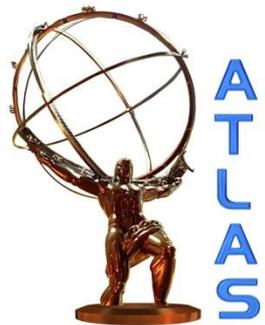


Searches for direct pair production of third generation squarks with the ATLAS detector

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Phenomenology 2014 Symposium, Pittsburgh



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Overview

- Motivation for 3rd generation searches
- ATLAS direct sbottom searches
 - [JHEP10\(2013\)189](#): 0 leptons + 2 b -jets + missing E_T
 - **blueprint of an ATLAS SUSY analysis**
 - [1404.2500](#): 2 same-sign / 3 -leptons + 0-3 b -jets + missing E_T
 - [ATLAS-CONF-2013-061](#): 0-1 leptons + ≥ 3 b -jets + missing E_T
- ATLAS direct stop searches
 - [1403.4853](#): 2 leptons + (b)jets + missing E_T
 - [ATLAS-CONF-2014-014](#): stop in b , τ and gravitino
 - [ATLAS-CONF-2013-037](#): 1 lepton + 4(1 b -)jets + missing E_T
 - [ATLAS-CONF-2013-024](#): 0 lepton + 6 (2 b -)jets + missing E_T
 - [ATLAS-CONF-2013-068](#): 0 leptons + mono-jet/ c -jets + missing E_T
 - [1403.5222](#): Z + b -jet + jets + missing E_T

NEW
(published 2014)

Only in back-up slides

All analyses use the full 2012 dataset, $\mathcal{L} \sim 20 \text{ fb}^{-1}$, $\sqrt{s} = 8 \text{ TeV}$.

<https://twiki.cern.ch/twiki/bin/view/AtlasPublic/SupersymmetryPublicResults>





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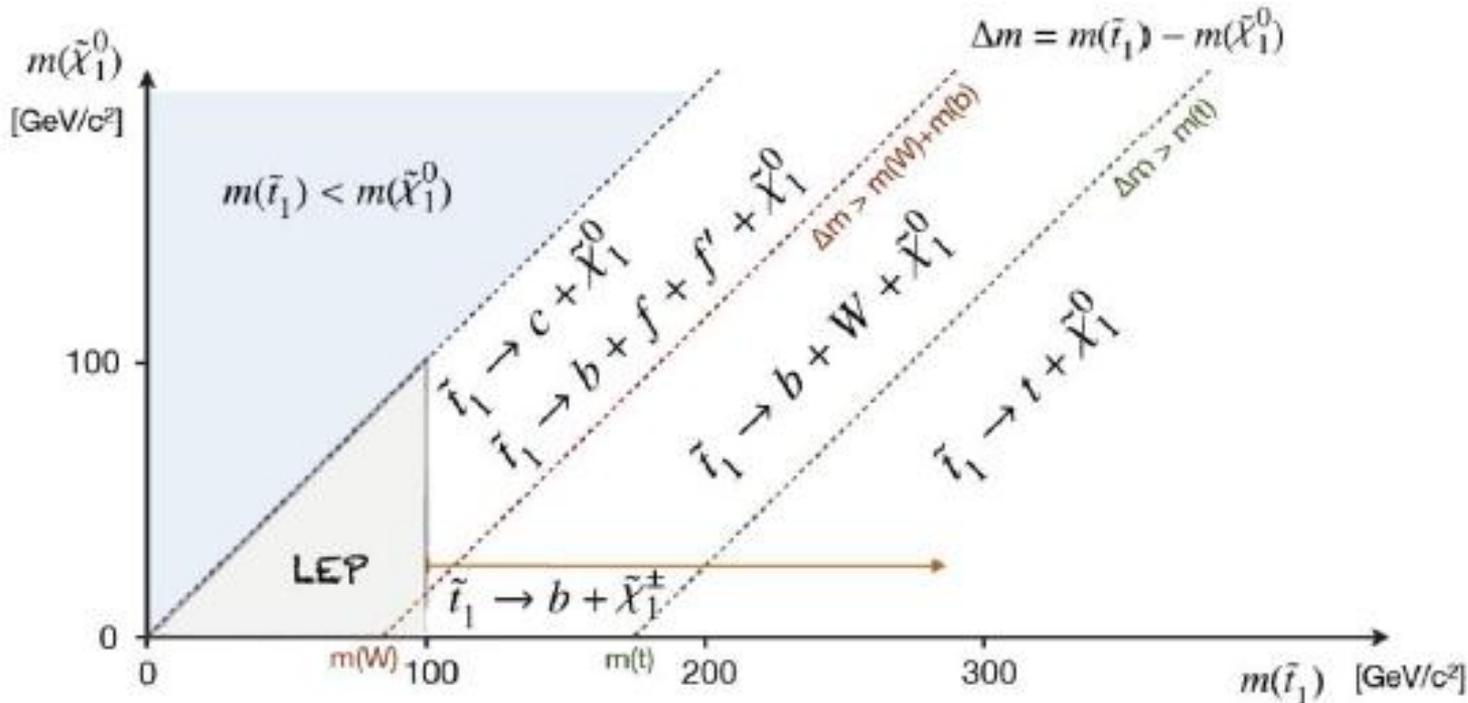
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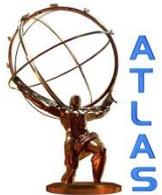
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Motivation and roadmap

- \tilde{q}_L, \tilde{q}_R mixing large for 3rd generation squarks due to large top Yukawa coupling \rightarrow **lighter masses** compared to 1st, 2nd gen. squarks
- Naturalness \rightarrow **light top/bottom squarks**, (higgsinos, gluino)
- Study simplified “models”:
 - assume only sbottom / stop pair production
 - simplified decays; depend on $\Delta m(\text{stop, chargino / neutralino})$
 - 100% branching fraction to the given decay



ATLAS DIRECT **SBOTTOM** SEARCHES



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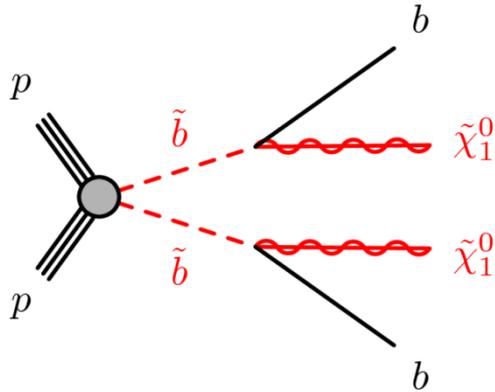
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JHEP10(2013)189 : Direct Sbottom



$$m_{CT}^2(v_1, v_2) = [E_T(v_1) + E_T(v_2)]^2 - [\mathbf{p}_T(v_1) - \mathbf{p}_T(v_2)]^2$$

(0910.0174)

$t\bar{t}$: endpoint at 135 GeV

$$\text{signal: } m_{CT}^{\max} = \frac{m^2(\tilde{b}) - m^2(\tilde{\chi}_1^0)}{m(\tilde{b})}$$

Requirement	SRA	SRB
	e / μ veto	
Missing E_T	> 150 GeV	> 250 GeV
Jet 1 p_T	> 130 GeV	> 150 GeV
Jet 2 p_T	> 50 GeV	> 30 GeV
Jet 3 p_T	veto if > 50 GeV	> 30 GeV
== 2 b -jets	J1, J2	J2, J3
m_{bb}	> 200 GeV	-
m_{CT}	> 150, 200, 250, 300, 350 GeV	-
$H_{T,3}$	-	< 50 GeV
Targeting	large $\Delta m(\tilde{b}, \tilde{\chi})$	low $\Delta m(\tilde{b}, \tilde{\chi})$, ISR boosts $b\tilde{b}$

$$H_{T,3} = \sum_{i=4}^n p_{T,i}$$



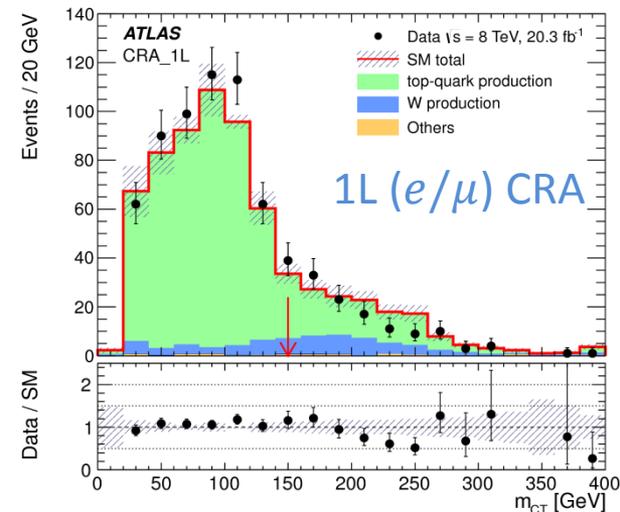
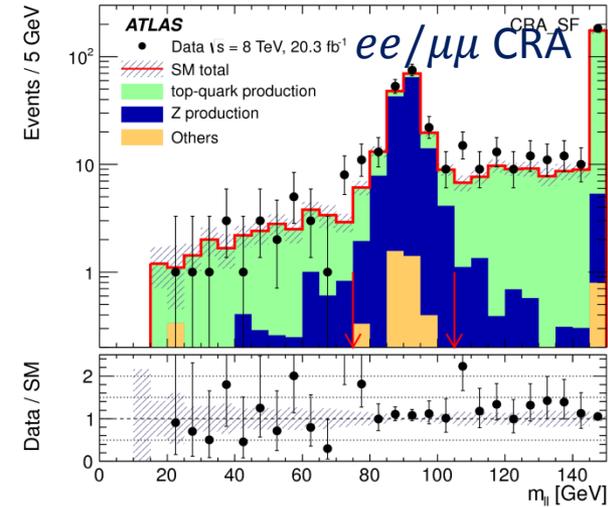
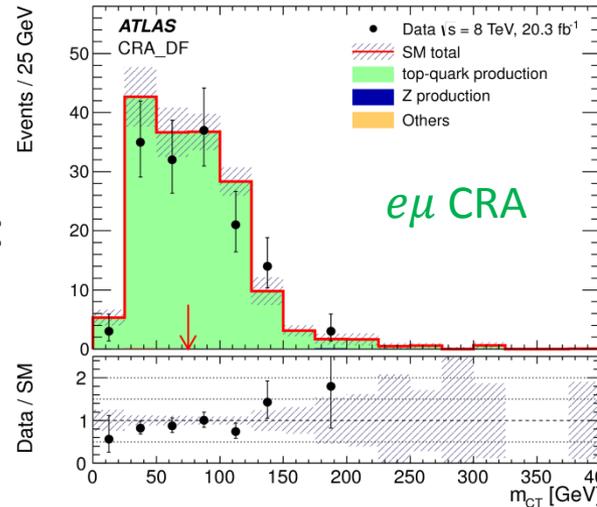
JHEP10(2013)189 : Direct Sbottom

- Backgrounds:
 - $t\bar{t}$, Z+HF, W+HF
- Define CRs enhanced in a particular background:

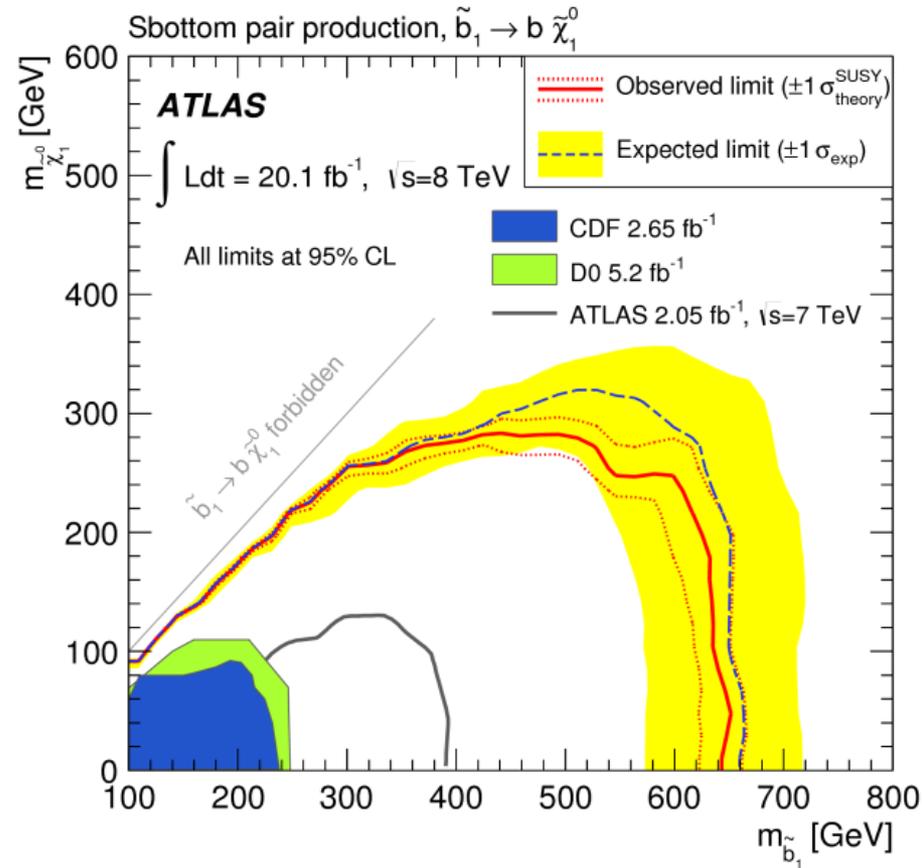
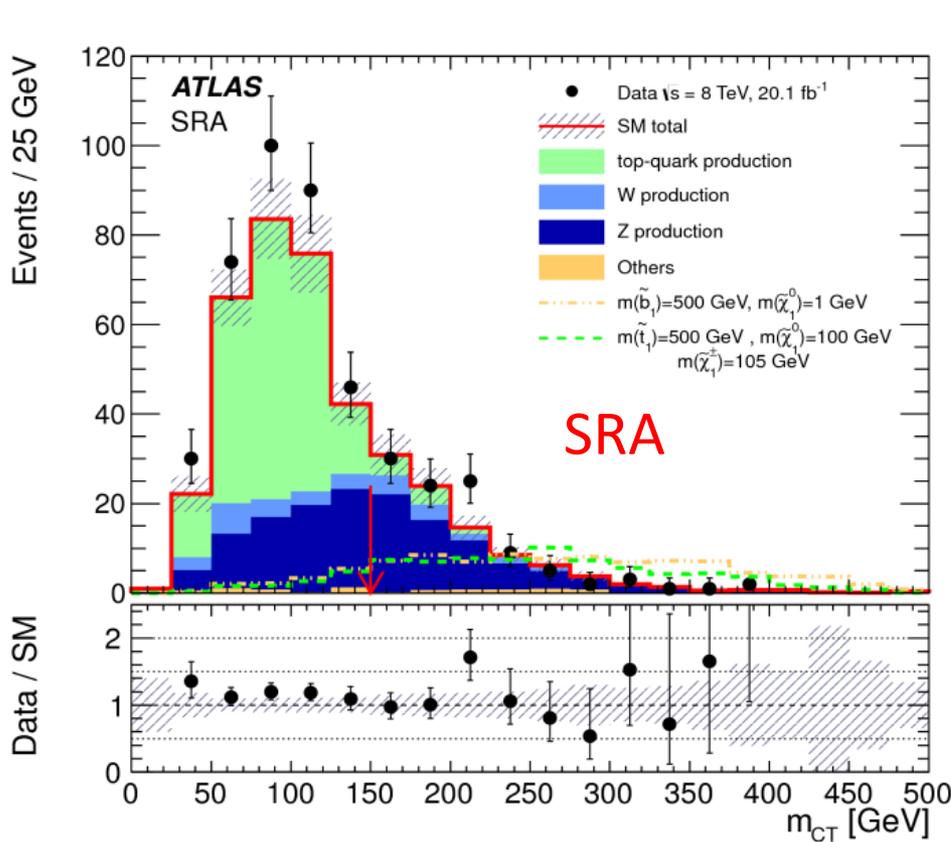
- $e\mu$ CRA: $t\bar{t}$
- $ee/\mu\mu$ CRA: Z+HF
- 1L CRA: $t\bar{t}$, W + HF

- Profile likelihood fit of MC yields to data in CRs:

- Extract bckg. normalisations / signal strength
- Pin down nuisance parameters: effect of Jet Energy Scale / Resolution / b -tagging uncertainty on event yields



JHEP10(2013)189 : Direct Sbottom



Analysis also has sensitivity to $\tilde{t} \rightarrow b + \tilde{\chi}_1^\pm, \tilde{\chi}_1^\pm \rightarrow W^* + \tilde{\chi}_1^0$, very low $\Delta m(\tilde{\chi}_1^\pm, \tilde{\chi}_1^0)$.

Analyses targeting $\tilde{b} \rightarrow t + \tilde{\chi}_1^\pm$ and $\tilde{b} \rightarrow b + \tilde{\chi}_2^0$ in backup slides.





ATLAS DIRECT **STOP** SEARCHES



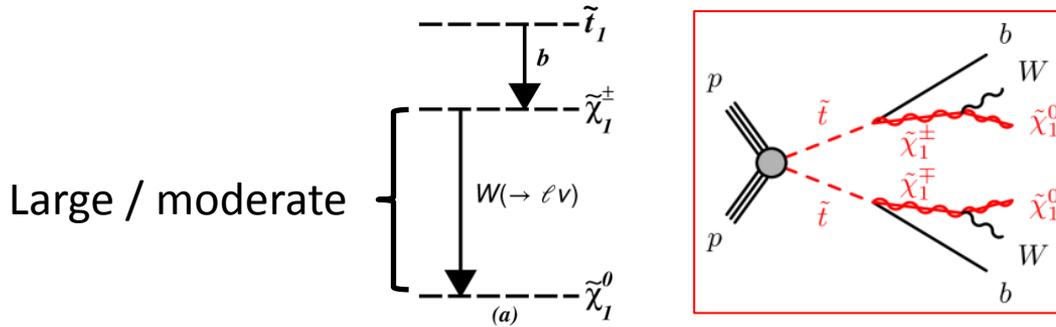
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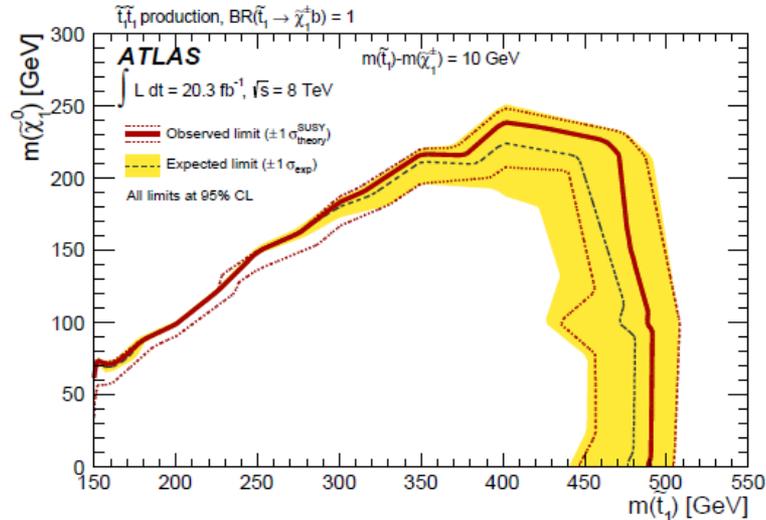
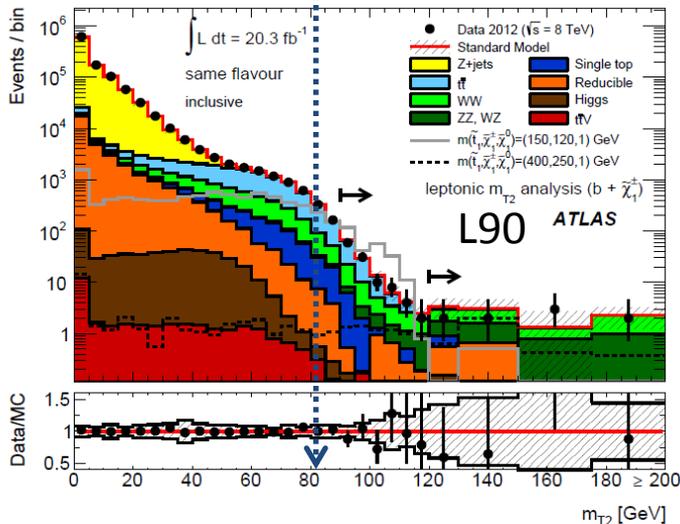
1403.4853: 2L + (b)jets + missing E_T



$$m_{T2}^2(\chi) \equiv \min_{\mathbf{q}_T^{(1)} + \mathbf{q}_T^{(2)} = \mathbf{p}_T} \left[\max \left\{ m_T^2(\mathbf{p}_T^{\pi^{(1)}}, \mathbf{q}_T^{(1)}; \chi), m_T^2(\mathbf{p}_T^{\pi^{(2)}}, \mathbf{q}_T^{(2)}; \chi) \right\} \right] \quad (0304.226)$$

Build m_{T2} from the two leptons' p_T (and the missing E_T).

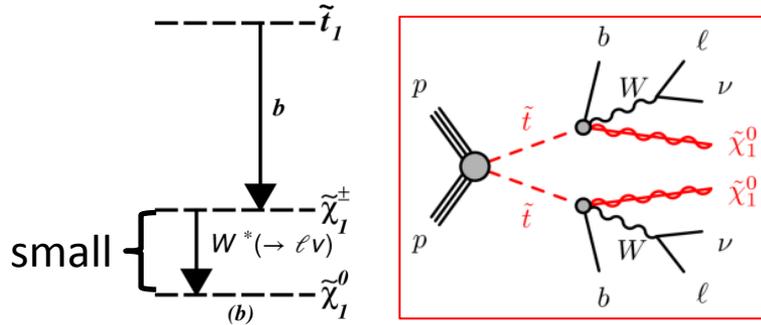
Dileptonic $t\bar{t}$, WW : m_{T2} kinematic endpoint at W mass.



