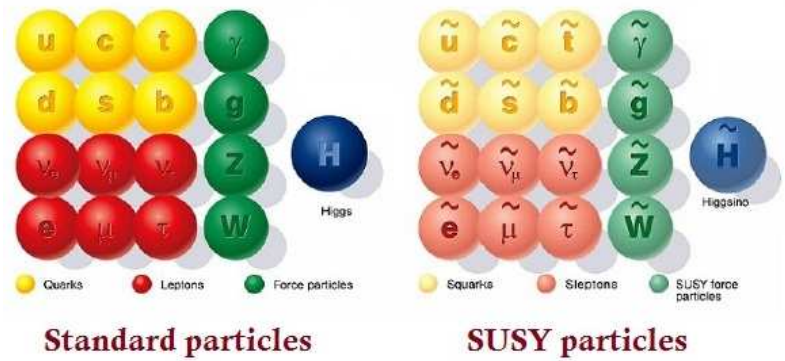
Stop Searches at ATLAS

Michael Begel

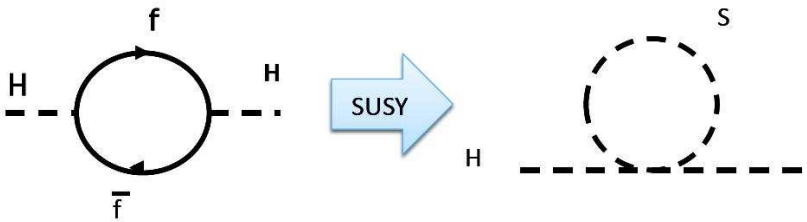
Fermilab Wine & Cheese
December 7, 2012

Supersymmetry

- ***Supersymmetry is a popular extension to the Standard Model***

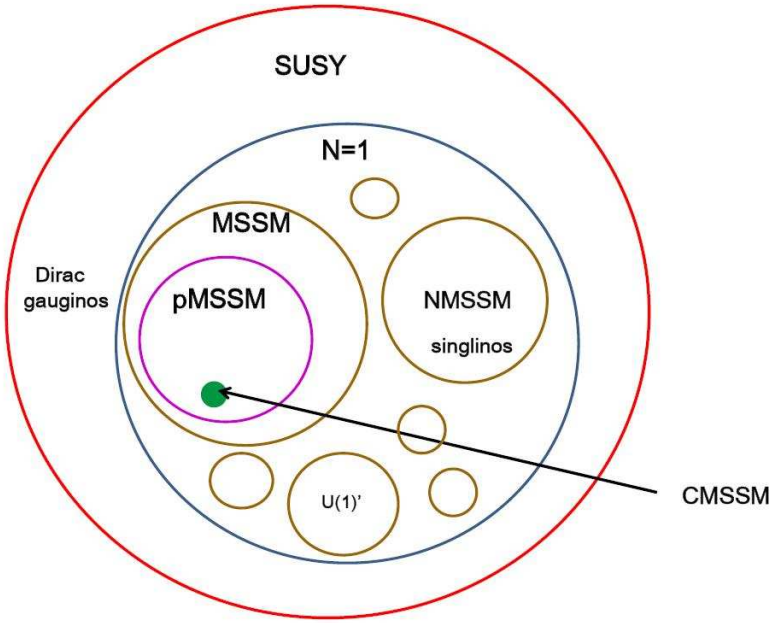


- ***Strong motivations for SUSY at the TeV-scale***
  - stabilize light Higgs mass
  - dark-matter candidate
  - gauge-coupling unification



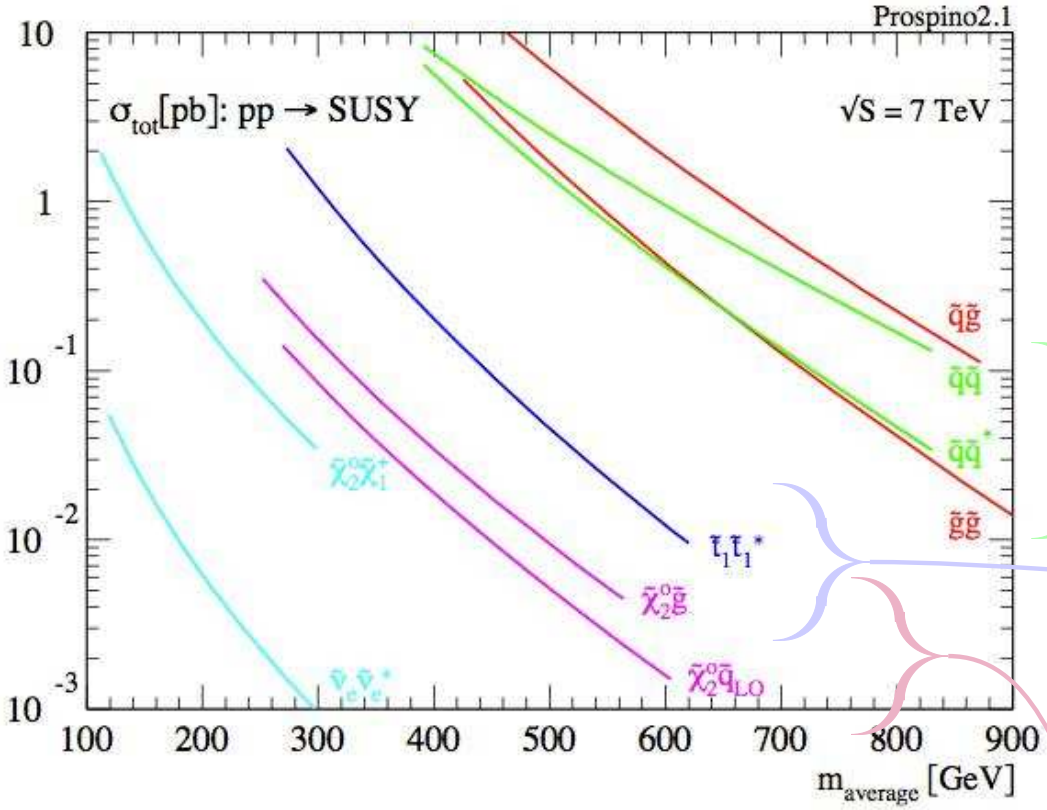
- ***There are many possible SUSY models:***
  - mechanism for breaking SUSY: gauge-, gravity-, anomaly-mediated
  - sparticle masses and SUSY parameters
  - *R*-parity conservation or violation

  - there is more to SUSY than the MSSM!



T. Rizzo (SLAC Summer Institute Aug 2012)

Supersymmetry



Strong Production

- squark & gluino production
- dominant at hadron colliders
- typically E_T^{miss} based search channels

Third Generation

- top squarks
- small cross section compared to generic di-squarks
- decays can include $t\bar{t}$

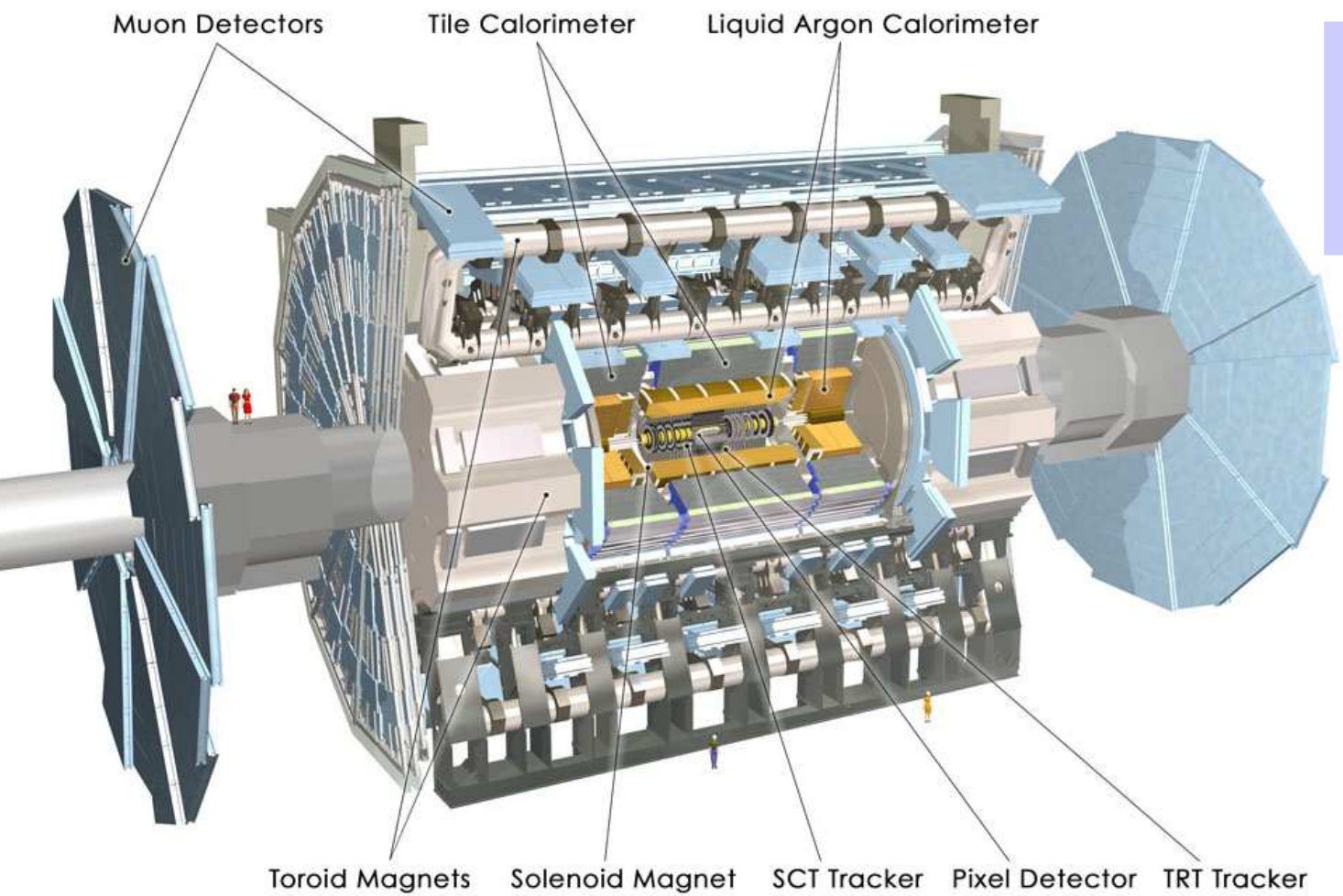
Weak Production

- direct gaugino production
- typically multi-lepton & E_T^{miss} search channels

Mural by Josef Kristofoletti
(painted 2009–10; 1/3 scale)
ATLAS
EXPERIMENT
http://atlas.ch

Multi-purpose, high resolution, hermetic detector

Magnets: Central Solenoid & 3 Toroids
Tracking: Pixels, Silicon Strips, Transition Radiation Tracker
Calorimeter: LAr & Scintillator
Muon: Drift Chambers & Scintillator



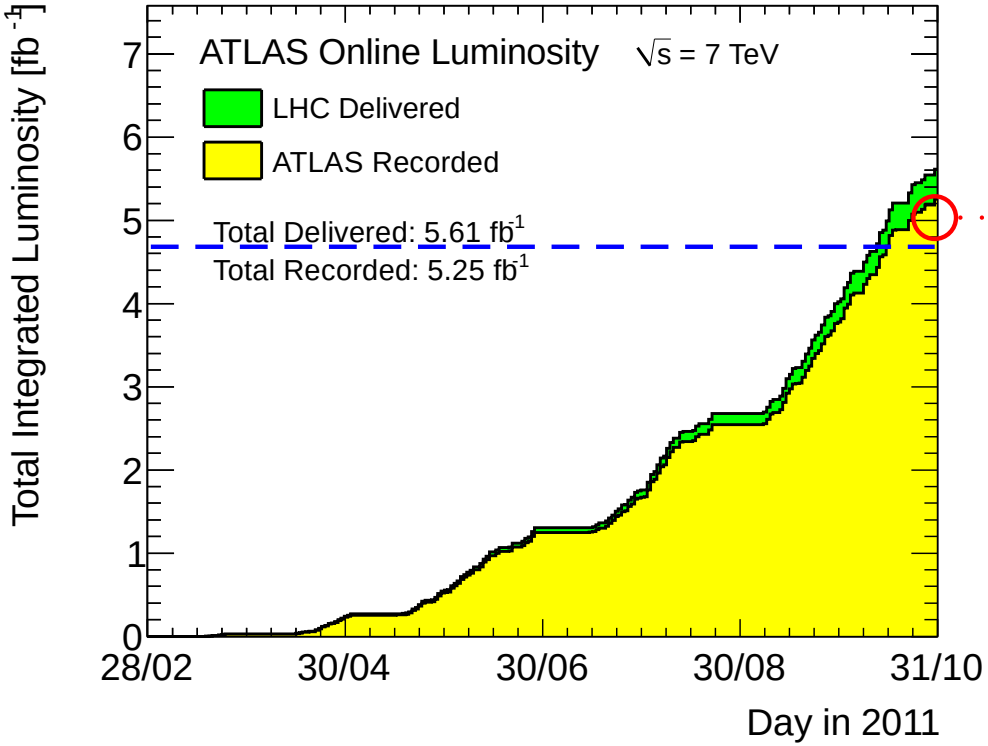
Trigger

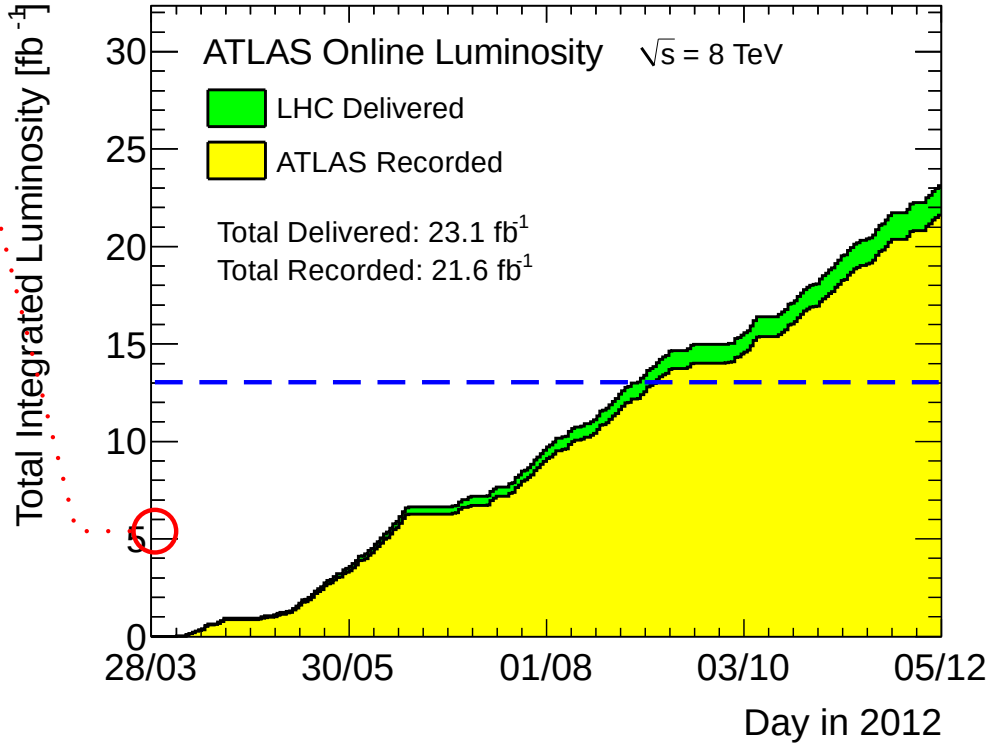
Level 1:	75000 Hz
Level 2:	6000 Hz
Event Filter:	600 Hz

