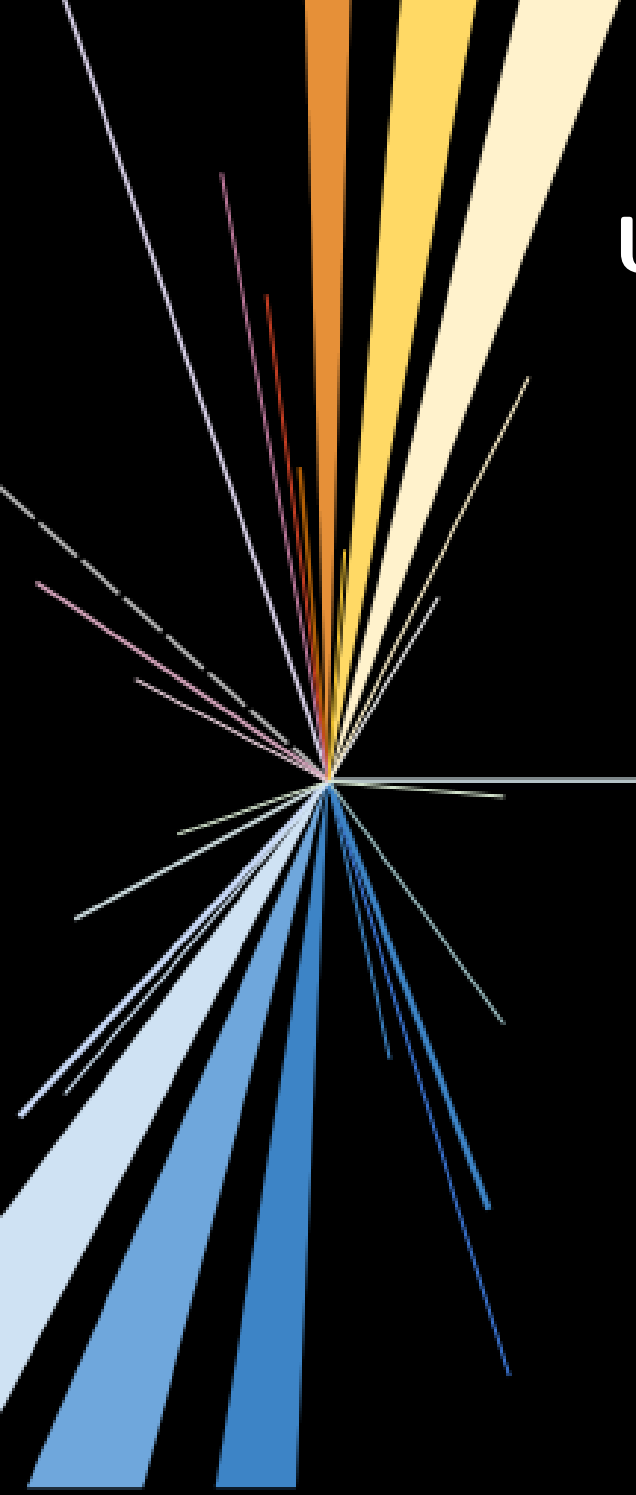

Using Higgs to bb in the search for EWK SUSY with ATLAS at LHC Run 2

Rima El Kosseifi, Steve Muanza

CPPM, Aix-Marseille Université, CNRS/IN2P3 (FR)

TAE 2017, September 13, 2017

Brief review of SUperSYmmetry

Motivation

mysteries left unexplained by SM COULD BE solved by SUSY

- No unification of coupl. const.
- No (cold) dark matter candidate
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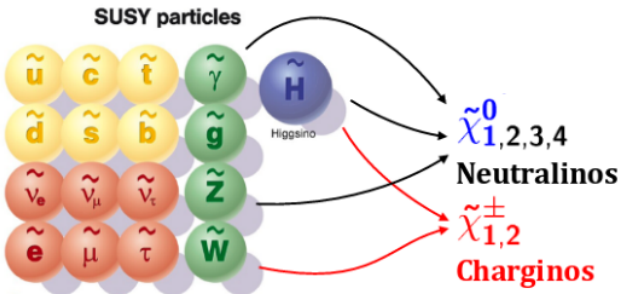

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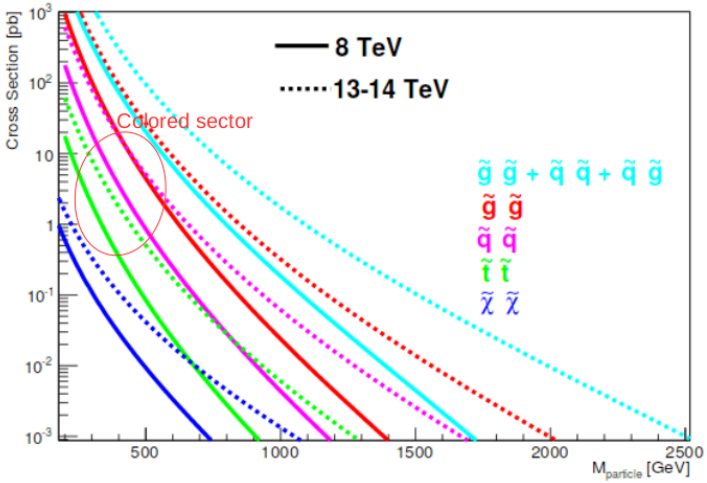