Also sensitive to 3-body decays

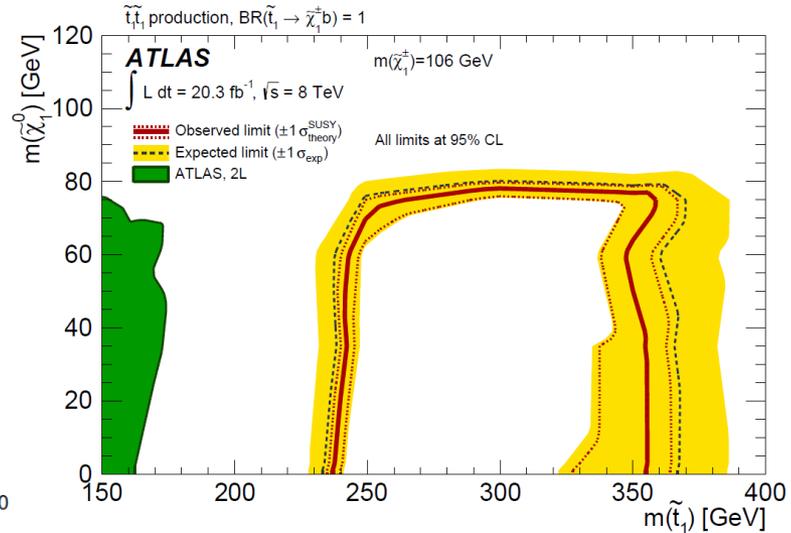
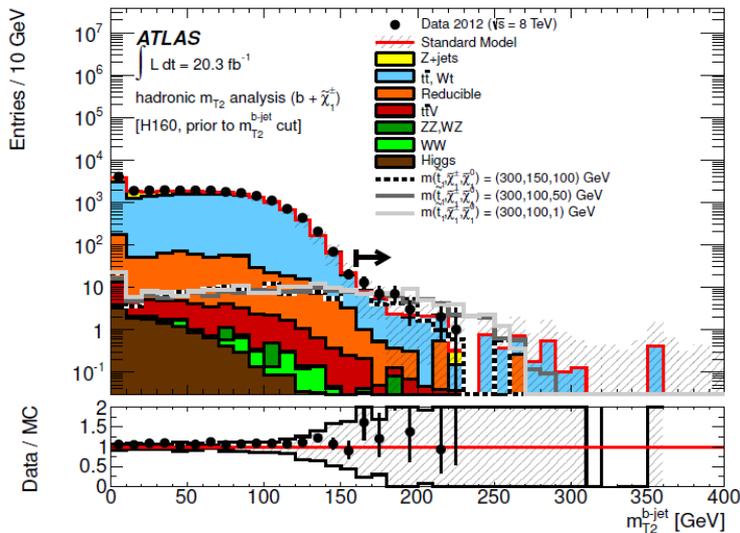


1403.4853: 2L + (b)jets + missing E_T



SR	H160
b -jets	= 2
Leading lepton p_T [GeV]	< 60
m_{T2} [GeV]	< 90
$m_{T2}^{b\text{-jet}}$ [GeV]	> 160
$\Delta m(\tilde{t}_1, \tilde{\chi}_1^\pm)$	large
$\Delta m(\tilde{\chi}_1^\pm, \tilde{\chi}_1^0)$	small

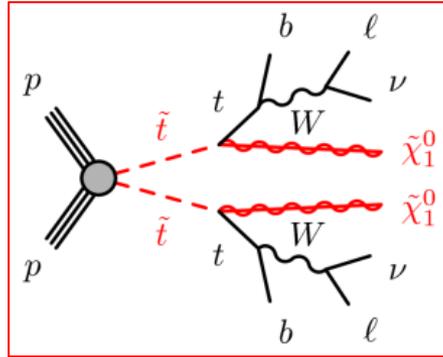
“Hadronic m_{T2} ”: $m_{T2}(b, b, \ell + \ell + E_T^{\text{miss}})$ ← For $t\bar{t}$ events, bound by $m(t)$.



1403.4853: 2L + (b)jets + missing E_T

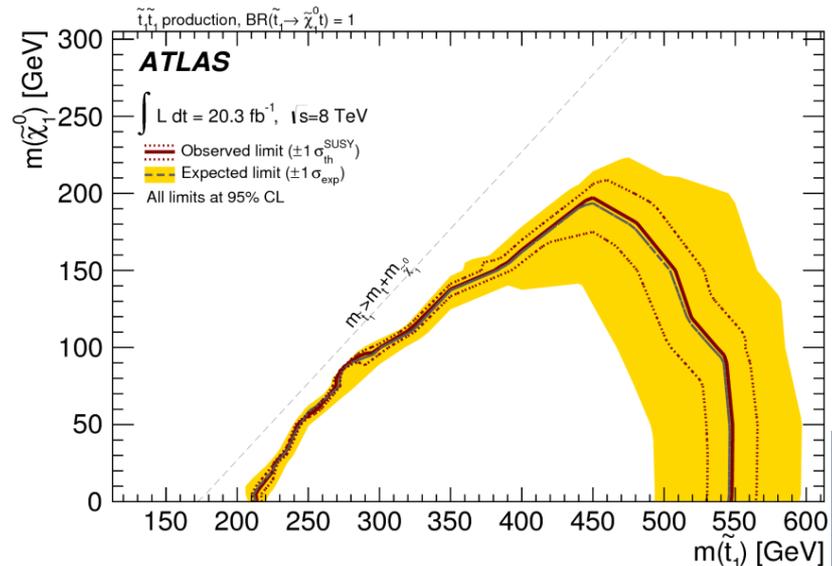
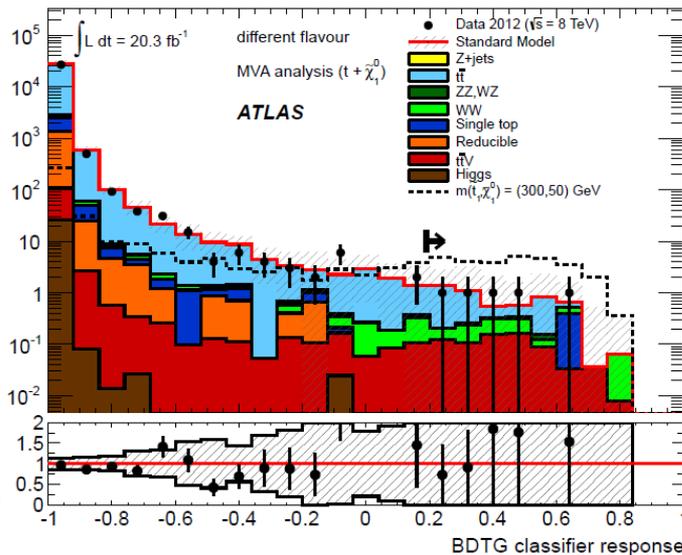


$$\tilde{t}_1 \rightarrow t + \tilde{\chi}_1^0, t \text{ on-shell}$$



5DF / 4 SF SRs with
“Boosted decision trees”:

- missing E_T
- m_U
- m_{T2}
- $\Delta\phi_U, \Delta\theta_U$
- $\Delta\phi_{lj}$
- $\Delta\phi_{j,l,b}$



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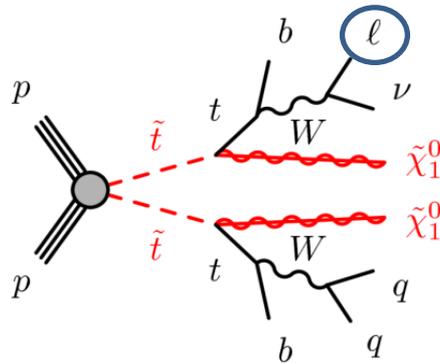
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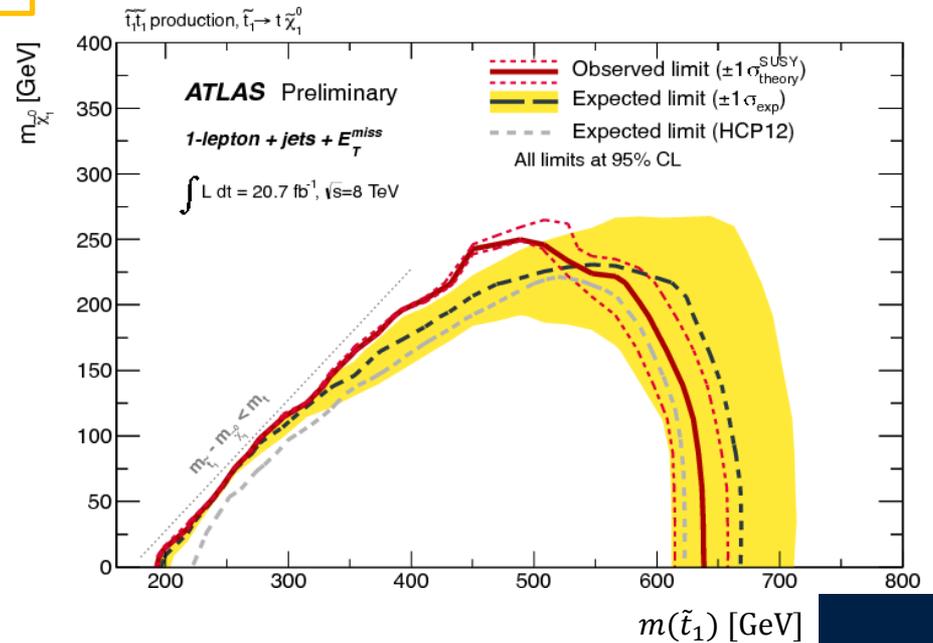
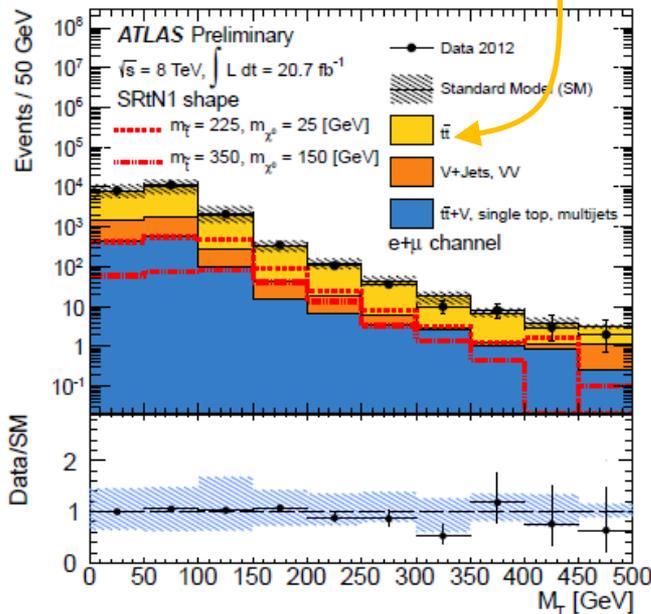
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ATLAS-CONF-2013-037: 1L + 4(1 b-)jets + missing E_T



$t\bar{t}$ dominant background

- SRs based on:
 - Missing E_T
 - (b-)jet multiplicity
 - m_{T1}, m_{T2} – variables
 - m_{eff}
 - reconstructed top mass
- Acceptance sensitive to stop polarisation (mostly RH assumed in plots)

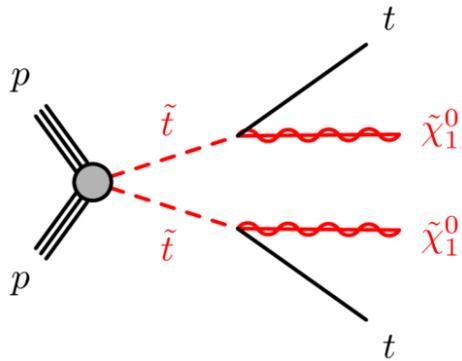


SRs/interpretation also exist for

$\tilde{t}_1\tilde{t}_1$ production, $\tilde{t}_1 \rightarrow b + \tilde{\chi}_1^\pm, \tilde{\chi}_1^\pm \rightarrow W^{(\pm)} + \tilde{\chi}_1^0, m_{\tilde{\chi}^\pm} = 150 \text{ GeV}$



ATLAS-CONF-2013-024: 0L + 6 (2 b -)jets + missing E_T



Signal-driven

Top mass reconstruction

Reduce jet mismeasurement

Reduce semi-leptonic $t\bar{t}$ (main background):

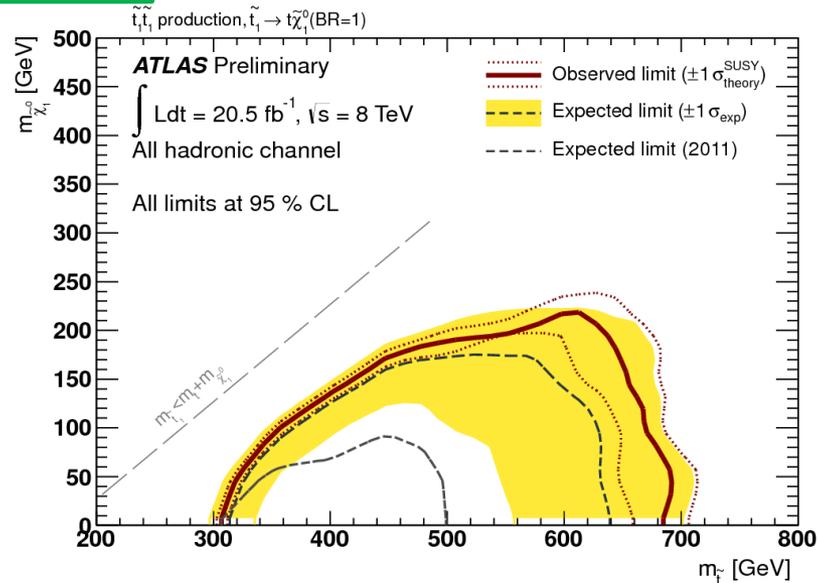
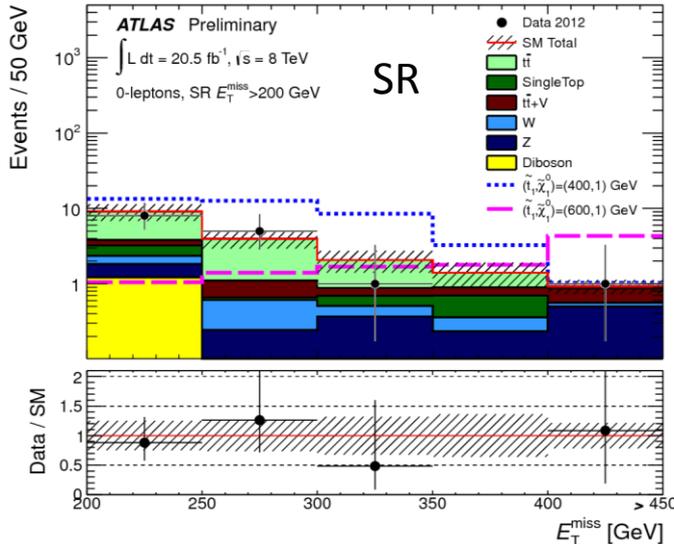
- missed lepton
- hadronic τ

Veto leptons

N_{jet}	≥ 6
p_T^{jet}	$> 80, 80, 35, \dots, 35$
N_{b-jet}	≥ 2
m_{jjj}	80 to 270
E_T^{miss}	$> 200, 300, 350$

$E_T^{miss, track}$	> 30
$\Delta\phi(E_T^{miss}, E_T^{miss, track})$	$< \pi/3$
$\Delta\phi(jet, E_T^{miss})$	$> \pi/5$

$m_T(b\text{-jet}, E_T^{miss})$	> 175
Tau veto	yes



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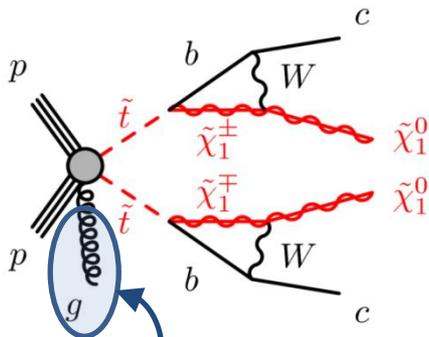
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ATLAS-CONF-2013-068: 0L + mono-jet/c-jets + missing E_T

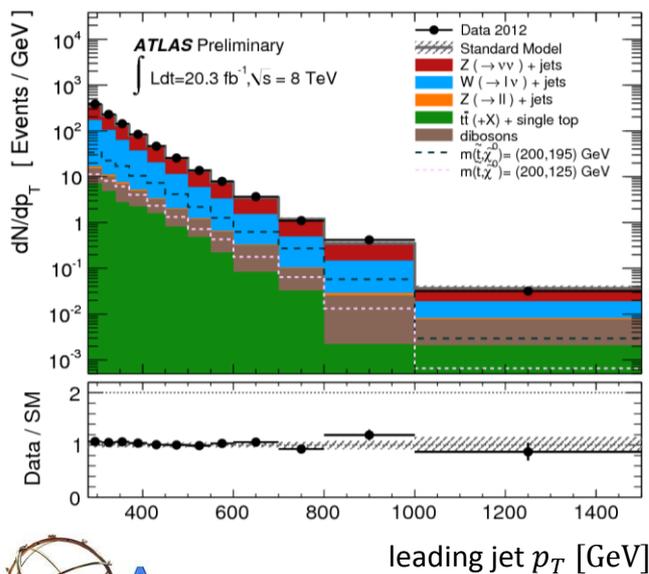
- If $m(\tilde{t}) < m(\tilde{\chi}_1^0) + m(b) + m(W)$, $\tilde{t} \rightarrow c + \tilde{\chi}_1^0$ can be dominant decay mode.
- **First LHC search** for this challenging scenario.



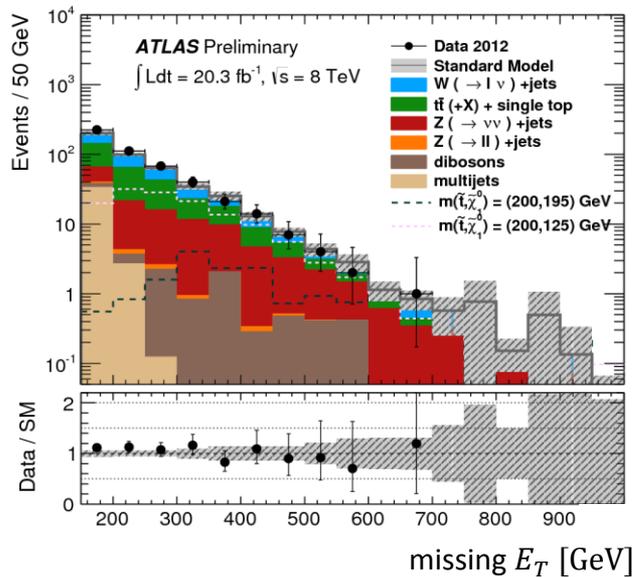
Lepton vetoes: no isolated electrons (muons) with $p_T > 20$ GeV ($p_T > 10$ GeV)

	Monojet-like selection M1	Charm-tagged selection C1
	At most three jets with $p_T > 30$ GeV and $ \eta < 2.8$	At least three jets with $p_T > 30$ GeV and $ \eta < 2.5$ (in addition to the leading jet) <i>b</i> -veto for second and third jet <i>medium c</i> -tag for fourth jet
	$\Delta\phi(\text{jet}, \mathbf{p}_T^{\text{miss}}) > 0.4$	$\Delta\phi(\text{jet}, \mathbf{p}_T^{\text{miss}}) > 0.4$
minimum leading jet p_T (GeV)	280	270
minimum E_T^{miss} (GeV)	220	410

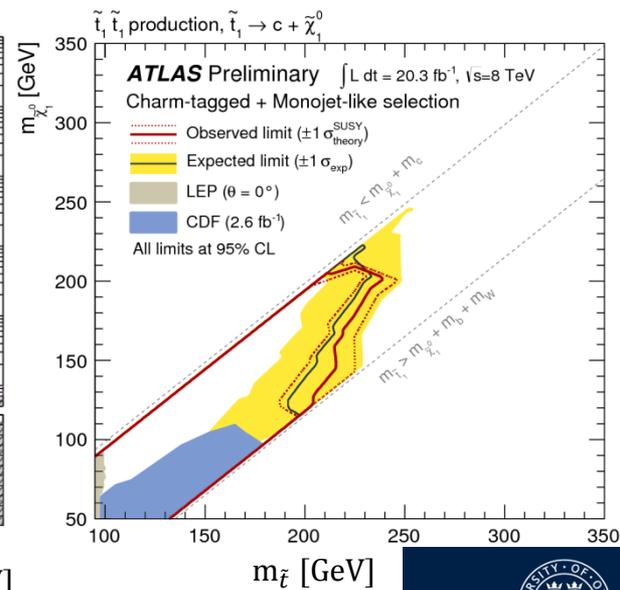
SRs rely on **ISR** jet to boost the \tilde{t} decay products.



Monojet selection



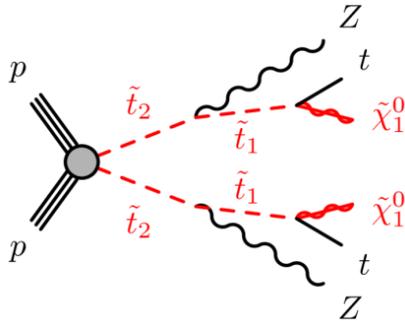
Charm-tagged selection



1403.5222: $Z + b\text{-jet} + \text{jets} + \text{missing } E_T$

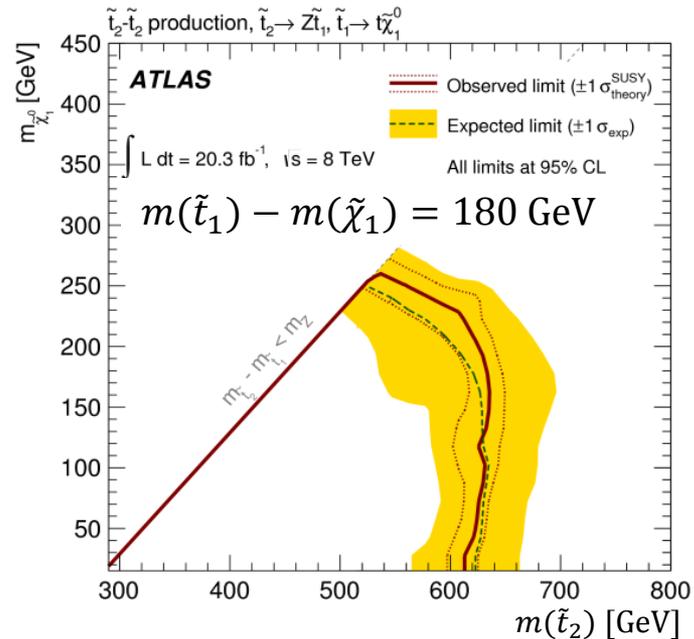
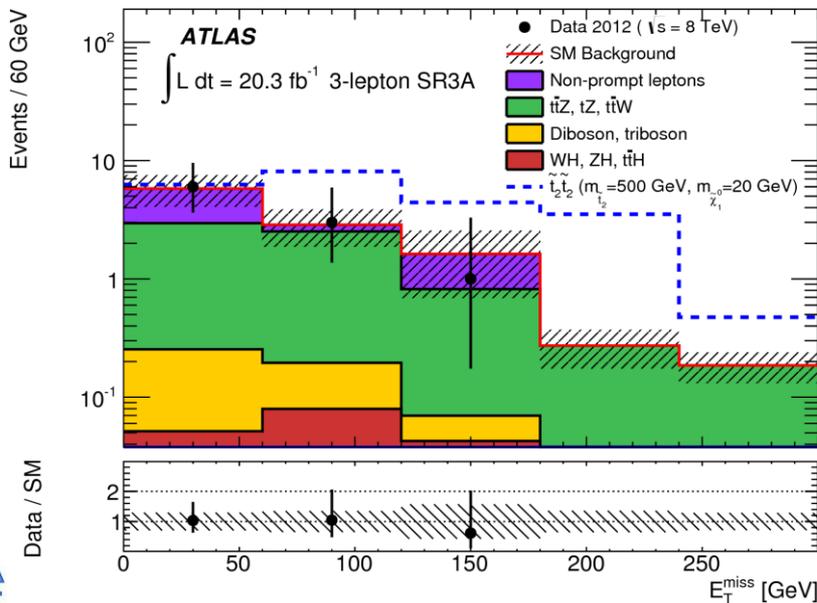


- If $m(\tilde{t}_1) \sim m(t) + m(\tilde{\chi}_1^0)$, difficult to distinguish $\tilde{t}\tilde{t}^*$ from $t\bar{t}$.
- Look instead for $\tilde{t}_2 \rightarrow \tilde{t}_1 + Z$.