Reconstructed Objects

- electrons
- photons
- muons
- hadronic taus
- jets
- *b*-jets
- E_T^{miss}

Data Taking





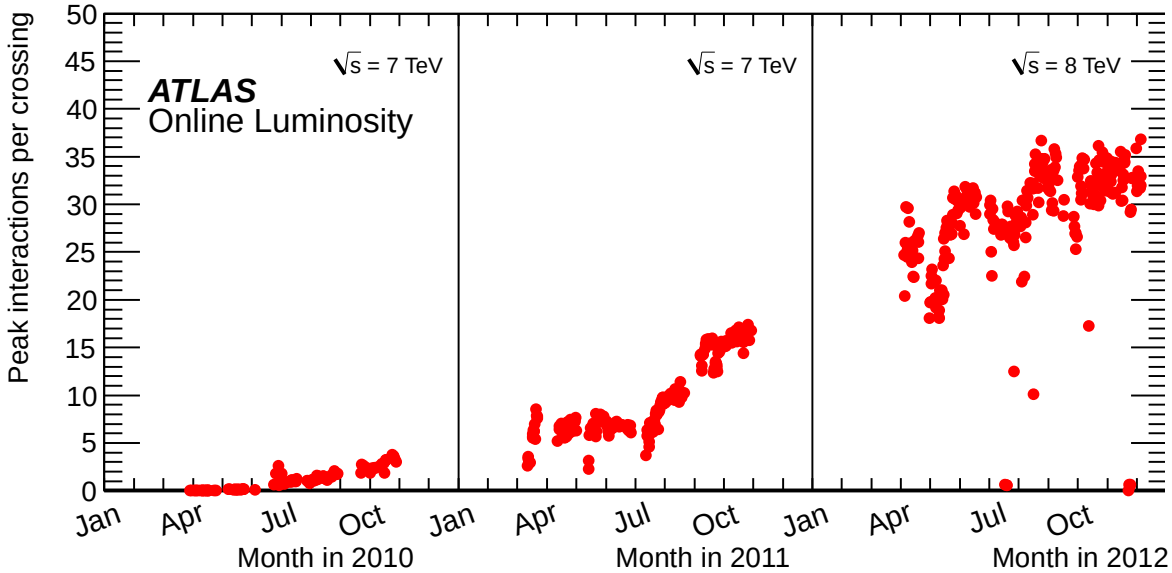
ATLAS p-p run: March-October 2011										
Inner Tracker			Calorimeters		Muon Spectrometer				Magnets	
Pixel	SCT	TRT	LAr	Tile	MDT	RPC	CSC	TGC	Solenoid	Toroid
99.8	99.6	99.2	96.9	99.2	99.4	98.8	99.4	99.1	99.8	99.3
All good for physics: 89.9%										

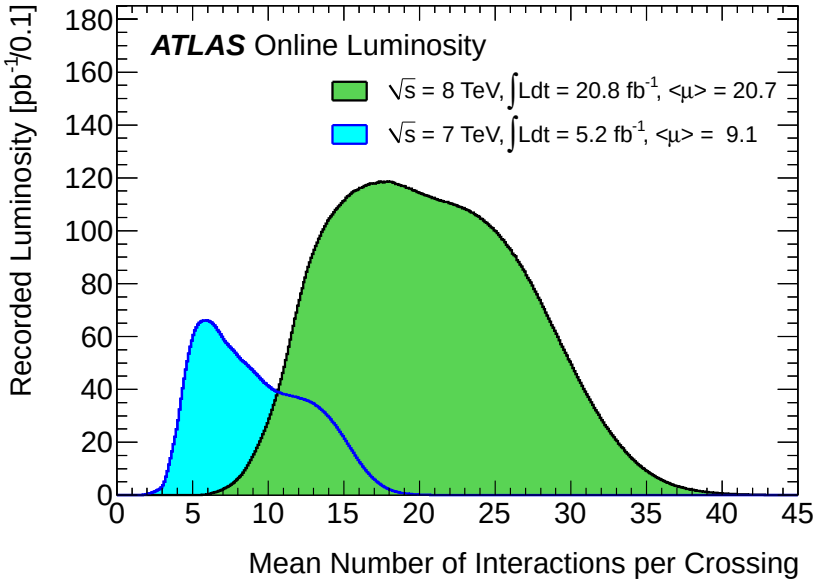
Luminosity weighted relative detector uptime and good quality data delivery during 2011 stable beams in pp collisions at √s=7 TeV between March 13th and October 30th (in %) - corresponding to 5.2 fb^{-1} of recorded data. This data quality status refers to the data after the summer reprocessing campaign.

ATLAS p-p run: April-Sept. 2012										
Inner Tracker			Calorimeters		Muon Spectrometer				Magnets	
Pixel	SCT	TRT	LAr	Tile	MDT	RPC	CSC	TGC	Solenoid	Toroid
100	99.3	99.5	97.0	99.6	99.9	99.8	99.9	99.9	99.7	99.2
All good for physics: 93.7%										

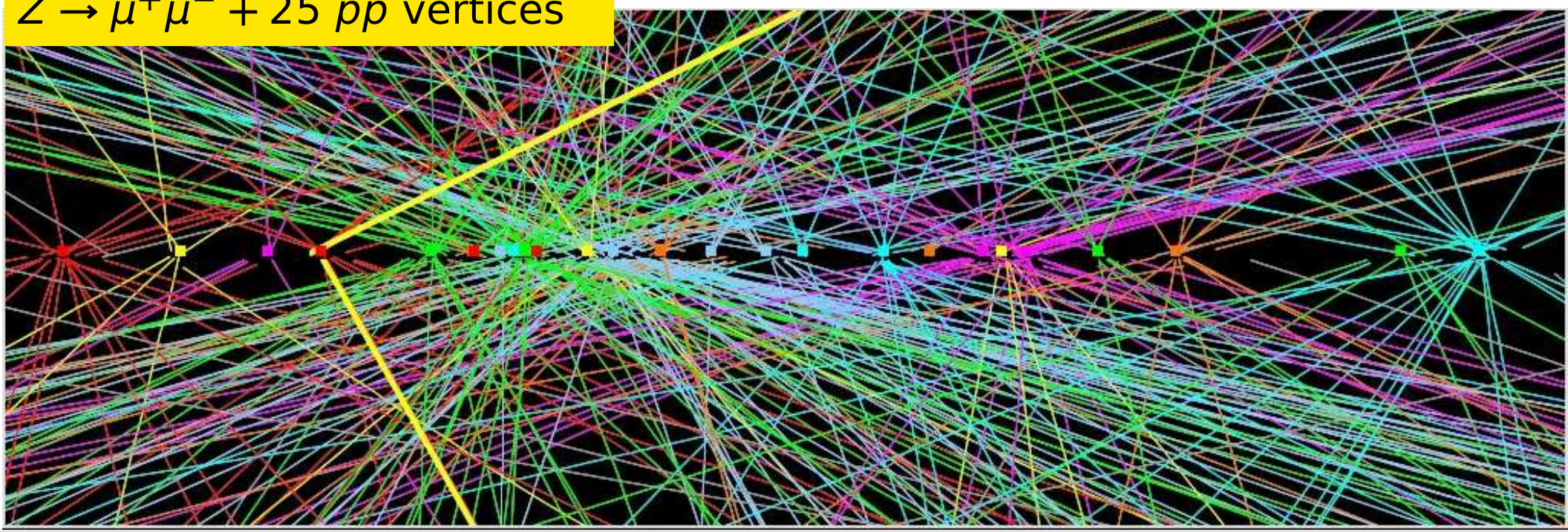
Luminosity weighted relative detector uptime and good quality data delivery during 2012 stable beams in pp collisions at √s=8 TeV between April 4th and September 17th (in %) – corresponding to 14.0 fb^{-1} of recorded data. The inefficiencies in the LAr calorimeter will partially be recovered in the future.

Pileup





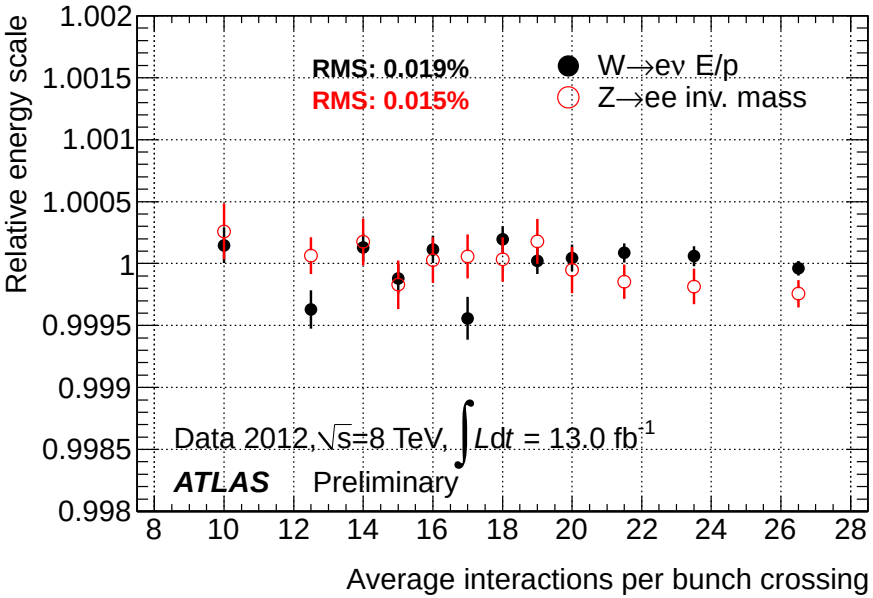
$Z \rightarrow \mu^+\mu^- + 25\ pp$ vertices