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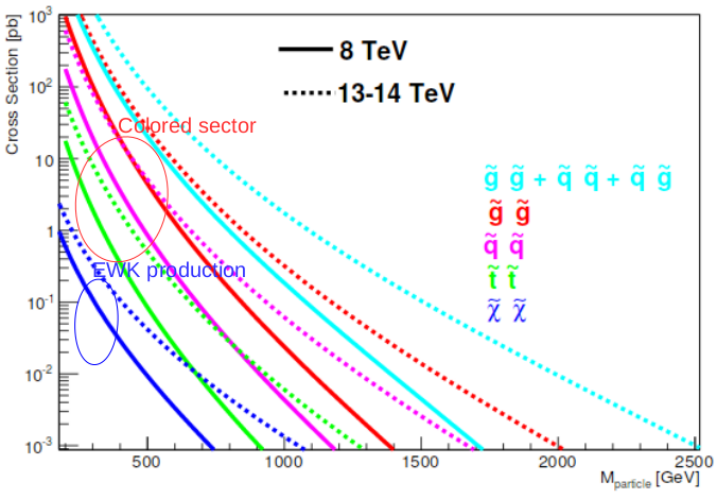

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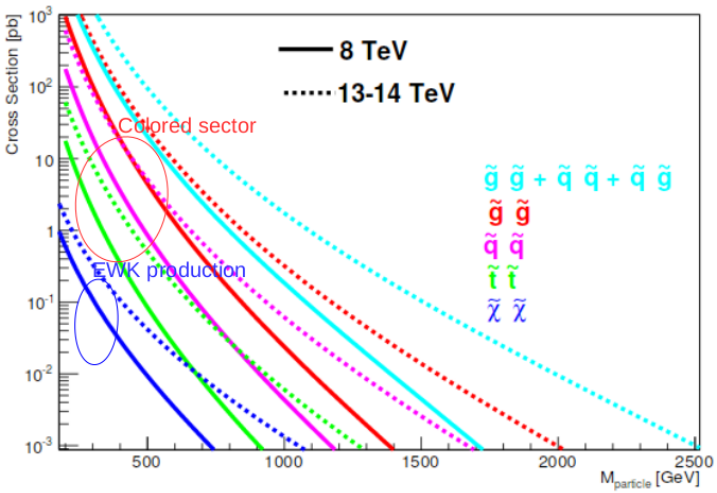

- However, limits were set for masses $\tilde{g}$, $\tilde{q}$ >1 TeV

$\Longrightarrow$

Direct production of Chargino-Neutralinos may dominate the SUSY production at the LHC.

$\tilde{\chi_1}^{\pm}\tilde{\chi_2}^{0} \rightarrow$ Wh + MET analyses

- $\widetilde{\chi}_2^0(\widetilde{\chi}_1^{\pm})$ is wino like, $\widetilde{\chi}_1^0$ is bino like. $m_{\widetilde{\chi}_1^{\pm}}=m_{\widetilde{\chi}_2^0}$ as in Run 1: Ref
- Like Run1, for Run2 different analyses channels in Wh

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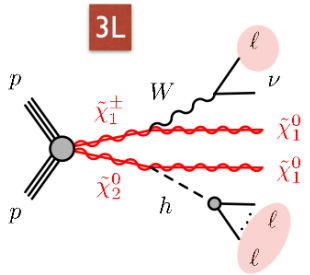
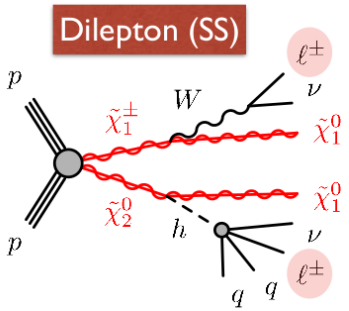
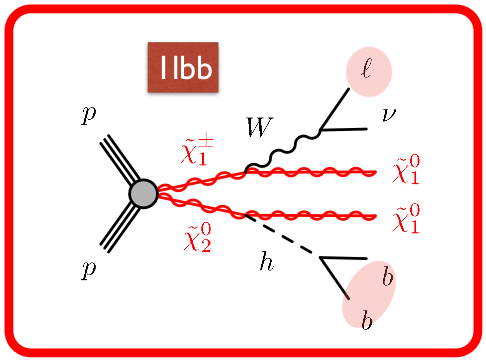
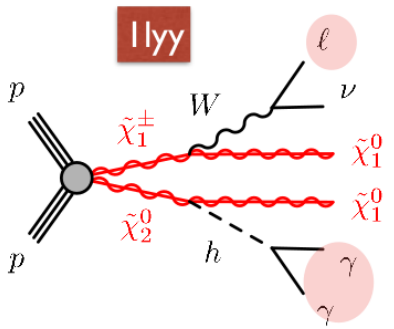