Final state targeted:

- High p_T Z boson (at least 2L SFOS)
- (3rd lepton requirement reduces $t\bar{t}$ bckg)
- ≥ 1 b -jet; large number of jets
- Missing E_T

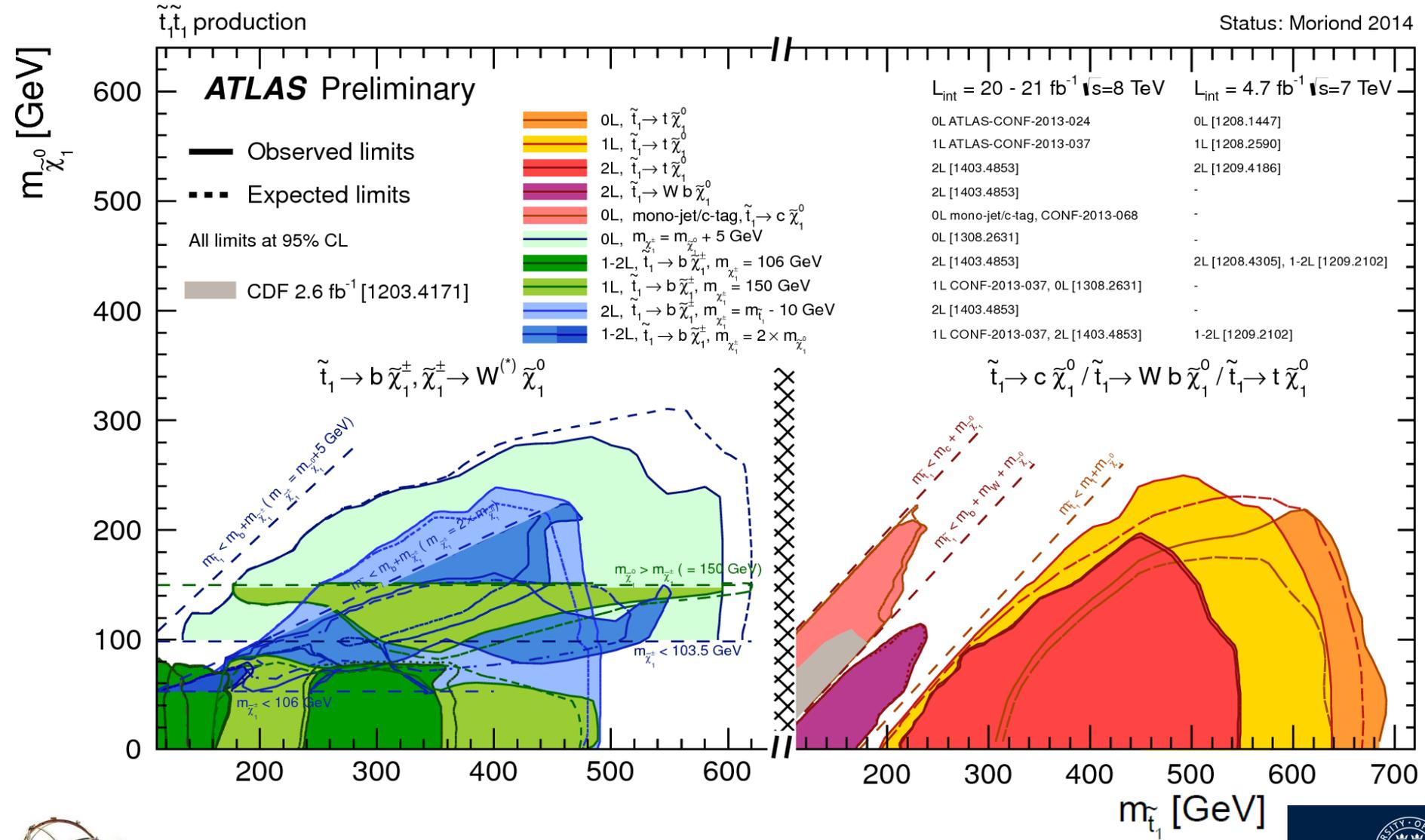


Also interpretation in a GMSB scenario exists.



Conclusions

Status: Moriond 2014



<https://twiki.cern.ch/twiki/bin/view/AtlasPublic/SupersymmetryPublicResults>

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THANK YOU FOR YOUR ATTENTION



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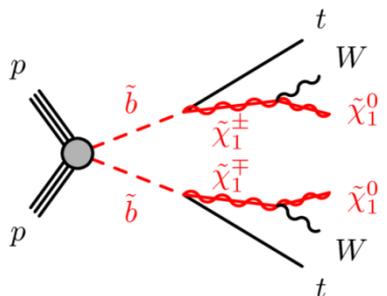
BACKUP



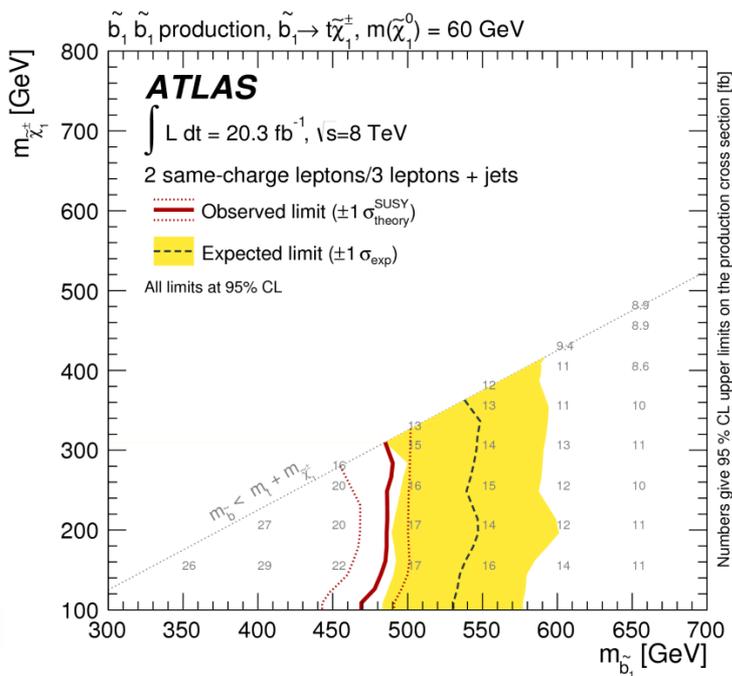


1404.2500

Sbottom to top + W + $\tilde{\chi}_1^0$



- 3 – leptons
– 2 same-sign
- 0-3 b -jets
- Missing E_T

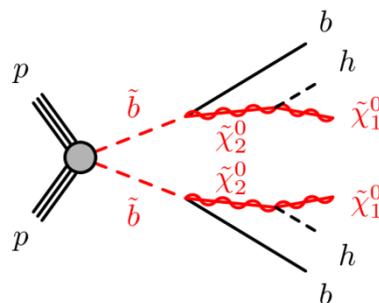


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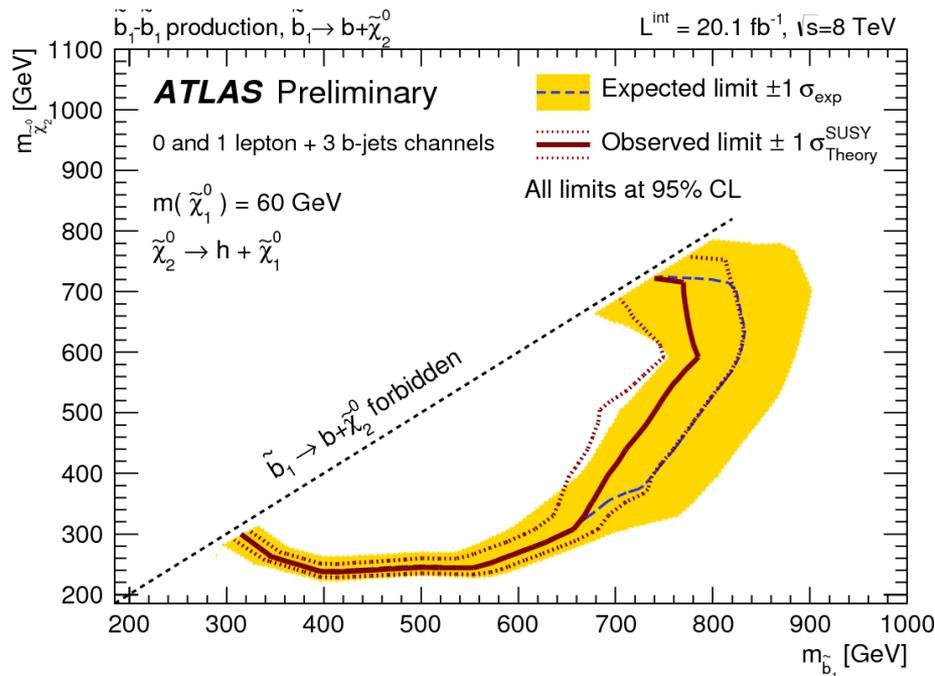
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ATLAS-CONF-2013-061

Higgs in sbottom decays



- 0-1 leptons,
 ≥ 3 b -jets, missing E_T
- $t\bar{t}$ background:
 - c/τ faking b
 - some $t\bar{t} + b/b\bar{b}$



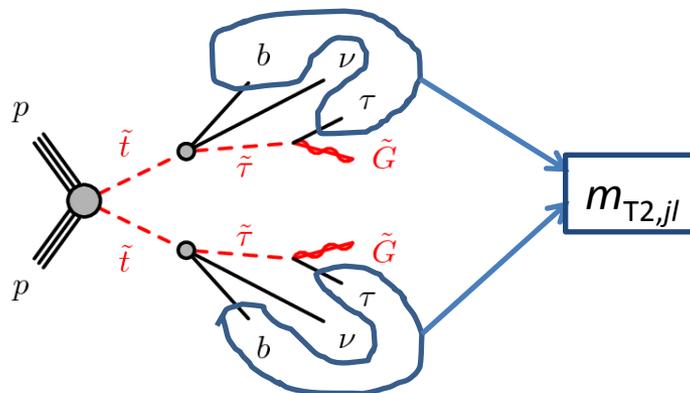
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ATLAS-CONF-2014-014: stop in b , τ and gravitino

- Reinterpretation of stop 2L ([1403.4853](#)) based on leptonic $m_{T2,l}$
- No sensitivity for small stop/stau masses

New SR:



- 2 OS leptons (e or μ from τ decay)
- Angular variables between jet, MET, lepton
- $m_{T2,jl}$ – plug in (lepton + jet) 4 momentum from each decay leg

ATLAS-CONF-2014-014: stop in b , τ and gravitino

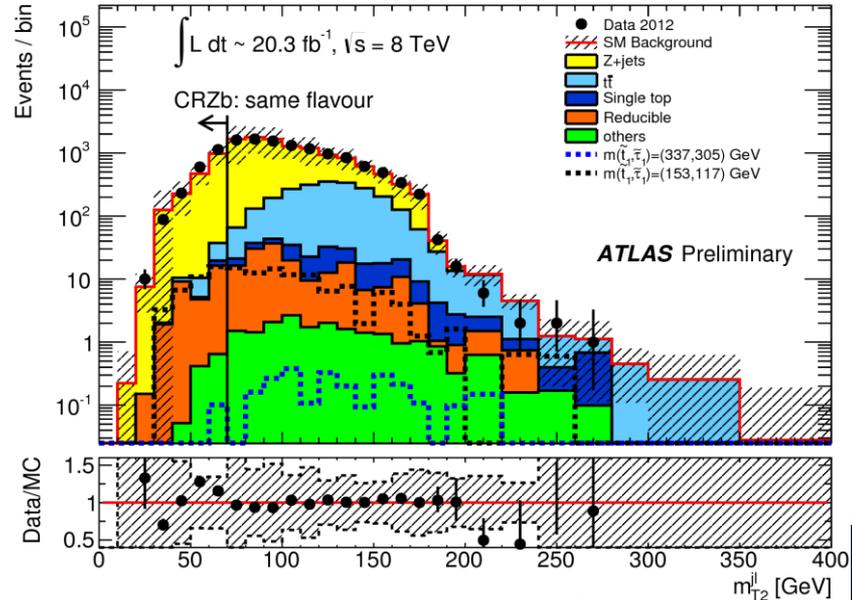
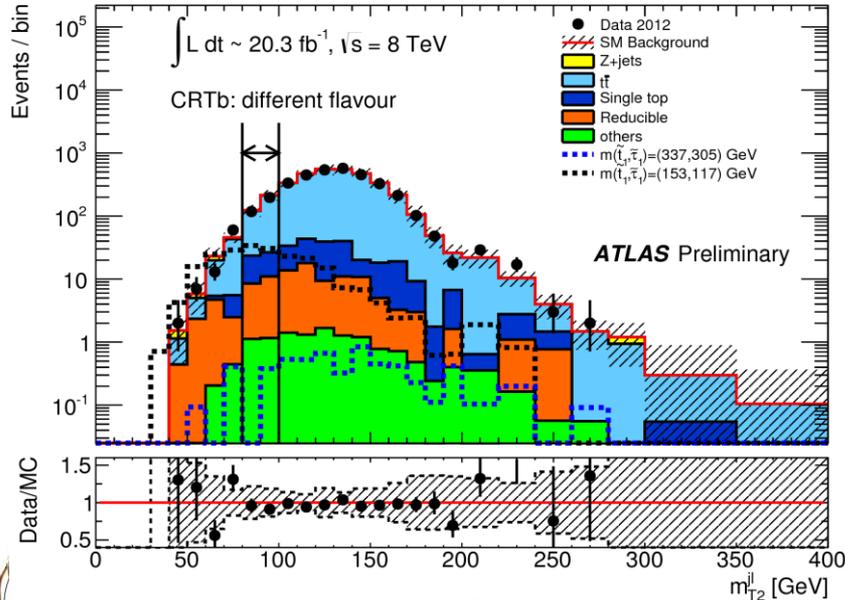
Preselection	
p_T leading lepton	> 25 GeV
p_T sub-leading lepton	> 10 GeV
$m(\ell\ell)$	$e\mu : > 20$ GeV $ee, \mu\mu : 20 < m(\ell\ell) < 71$ GeV or $m(\ell\ell) > 111$ GeV
$\Delta\phi(\mathbf{p}_T^{\text{miss}}, \text{closest jet})$	> 1.0
$\Delta\phi(\mathbf{p}_T^{\text{miss}}, \mathbf{p}_{Tb}^{\ell\ell})$	< 1.5
Small $m_{T2}^{j\ell}$ selection	
jets with $p_T > 20$ GeV	≥ 2
b -jets with $p_T > 20$ GeV	≥ 1
$m_{T2}^{j\ell}$	< 70 GeV
H_T/m_{eff}	< 0.4
$E_T^{\text{miss}}/(E_T^{\text{miss}} + \text{lepton momenta})$	> 0.45
$ \Delta x $	< 0.04

$$\Delta x = \frac{2 \cdot (p_z^{\ell_1} + p_z^{\ell_2})}{\sqrt{(s)}}$$



ATLAS-CONF-2014-014: stop in b , τ and gravitino

channel	CRTb	CRZ	VR
Flavour	$e\mu$	ee and $\mu\mu$	$e\mu$
$m(\ell\ell)$	> 20 GeV	$71 \text{ GeV} < m(\ell\ell) < 111$ GeV	< 80 GeV
jets with $p_T > 20$ GeV	≥ 2	≥ 2	≥ 2
b -jets with $p_T > 20$ GeV	≥ 1	0	0
$m_{T2}^{\ell\ell}$	no requirement	< 15 GeV	< 15 GeV
$m_{T2}^{j\ell}$	$80 \text{ GeV} < m_{T2}^{j\ell} < 100$ GeV	no requirement	no requirement
H_T/m_{eff}	< 0.4	no requirement	no requirement
$E_T^{\text{miss}}/(E_T^{\text{miss}} + \text{lepton momenta})$	> 0.45	no requirement	no requirement
$ \Delta x $	< 0.04	no requirement	no requirement
Observed events	315	277557	5879
Fitted bkg events (*)	315 ± 18	277557 ± 500	6100 ± 500



CRT: 2 DF leptons

CRZ: 2 SFOS leptons

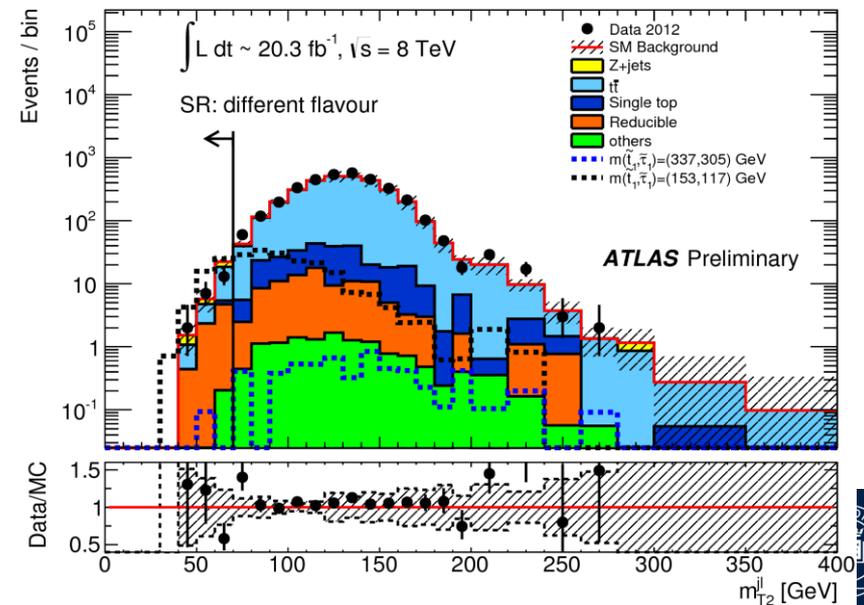
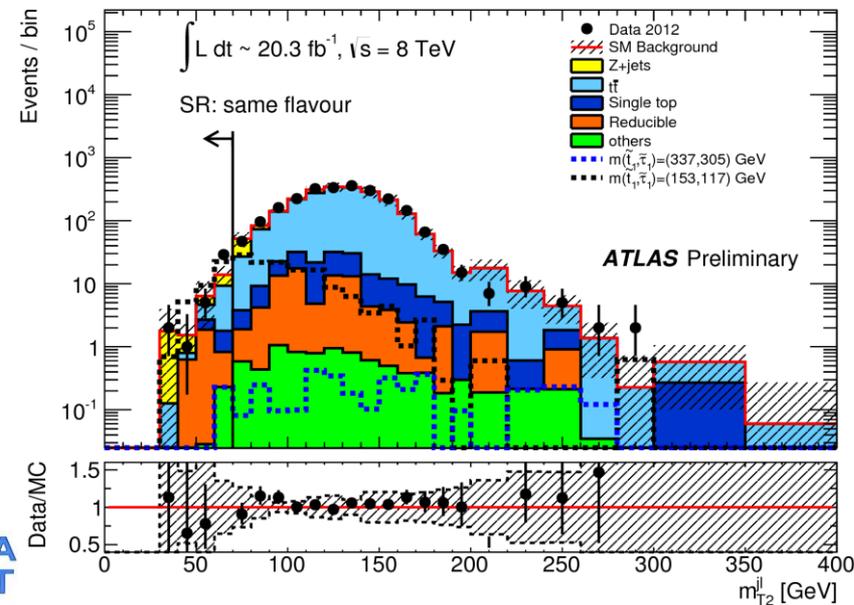
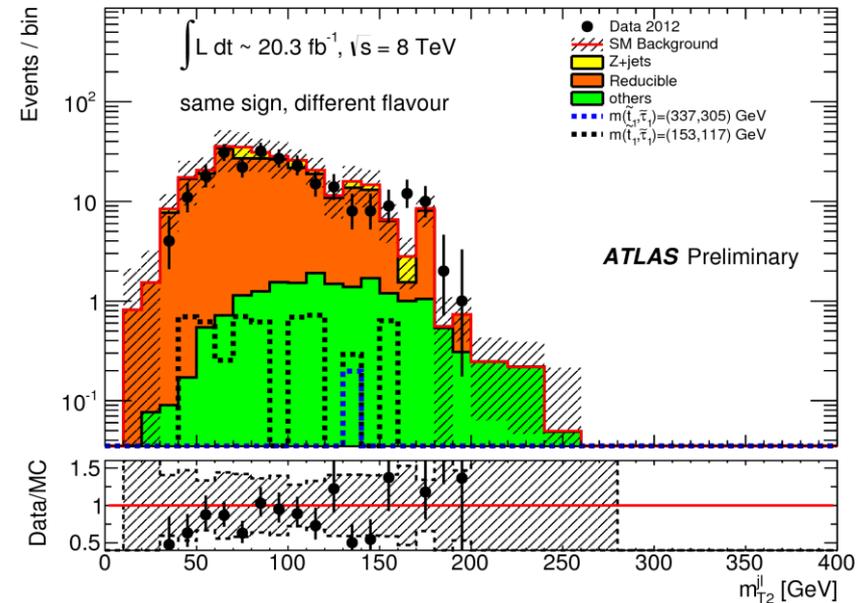
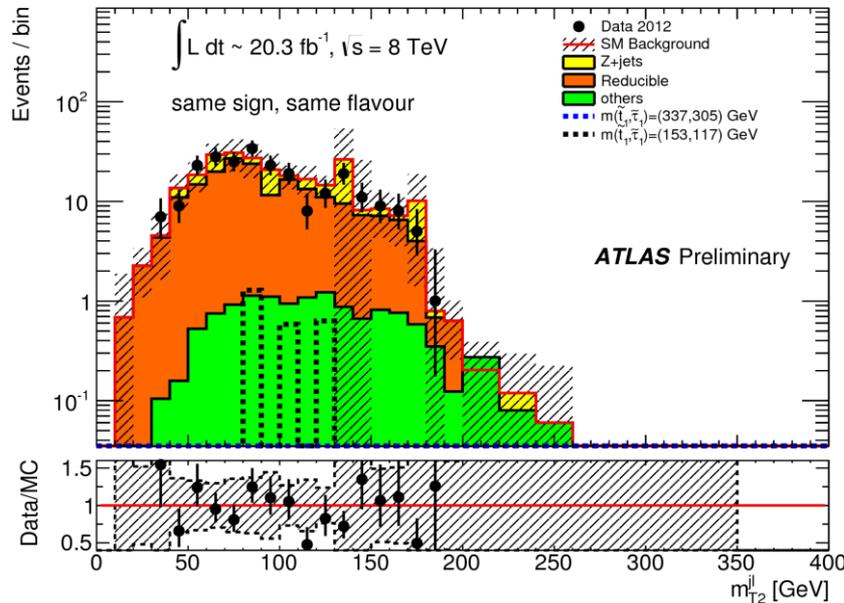


ATLAS-CONF-2014-014: stop in b , τ and gravitino

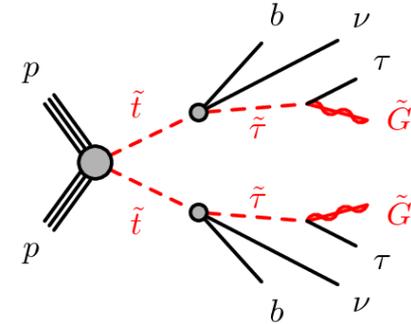
channel	CRTb	CRZ	VR
Flavour	$e\mu$	ee and $\mu\mu$	$e\mu$
$m(\ell\ell)$	> 20 GeV	71 GeV $< m(\ell\ell) < 111$ GeV	< 80 GeV
jets with $p_T > 20$ GeV	≥ 2	≥ 2	≥ 2
b -jets with $p_T > 20$ GeV	≥ 1	0	0
$m_{T2}^{\ell\ell}$	no requirement	< 15 GeV	< 15 GeV
$m_{T2}^{j\ell}$	80 GeV $< m_{T2}^{j\ell} < 100$ GeV	no requirement	no requirement
H_T/m_{eff}	< 0.4	no requirement	no requirement
$E_T^{\text{miss}}/(E_T^{\text{miss}} + \text{lepton momenta})$	> 0.45	no requirement	no requirement
$ \Delta x $	< 0.04	no requirement	no requirement
Observed events	315	277557	5879
Fitted bkg events (*)	315 ± 18	277557 ± 500	6100 ± 500