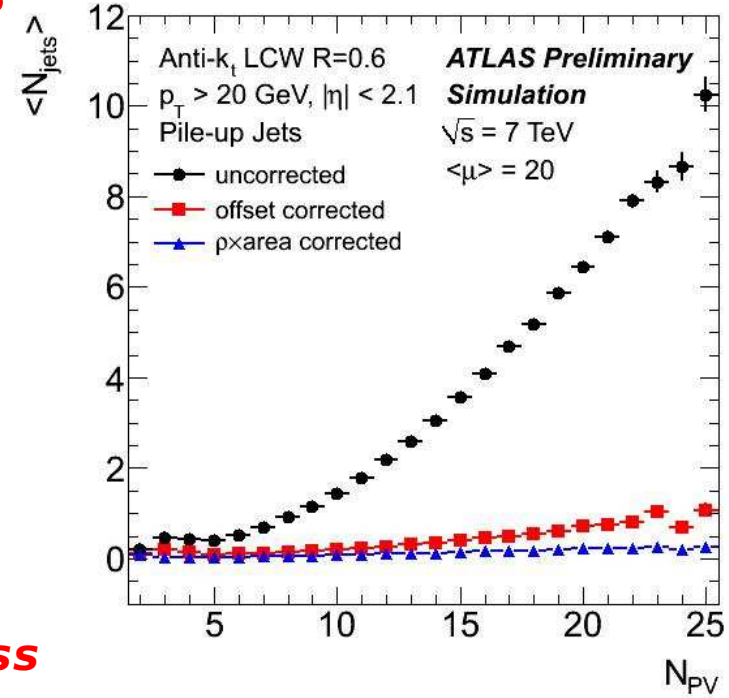
Performance with Pileup

BROOKHAVEN NATIONAL LABORATORY

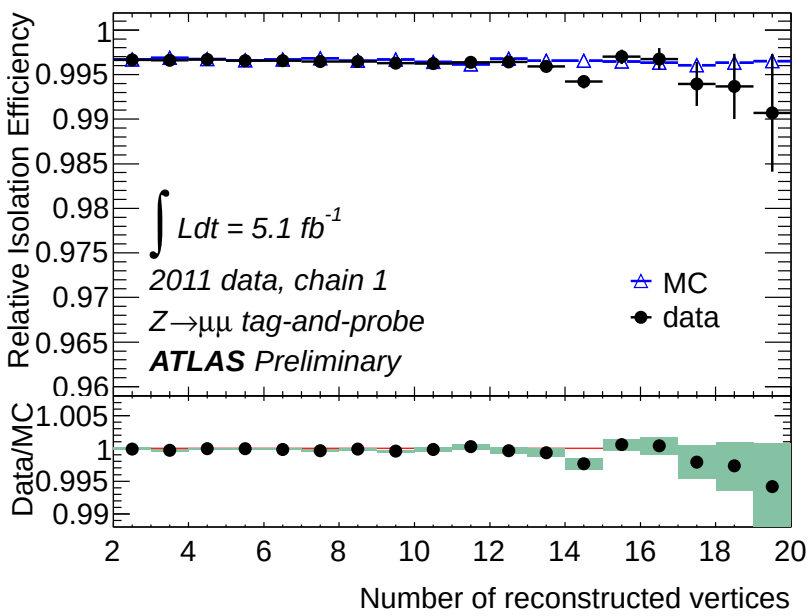
Electrons



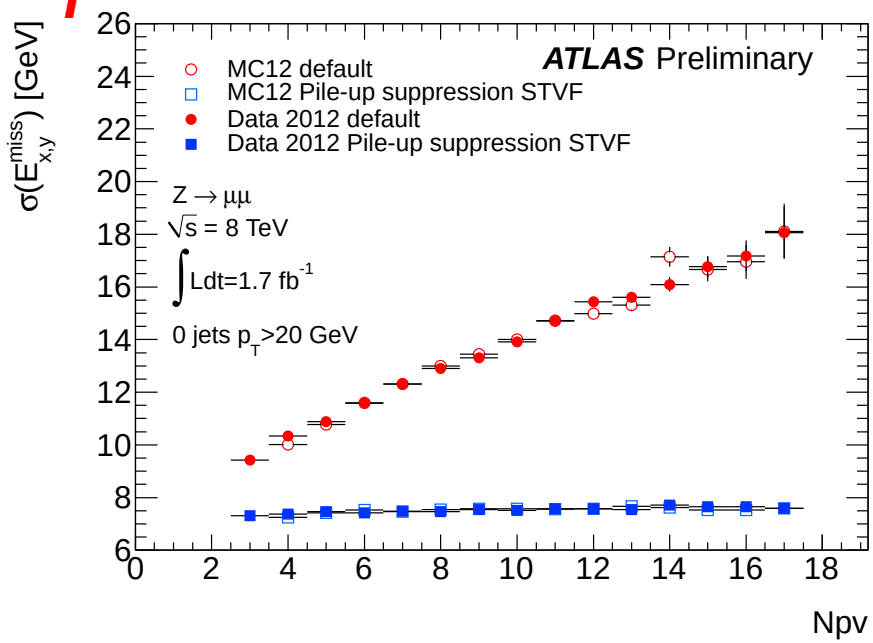
Jets



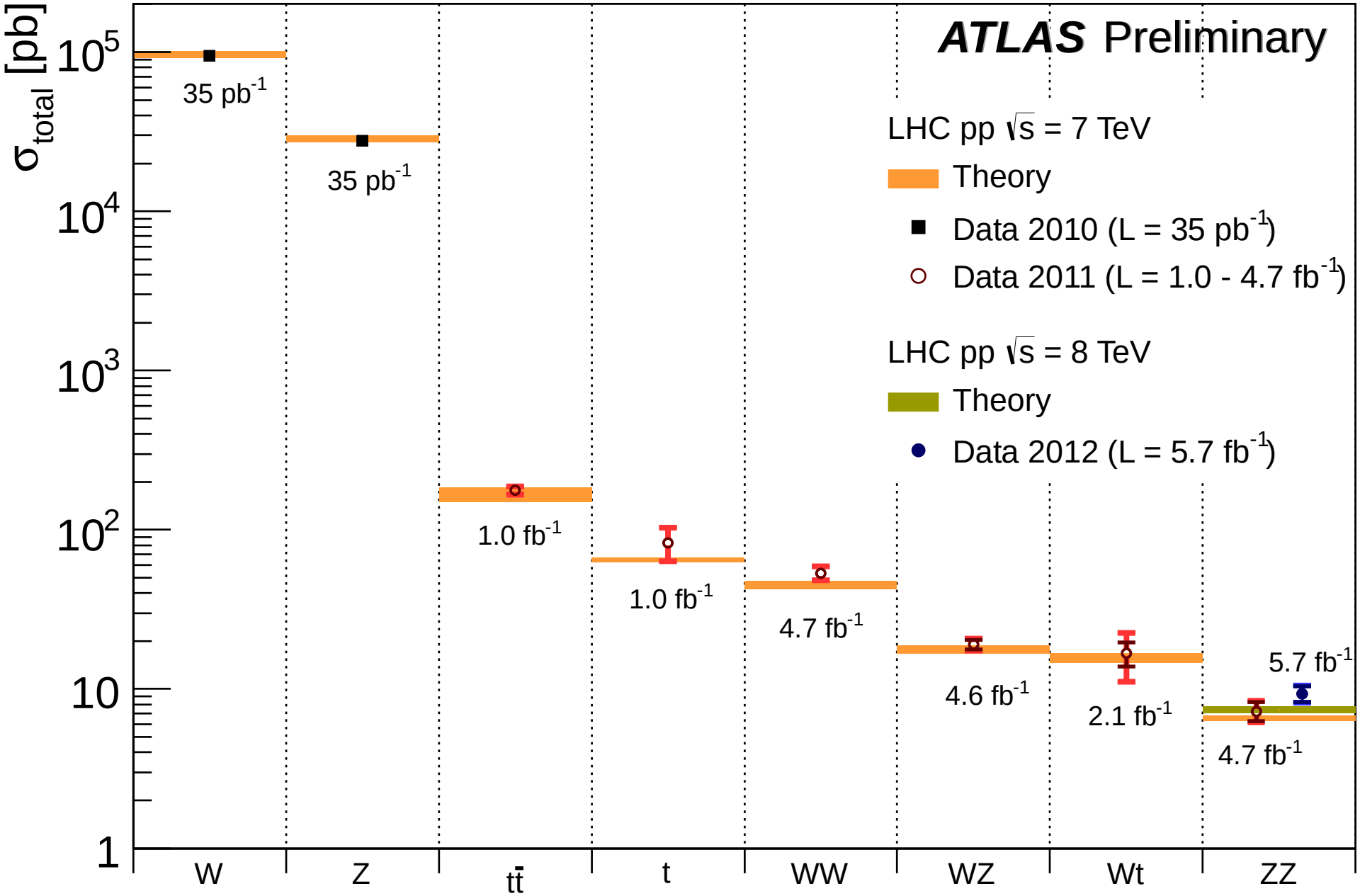
Muons



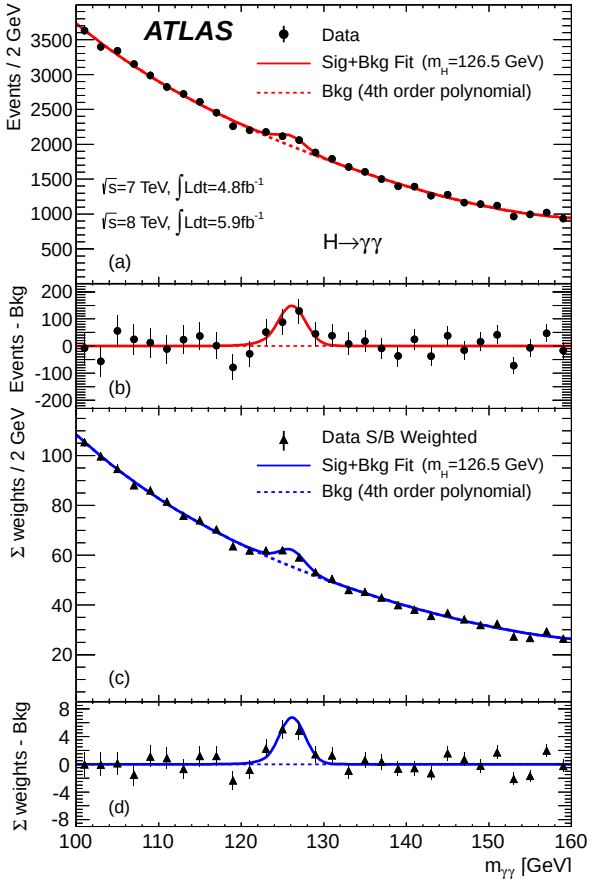
E_T^{miss}

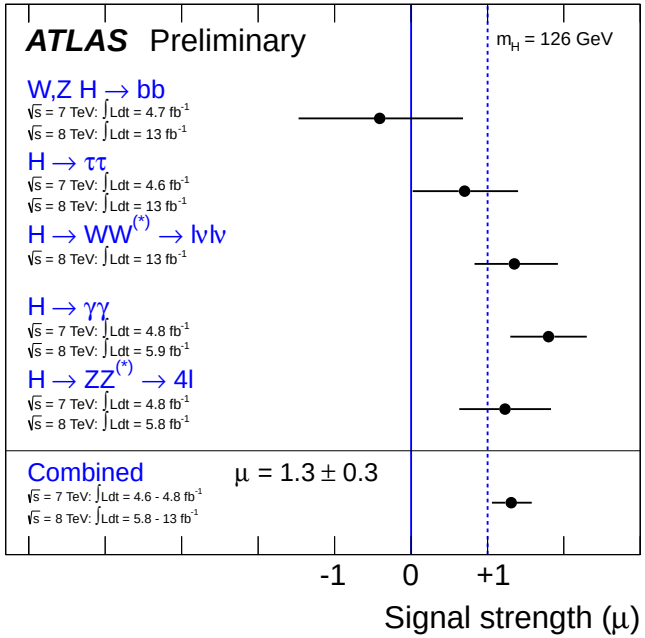


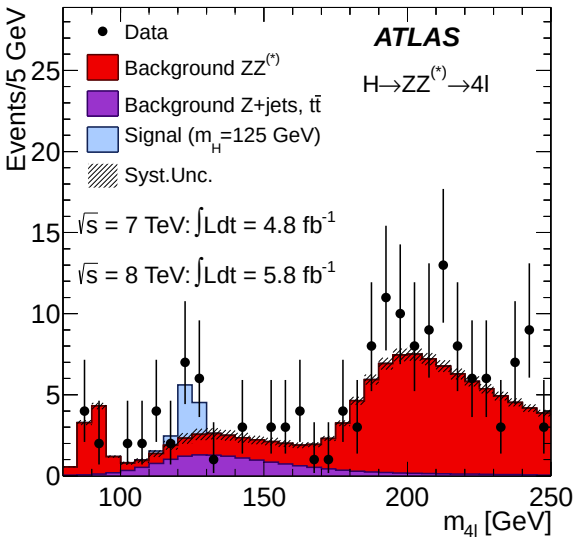
Standard Model

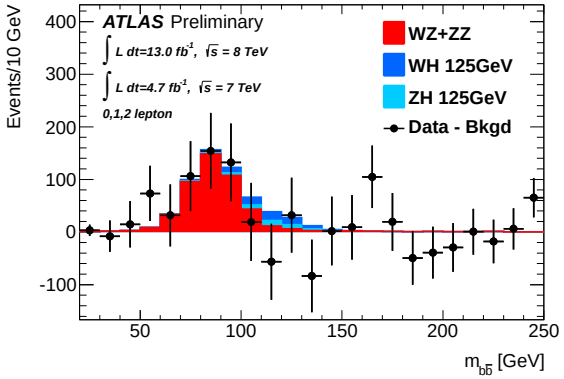


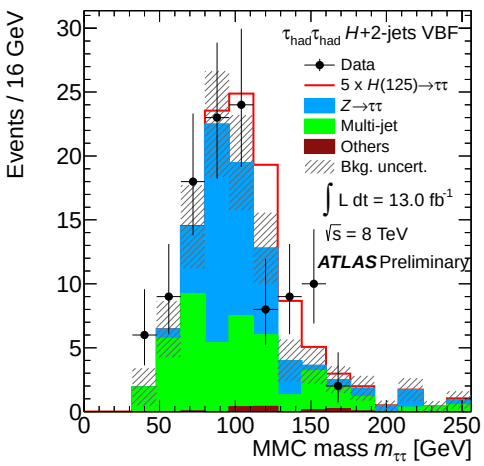
Higgs Boson

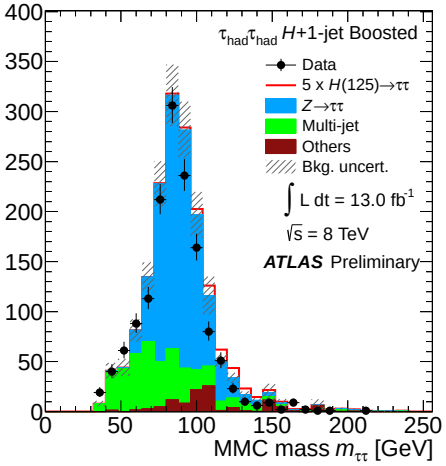

ATLAS
Data
Sig+Bkg Fit (m_H=126.5 GeV)
Bkg (4th order polynomial)
$\sqrt{s}$=7 TeV, $\int$Ldt=4.8fb^{-1}
$\sqrt{s}$=8 TeV, $\int$Ldt=5.9fb^{-1}
H→γγ
(a)
(b)
Data S/B Weighted
Sig+Bkg Fit (m_H=126.5 GeV)
Bkg (4th order polynomial)
(c)
(d)
Events / 2 GeV
Events - Bkg
Σ weights / 2 GeV
Σ weights - Bkg
$m_{\gamma\gamma}$ [GeV]

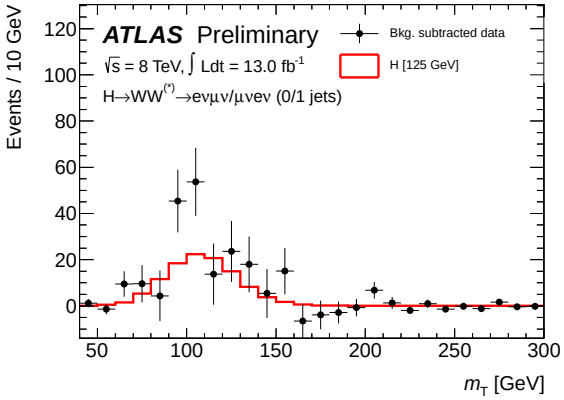

ATLAS Preliminary
m_H = 126 GeV
W,Z H → bb
$\sqrt{s}$ = 7 TeV: $\int$Ldt = 4.7 fb^{-1}
$\sqrt{s}$ = 8 TeV: $\int$Ldt = 13 fb^{-1}
H → ττ
$\sqrt{s}$ = 7 TeV: $\int$Ldt = 4.6 fb^{-1}
$\sqrt{s}$ = 8 TeV: $\int$Ldt = 13 fb^{-1}
H → WW$^{(*)}$ → lνlν
$\sqrt{s}$ = 8 TeV: $\int$Ldt = 13 fb^{-1}
H → γγ
$\sqrt{s}$ = 7 TeV: $\int$Ldt = 4.8 fb^{-1}
$\sqrt{s}$ = 8 TeV: $\int$Ldt = 5.9 fb^{-1}
H → ZZ$^{(*)}$ → 4l
$\sqrt{s}$ = 7 TeV: $\int$Ldt = 4.8 fb^{-1}
$\sqrt{s}$ = 8 TeV: $\int$Ldt = 5.8 fb^{-1}
Combined
μ = 1.3 ± 0.3
$\sqrt{s}$ = 7 TeV: $\int$Ldt = 4.6 - 4.8 fb^{-1}
$\sqrt{s}$ = 8 TeV: $\int$Ldt = 5.8 - 13 fb^{-1}
-1
0
+1
Signal strength (μ)


