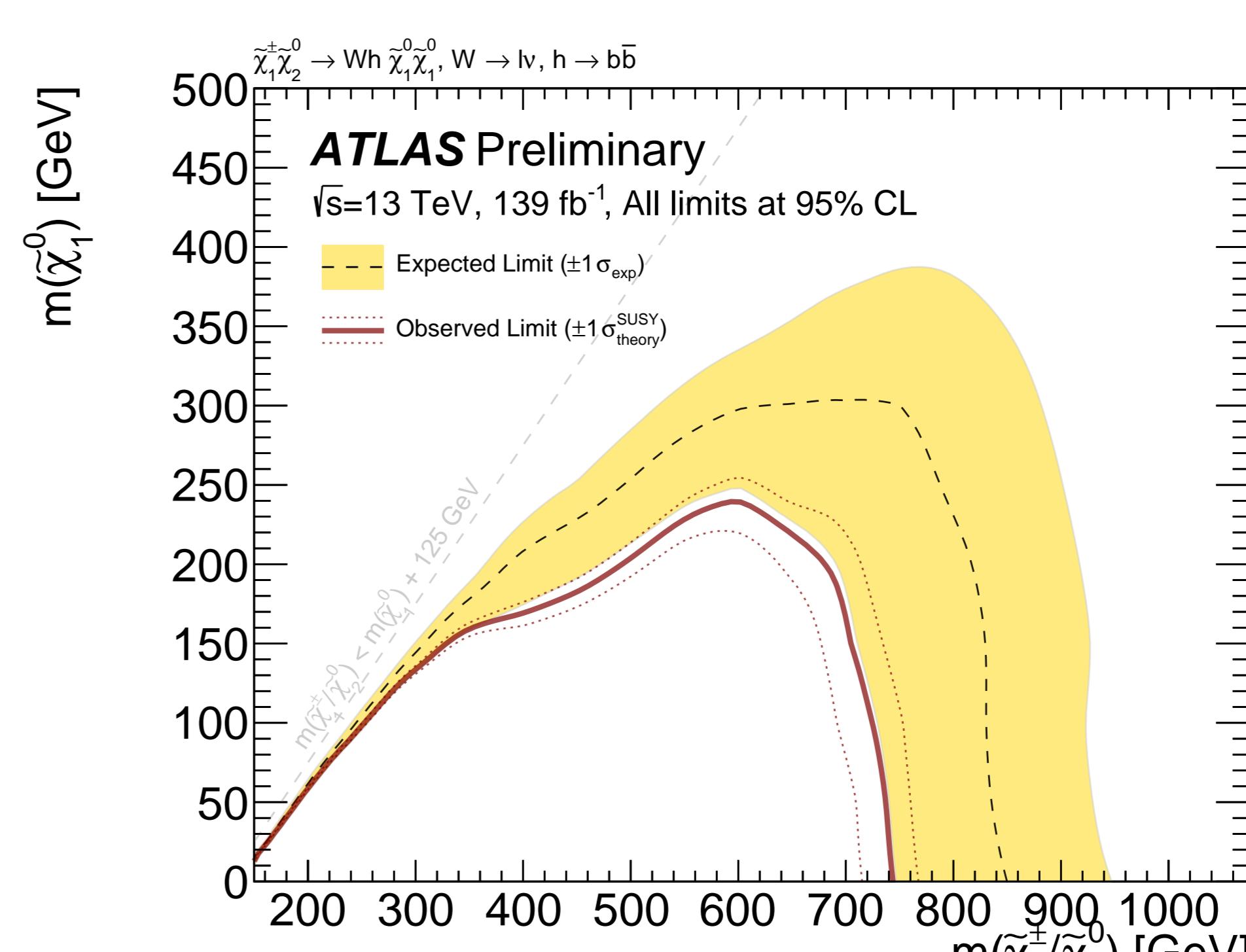


- Derivation of upper limits on contributions from physics processes beyond SM.

Signal Region	$\langle\sigma\rangle_{\text{obs}}^{95} \text{ [fb]}$	S_{obs}^{95}	S_{exp}^{95}	CL_B	p_0	Z
SR-LM(disc.)	0.26	36.8	$20.0^{+8.0}_{-5.4}$	0.97	0.03	1.88
SR-MM(disc.)	0.18	24.8	$15.3^{+3.2}_{-4.6}$	0.94	0.06	1.54
SR-HM(disc.)	0.11	14.7	$9.7^{+3.3}_{-2.7}$	0.89	0.10	1.30

- Derivation of exclusion limits at 95% confidence level (CL).

$\tilde{\chi}_1^\pm/\tilde{\chi}_2^0$ masses up to 740 GeV can be excluded for a massless $\tilde{\chi}_1^0$.



References

- [1] ATLAS Collaboration. "Search for direct production of electroweakinos in final states with one lepton, missing transverse energy and a Higgs boson decaying into two b -jets in pp collisions at $\sqrt{s} = 13 \text{ TeV}$ with the ATLAS detector". *ATLAS-CONF-2019-031* (July 2019).