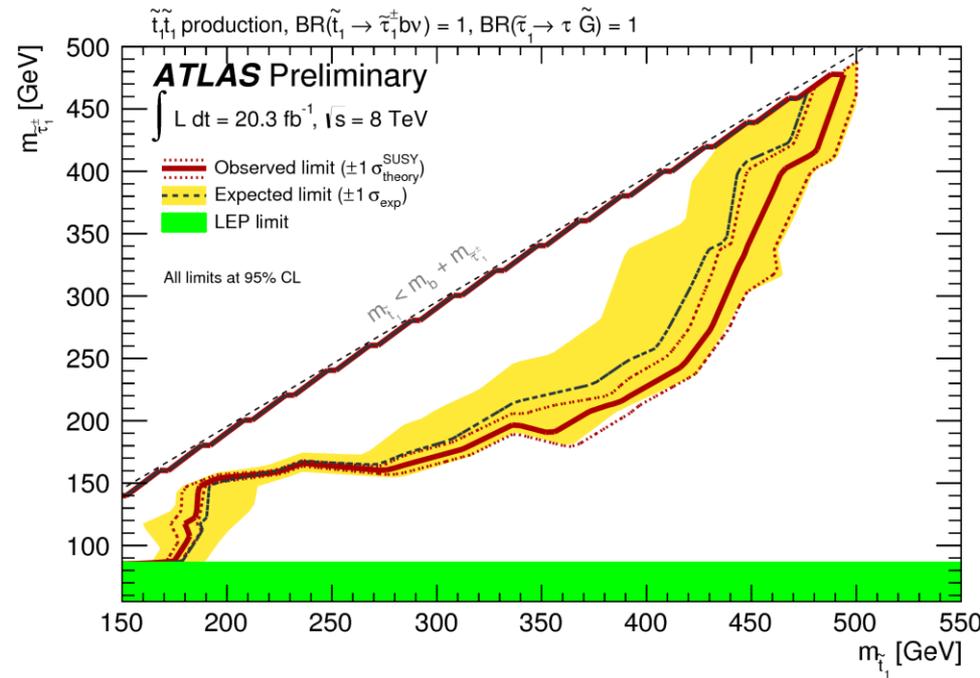
ATLAS-CONF-2014-014: stop in b , τ and gravitino



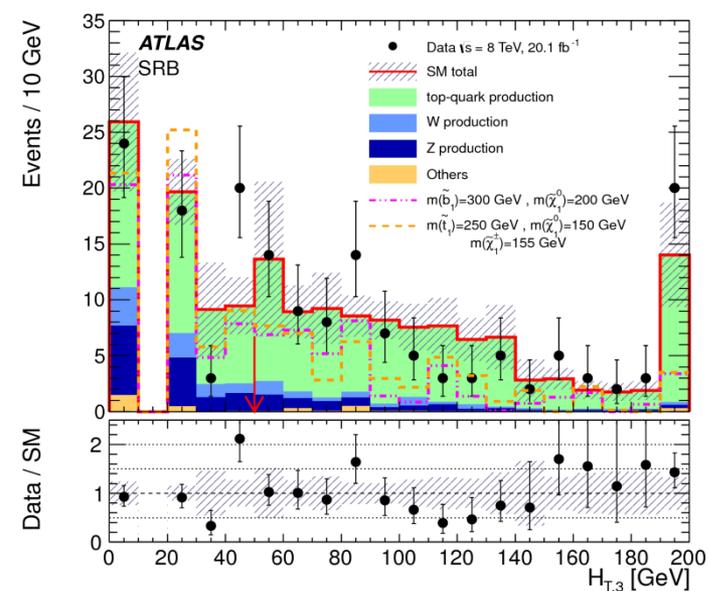
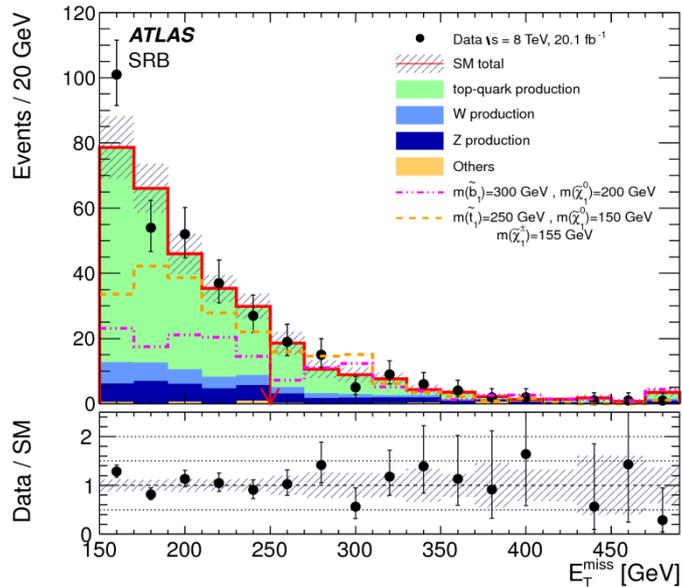
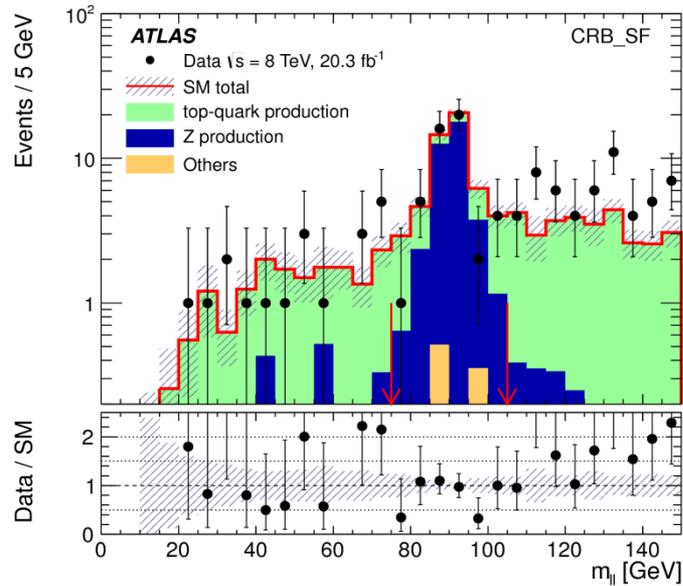
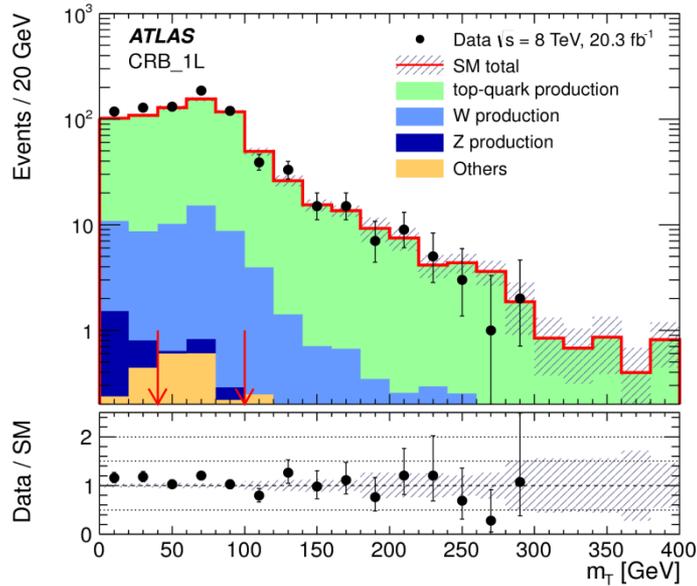
ATLAS-CONF-2014-014: stop in b , τ and gravitino



channel	SR
Observed events	59
Fitted bkg events	53 ± 10
Fitted Top events	26 ± 5
Fitted $Z(ee, \mu\mu, \tau\tau)$ events	14 ± 7
MC exp. SM events	54 ± 14
MC exp. Top events	29 ± 8
τ contribution	32%
MC exp. $Z(ee, \mu\mu, \tau\tau)$ events	12 ± 7
τ contribution	52%
MC exp. Wt events	2.5 ± 2.0
MC other backgrounds	$0.47^{+0.51}_{-0.39}$
data-driven exp. misidentified/non-prompt lept	10.0 ± 3.5



Direct Sbottom – CRB/SRB



Direct Sbottom

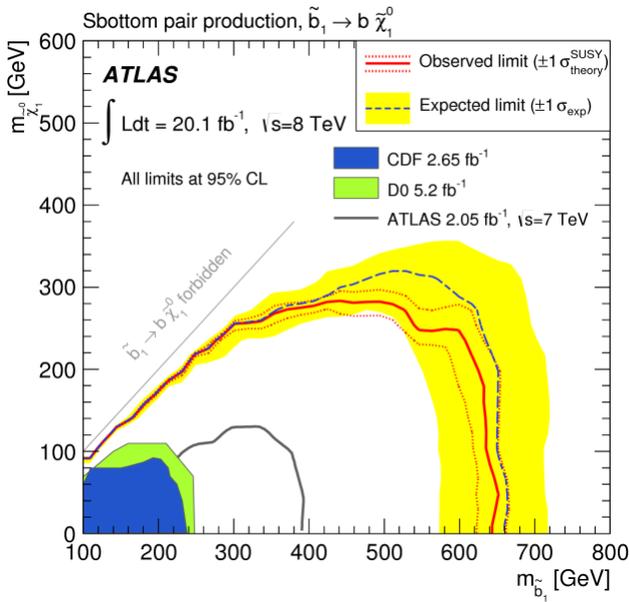
Channel	CRA_1L	CRA_SF	CRA_DF
Observed events	135	68	75
Fitted background events			
Total SM	135 ± 11	68 ± 8	75 ± 9
Top-quark production	91 ± 17	10.0 ± 1.3	75 ± 9
Z production	0.46 ± 0.12	58 ± 8	$0.07^{+0.10}_{-0.07}$
W production	40 ± 20	< 0.1	0.06 ± 0.03
Others	3.8 ± 2.0	0.44 ± 0.18	0.37 ± 0.13
MC expected events			
Top-quark production	100	11.0	82
Z production	0.44	54	0.07
W production	42	< 0.1	0.07
Others	3.8	0.44	0.37

Channel	CRB_1L	CRB_SF
Observed events	437	48
Fitted background events		
Total SM	437 ± 21	48 ± 7
Top-quark production	403 ± 27	16.2 ± 2.2
Z production	0.26 ± 0.15	31 ± 7
W production	32 ± 20	< 0.1
Others	1.4 ± 0.5	1.0 ± 0.5
MC expected events		
Top-quark production	370	15
Z production	0.32	38
W production	32	< 0.1
Others	1.4	1.0

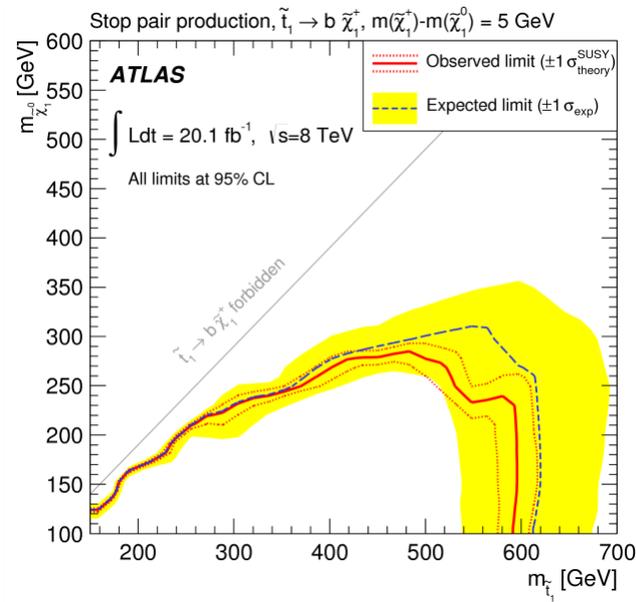
Channel	SRA, m_{CT} selection					SRB
	150 GeV	200 GeV	250 GeV	300 GeV	350 GeV	
Observed	102	48	14	7	3	65
Total SM	94 ± 13	39 ± 6	15.8 ± 2.8	5.9 ± 1.1	2.5 ± 0.6	64 ± 10
Top-quark	11.1 ± 1.8	2.4 ± 1.4	0.44 ± 0.25	< 0.01	< 0.01	41 ± 7
Z production	66 ± 11	28 ± 5	11.4 ± 2.2	4.7 ± 0.9	1.9 ± 0.4	13 ± 4
W production	13 ± 6	4.9 ± 2.6	2.1 ± 1.1	1.0 ± 0.5	0.46 ± 0.26	8 ± 5
Others	4.3 ± 1.5	3.4 ± 1.3	1.8 ± 0.6	0.12 ± 0.11	$0.10^{+0.12}_{-0.10}$	2.0 ± 1.0
Multijet	0.21 ± 0.21	0.06 ± 0.06	0.02 ± 0.02	< 0.01	< 0.01	0.16 ± 0.16



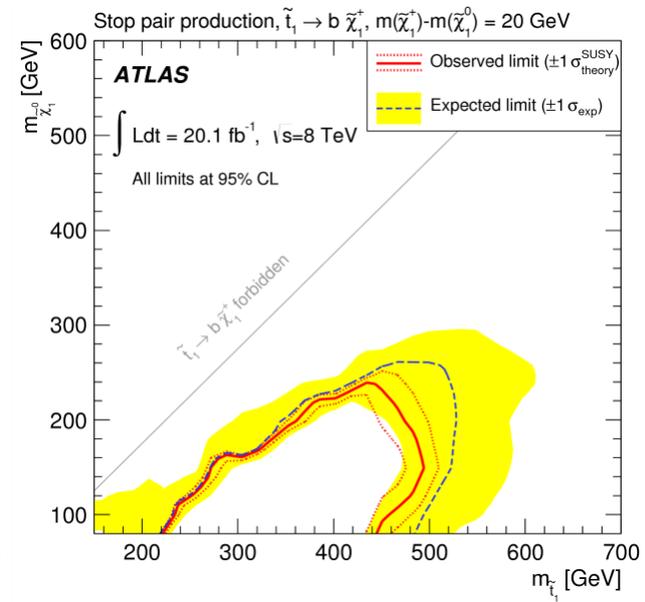
JHEP10(2013)189 : Direct Sbottom



Sbottom pair production



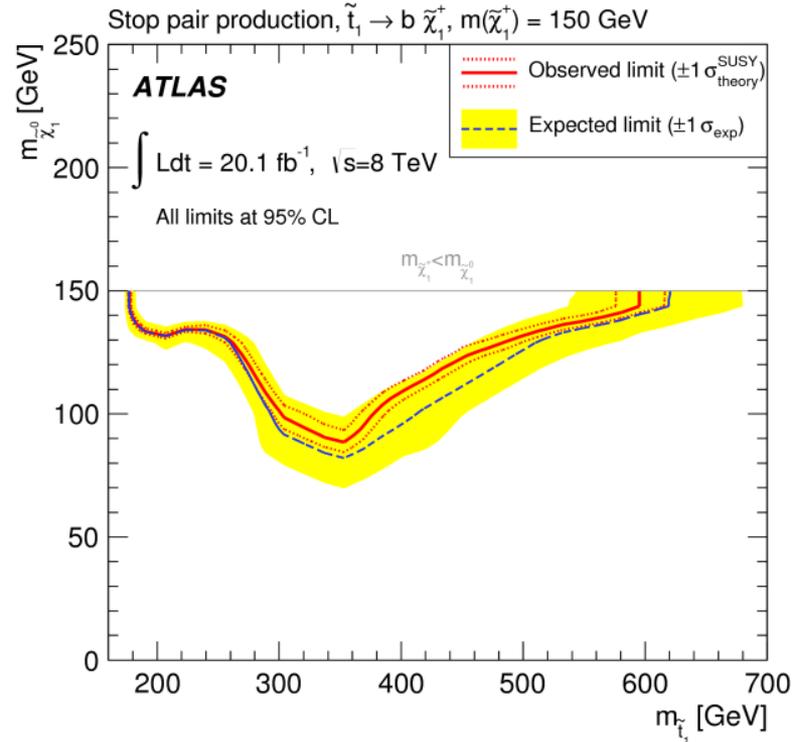
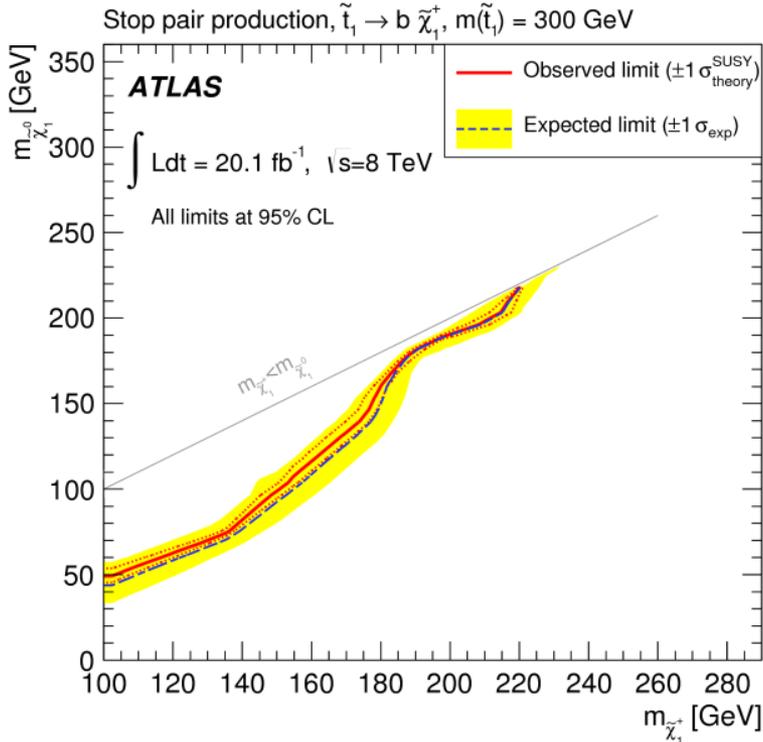
Stop pair production
 $\Delta m(\tilde{\chi}^{\pm}, \tilde{\chi}^0) = 5 \text{ GeV}$



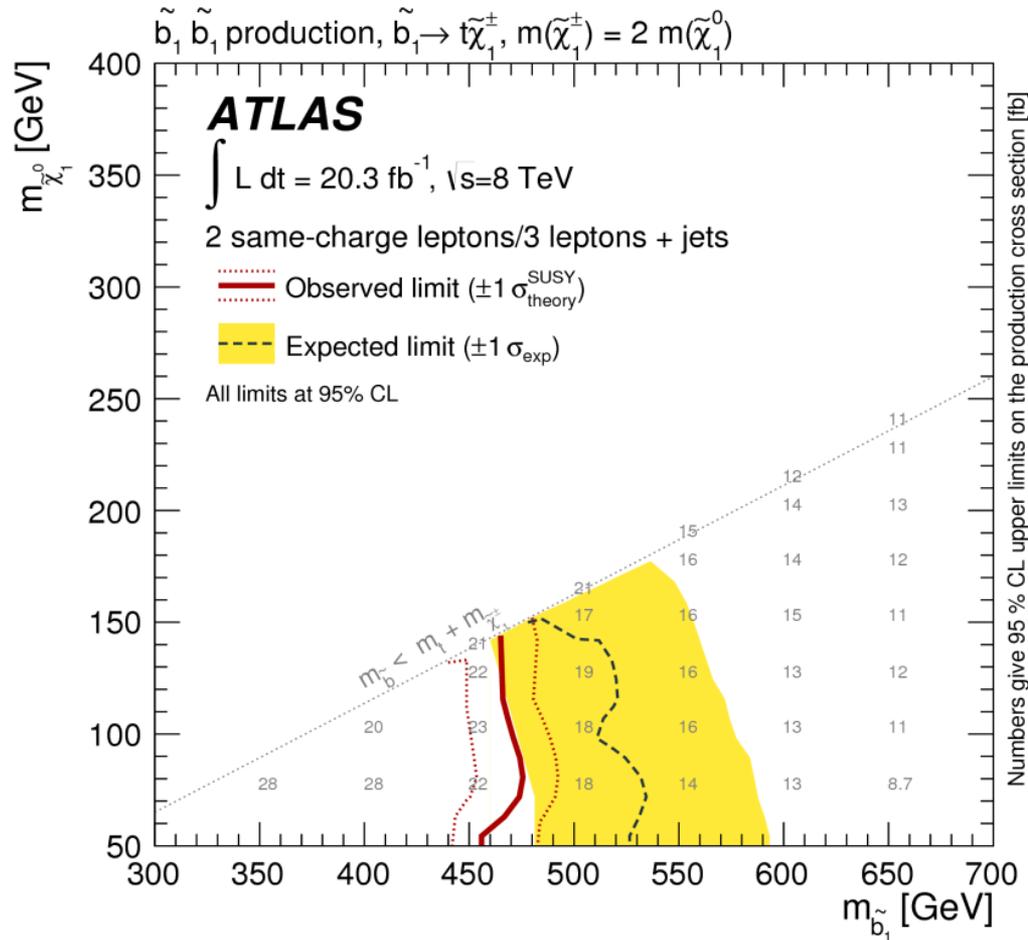
Stop pair production
 $\Delta m(\tilde{\chi}^{\pm}, \tilde{\chi}^0) = 20 \text{ GeV}$



Direct Sbottom – Further exclusions



1404.2500: S bottom to top + W + $\tilde{\chi}_1^0$



[1403.4853](#): 2L + (*b*)jets + missing E_T

Selection Variable	CRT _L	CRW _L	CRZ _L	VR _L ^{DF}	VR _L ^{SF}	VR _L ¹¹⁰	VR _L ¹⁰⁰
Flavour	DF	DF	SF	DF	SF	DF	DF
$m_{\ell\ell}$ [GeV]	-	-	71–111	-	< 71 or > 111	-	-
m_{T2} [GeV]	40–80	-40-80	> 90	80–90	80–90	40–80	40–80
p_{Tb}^{μ} [GeV]	> 30	< 15	-	-	-	> 30	> 30
$\Delta\phi_j$ [rad]	> 1.0	> 1.0	> 1.0	> 1.0	> 1.0	> 1.0	> 1.0
$\Delta\phi_b$ [rad]	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5
Leading jet p_T [GeV]	-	-	-	-	-	> 20	> 100
Second leading jet p_T [GeV]	-	-	-	-	-	> 20	> 50