Data
Background ZZ$^{(*)}$
Background Z+jets, $t\bar{t}$
Signal (m_H=125 GeV)
Syst.Unc.
ATLAS
H→ZZ$^{(*)}$→4l
$\sqrt{s}$ = 7 TeV: $\int$Ldt = 4.8 fb^{-1}
$\sqrt{s}$ = 8 TeV: $\int$Ldt = 5.8 fb^{-1}
Events/5 GeV
m_{4l} [GeV]

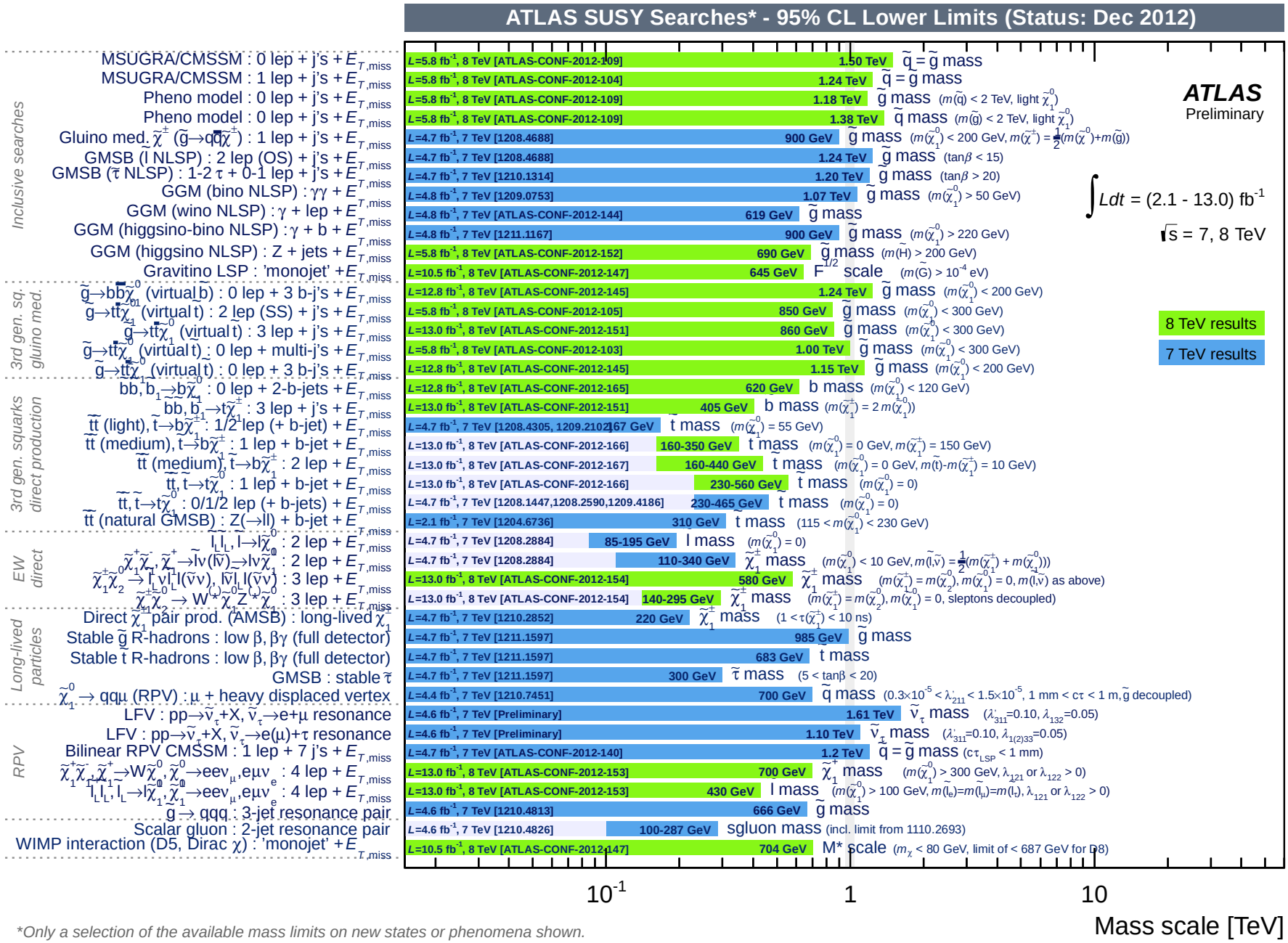

ATLAS Preliminary
$\int$ L dt=13.0 fb^{-1}, $\sqrt{s}$ = 8 TeV
$\int$ L dt=4.7 fb^{-1}, $\sqrt{s}$ = 7 TeV
0,1,2 lepton
WZ+ZZ
WH 125GeV
ZH 125GeV
Data - Bkgd
Events/10 GeV
$m_{b\bar{b}}$ [GeV]


$\tau_{had}\tau_{had}$ H+2-jets VBF
Data
5 x H(125)→ττ
Z→ττ
Multi-jet
Others
Bkg. uncert.
$\int$ L dt = 13.0 fb^{-1}
$\sqrt{s}$ = 8 TeV
ATLAS Preliminary
Events / 16 GeV
MMC mass $m_{\tau\tau}$ [GeV]


$\tau_{had}\tau_{had}$ H+1-jet Boosted
Data
5 x H(125)→ττ
Z→ττ
Multi-jet
Others
Bkg. uncert.
$\int$ L dt = 13.0 fb^{-1}
$\sqrt{s}$ = 8 TeV
ATLAS Preliminary
MMC mass $m_{\tau\tau}$ [GeV]


ATLAS Preliminary
$\sqrt{s}$ = 8 TeV, $\int$ Ldt = 13.0 fb^{-1}
H→WW$^{(*)}$→eνμν/μνeν (0/1 jets)
Bkg. subtracted data
H [125 GeV]
Events / 10 GeV
m_T [GeV]

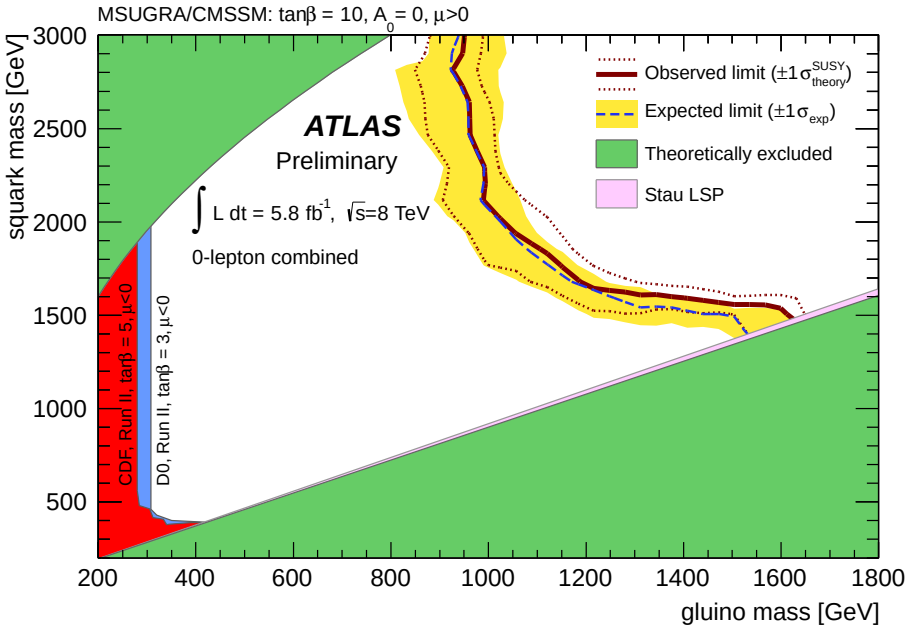
SUSY Searches



*Only a selection of the available mass limits on new states or phenomena shown.
All limits quoted are observed minus 1σ theoretical signal cross section uncertainty.

Desperately Seeking SUSY

- ***No sign of SUSY!***
  - many limits at $\gtrsim$ 1 TeV
  - no light squarks or gluinos
- ***Allowed phase space strongly squeezed***
  - MSUGRA & CMSSM under pressure



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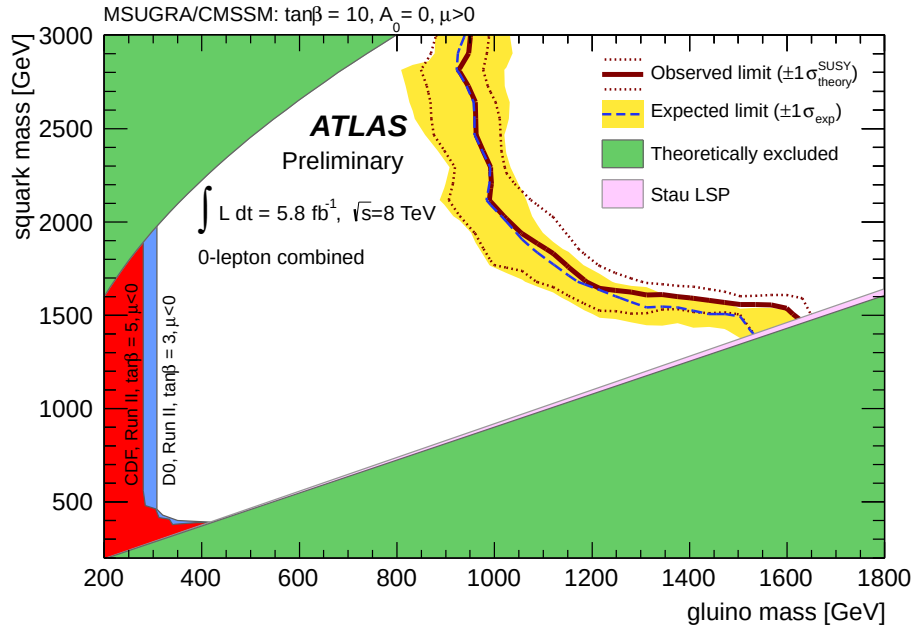
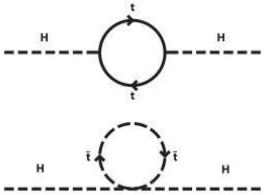
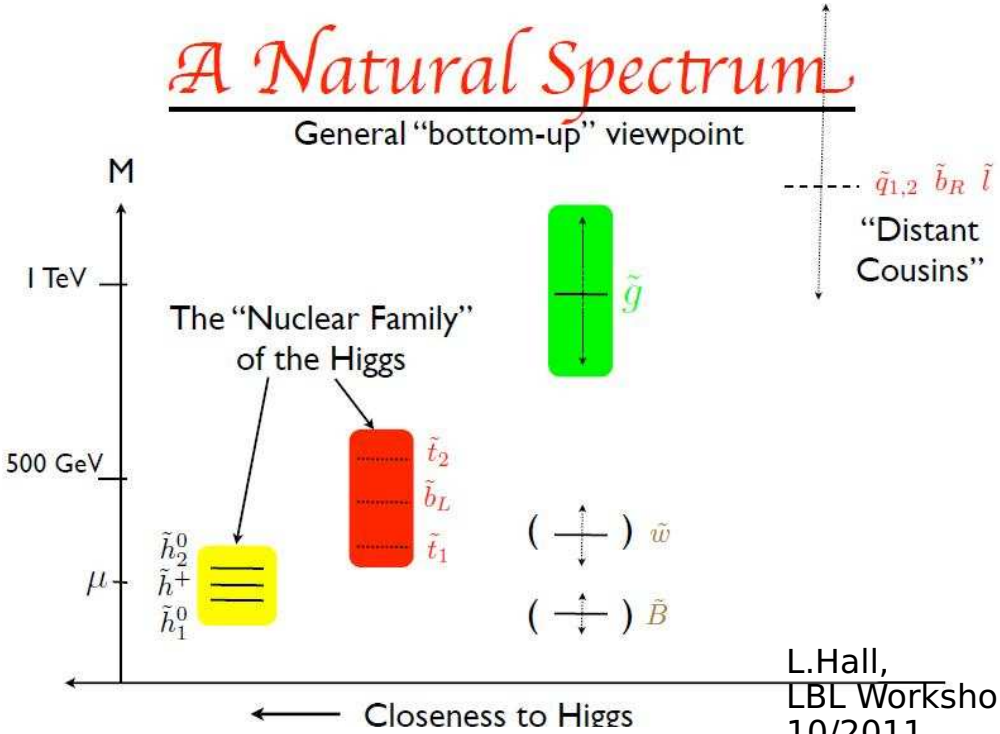


- ***However, only the stop and gauginos need to be light!***
  - *Natural* SUSY
  - Higgs boson mass regularized by stop
  - For MSSM: large mixing in stop sector or heavy squarks