BR($h \rightarrow$bb)=58%



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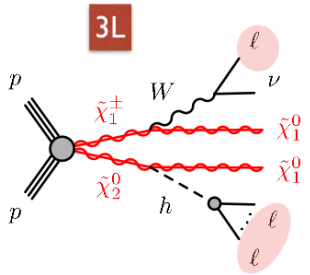

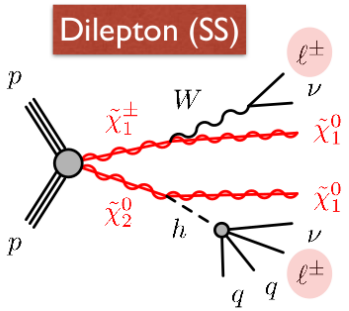

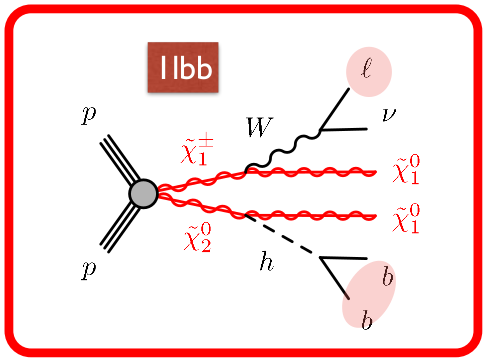

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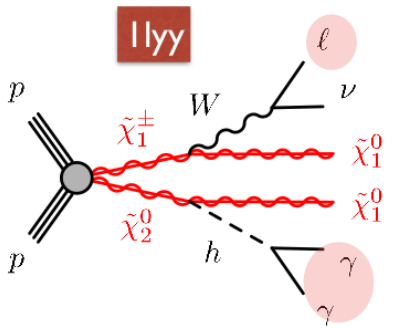
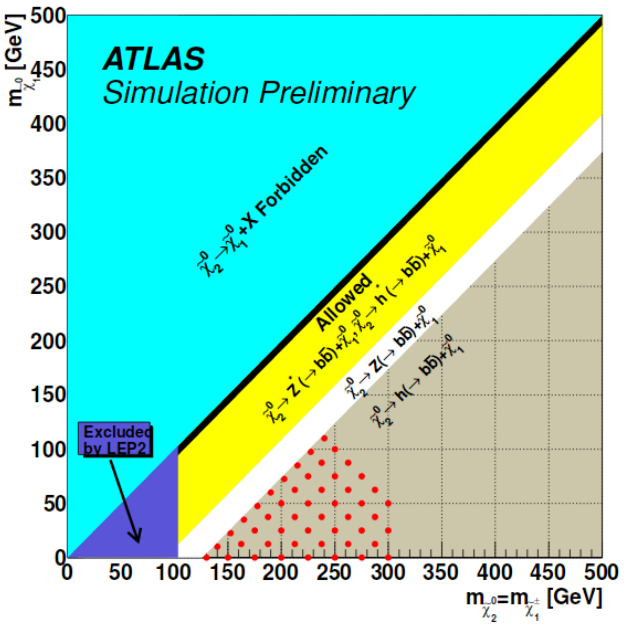
- 1lbb main background: $t\bar{t}$