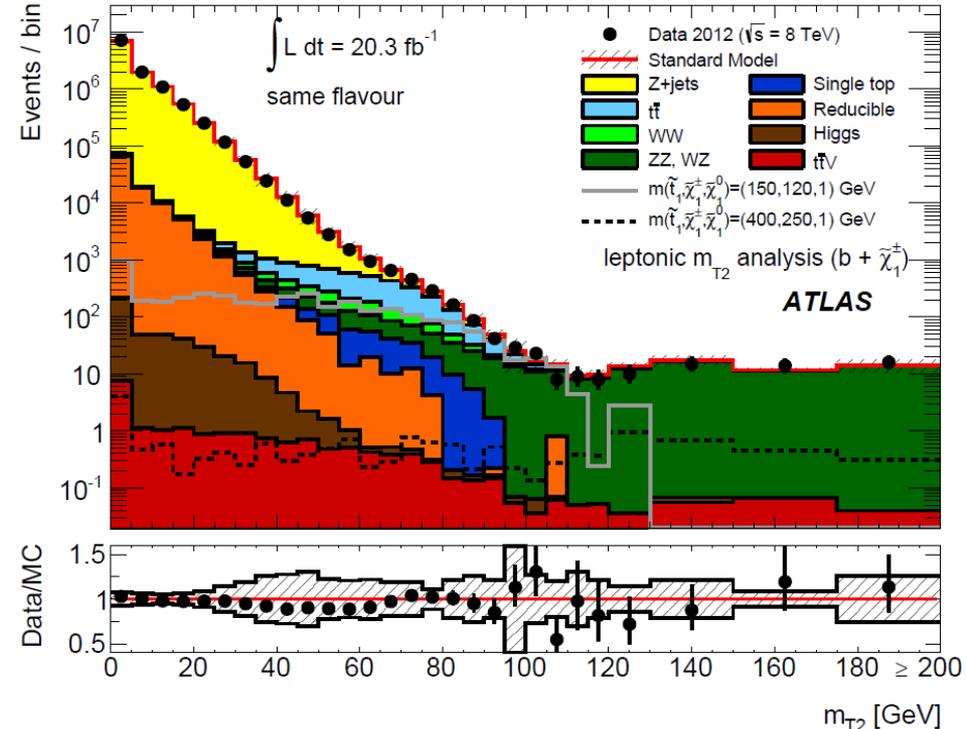
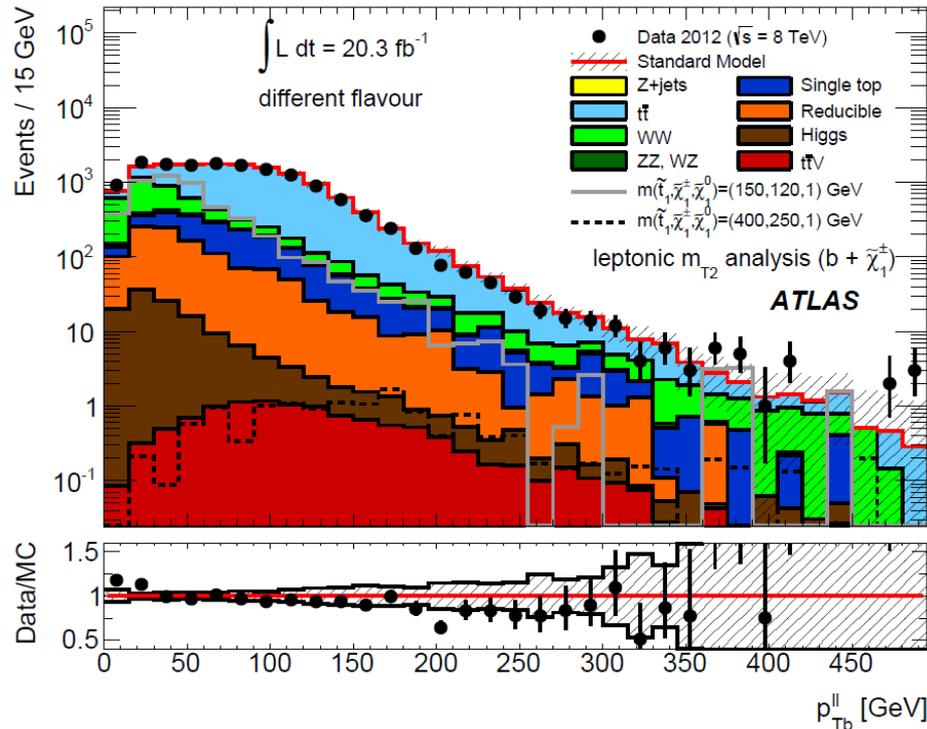
Channel	CRT _L	CRW _L	CRZ _L
Observed events	12158	913	174
Total (constrained) bkg events	12158 ± 110	913 ± 30	174 ± 13
Fit output, $t\bar{t}$ events	8600 ± 400	136 ± 24	27 ± 6
Fit output, WW events	1600 ± 400	630 ± 50	14 ± 4
Fit output, WZ, ZZ events	64 ± 14	14 ± 5	112 ± 19
Total expected bkg events	12700 ± 700	800 ± 90	190 ± 20
Fit input, expected $t\bar{t}$ events	9500 ± 600	150 ± 25	30 ± 7
Fit input, expected WW events	1260 ± 110	490 ± 80	10.7 ± 2.5
Fit input, expected WZ, ZZ events	76 ± 12	17 ± 4	132 ± 11
Expected $Z/\gamma^* \rightarrow \ell\ell$ events	9 ⁺¹¹ ₋₉	1.5 ^{+2.2} _{-1.5}	19 ± 8
Expected $t\bar{t} V$ events	10.8 ± 3.4	0.08 ± 0.04	0.64 ± 0.21
Expected Wt events	1070 ± 90	35 ± 7	1.6 ± 1.1
Expected Higgs boson events	67 ± 21	20 ± 6	0.08 ± 0.04
Expected events with fake and non-prompt leptons	740 ± 90	81 ± 16	--



1403.4853: 2L + (b)jets + missing E_T

WW and $t\bar{t}$ CR

Z CR



1403.4853: 2L + (b)jets + missing E_T

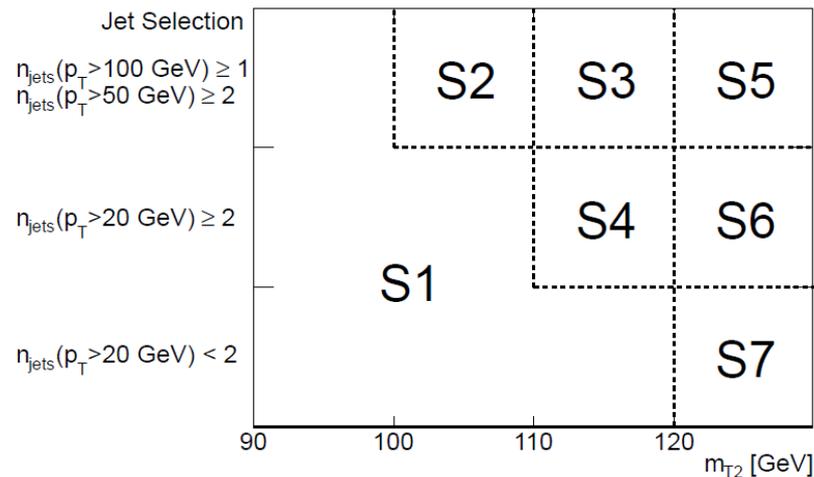
SR	L90	L100	L110	L120
leading lepton p_T [GeV]		> 25		
$\Delta\phi_j$ [rad]		> 1.0		
$\Delta\phi_b$ [rad]		< 1.5		
m_{T2} [GeV]	> 90	> 100	> 110	> 120
Leading jet p_T [GeV]	-	> 100	> 20	-
Second jet p_T [GeV]	-	> 50	> 20	-
$\Delta m(\tilde{t}_1, \tilde{\chi}_1^\pm)$	small	large	moderate	small
$\Delta m(\tilde{\chi}_1^\pm, \tilde{\chi}_1^0)$	moderate	large	moderate	large

Channel	L90	L100	L110	L120
Observed events	274	3	8	18
Total bkg events	300 ± 50	5.2 ± 2.2	9.3 ± 3.5	19 ± 9
Fit output, $t\bar{t}$ events	172 ± 33	3.5 ± 2.1	3.4 ± 2.9	1.1 ± 1.1
Fit output, WW events	78 ± 20	1.0 ± 0.5	3.2 ± 1.4	12 ± 7
Fit output, WZ, ZZ events	11.6 ± 2.4	$0.22^{+0.26}_{-0.22}$	0.9 ± 0.5	4.1 ± 2.1
Fit input, expected $t\bar{t}$ events	190 ± 40	3.9 ± 2.4	3.7 ± 3.2	1.2 ± 1.2
Fit input, expected WW events	62 ± 9	0.75 ± 0.38	3 ± 1	9 ± 5
Fit input, expected WZ, ZZ events	13.6 ± 2.4	$0.26^{+0.31}_{-0.26}$	1.1 ± 0.6	4.8 ± 2.5
Expected $Z/\gamma^* \rightarrow \ell\ell$ events	2.8 ± 1.4	$0.14^{+0.14}_{-0.14}$	$0.09^{+0.14}_{-0.09}$	$0.07^{+0.09}_{-0.07}$
Expected $t\bar{t}V$ events	1.8 ± 0.6	0.35 ± 0.14	0.62 ± 0.21	0.51 ± 0.18
Expected Wt events	21 ± 7	$0.00^{+0.19}_{-0.00}$	--	$0.35^{+0.39}_{-0.35}$
Expected Higgs boson events	0.65 ± 0.22	$0.02^{+0.02}_{-0.02}$	0.03 ± 0.03	0.31 ± 0.12
Expected events with fake and non-prompt leptons	13.0 ± 3.5	--	1.0 ± 0.6	1.1 ± 0.8



1403.4853: 2L + (b)jets + missing E_T

- Previously defined SRs maximise discovery potential
- For exclusion, redefine SRs and combine statistically:



Channel	S1	S2	S3	S4
Observed events	250	1	2	3
Total bkg events	270 ± 40	3.4 ± 1.8	1.3 ± 0.6	3.7 ± 2.7
$\langle \mathcal{A}\epsilon\sigma \rangle_{\text{exp. (obs.)}}^{95}$ [fb]	3.79 (3.76) [3.85 (3.79)]	0.22 (0.18) [0.23 (0.17)]	0.20 (0.23) [0.19 (0.23)]	0.32 (0.32) [0.13 (0.11)]

channel	S5	S6	S7
Observed events	0	3	15
Total bkg events	0.5 ± 0.4	3.8 ± 1.6	15 ± 7
$\langle \mathcal{A}\epsilon\sigma \rangle_{\text{exp. (obs.)}}^{95}$ [fb]	0.15 (0.15) [0.13 (0.11)]	0.28 (0.28) [0.28 (0.25)]	0.46 (0.48) [0.48 (0.48)]

5 May 2014

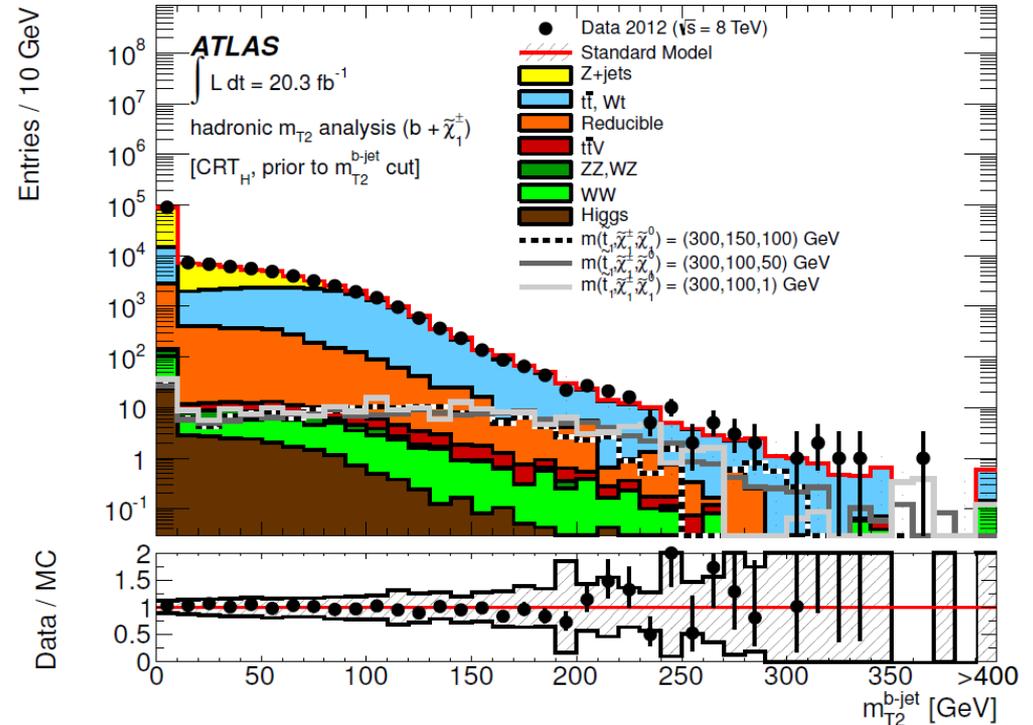
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1403.4853

2L + (b)jets + missing E_T

Selection Variable	CRT _H	CRZ _H	VRT _H
Flavour	any	SF	any
b-jets	= 1	= 2	= 2
leading lepton p_T [GeV]	< 60	> 60	> 60
$m_{\ell\ell}$ (SF events only) [GeV]	-	81 – –101	< 81 or > 101
m_{T2} [GeV]	< 90	< 90	< 90
$m_{T2}^{b\text{-jet}}$ [GeV]	> 160	> 160	> 160



Channel	CRT _H	CRZ _H	VRT _H
Observed events	315	156	112
Total (constrained) bkg events	315 ± 18	156 ± 13	110 ± 50
Fit output, $t\bar{t}, Wt$ events	256 ± 27	4 ± 4	70 ± 40
Fit output, $Z/\gamma^* \rightarrow ee, \mu\mu$ +jets events	0.9 ^{+1.1} _{-0.9}	147 ± 13	20 ± 8
Total expected bkg events	335 ± 90	110 ± 36	110 ± 60
Fit input, expected $t\bar{t}, Wt$ events	280 ± 90	5 ± 5	80 ± 60
Fit input, expected $Z/\gamma^* \rightarrow ee, \mu\mu$ +jets events	0.6 ^{+0.7} _{-0.6}	100 ± 34	13.8 ± 2.4
Expected WW events	3 ⁺⁴ ₋₃	0.07 ^{+0.14} _{-0.07}	1 ⁺³ ₋₁
Expected $t\bar{t}V$ events	2.3 ± 0.8	1.5 ± 0.5	2.3 ± 0.7
Expected WZ, ZZ events	0.40 ± 0.16	0.06 ^{+0.32} _{-0.06}	0.10 ^{+0.15} _{-0.10}
Expected $Z/\gamma^* \rightarrow \tau\tau$ +jets events	23 ± 17	0.14 ± 0.09	2.15 ± 0.28
Expected events with fake and non-prompt leptons	29.4 ± 1.7	0.36 ± 0.24	12.8 ± 1.2
Expected Higgs boson events	0.35 ± 0.05	2.06 ± 0.30	0.50 ± 0.06

5 May 2014

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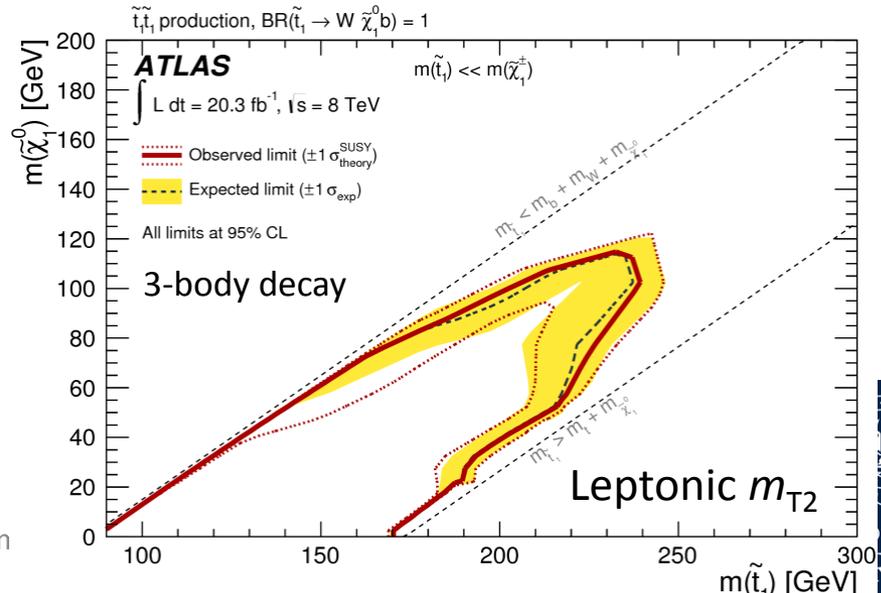
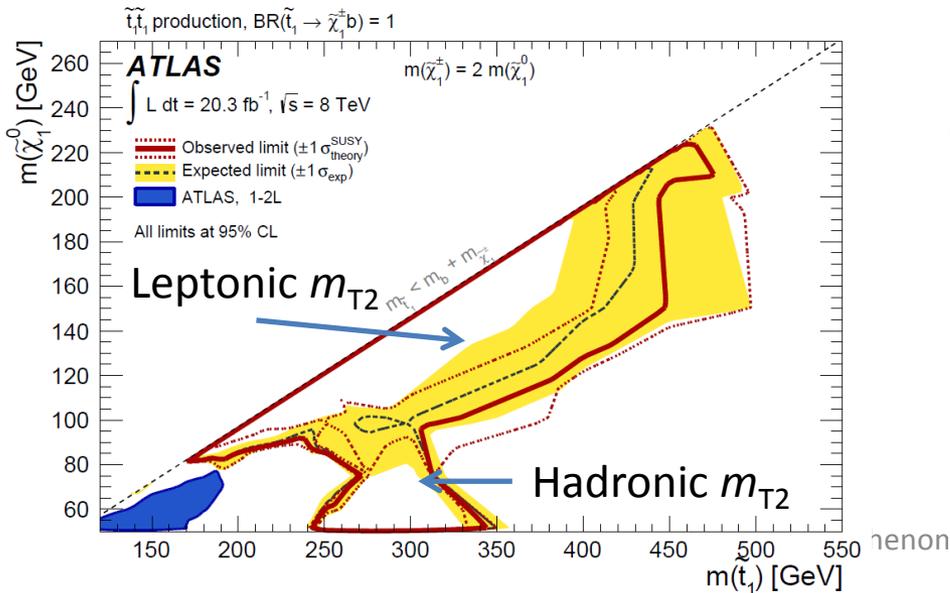
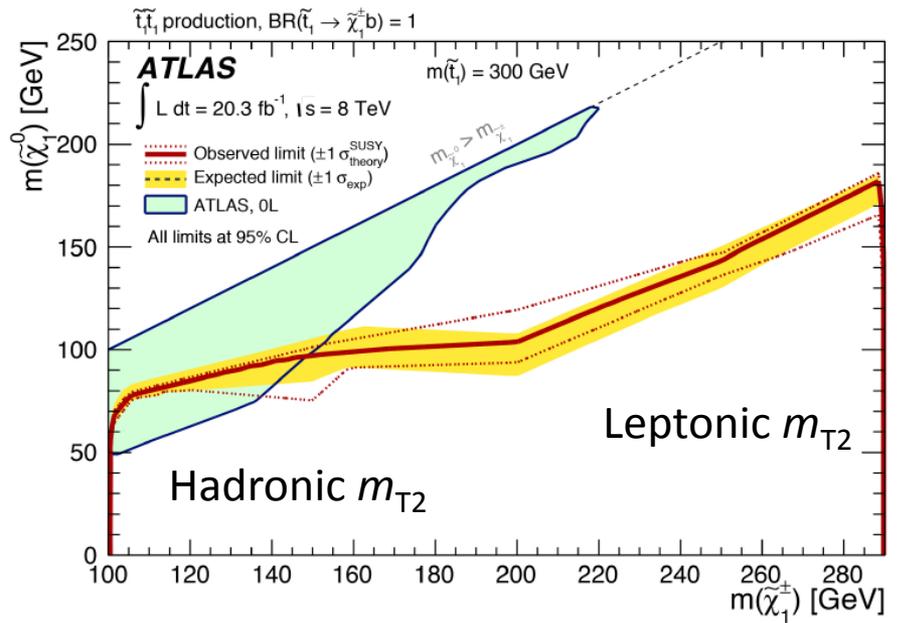
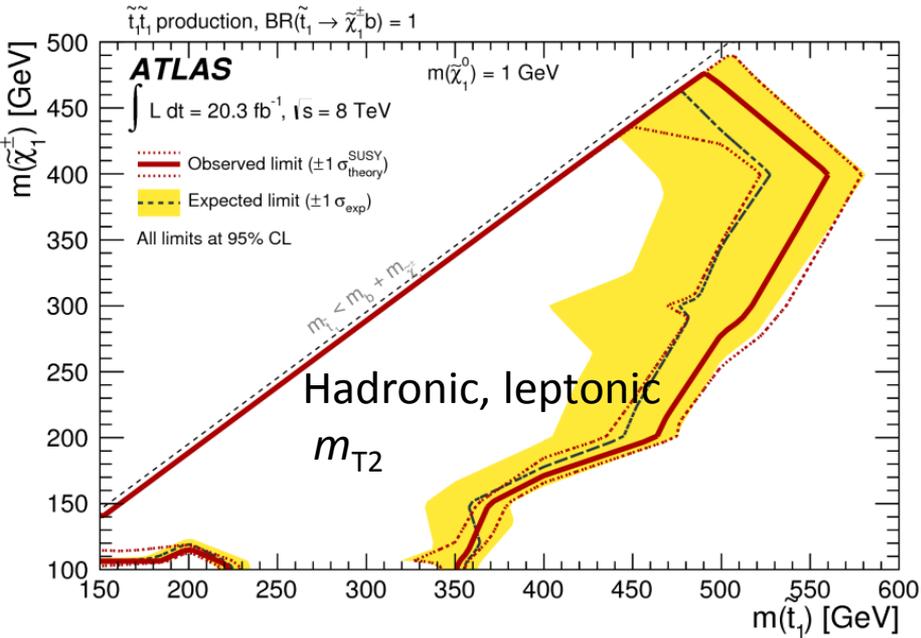


1403.4853: 2L + (*b*)jets + missing E_T

Channel	H160
Observed events	33
Total bkg events	26 ± 6
Fit output, $t\bar{t}$, Wt events	22 ± 5
Fit output, $Z/\gamma^* \rightarrow ee, \mu\mu + \text{jets}$ events	$0.2^{+1.8}_{-0.2}$
Fit input, expected $t\bar{t}$, Wt events	24 ± 7
Fit input, expected $Z/\gamma^* \rightarrow ee, \mu\mu + \text{jets}$ events	$0.2^{+1.2}_{-0.2}$
Expected WW events	$0.00^{+0.35}_{-0.00}$
Expected $t\bar{t}V$ events	0.47 ± 0.16
Expected WZ , ZZ events	0.11 ± 0.11
Expected $Z/\gamma^* \rightarrow \tau\tau + \text{jets}$ events	0.86 ± 0.15
Expected events with fake and non-prompt leptons	2.5 ± 0.4
Expected Higgs boson events	0.08 ± 0.02



1403.4853: 2L + (b)jets + missing E_T



1403.4853: 2L + (*b*)jets + missing E_T

$t\bar{t}$ control regions

Control Region	Event Variable Selection [GeV]	BDTG range
$\text{CRT}_{M1}^{\text{DF}}$	C1, $m_{T2} > 90$	$[-1.00, -0.20]$
$\text{CRT}_{M2}^{\text{DF}}$	C1, $m_{T2} > 90$	$[-1.00, -0.30]$
$\text{CRT}_{M3}^{\text{DF}}$	C1, $m_{T2} > 90$	$[-1.00, 0.00]$
$\text{CRT}_{M4}^{\text{DF}}$	C2, $m_{T2} > 90$	$[-1.00, -0.70]$
$\text{CRT}_{M5}^{\text{DF}}$	C4, $m_{T2} > 90$	$[-1.00, -0.50]$
$\text{CRT}_{M1}^{\text{SF}}$	C1, $m_{T2} > 90, m_{\ell\ell} < 61$ or $m_{\ell\ell} > 121$	$[-0.85, -0.75]$
$\text{CRT}_{M2}^{\text{SF}}$	C1, $m_{T2} > 90, m_{\ell\ell} < 61$ or $m_{\ell\ell} > 121$	$[-0.85, -0.20]$
$\text{CRT}_{M3}^{\text{SF}}$	C1, $m_{T2} > 90, m_{\ell\ell} < 61$ or $m_{\ell\ell} > 121$	$[-0.95, -0.80]$
$\text{CRT}_{M4}^{\text{SF}}$	C3, $m_{T2} > 90, m_{\ell\ell} < 61$ or $m_{\ell\ell} > 121$	$[-0.98, -0.78]$