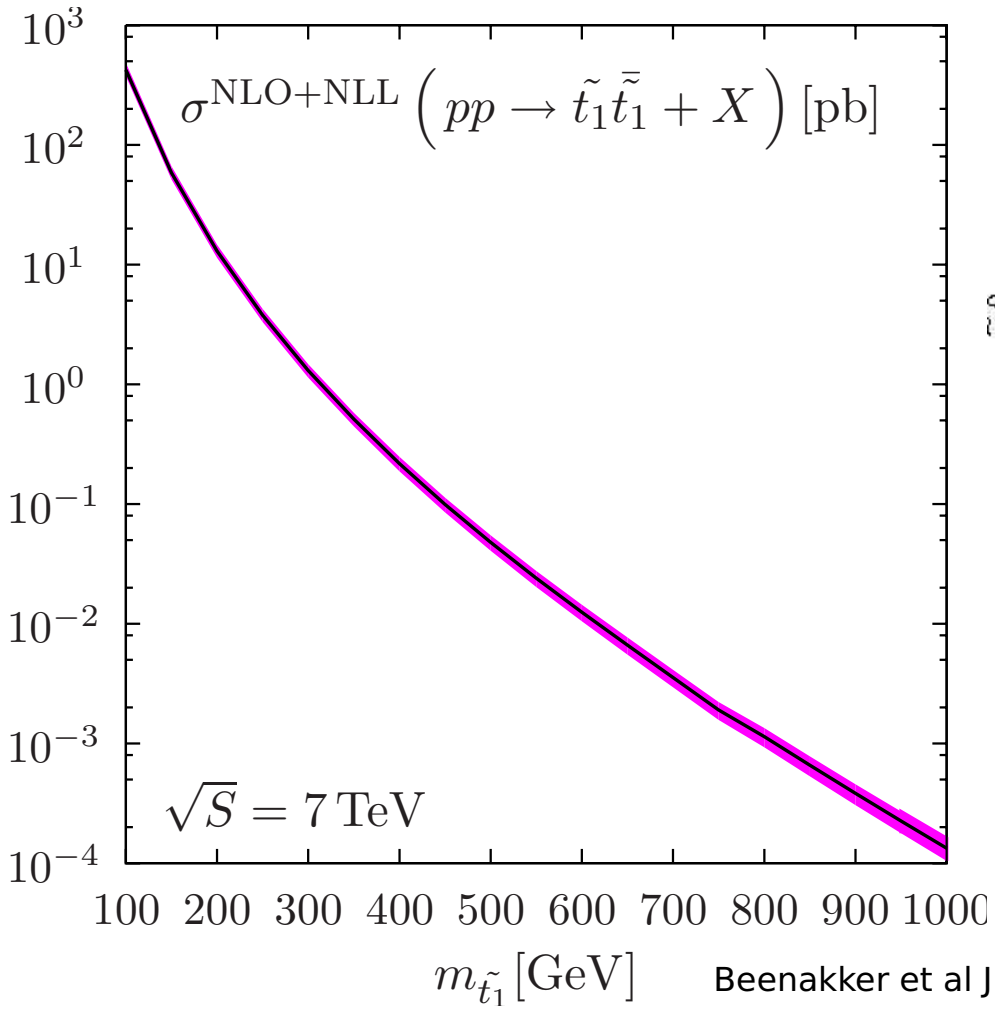




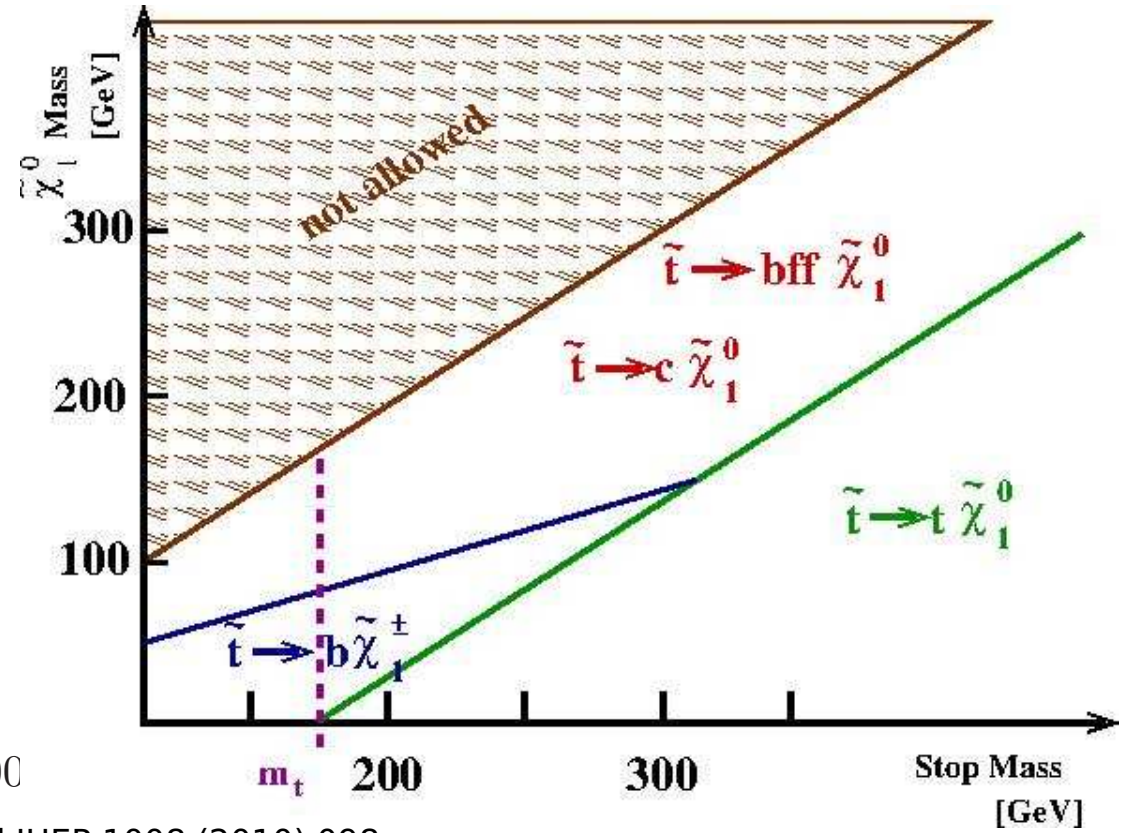
L.Hall, LBL Workshop 10/2011

Stop Production and Decay

- ***Stop pair production cross section is strong function of stop mass***
  - little dependence on other SUSY parameters



- ***Primary stop decay channel depends on $m_{\tilde{t}_1}$ vs m_t (and $m_{\tilde{\chi}_1^0}$ & $m_{\tilde{\chi}_1^\pm}$)***
  - $\tilde{t}_1 \to t\tilde{\chi}_1^0$
  - $\tilde{t}_1 \to b\tilde{\chi}_1^\pm$



Beenakker et al JHEP 1008 (2010) 098

Recent Stop Results

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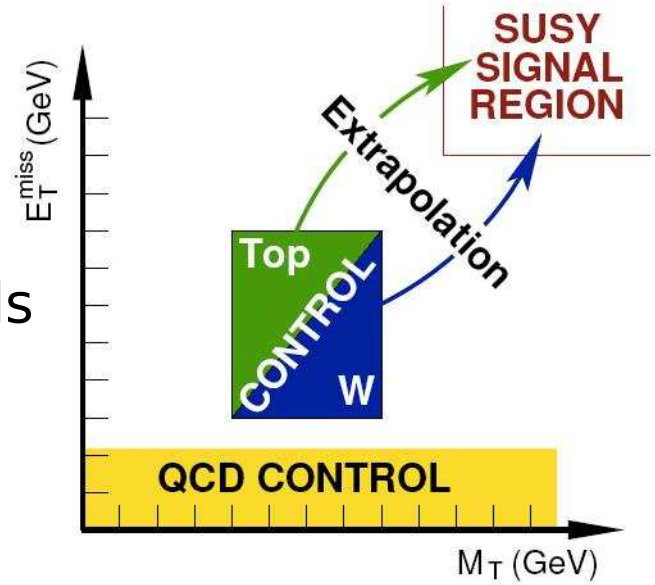
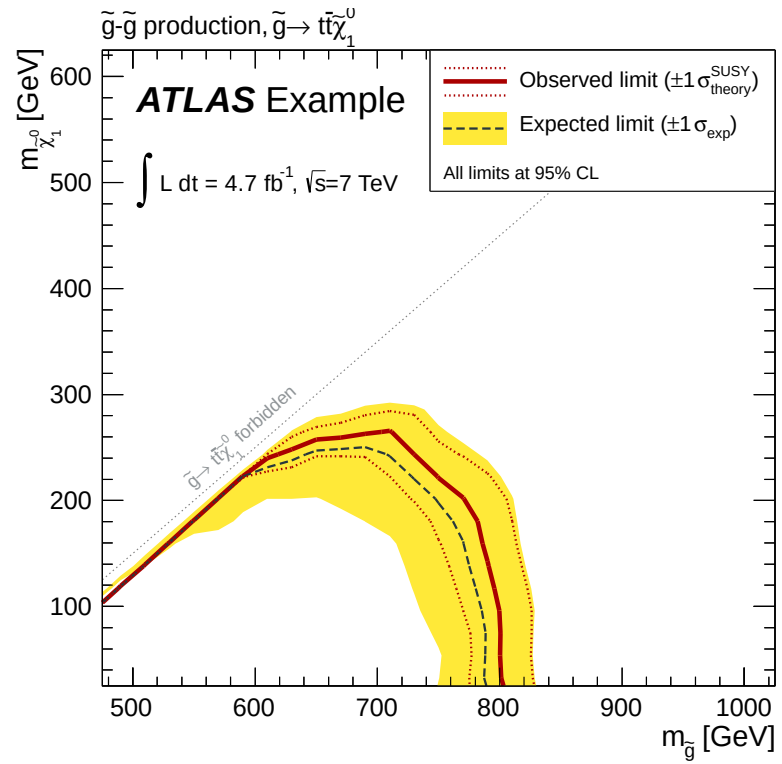
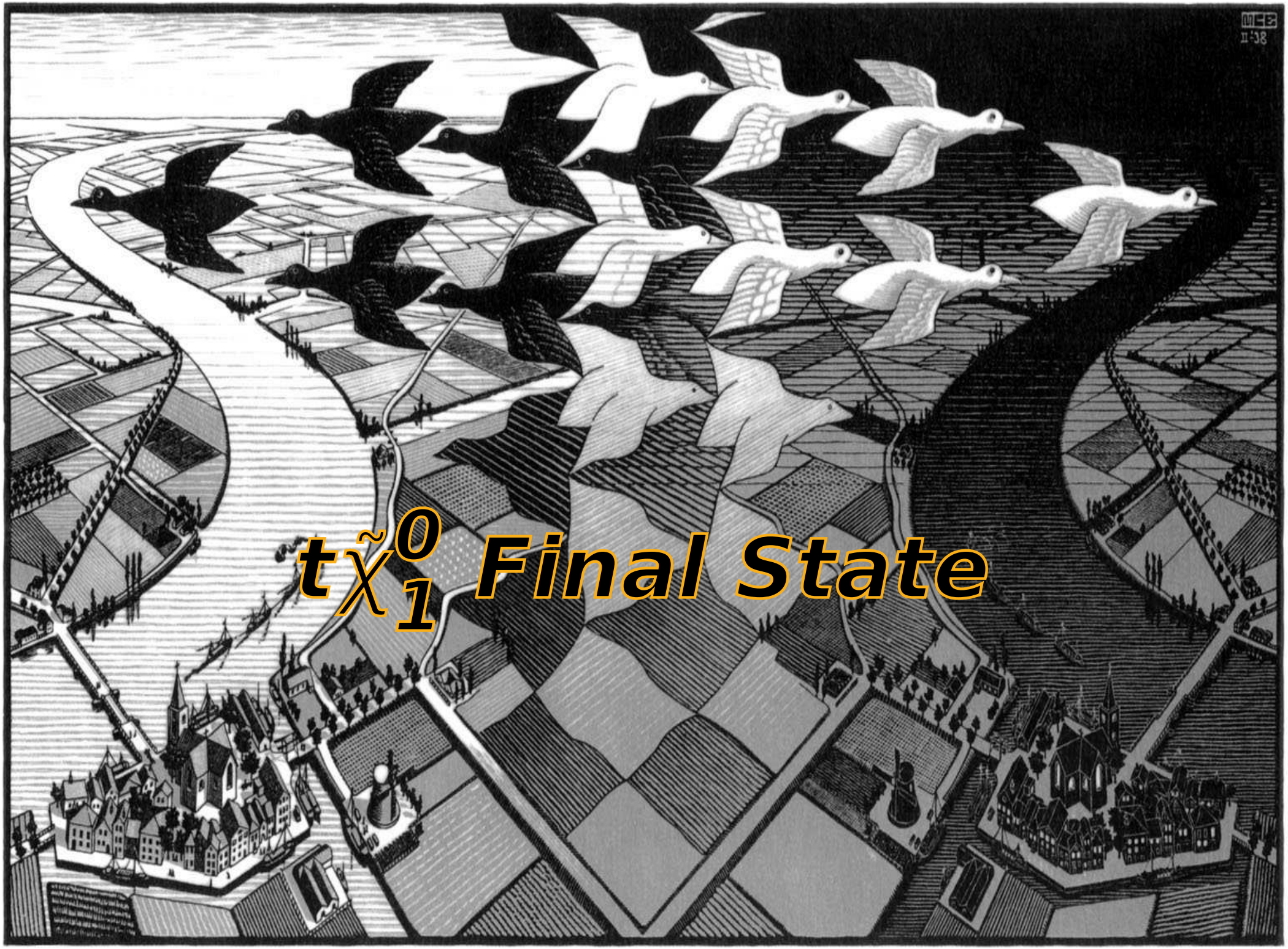
Search for a supersymmetric partner to the top quark in final states with jets and missing transverse momentum at $\sqrt{s} = 7$ TeV with the ATLAS detector	PRL 109,211802 (2012)	Jul 2012	$\tilde{t}_1 \to t\tilde{\chi}_1^0$
Search for direct top squark pair production in final states with one isolated lepton, jets, and missing transverse momentum in $\sqrt{s} = 7$ TeV pp collisions using 4.7 fb^{-1} of ATLAS data	PRL 109,211803 (2012)	Jul 2012	$\tilde{t}_1 \to t\tilde{\chi}_1^0$
Search for a heavy top-quark partner in final states with two leptons with the ATLAS detector at the LHC	JHEP11(2012)094	Jul 2012	$\tilde{t}_1 \to t\tilde{\chi}_1^0$
Search for light scalar top quark pair production in final states with two leptons with the ATLAS detector in $\sqrt{s} = 7$ TeV proton-proton collisions	EPJC(2012)72:2237	Jul 2012	$\tilde{t}_1 \to b\tilde{\chi}_1^\pm$
Search for light top squark pair production in final states with leptons and b-jets with the ATLAS detector in $\sqrt{s} = 7$ TeV proton-proton collisions	hep-ex/1209.2102	Jul 2012	$\tilde{t}_1 \to b\tilde{\chi}_1^\pm$
Search for new phenomena using large jet multiplicities and missing transverse momentum with ATLAS in 5.8 fb^1 of $\sqrt{s} = 8$ TeV proton-proton collisions	ATLAS-CONF-2012-103	Aug 2012	$\tilde{g} \to \tilde{t}_1^{(\star)} t$
Search for Supersymmetry in final states with two same-sign leptons, jets and missing transverse momentum with the ATLAS detector in pp collisions at $\sqrt{s} = 8$ TeV	ATLAS-CONF-2012-105	Aug 2012	$\tilde{g} \to \tilde{t}_1^{(\star)} t$
Search for gluino pair production in final states with missing transverse momentum and at least three b-jets using 12.8 fb^1 of pp collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector	ATLAS-CONF-2012-145	Nov 2012	$\tilde{g} \to \tilde{t}_1^{(\star)} t$
Search for supersymmetry using events with three leptons, multiple jets, and missing transverse momentum in 13.0 fb^1 of pp collisions with the ATLAS detector at $\sqrt{s} = 8$ TeV	ATLAS-CONF-2012-151	Nov 2012	$\tilde{g} \to \tilde{t}_1^{(\star)} t$
Search for direct top squark pair production in final states with one isolated lepton, jets, and missing transverse momentum in $\sqrt{s} = 8$ TeV pp collisions using 13 fb^{-1} of ATLAS data	ATLAS-CONF-2012-166	Dec 2012	$\tilde{t}_1 \to t\tilde{\chi}_1^0$ $\tilde{t}_1 \to b\tilde{\chi}_1^\pm$
Search for the charged current decay of a supersymmetric top-quark partner in final states with two leptons in $\sqrt{s} = 8$ TeV pp collisions using 13 fb^{-1} of ATLAS data	ATLAS-CONF-2012-167	Dec 2012	$\tilde{t}_1 \to b\tilde{\chi}_1^\pm$