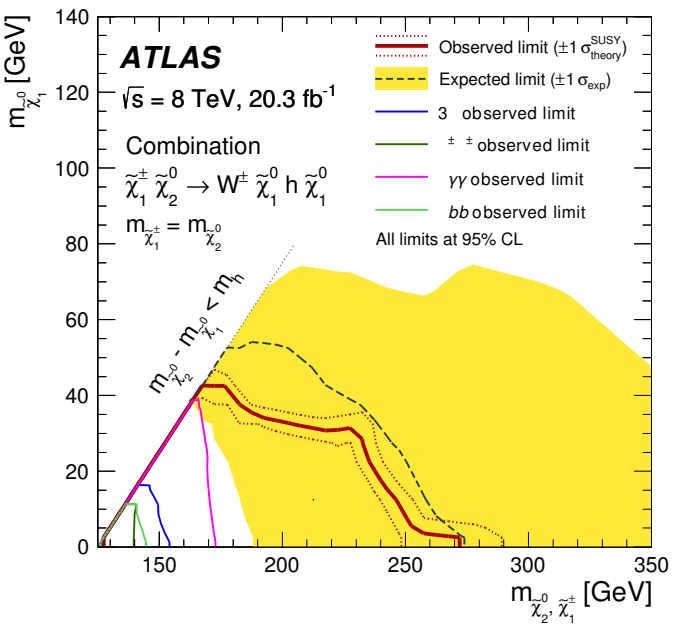


Process	m=250 GeV	$t\bar{t}$
Xsec(pb) 13 TeV	0.7	831
8 TeV	0.1	250

Previous results

- $\Delta M = M_{\widetilde{\chi}_1^{\pm}} - M_{\widetilde{\chi}_1^0}$
- First priority: h on-shell ($\Delta M > m_h$)