Channel	$\text{CRT}_{M1}^{\text{DF}}$	$\text{CRT}_{M2}^{\text{DF}}$	$\text{CRT}_{M3}^{\text{DF}}$	$\text{CRT}_{M4}^{\text{DF}}$	$\text{CRT}_{M5}^{\text{DF}}$
Observed events	419	410	428	368	251
Total (constrained) bkg events	419 ± 20	410 ± 20	428 ± 21	368 ± 19	251 ± 16
Fit output, $t\bar{t}$ events	369 ± 23	363 ± 23	379 ± 24	325 ± 22	214 ± 19
Total expected bkg events	430 ± 70	420 ± 60	440 ± 70	380 ± 60	260 ± 50
Fit input, expected $t\bar{t}$	380 ± 60	375 ± 60	390 ± 70	340 ± 50	220 ± 40
Expected $t\bar{t}V$ events	2.7 ± 0.8	2.2 ± 0.7	2.4 ± 0.7	2.7 ± 0.8	1.9 ± 0.6
Expected Wt events	20 ± 5	19 ± 5	20 ± 5	16 ± 5	15 ± 4
Expected WW events	8_{-8}^{+9}	7_{-7}^{+8}	7_{-7}^{+9}	6_{-6}^{+8}	6_{-6}^{+7}
Expected ZW, ZZ events	1.0 ± 1.0	$0.9_{-0.9}^{+1.0}$	1.0 ± 1.0	$0.5_{-0.5}^{+0.8}$	1.0 ± 0.8
Expected $Z/\gamma^* \rightarrow \ell\ell$ +jets events	$0.3_{-0.3}^{+0.4}$	$0.31_{-0.31}^{+0.35}$	$0.31_{-0.31}^{+0.35}$	$0.3_{-0.3}^{+0.4}$	$0.3_{-0.3}^{+0.4}$
Expected Higgs boson events	0.26 ± 0.10	0.24 ± 0.10	0.26 ± 0.10	0.12 ± 0.05	0.19 ± 0.10
Expected events with fake and non-prompt leptons	18 ± 4	18 ± 4	19 ± 4	17 ± 4	12.5 ± 3.2



1403.4853: 2L + (*b*)jets + missing E_T

Channel	M1 ^{DF}	M2 ^{DF}	M3 ^{DF}	M4 ^{DF}	M5 ^{DF}
Observed events	9	11	5	3	1
Total bkg events	5.8 ± 1.9	13 ± 4	5.1 ± 2.0	1.3 ± 1.0	1.0 ± 0.5
Fit output, $t\bar{t}$ events	5.0 ± 1.9	11 ± 4	3.1 ± 1.7	$0.6^{+0.8}_{-0.6}$	$0.29^{+0.35}_{-0.29}$
Fit input, expected $t\bar{t}$	5.2 ± 2.6	11 ± 5	3.2 ± 2.1	$0.6^{+0.8}_{-0.6}$	$0.3^{+0.4}_{-0.3}$
Expected $t\bar{t}V$ events	0.43 ± 0.15	0.83 ± 0.27	0.73 ± 0.24	0.38 ± 0.13	0.23 ± 0.09
Expected Wt events	$0.00^{+0.09}_{-0.00}$	0.9 ± 0.7	0.4 ± 0.4	--	--
Expected WW events	$0.3^{+0.5}_{-0.3}$	$0.7^{+1.1}_{-0.7}$	$0.8^{+0.9}_{-0.8}$	$0.3^{+0.5}_{-0.3}$	0.49 ± 0.19
Expected ZW, ZZ events	$0.05^{+0.06}_{-0.05}$	0.11 ± 0.10	$0.10^{+0.12}_{-0.10}$	$0.05^{+0.07}_{-0.05}$	0.03 ± 0.03
Expected events with fake and non-prompt leptons	$0.00^{+0.29}_{-0.00}$	$0.00^{+0.33}_{-0.00}$	$0.00^{+0.30}_{-0.00}$	$0.00^{+0.27}_{-0.00}$	$0.00^{+0.35}_{-0.00}$

Channel	M1 ^{SF}	M2 ^{SF}	M3 ^{SF}	M4 ^{SF}
Observed events	6	9	0	5
Total bkg events	7.6 ± 2.2	9.5 ± 2.1	1.1 ± 0.7	2.5 ± 1.0
Fit output, $t\bar{t}$ events	7.1 ± 2.2	3.8 ± 1.6	0.7 ± 0.7	0.6 ± 0.5
Fit input, expected $t\bar{t}$	6.6 ± 2.2	4.4 ± 1.8	0.7 ± 0.7	0.7 ± 0.6
Expected $t\bar{t}V$ events	0.07 ± 0.03	0.50 ± 0.17	0.06 ± 0.04	0.17 ± 0.10
Expected Wt events	$0.02^{+0.08}_{-0.02}$	$0.02^{+0.20}_{-0.02}$	--	--
Expected WW events	$0.08^{+0.14}_{-0.08}$	$0.18^{+0.30}_{-0.18}$	$0.00^{+0.04}_{-0.00}$	$0.06^{+0.07}_{-0.06}$
Expected ZW, ZZ events	$0.03^{+0.05}_{-0.03}$	2.3 ± 0.5	$0.08^{+0.15}_{-0.08}$	1.2 ± 0.9
Expected $Z/\gamma^* \rightarrow \ell\ell$ +jets events	$0.02^{+0.03}_{-0.02}$	$1.4^{+1.6}_{-1.4}$	--	$0.5^{+0.6}_{-0.5}$
Expected events with fake and non-prompt leptons	$0.3^{+0.4}_{-0.3}$	1.1 ± 0.8	$0.25^{+0.26}_{-0.25}$	$0.00^{+0.06}_{-0.00}$

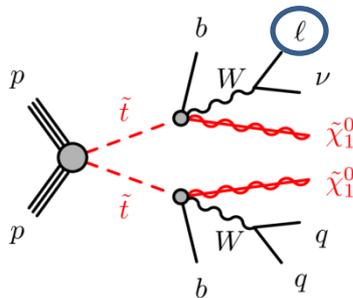


ATLAS-CONF-2013-037: 1L + 4(1 b -)jets + missing E_T

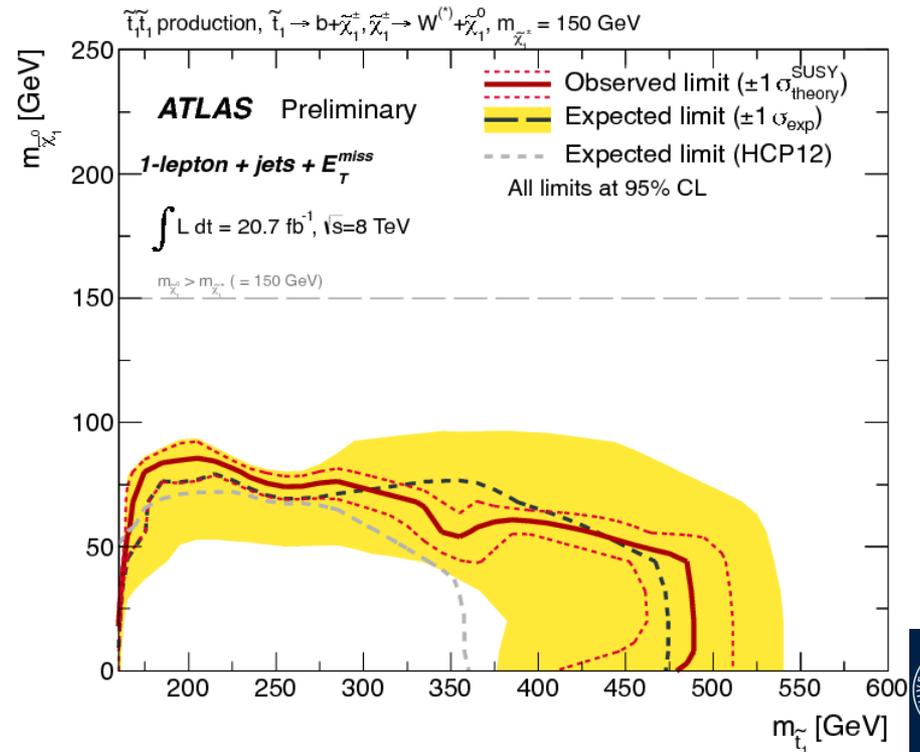
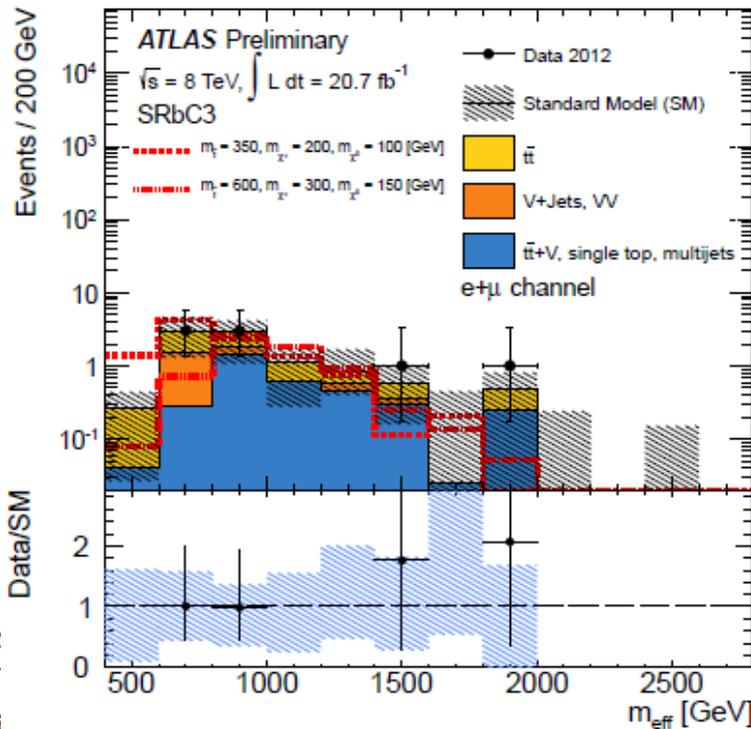
Requirement	SRtN1_shape	SRtN2	SRtN3	SRbC1	SRbC2	SRbC3
$\Delta\varphi(\text{jet}_1, \vec{p}_T^{\text{miss}}) >$	0.8	-	0.8	0.8	0.8	0.8
$\Delta\varphi(\text{jet}_2, \vec{p}_T^{\text{miss}}) >$	0.8	0.8	0.8	0.8	0.8	0.8
$E_T^{\text{miss}} [\text{GeV}] >$	100 ^(*)	200	275	150	160	160
$E_T^{\text{miss}} / \sqrt{H_T} [\text{GeV}^{1/2}] >$	5	13	11	7	8	8
$m_T [\text{GeV}] >$	60 ^(*)	140	200	120	120	120
$m_{\text{eff}} [\text{GeV}] >$	-	-	-	-	550	700
$am_{T2} [\text{GeV}] >$	-	170	175	-	175	200
$m_{T2}^\tau [\text{GeV}] >$	-	-	80	-	-	-
m_{jjj}	Yes	Yes	Yes	-	-	-
$N^{\text{iso-trk}} = 0$	-	-	-	Yes	Yes	Yes
Number of b -jets \geq	1	1	1	1	2	2
p_T (leading b -jet) [GeV] $>$	25	25	25	25	100	120
p_T (second b -jet) [GeV] $>$	-	-	-	-	50	90



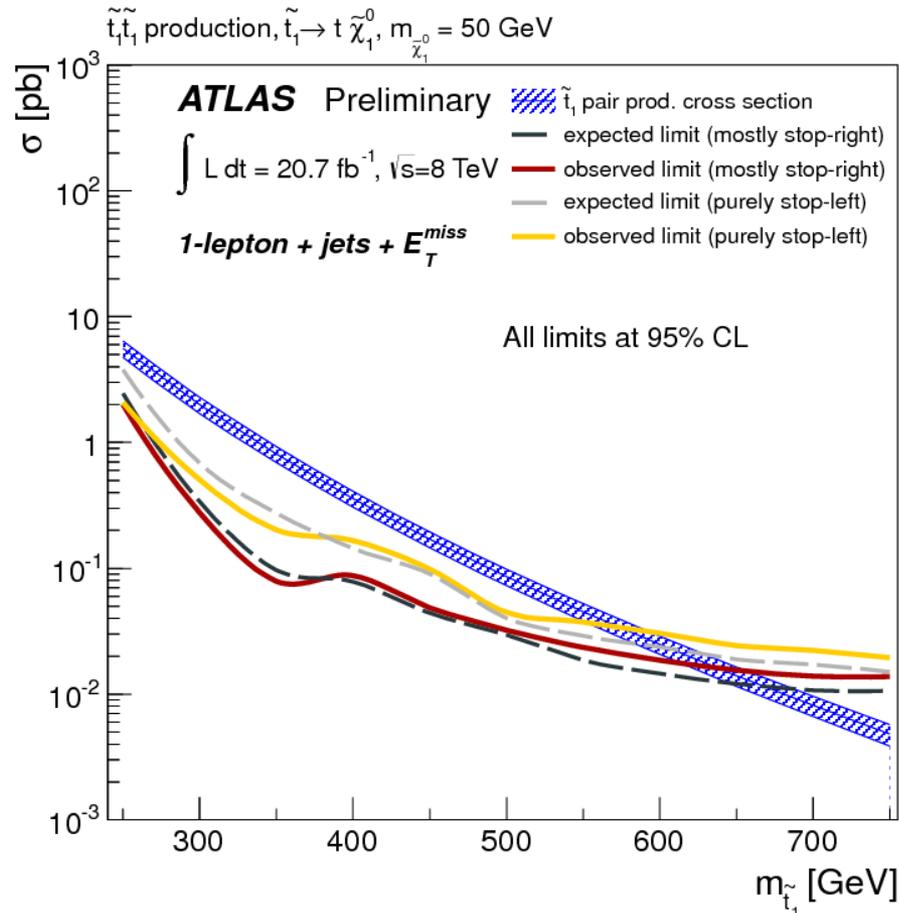
ATLAS-CONF-2013-037: 1L + 4(1 b-)jets + missing E_T



$\tilde{t}_1\bar{\tilde{t}}_1$ production, $\tilde{t}_1 \rightarrow b + \tilde{\chi}_1^\pm, \tilde{\chi}_1^\pm \rightarrow W^{(\prime)} + \tilde{\chi}_1^0, m_{\tilde{\chi}_1^\pm} = 150 \text{ GeV}$



ATLAS-CONF-2013-037: 1L + 4(1 b -)jets + missing E_T



ATLAS-CONF-2013-024: 0L + 6 (2 b)jets + missing E_T [Heavy stop]

	Signal	$t\bar{t}$ CR	Z+jets CR	Multijet CR
Trigger	E_T^{miss}	single electron (muon)	two electron (muon)	E_T^{miss}
N_{lep}	0	1	2	0
p_T^ℓ	< 10 (10)	> 35 (35)	> 20 (20)	< 10 (10)
$p_T^{\ell_2}$	—	< 10 (10)	> 20 (10)	—
$m_{\ell\ell}$	—	—	81 to 101	—
N_{jet}	≥ 6	≥ 6	≥ 6	≥ 6
p_T^{jet}	> 80,80,35,...35	> 80,80,35,...35	> 80,80,35,...35	> 80,80,35,...35
$N_{b\text{-jet}}$	≥ 2	≥ 2	≥ 2	≥ 2
m_{jjj}	80 to 270	0 to 600	80 to 270	—
E_T^{miss}	> 200, 300, 350	> 200, 300, 350	> 70	> 160
$E_T^{\text{miss,track}}$	> 30	> 30	> 30	> 30
$\Delta\phi(E_T^{\text{miss}}, E_T^{\text{miss,track}})$	< $\pi/3$	< $\pi/3$	< $\pi/3$	> $\pi/3$
$m_T(\ell, E_T^{\text{miss}})$	—	40 to 120	—	—
$\Delta\phi(\text{jet}, E_T^{\text{miss}})$	> $\pi/5$	> $\pi/10$	> $\pi/5$	< $\pi/5$
$m_T(b\text{-jet}, E_T^{\text{miss}})$	> 175	—	> 175	> 175
Tau veto	yes	no	yes	no

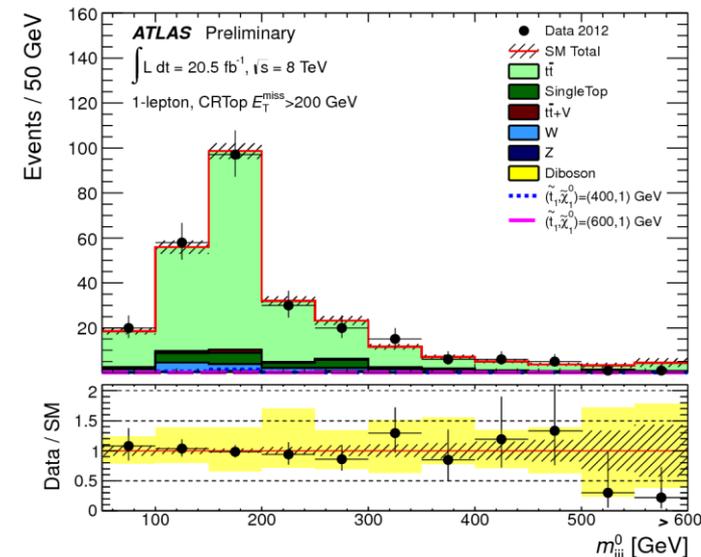
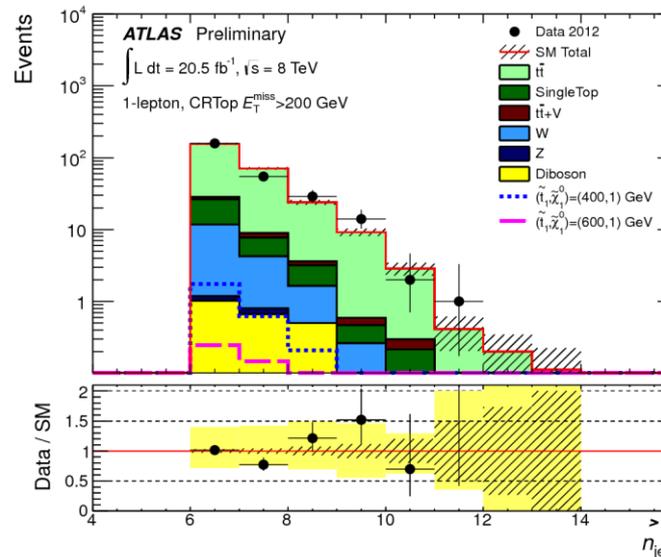
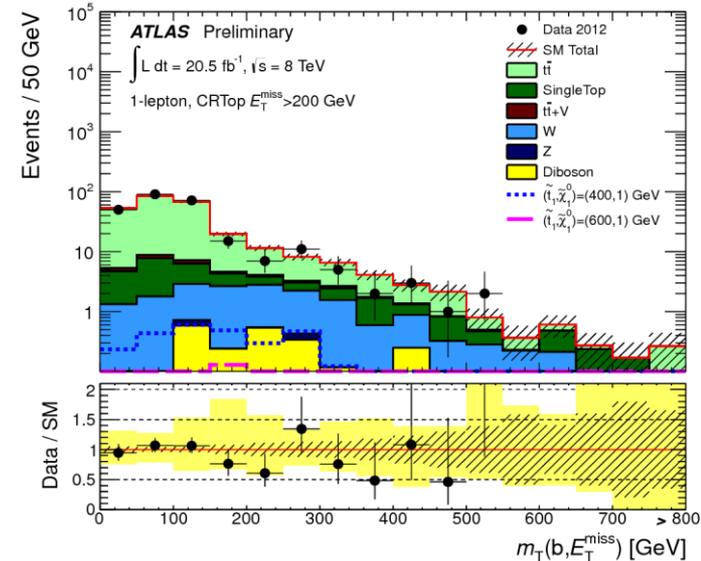
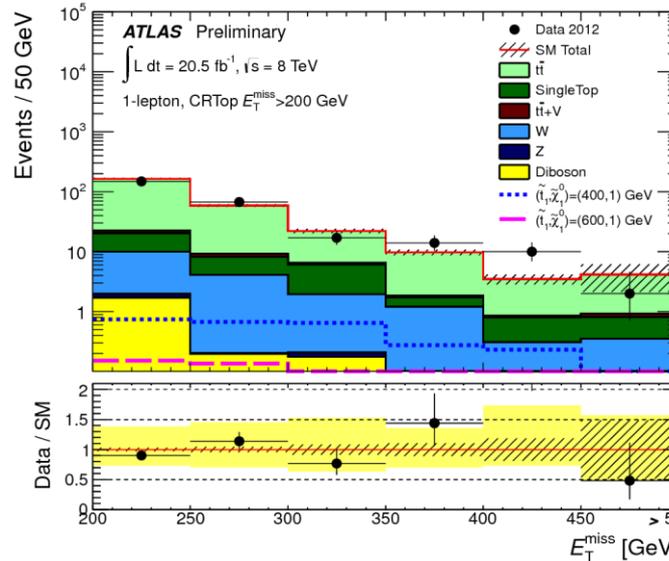
ATLAS-CONF-2013-024: 0L + 6 (2 b)jets + missing E_T

Control Region Distributions

Main background:

- semi-leptonic $t\bar{t}$
 - hadronic τ
 - missed lepton

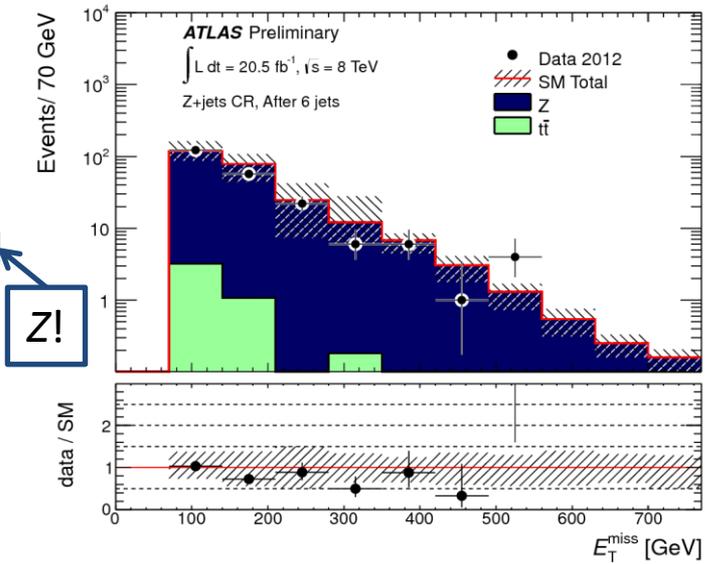
$t\bar{t}$ CR	
single electron (muon)	
Trigger	electron (muon)
N_{lep}	1
p_T^{ℓ}	> 35 (35)
$p_T^{\ell_2}$	< 10 (10)
$m_{\ell\ell}$	—
N_{jet}	≥ 6
p_T^{jet}	> 80, 80, 35, ... 35
$N_{b\text{-jet}}$	≥ 2
m_{jjj}	0 to 600
E_T^{miss}	> 200, 300, 350
$E_T^{\text{miss, track}}$	> 30
$\Delta\phi(E_T^{\text{miss}}, E_T^{\text{miss, track}})$	< $\pi/3$
$m_T(\ell, E_T^{\text{miss}})$	40 to 120
$\Delta\phi(\text{jet}, E_T^{\text{miss}})$	> $\pi/10$
$m_T(b\text{-jet}, E_T^{\text{miss}})$	—
Tau veto	no