Generic Analysis Strategy

- ***"Cut & Count" methodology***
- ***Main background: $t\bar{t}$ production***
  - reject $t\bar{t}$ using event kinematics
  - use *b*-tagging to suppress other backgrounds
- ***Define Signal & Control regions***
  - control regions to normalize SM backgrounds to data
- ***Dominant uncertainties:***
  - jet energy scale & resolution
  - *b*-tagging
  - theory and simulation
- ***Interpret results using Simplified Models***
  - 95% CL_S limits in mass plane
  - publish values for external use (HEPData)



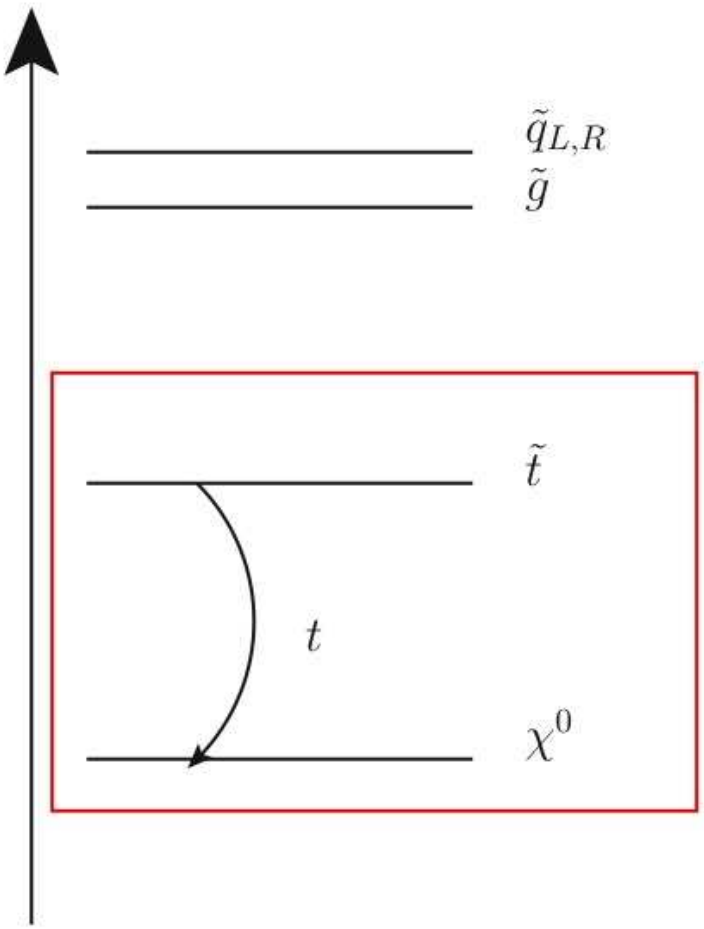


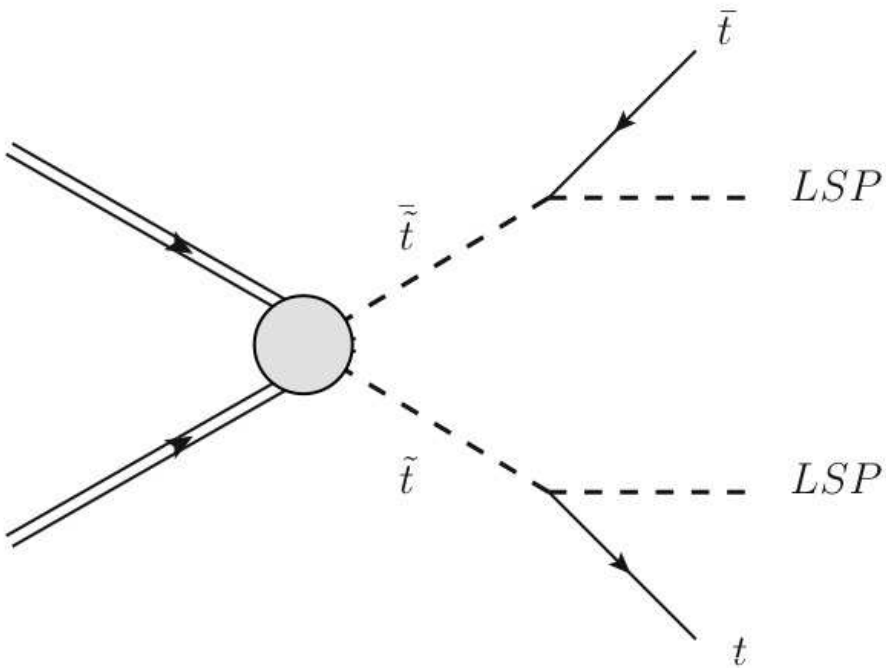


$t\tilde{\chi}_1^0$ Final State

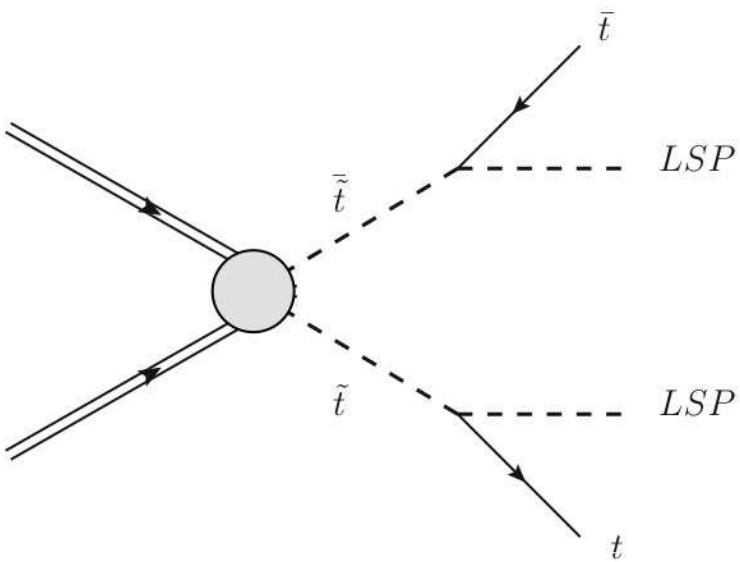
$t\tilde{\chi}_1^0$ Final State

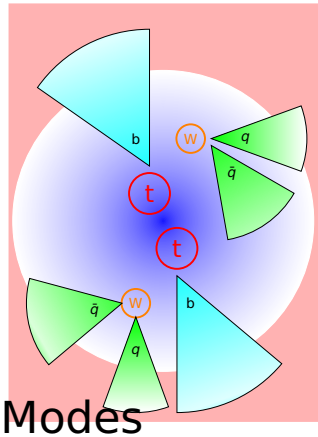
- ***Consider $m_{\tilde{t}_1} > m_t + m_{\tilde{\chi}_1^0}$ so that $\tilde{t}_1 \rightarrow t + \tilde{\chi}_1^0$ is an available decay channel***
  - assume other squarks and gluino are much heavier
  - stop is essentially decoupled from the rest of SUSY





$t\tilde{\chi}_1^0$ Final State

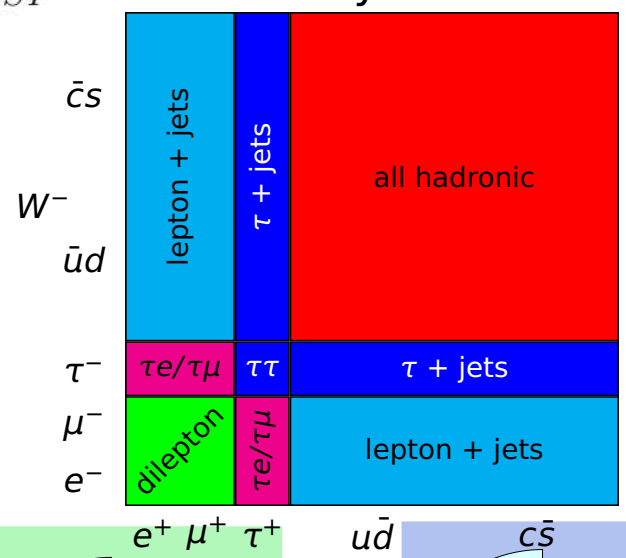




0-lepton

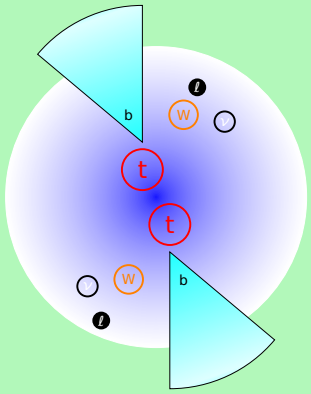
no leptons
$\geq$ 6 jets with $p_T > 30$ GeV
leading jet $p_T > 130$ GeV
$\geq$ 1 b-tagged jets
$E_T^{miss} > 150$ GeV

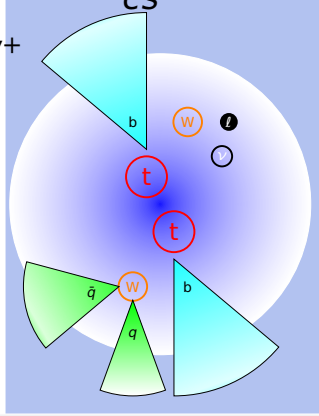
$t\bar{t}$ Decay Modes



2-lepton

two leptons (e or μ)
with $p_T > 20 - 25$ GeV
$\geq$ 2 jets with $p_T > 25$ GeV
leading jet with $p_T > 50$ GeV
$\geq$ 1 b-tagged jets
$m_{T2} > 120$ GeV