- Second priority: Z on-shell (extend to $\Delta M > m_Z$)





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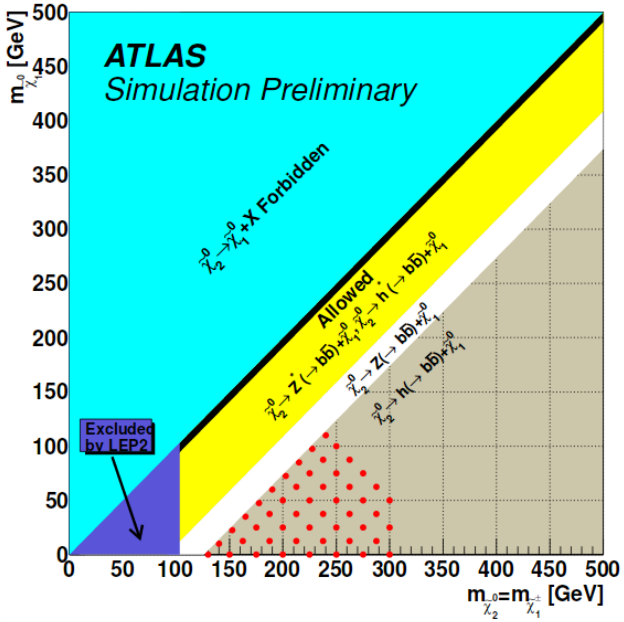
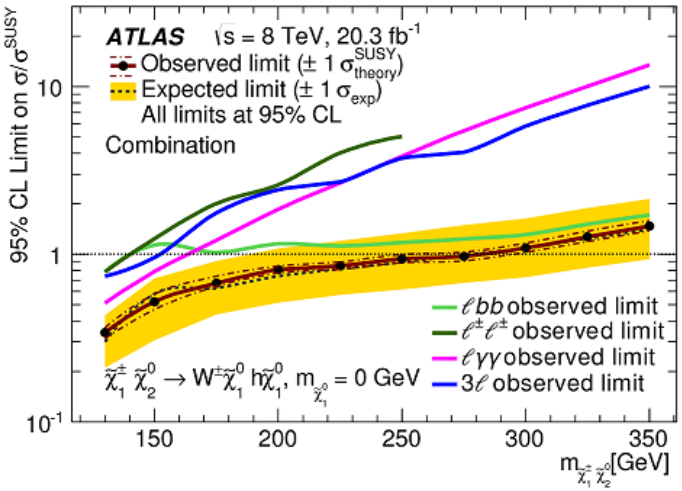
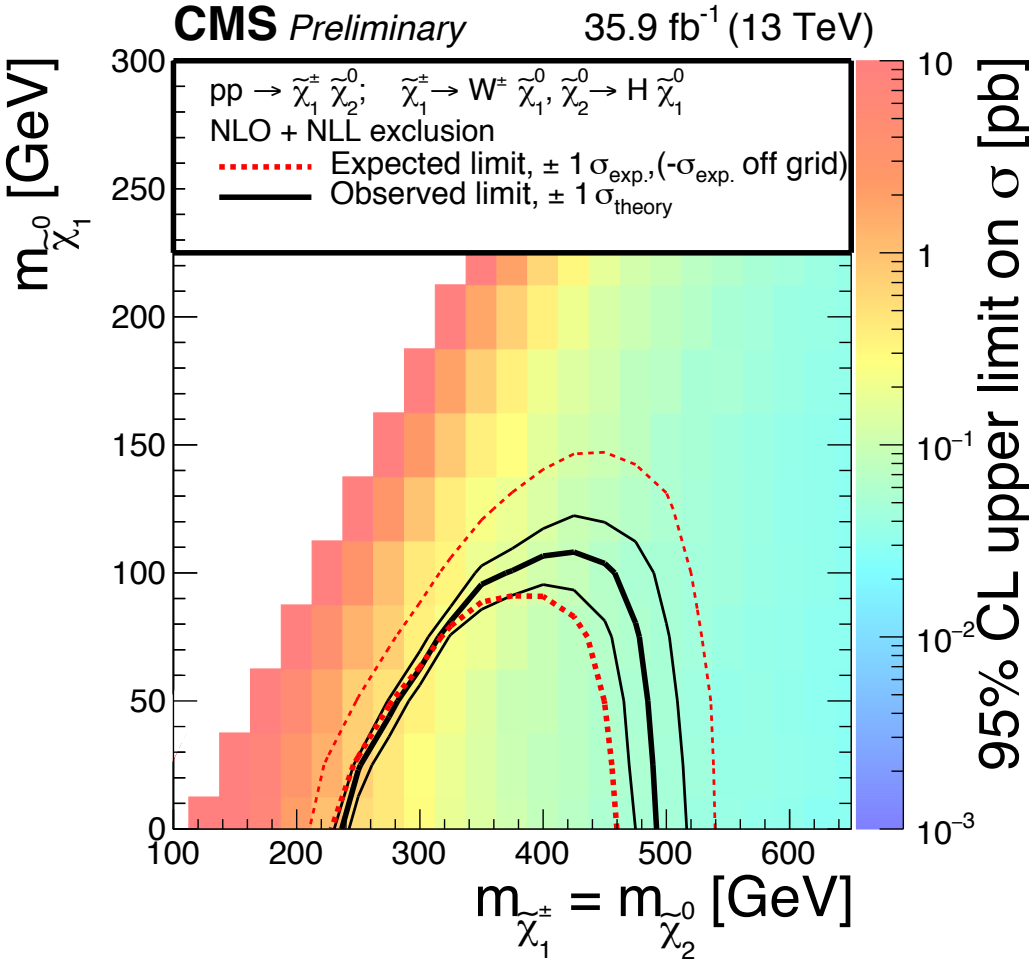