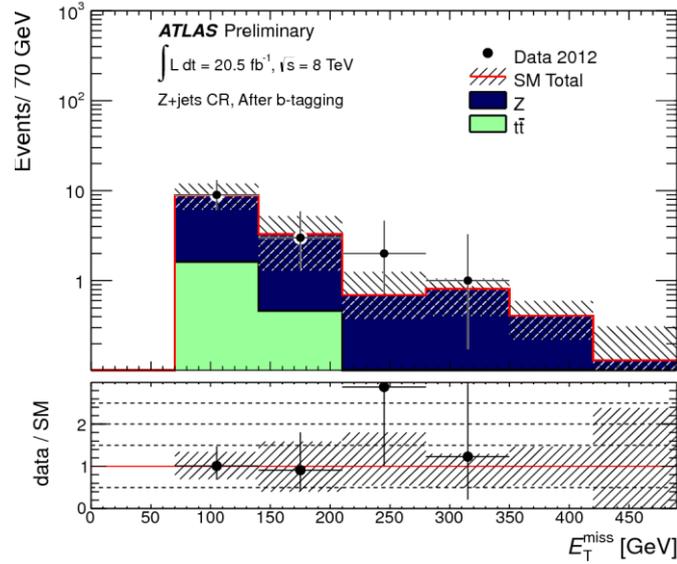
ATLAS-CONF-2013-024: 0L + 6 (2 *b*)jets + missing E_T

Control Region Distributions

	Z+jets CR
	two
Trigger	electron (muon)
N_{lep}	2
$p_T^{\ell_1}$	> 20 (20)
$p_T^{\ell_2}$	> 20 (10)
$m_{\ell\ell}$	81 to 101
N_{jet}	≥ 6
p_T^{jet}	> 80,80,35,...35
N_{b-jet}	≥ 2
m_{jjj}	80 to 270
E_T^{miss}	> 70
$E_T^{miss,track}$	> 30
$\Delta\phi(E_T^{miss}, E_T^{miss,track})$	$< \pi/3$
$m_T(\ell, E_T^{miss})$	—
$\Delta\phi(jet, E_T^{miss})$	$> \pi/5$
$m_T(b-jet, E_T^{miss})$	> 175
Tau veto	yes



No *b*-tag requirements



All requirements applied

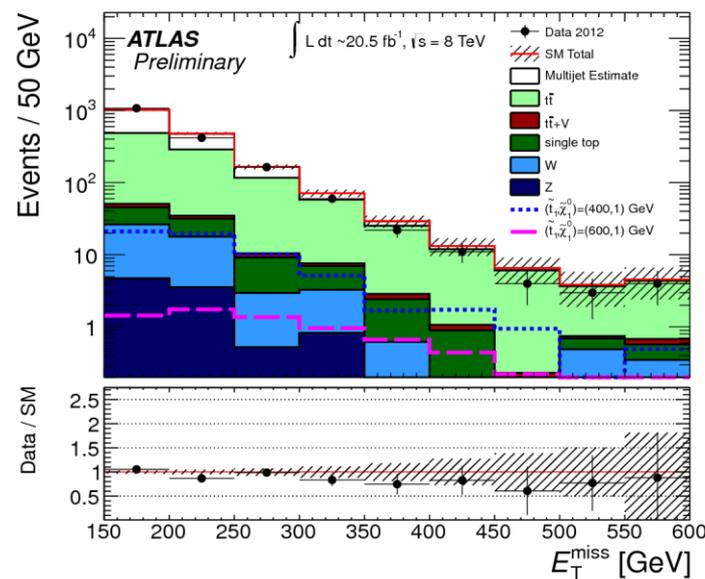
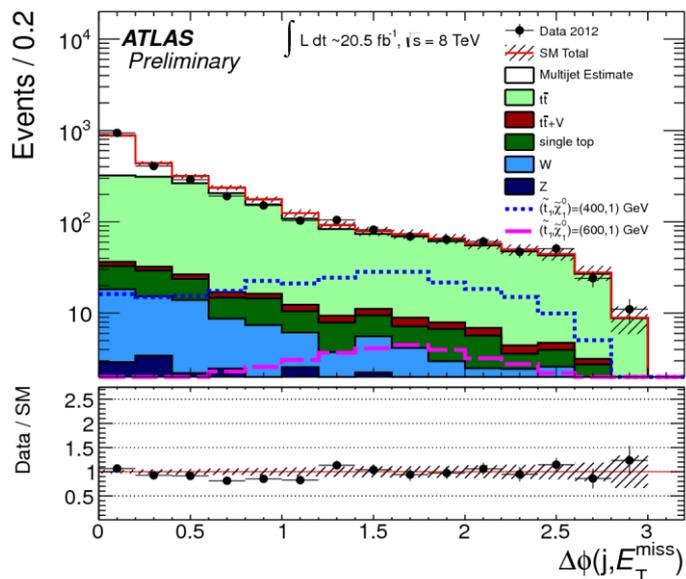


ATLAS-CONF-2013-024: 0L + 6 (2 b)jets + missing E_T

Control Region Distributions

Multijet CR

Trigger	E_T^{miss}
N_{lep}	0
$p_T^{\ell_1}$	< 10 (10)
$p_T^{\ell_2}$	—
$m_{\ell\ell}$	—
N_{jet}	≥ 6
p_T^{jet}	> 80,80,35,...35
$N_{b\text{-jet}}$	≥ 2
m_{jjj}	—
E_T^{miss}	> 160
$E_T^{\text{miss,track}}$	> 30
$\Delta\phi(E_T^{\text{miss}}, E_T^{\text{miss,track}})$	> $\pi/3$
$m_T(\ell, E_T^{\text{miss}})$	—
$\Delta\phi(\text{jet}, E_T^{\text{miss}})$	< $\pi/5$
$m_T(b\text{-jet}, E_T^{\text{miss}})$	> 175
Tau veto	no



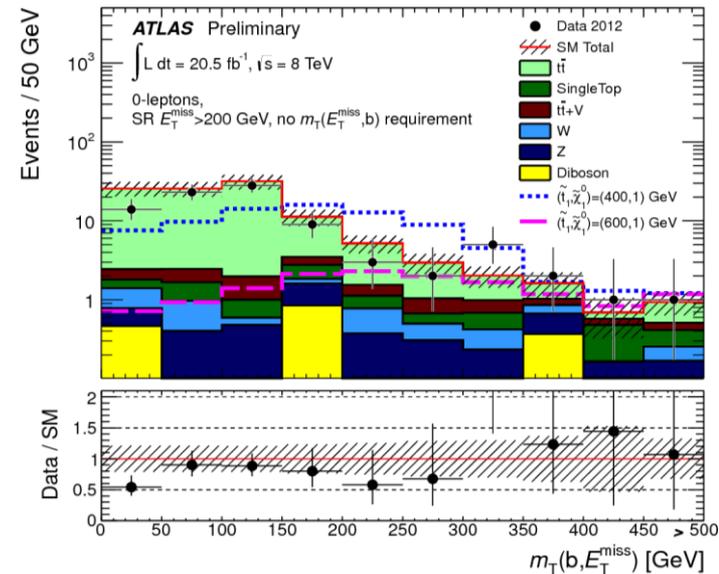
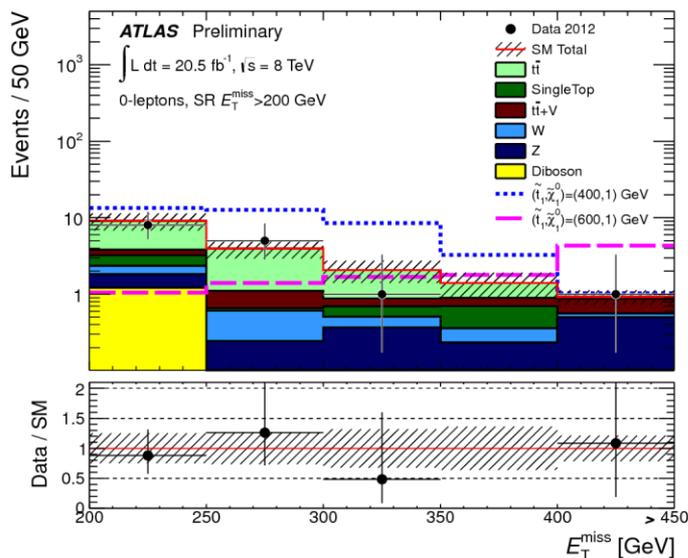
No $\Delta\phi(j, \text{MET})$,
 no $\Delta\phi(\text{track MET}, \text{MET})$
 requirements



ATLAS-CONF-2013-024: 0L + 6 (2 b -)jets + missing E_T

Signal region distributions

	Signal
Trigger	E_T^{miss}
N_{lep}	0
$p_T^{\ell_1}$	< 10 (10)
$p_T^{\ell_2}$	—
$m_{\ell\ell}$	—
N_{jet}	≥ 6
p_T^{jet}	$> 80, 80, 35, \dots, 35$
$N_{b\text{-jet}}$	≥ 2
m_{jjj}	80 to 270
E_T^{miss}	$> 200, 300, 350$
$E_T^{\text{miss,track}}$	> 30
$\Delta\phi(E_T^{\text{miss}}, E_T^{\text{miss,track}})$	$< \pi/3$
$m_T(\ell, E_T^{\text{miss}})$	—
$\Delta\phi(\text{jet}, E_T^{\text{miss}})$	$> \pi/5$
$m_T(b\text{-jet}, E_T^{\text{miss}})$	> 175
Tau veto	yes



ATLAS-CONF-2013-024: 0L + 6 (2 b -)jets + missing E_T

Number of events	SR1	SR2	SR3
Observed	15	2	1
Expected background	17.5 ± 3.2	4.7 ± 1.5	2.7 ± 1.2
Expected $t\bar{t}$	9.8 ± 2.6	1.9 ± 1.3	0.9 ± 0.7
Expected $t\bar{t} + W/Z$	1.7 ± 1.0	0.7 ± 0.4	0.51 ± 0.30
Expected Z+jets	2.1 ± 1.0	1.2 ± 0.5	0.8 ± 0.4
Expected W+jets	1.2 ± 0.8	0.32 ± 0.29	$0.19^{+0.23}_{-0.19}$
Expected single-top	1.5 ± 0.9	0.5 ± 0.4	$0.3^{+0.5}_{-0.3}$
Expected multijet	0.12 ± 0.12	0.01 ± 0.01	< 0.01
Expected diboson	1.2 ± 1.2	< 0.22	< 0.22
Fit input expectation $t\bar{t}$	9.9	1.7	0.6

Uncertainty	SR1	SR2	SR3
Total	18%	33%	45%
Background sample sizes (data and simulation)	10%	17%	21%
Jet energy scale and resolution	10%	10%	25%
$t\bar{t}$ theory	10%	19%	22%
Z+jets theory	4%	8%	8%
$t\bar{t} + W/Z$ theory	5%	8%	10%



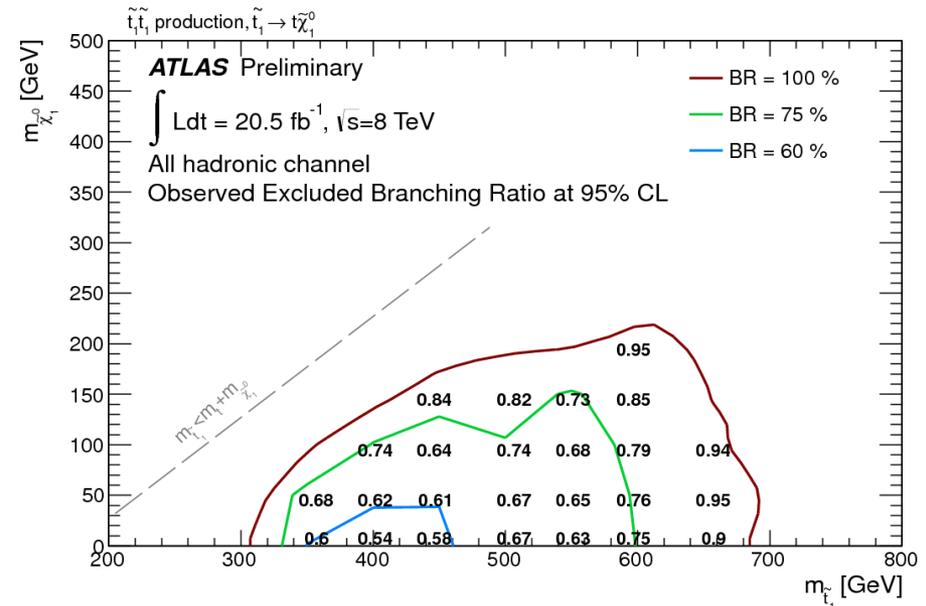
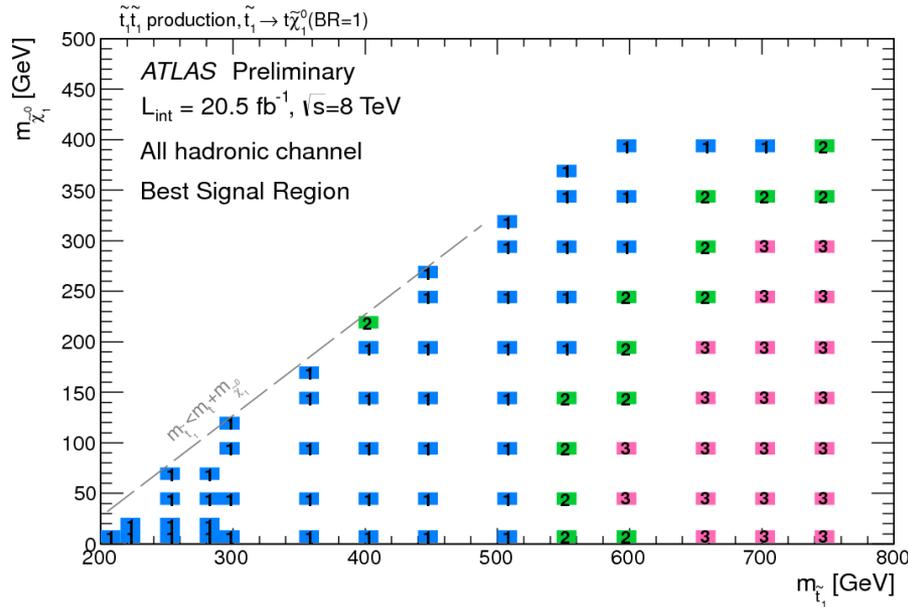
ATLAS-CONF-2013-024: 0L + 6 (2 b -)jets + missing E_T

1: Missing $E_T > 200$ GeV

2: Missing $E_T > 300$ GeV

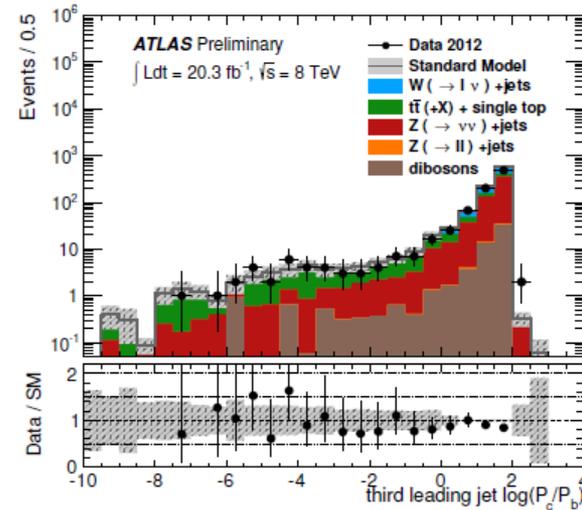
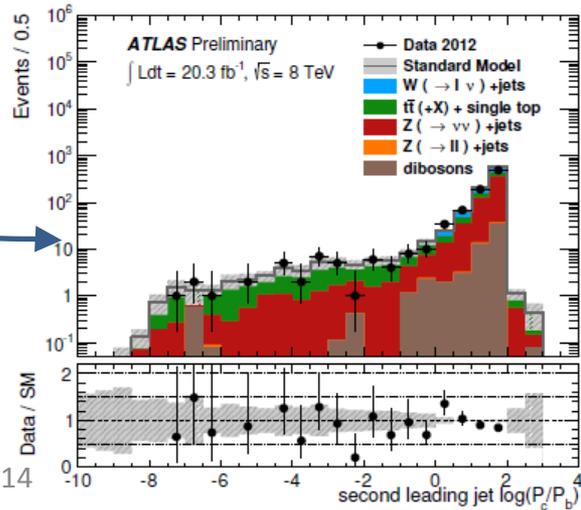
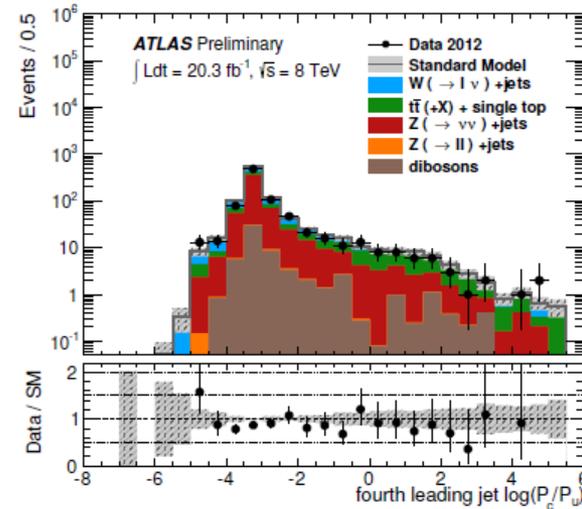
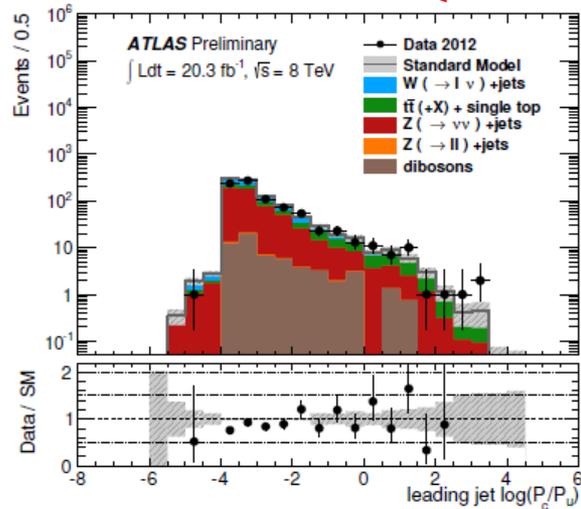
3: Missing $E_T > 350$ GeV

Assume no sensitivity to other decay channels



ATLAS-CONF-2013-068: Stop to charm

anti- $b \equiv \log\left(\frac{P_c}{P_b}\right)$ and anti- $u \equiv \log\left(\frac{P_c}{P_u}\right)$



5 May 2014

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1403.5222: $Z + b\text{-jet} + \text{jets} + \text{missing } E_T$

	SR2A	SR2B	SR2C	SR3A	SR3B
N^{leptons}	2	2	2	3	3
$p_T(\ell_1)$ [GeV]	> 25	> 25	> 25	> 40	> 60
dilepton flavour	SF	SF	SF	SF	SF
$ m_{\ell\ell} - m_Z $ [GeV]	< 5	< 10	< 5	< 10	< 10
$N^{b\text{-jets}}$	≥ 1				
N^{jets}	3, 4	3, 4	≥ 5	≥ 5	≥ 5
$p_T(\text{jet}_1)$ [GeV]	> 30	> 30	> 30	> 50	> 40
$p_T(\text{jet}_N)$ [GeV]	> 30	> 30	> 30	> 30	> 40
E_T^{miss} [GeV]	> 160	> 200	> 160	> 60	> 60
$p_T(\ell\ell)$ [GeV]	> 80	> 160	> 80	-	> 75
$\Delta\phi^{\ell\ell}$ [rad]	< 1.5	< 1.5	< 1.5	-	-

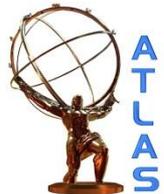
- SR2L backgrounds:
 - Prompt leptons from $t\bar{t}$, $Z + \text{jets}$
 - Fake leptons (multijets, $W + \text{jets}$)
- SR3L backgrounds:
 - Fake leptons ($t\bar{t} + \text{jets}$, $Z + \text{jets}$)
 - Prompt leptons from $t\bar{t}V$, tZ , diboson, triboson events



1403.5222: $Z + b\text{-jet} + \text{jets} + \text{missing } E_T$ SR3L background estimation

- $t\bar{t}Z$ from MC
- Check in VRs:
 - VR3A ($p_{T,\parallel} < 120$ GeV)
 - VR3B ($p_{T,\parallel} > 120$ GeV)