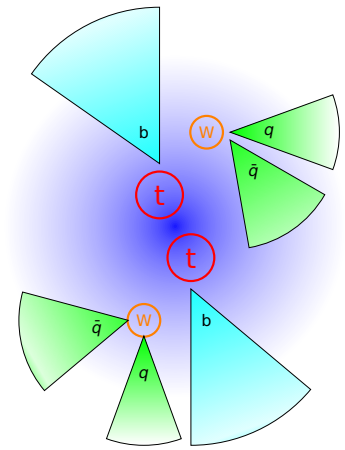


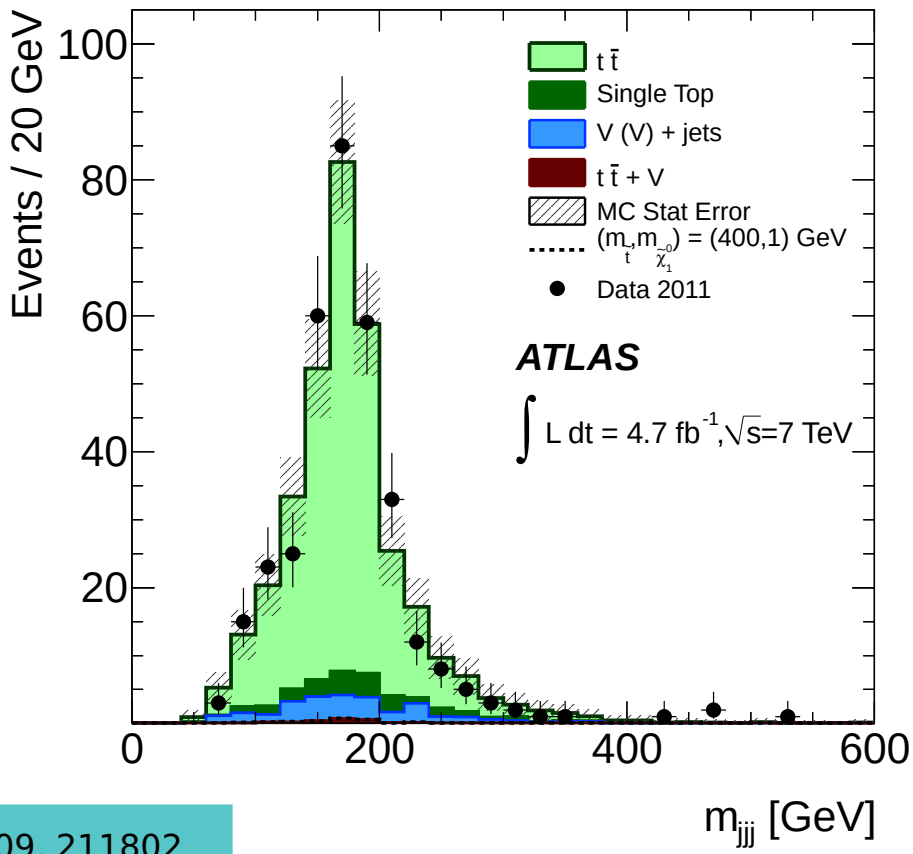
1-lepton

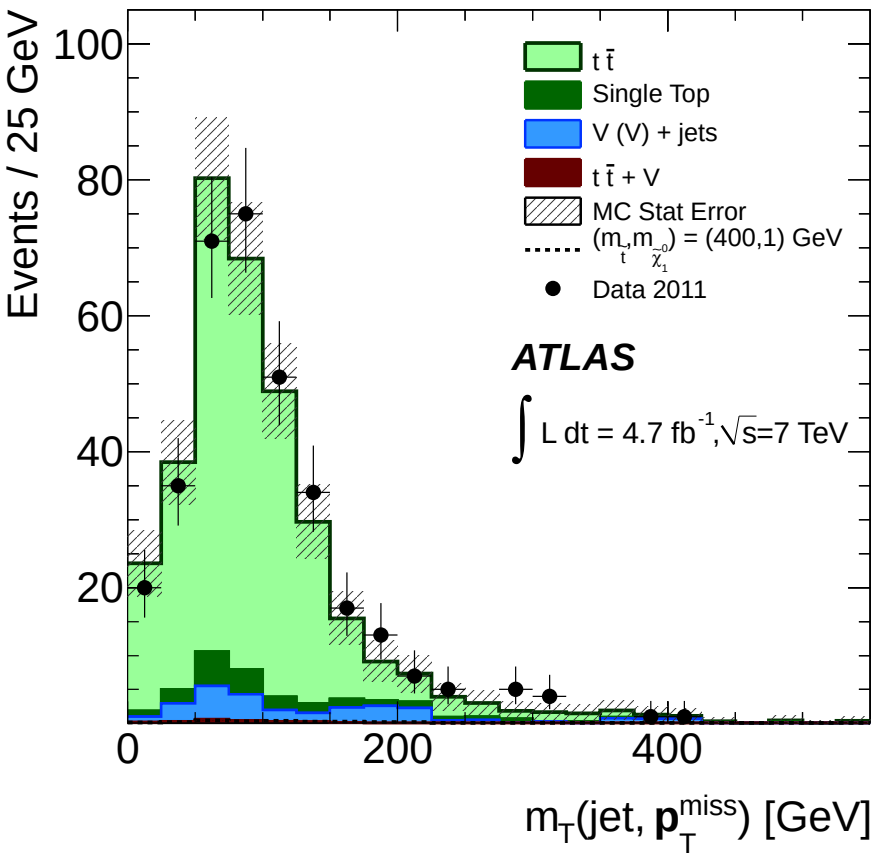
e or μ with $p_T > 25$ GeV
$\geq$ 4 jets with $p_T > 80, 60, 40, 25$ GeV
$\geq$ 1 b-tagged jets
$E_T^{miss} > 150$ GeV
$E_T^{miss}/\sqrt{H_T} > 8$ GeV$^{1/2}$

0-Lepton Search

- ***$t\bar{t} \rightarrow \tau$+jets background dominant***
  - require two reconstructed top quark mass peaks
  - use m_T between b-tagged jet and E_T^{miss}
  - ℓ+jets control region: convert ℓ to tau

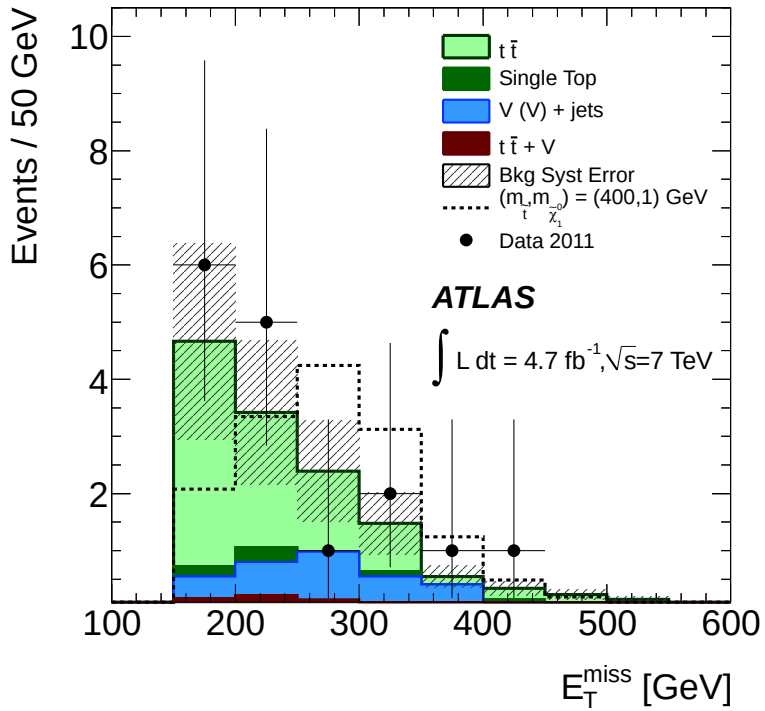


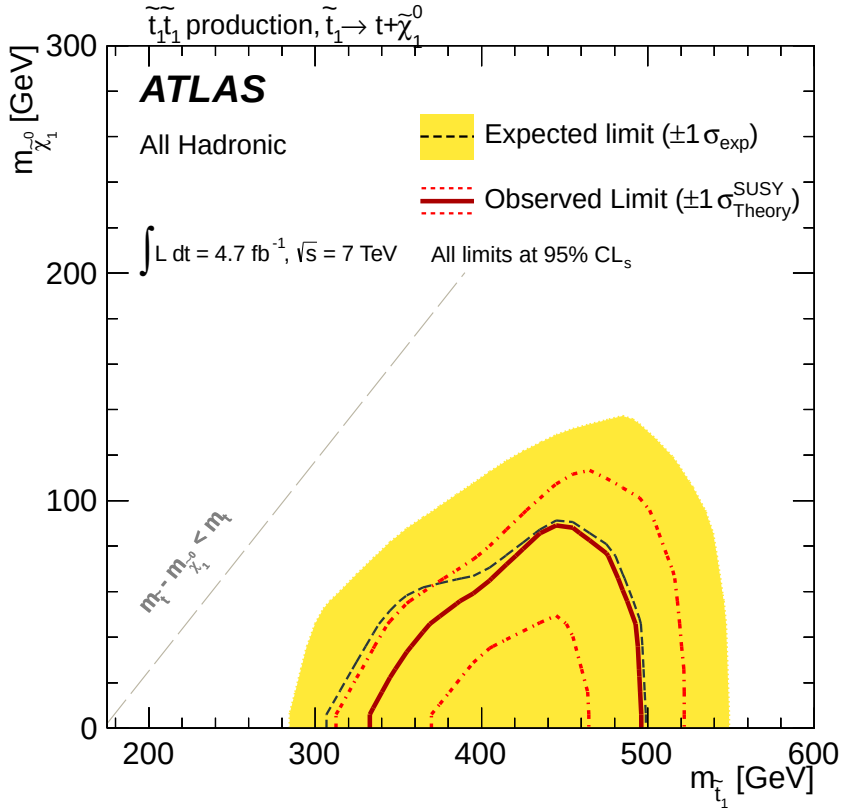


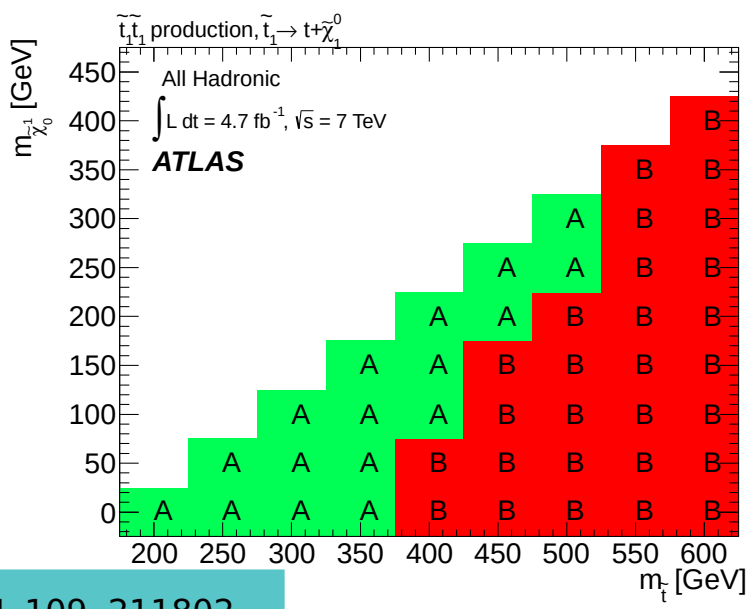


PRL 109, 211802

0-Lepton Search





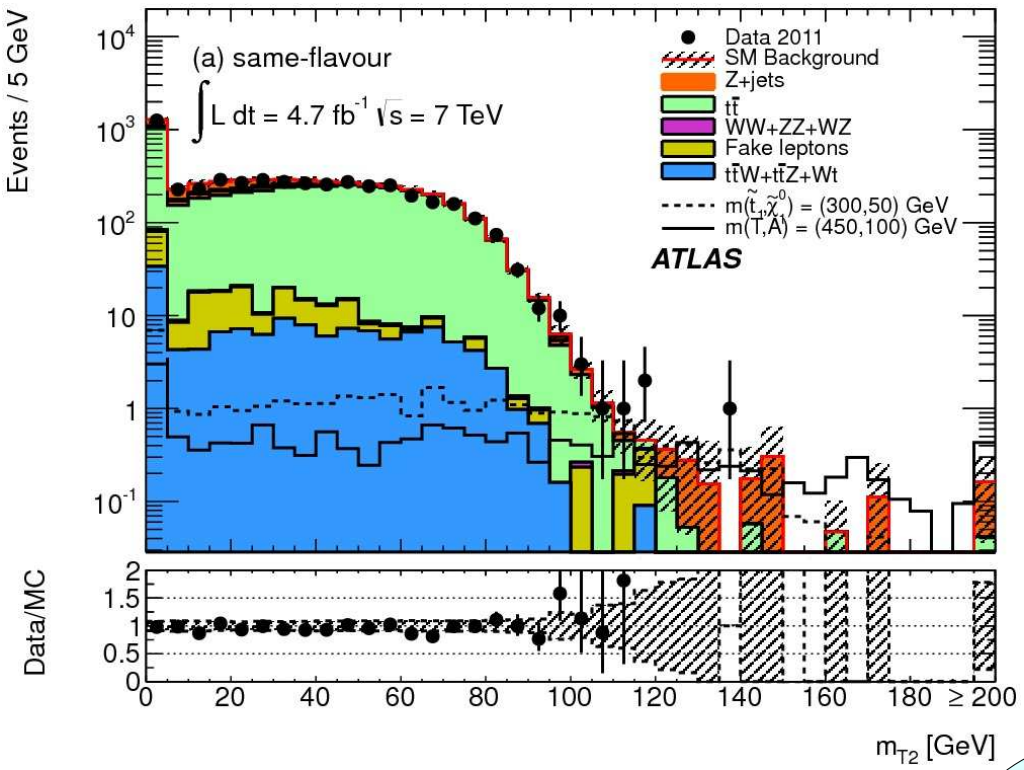


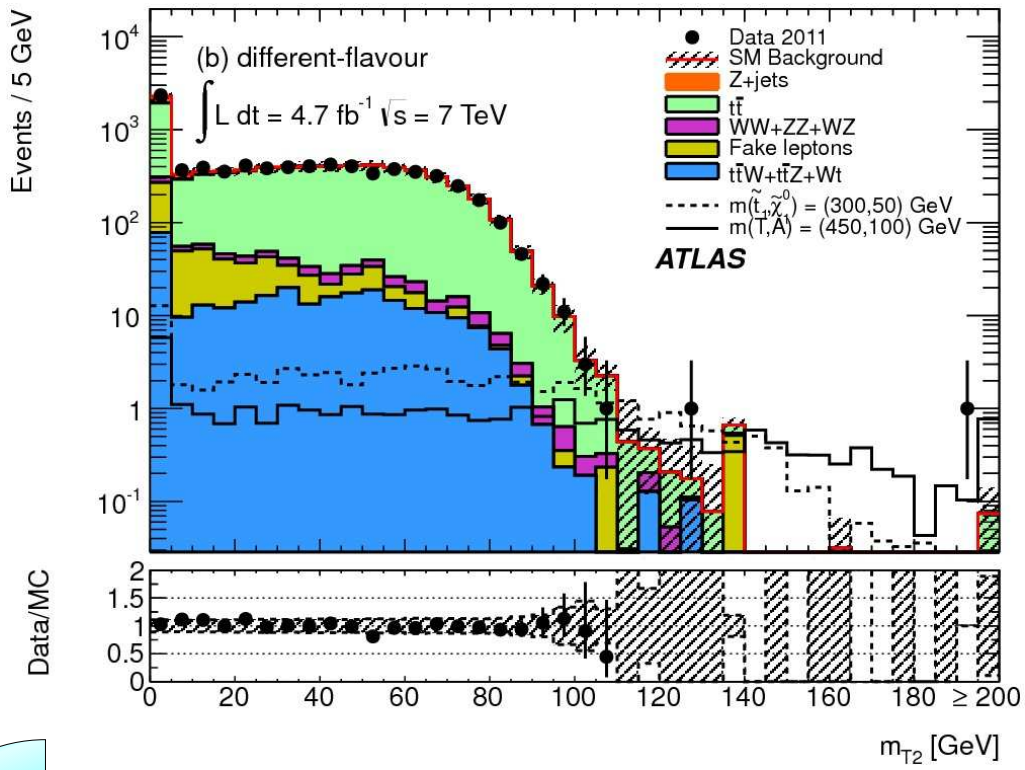
	SRA $E_T^{miss} > 150$ GeV	SRB >260 GeV
$t\bar{t}$	9.2 ± 2.7	2.3 ± 0.6
$t\bar{t} + W/Z$	0.8 ± 0.2	0.4 ± 0.1
Single top	0.7 ± 0.4	$0.2^{+0.3}_{-0.2}$
Z + jets	$1.3^{+1.1}_{-1.0}$	$0.9^{+0.8}_{-0.7}$
W + jets	$1.2^{+1.4}_{-1.0}$	0.5 ± 0.4
Diboson	$0.1^{+0.2}_{-0.1}$	$0.1^{+0.2}_{-0.1}$
Multijets	0.2 ± 0.2	0.02 ± 0.02
Total SM	$13.5^{+3.7}_{-3.6}$	$4.4^{+1.7}_{-1.3}$
SUSY $(m_{\tilde{t}_1}, m_{\tilde{\chi}_1^0}) = (400, 1)$ GeV	14.8 ± 4.0	8.9 ± 3.1
Data (observed)	16	4
Visible cross section limit [fb]	2.9 (2.5)	1.3 (1.3)