Recent results

- Recent results by CMS, consistent with our expectations from sensitivity studies.



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Variables separating S/B

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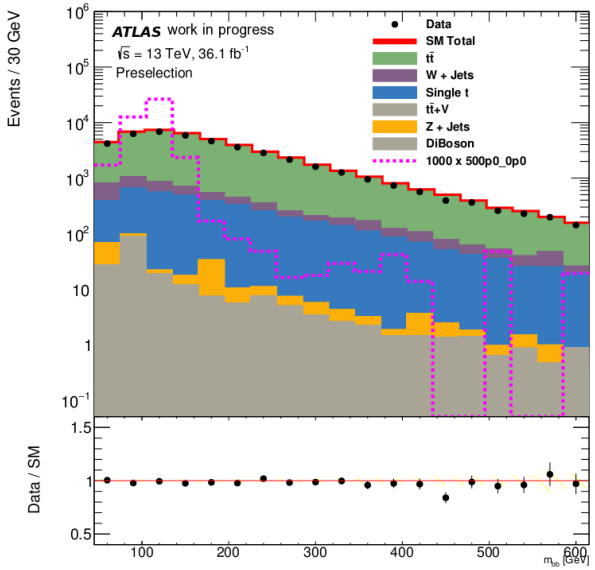

Selected events

N sig lep	1 matched to single lep trigger, $p_T > 27$ GeV
N jets	2 or 3, $p_T > 25$ Gev and $\|\eta\| < 2.8$
N b-jets	2
MET	> 100 GeV
m_{bb}	> 50 GeV
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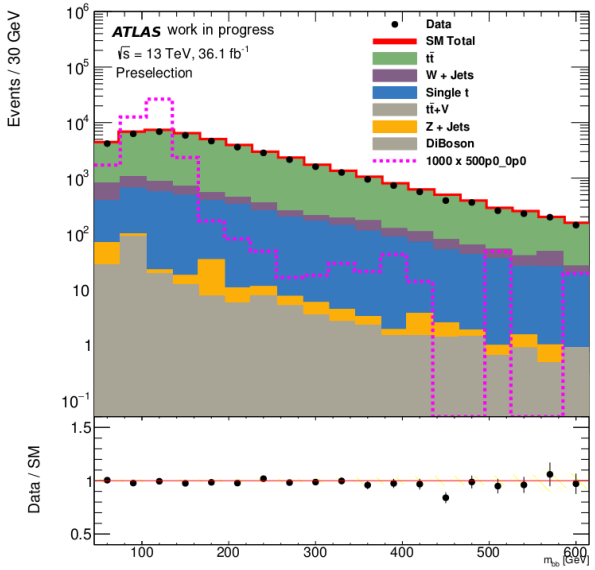
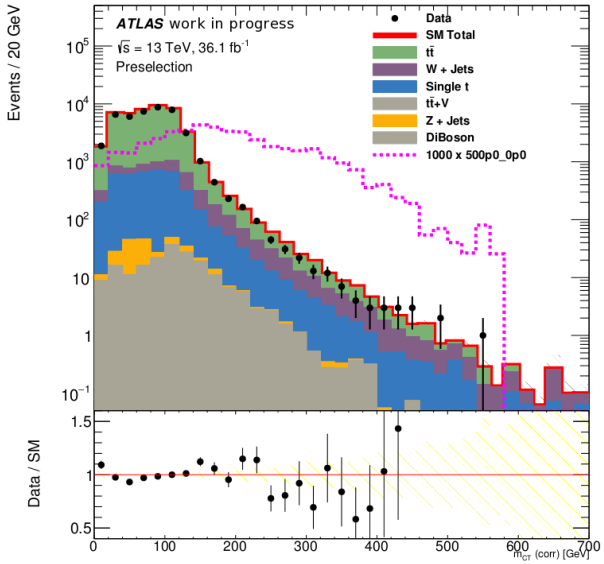
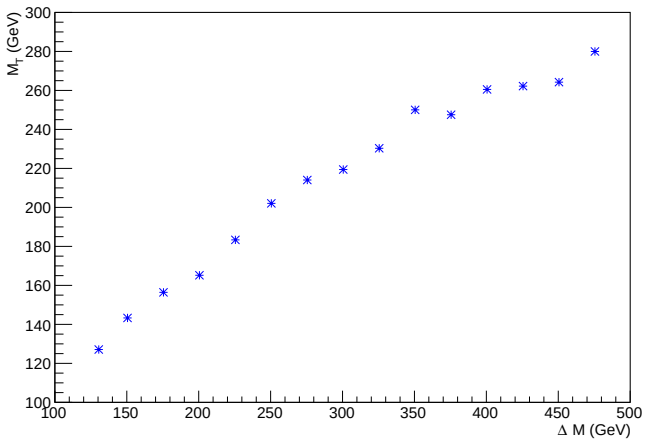
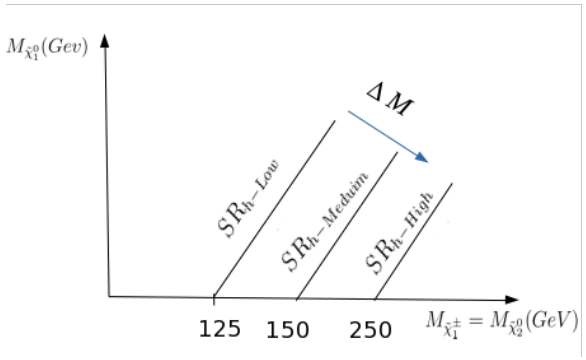




Signal Regions

- Signal sensitivity depends on two factors ΔM and $M_{\tilde{\chi}_1^\pm}$
- It decreases with increasing $M_{\tilde{\chi}_1^\pm}$, increases with increasing ΔM
- m_T strongly correlated to ΔM
- Three ranges of m_T where optimized for signal processes with ΔM Low, Medium and high respectively





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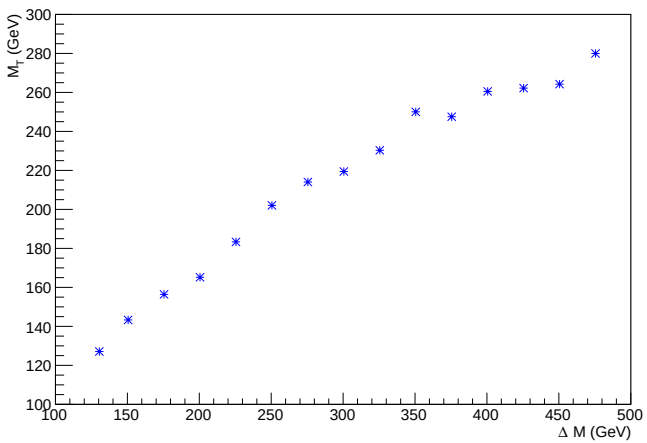