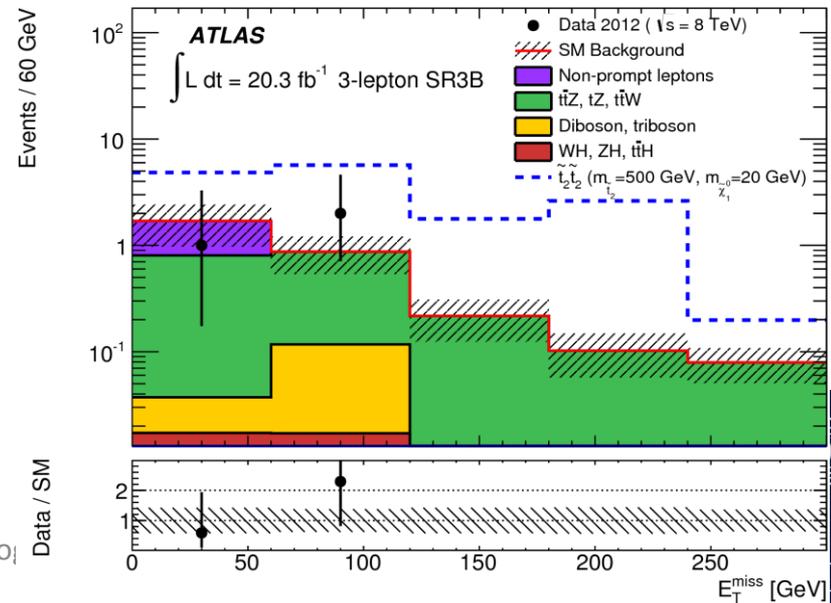
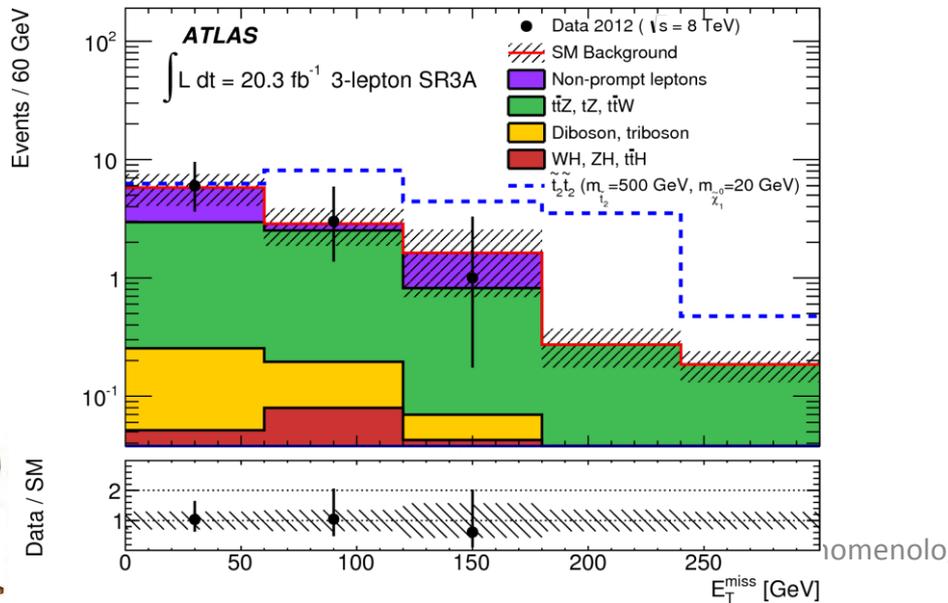
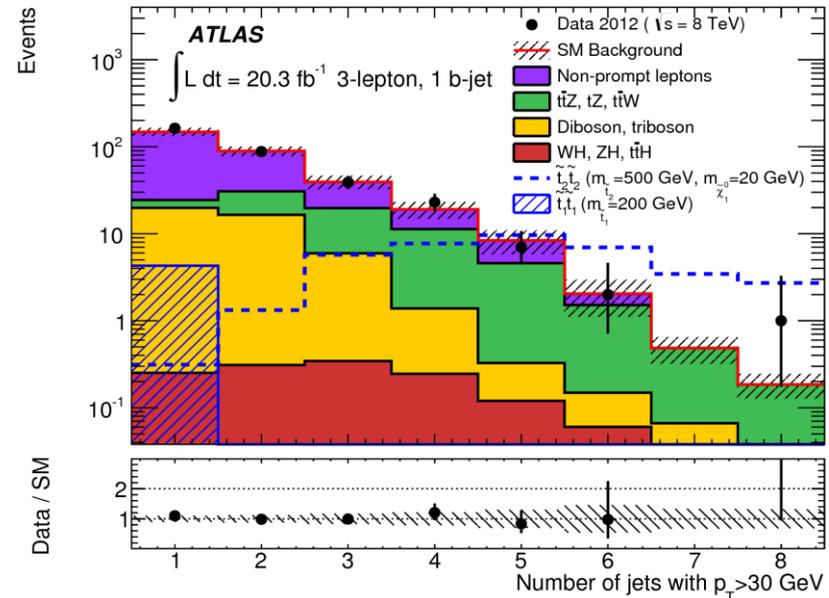
	VR3A	VR3B
Data	24	13
Total SM	19 ± 5	12.1 ± 3.2
MC exp. $t\bar{t}Z$	7.9 ± 2.1	5.9 ± 1.6
MC exp. tZ	2.7 ± 2.7	1.5 ± 1.5
Data-driven non-prompt	5.9 ± 2.9	2.7 ± 1.4
MC exp. diboson, triboson	1.5 ± 0.5	1.9 ± 0.6
MC exp. $t\bar{t}W$	0.35 ± 0.10	0.05 ± 0.02
MC exp. $Wh, Zh, t\bar{t}h$	0.3 ± 0.3	0.05 ± 0.05
$(m_{\tilde{t}_2}, m_{\tilde{\chi}_1^0}) = (500, 20)$ GeV	1.6 ± 0.6	7.5 ± 1.2
$(m_{\tilde{t}_2}, m_{\tilde{\chi}_1^0}) = (500, 120)$ GeV	3.3 ± 0.8	3.9 ± 0.8
$(m_{\tilde{t}_2}, m_{\tilde{\chi}_1^0}) = (550, 20)$ GeV	0.6 ± 0.3	4.6 ± 0.7
$(m_{\tilde{t}_2}, m_{\tilde{\chi}_1^0}) = (550, 220)$ GeV	2.7 ± 0.5	2.2 ± 0.5



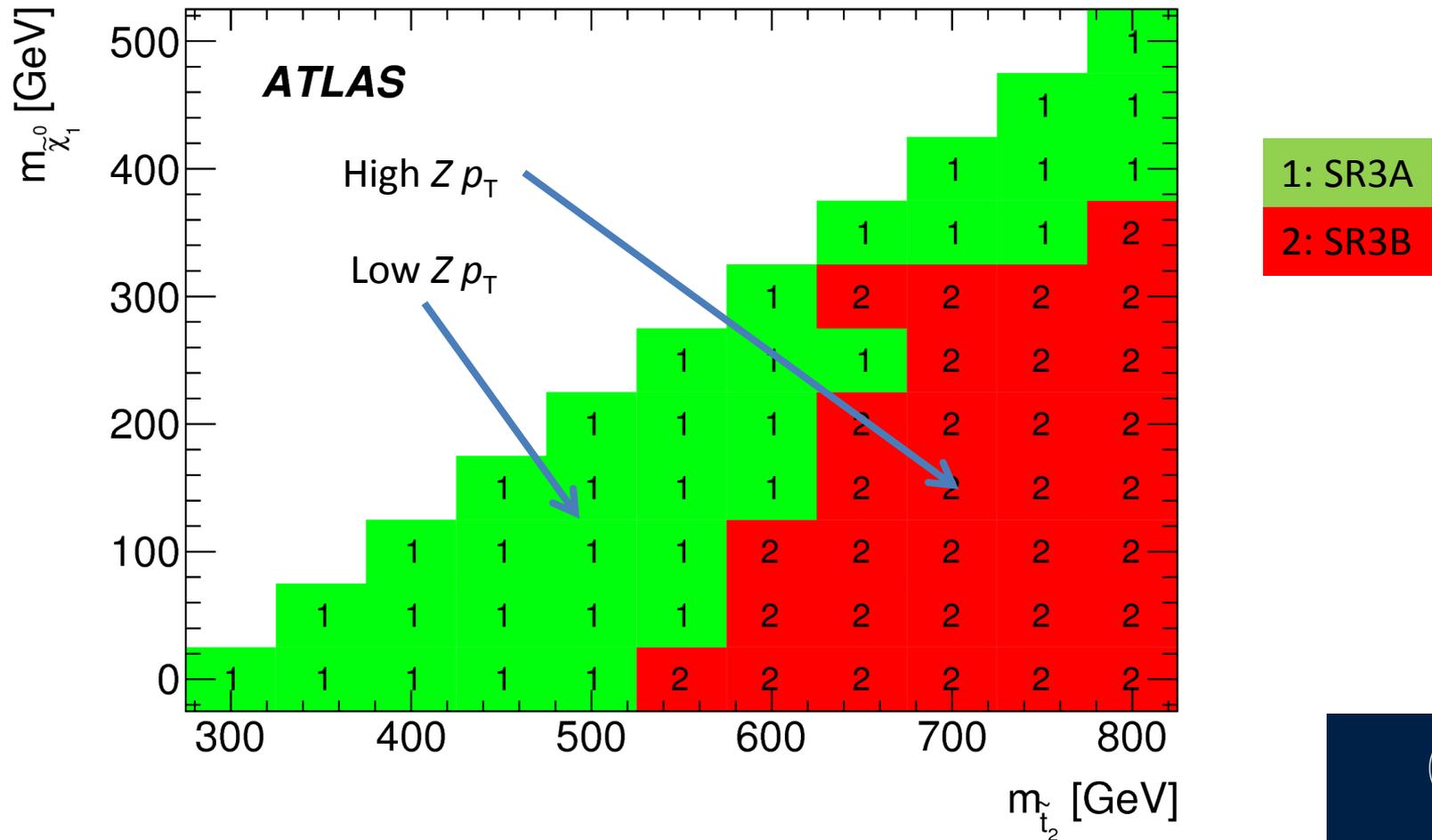
1403.5222: $Z + b\text{-jet} + \text{jets} + \text{missing } E_T$

SR3L background estimation

	SR3A	SR3B
Data	4	2
Total SM	4.5 ± 1.4	1.3 ± 0.4
p_0	0.50	0.30
MC exp. $t\bar{t}V, tZ$	3.5 ± 1.2	1.1 ± 0.4
MC exp. diboson, triboson	0.1 ± 0.1	0.1 ± 0.1
MC exp. $Wh, Zh, t\bar{t}h$	0.1 ± 0.1	0.04 ± 0.04
Data-driven non-prompt	0.8 ± 0.7	< 0.2



1403.5222: $Z + b\text{-jet} + \text{jets} + \text{missing } E_T$



1403.5222: $Z + b\text{-jet} + \text{jets} + \text{missing } E_T$ SR2L background estimation

- $t\bar{t}$ control region; SF and DF dilepton events:
 - $10 \text{ GeV} < |m_{\ell\ell} - m_Z| < 50 \text{ GeV}$ (SF)
 - $|m_{\ell\ell} - m_Z| < 50 \text{ GeV}$ (DF)
- $Z + \text{jets}$: jet smearing method
- Other: normalisation from MC.

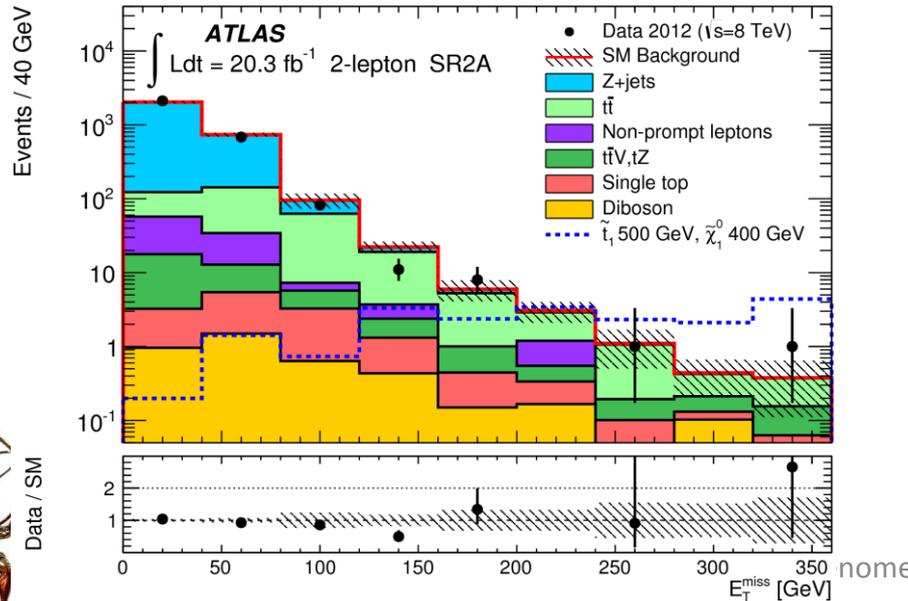
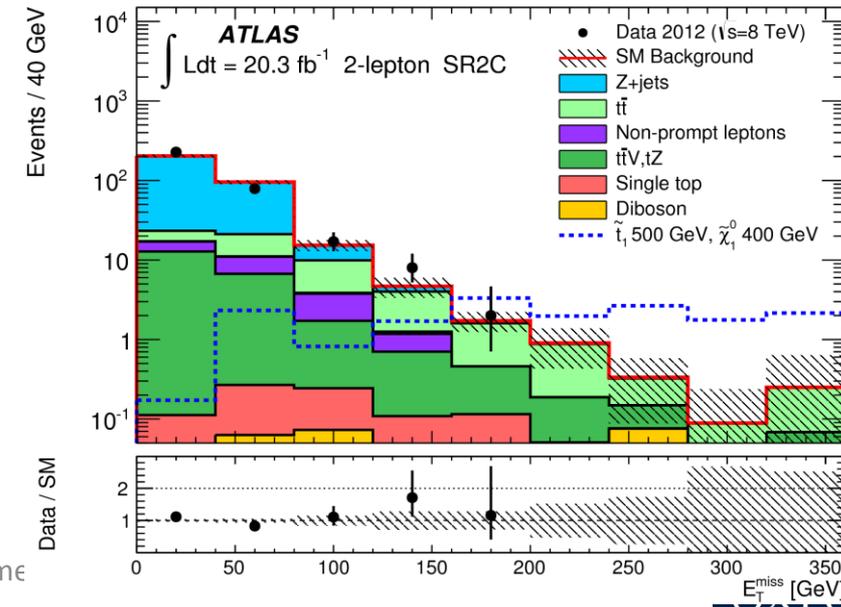
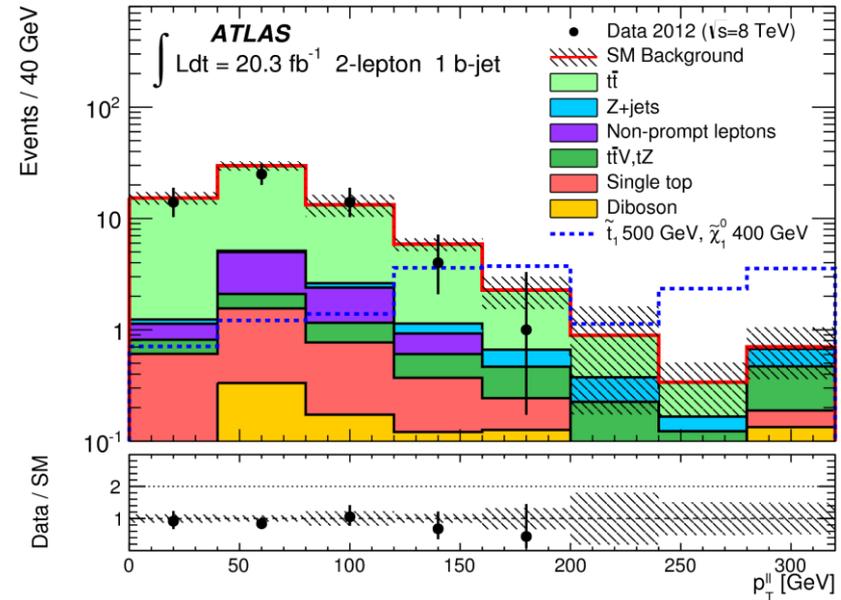
	CR2A	CR2C
Data	152	101
Fitted total SM	152 ± 13	101 ± 11
Fitted $t\bar{t}$	128 ± 13	88 ± 11
Fitted single top	12 ± 4	4.4 ± 3.2
Fitted $Z+\text{jets}$	0.62 ± 0.04	0.75 ± 0.07
Fitted diboson	1.6 ± 1.4	0.5 ± 0.4
Fitted $t\bar{t}V, tZ$	1.6 ± 0.4	1.7 ± 0.5
Fitted non-prompt	7.4 ± 2.4	6.1 ± 1.9
MC exp. total SM	176	146
MC exp. $t\bar{t}$	152	132
MC exp. single top	13	5.2
MC exp. $Z+\text{jets}$	0.62	0.75
MC exp. diboson	1.7	0.5
MC exp. $t\bar{t}V, tZ$	1.6	1.7
Data-driven non-prompt	7.4	6.1



1403.5222: Z + b-jet + jets + missing E_T

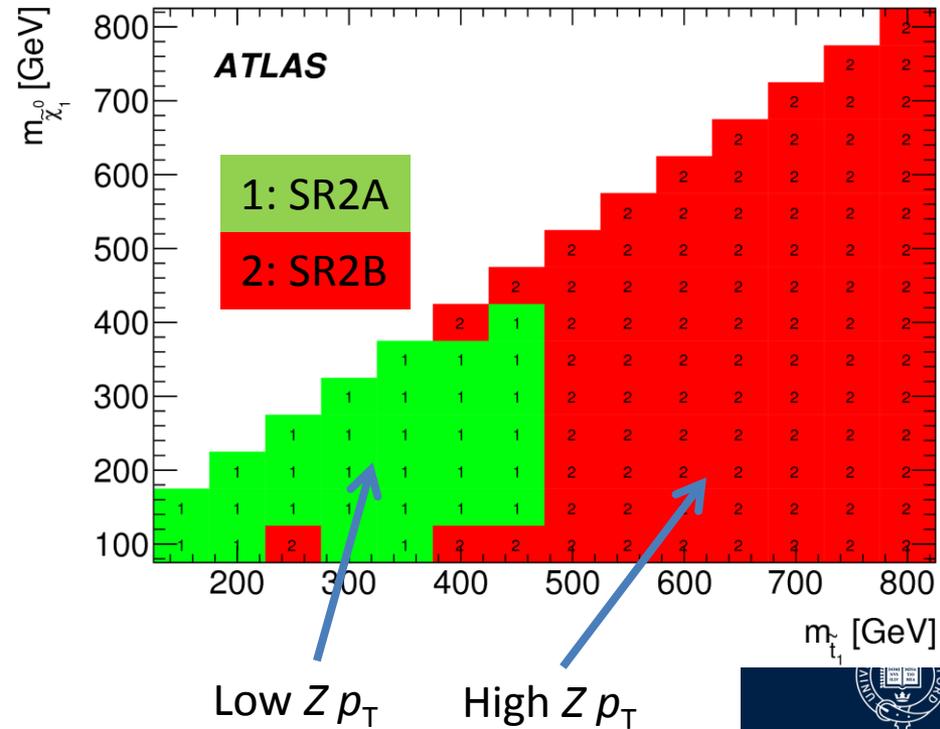
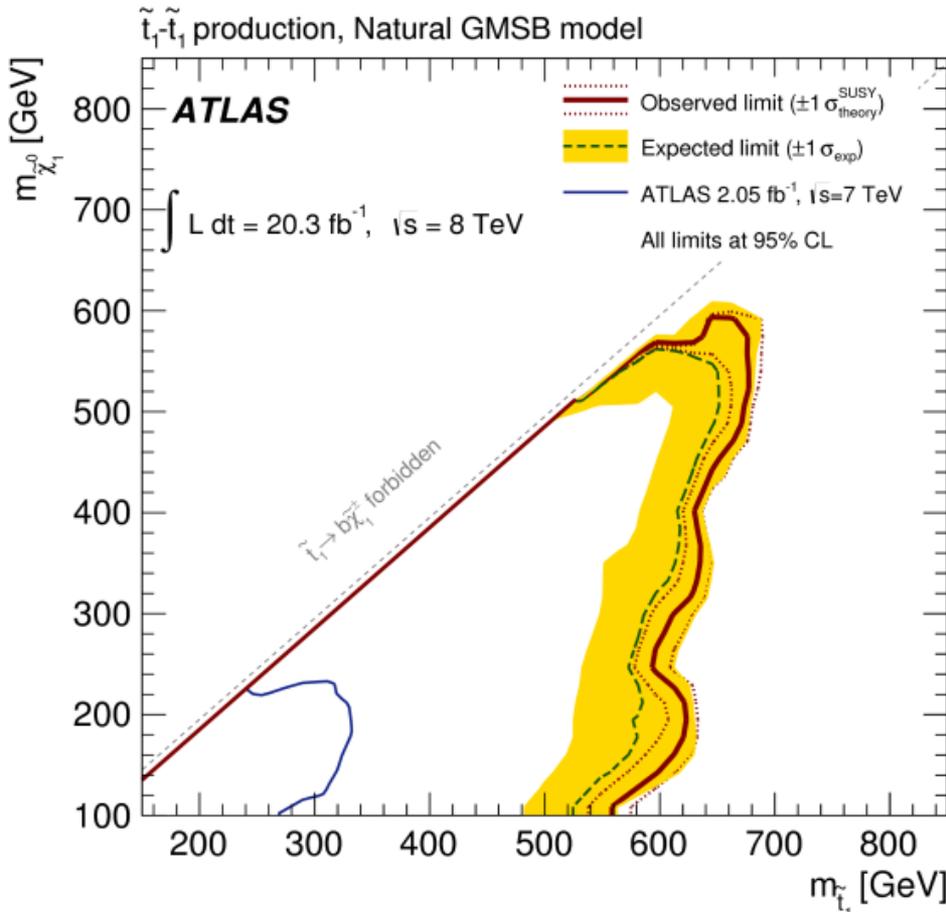
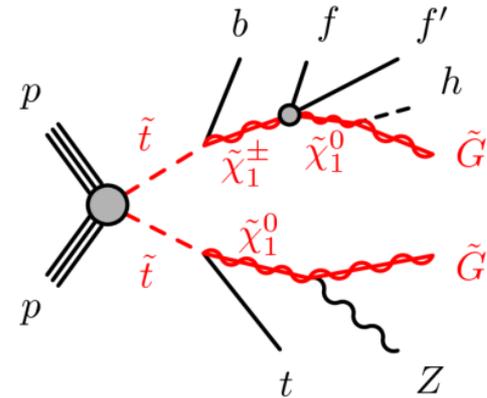
SR2L background estimation

	SR2A	SR2B	SR2C
Data	10	1	2
Fitted total SM	10.8 ± 1.7	2.4 ± 0.9	3.5 ± 0.5
p_0	0.50	0.50	0.50
Fitted $t\bar{t}$	7.3 ± 1.4	1.4 ± 0.7	2.4 ± 0.4
Fitted single top	0.61 ± 0.15	0.23 ± 0.17	$0.10^{+0.13}_{-0.10}$
Fitted Z+jets	0.91 ± 0.22	0.14 ± 0.06	0.16 ± 0.06
Fitted diboson	0.46 ± 0.34	0.27 ± 0.21	0.15 ± 0.12
Fitted $t\bar{t}V, tZ$	1.0 ± 0.4	0.38 ± 0.18	0.65 ± 0.23
Fitted non-prompt	0.52 ± 0.11	< 0.05	< 0.01
MC exp. total SM	11.6	3.0	4.8
MC exp. $t\bar{t}$	8.1	2.0	3.7
MC exp. single top	0.61	0.24	0.14
Data-driven Z+jets	0.88	0.13	0.18
MC exp. diboson	0.48	0.28	0.15
MC exp. $t\bar{t}V, tZ$	1.0	0.38	0.66
Data-driven non-prompt	0.52	< 0.05	< 0.01

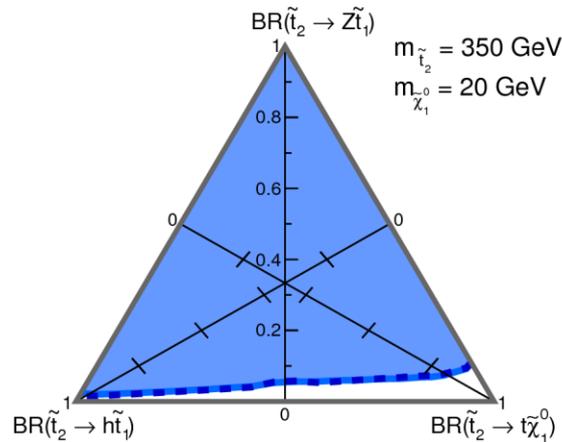


1403.5222: $Z + b\text{-jet} + \text{jets} + \text{missing } E_T$

- GMSB interpretation:



1403.5222: $Z + b\text{-jet} + \text{jets} + \text{missing } E_T$



ATLAS $L_{\text{int}} = 20.3 \text{ fb}^{-1}$ $\sqrt{s} = 8 \text{ TeV}$

$\tilde{t}_2\text{-}\tilde{t}_2$ production, $\tilde{t}_2 \rightarrow Z\tilde{t}_1, h\tilde{t}_1, t\tilde{\chi}_1^0$; $\tilde{t}_1 \rightarrow t\tilde{\chi}_1^0$

$$m_{\tilde{t}_1} = m_{\tilde{\chi}_1^0} + 180 \text{ GeV}$$

Observed
 Expected