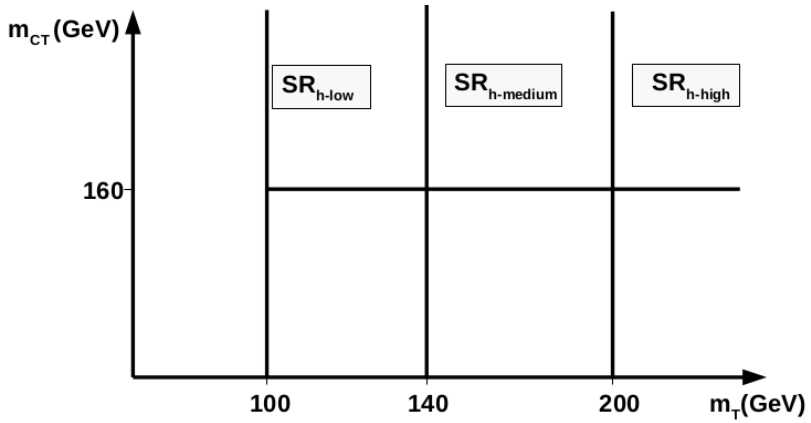

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CR, VR & SR

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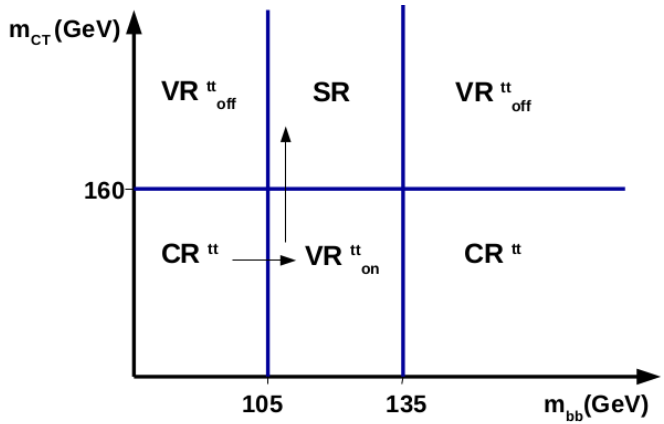
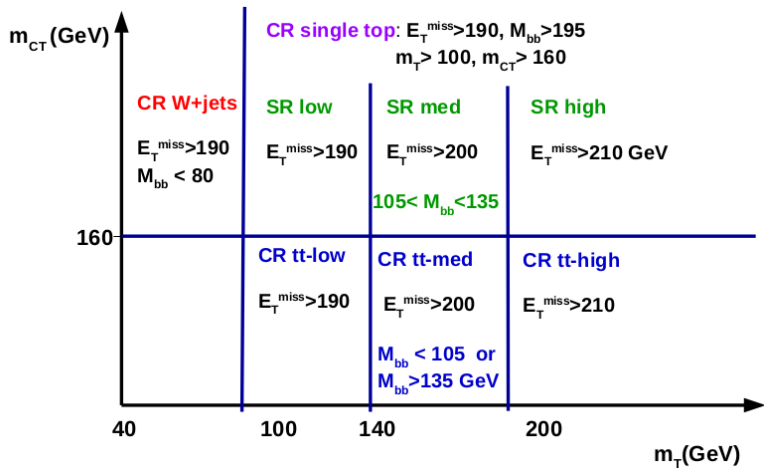


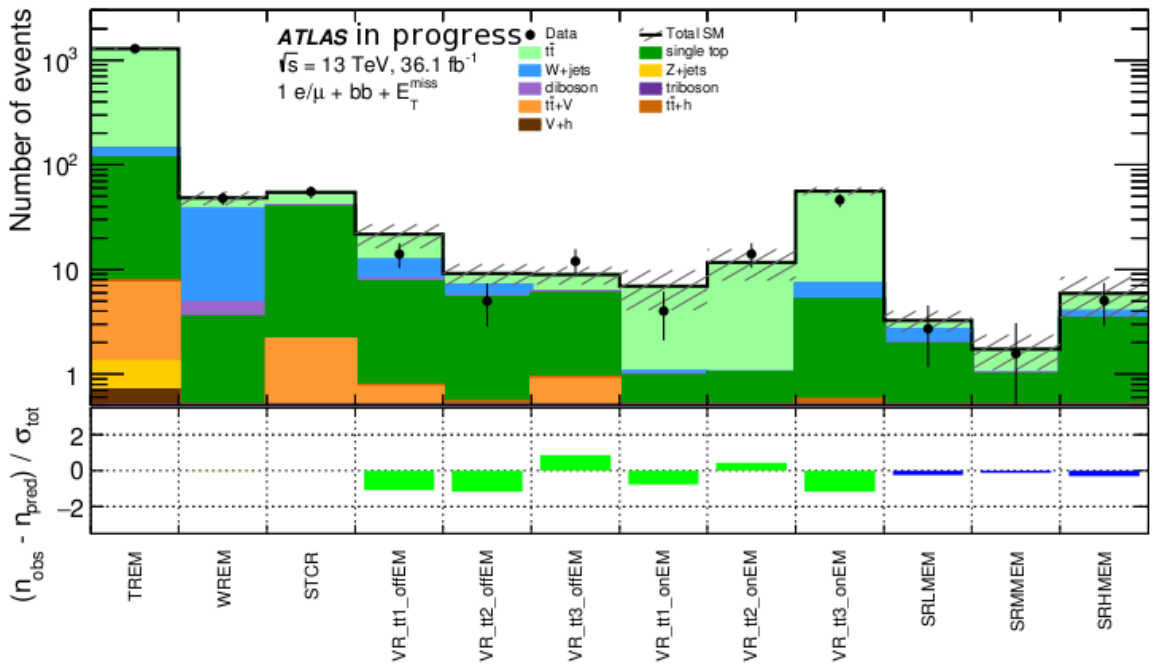
Implementation

Region	m_{CT} (GeV)	m_T (GeV)	m_{bb} (GeV)
CR-tt	< 160	>100	![105, 135]
CR-w+jets	> 160	[40, 100]	[50, 80]
CR-singletop	> 160	>100	> 195
VR-tt-off	>160	>100	![105, 135]
VR-tt-on	<160	>100	105-135



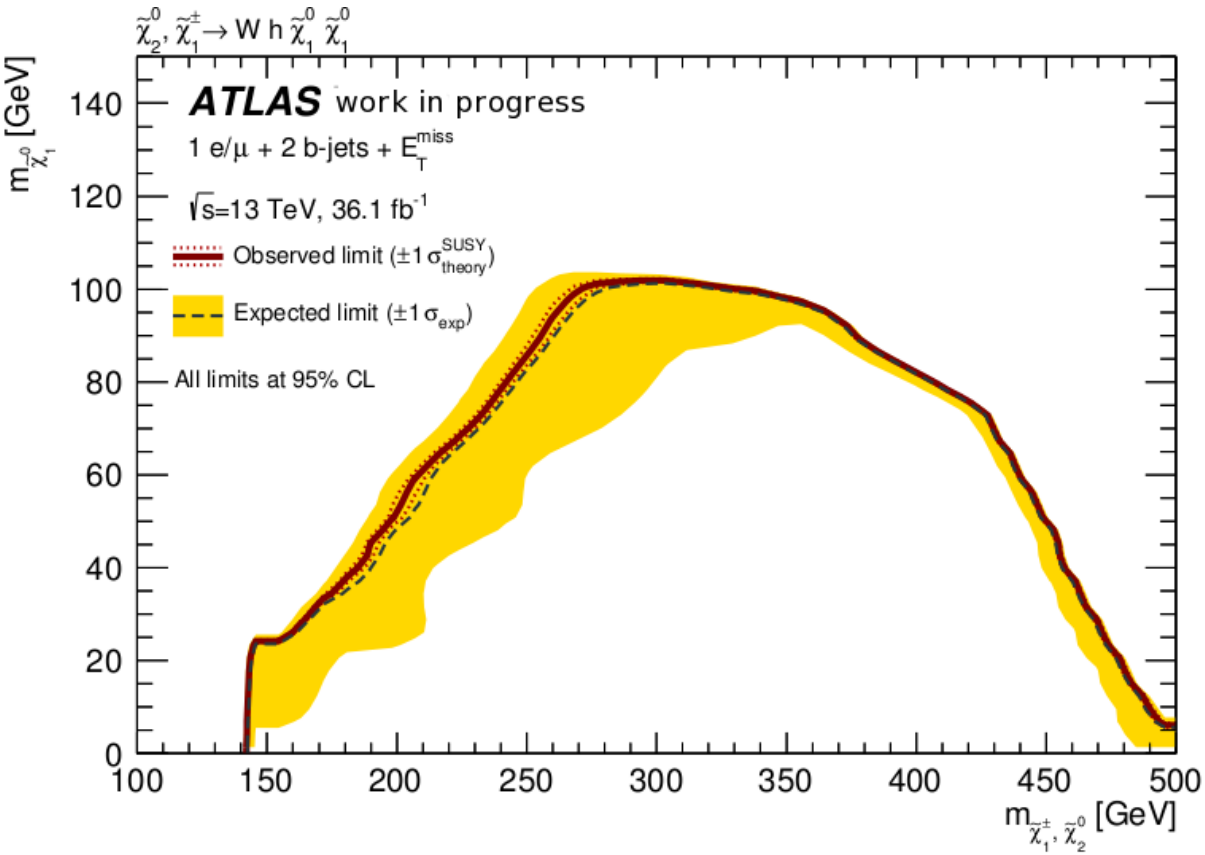
Bkgd only fit result

- To extract the final results a joint fit of SR with CR is performed
- Top pair, W+jets and Single top background are normalised on data in CR



Expected sensitivities

- Preliminary expected sensitivities not including theory uncertainties



Summary

- Analysis strategy is well-defined with preliminary exclusion result
- Outstanding points to check
  $\rightarrow$ Change the leading by p_T requirement of the b-jets
  $\rightarrow$ Improve the m_{bb} resolution
  $\rightarrow$ Fully implement the theory uncertainties for both signal and background

BACKUP

- M_{CT}: Contransverse mass, used to remove $t\bar{t}$ events
- It serves to measure the mass of pair produced heavy particles decaying identically and semi invisibly

$$M_{CT}^2(b_1, b_2) = (E_T(b_1) + E_T(b_2))^2 - (p_T(b_1) - p_T(b_2))^2$$

$$M_{CT}^{max} = \frac{m_{heavy}^2 - m_{inv}^2}{m_{heavy}}$$

- In case of $t\bar{t}$: $m_{heavy} = m_t$ and $m_{inv} = m_W \rightarrow$ endpoint at 135 GeV