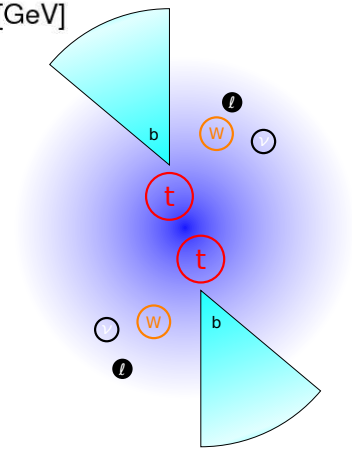
PRL 109, 211802

2-lepton Search

$$m_{T2}(\boldsymbol{p}_T^{\ell_1}, \boldsymbol{p}_T^{\ell_2}, \boldsymbol{p}_T^{\text{miss}}) = \min_{\boldsymbol{q}_T + \boldsymbol{r}_T = \boldsymbol{p}_T^{\text{miss}}} \left\{ \max \left[m_T(\boldsymbol{p}_T^{\ell_1}, \boldsymbol{q}_T), m_T(\boldsymbol{p}_T^{\ell_2}, \boldsymbol{r}_T) \right] \right\}$$

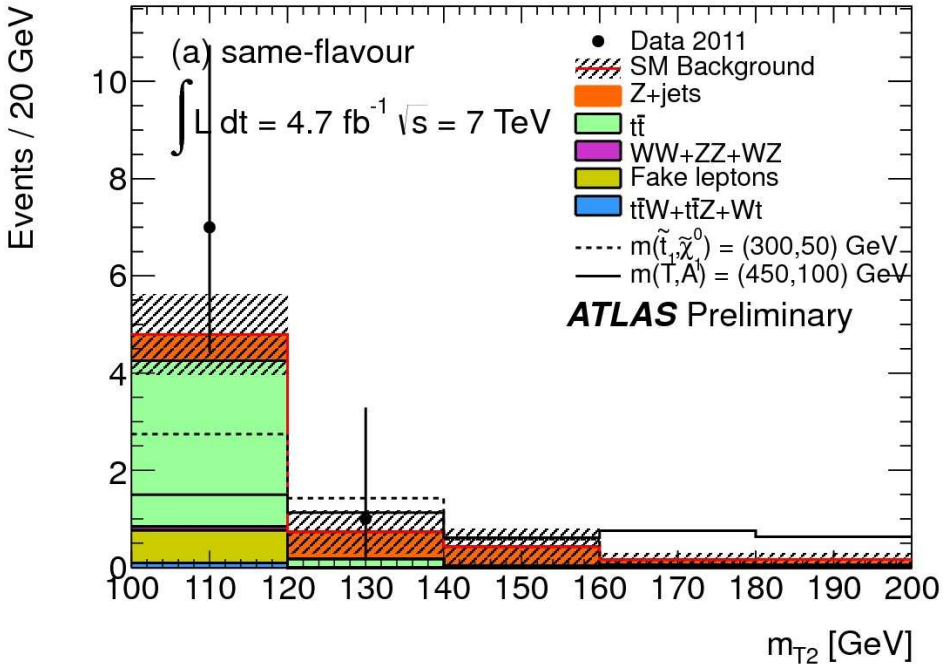


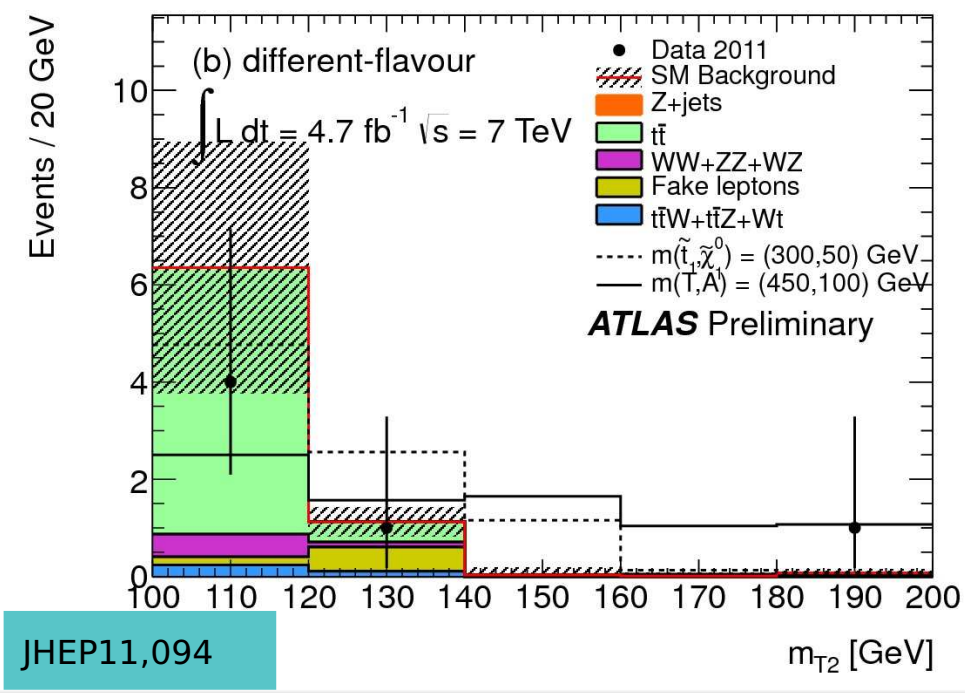




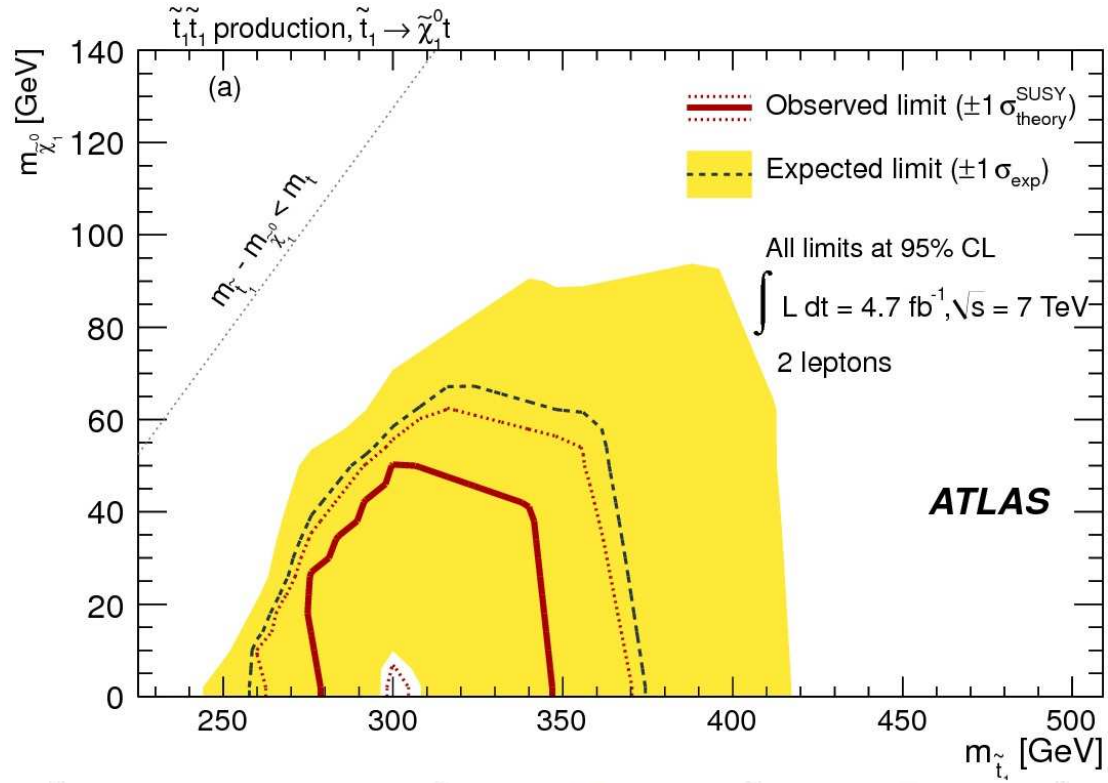
JHEP11,094

2-lepton Search



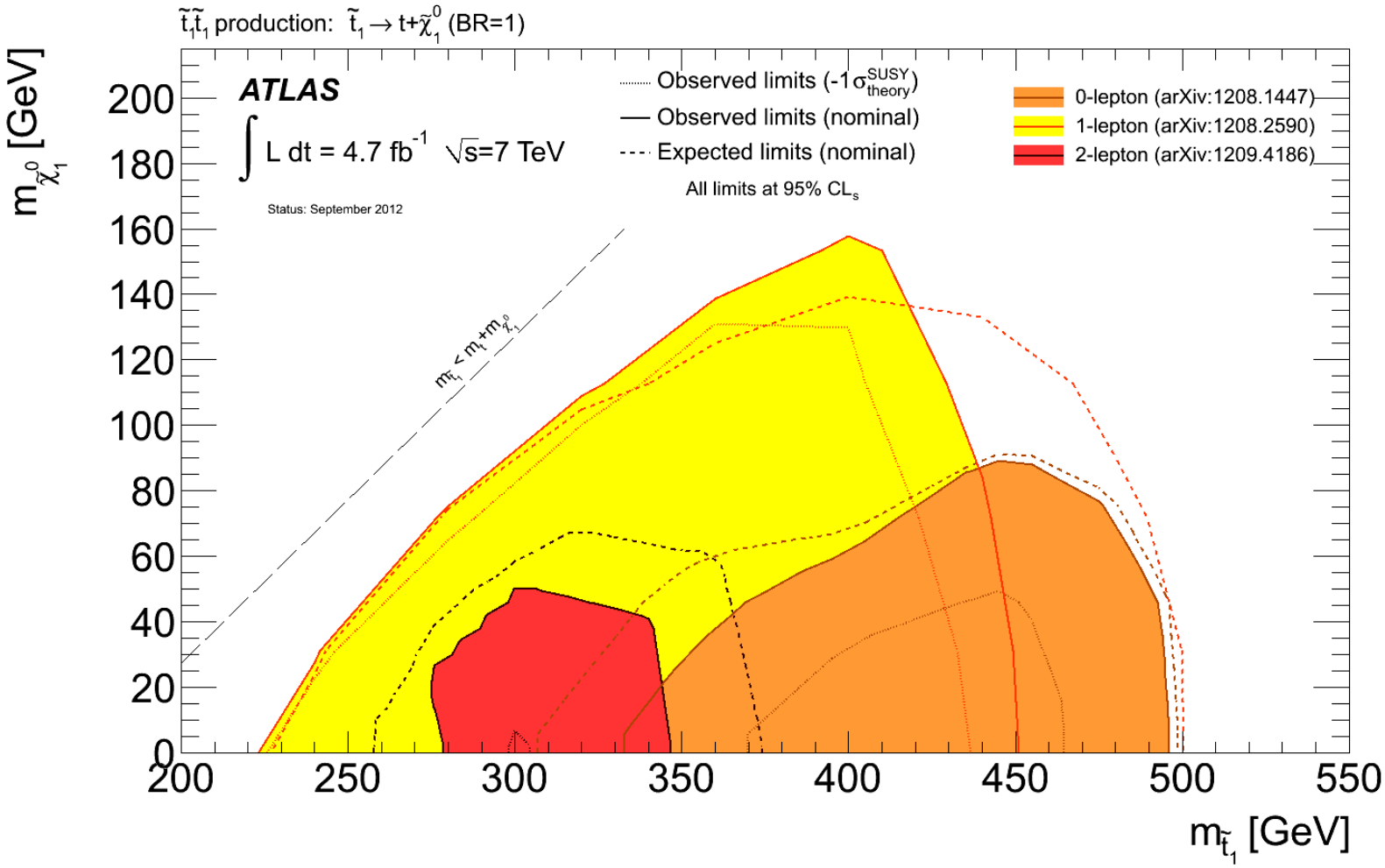


JHEP11,094

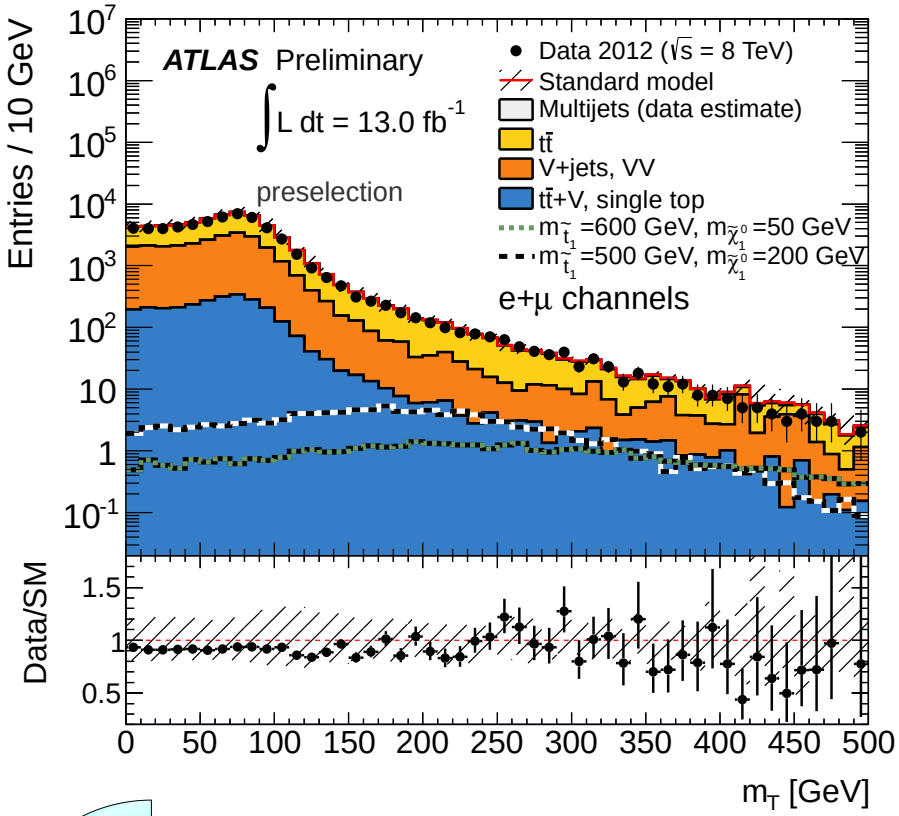


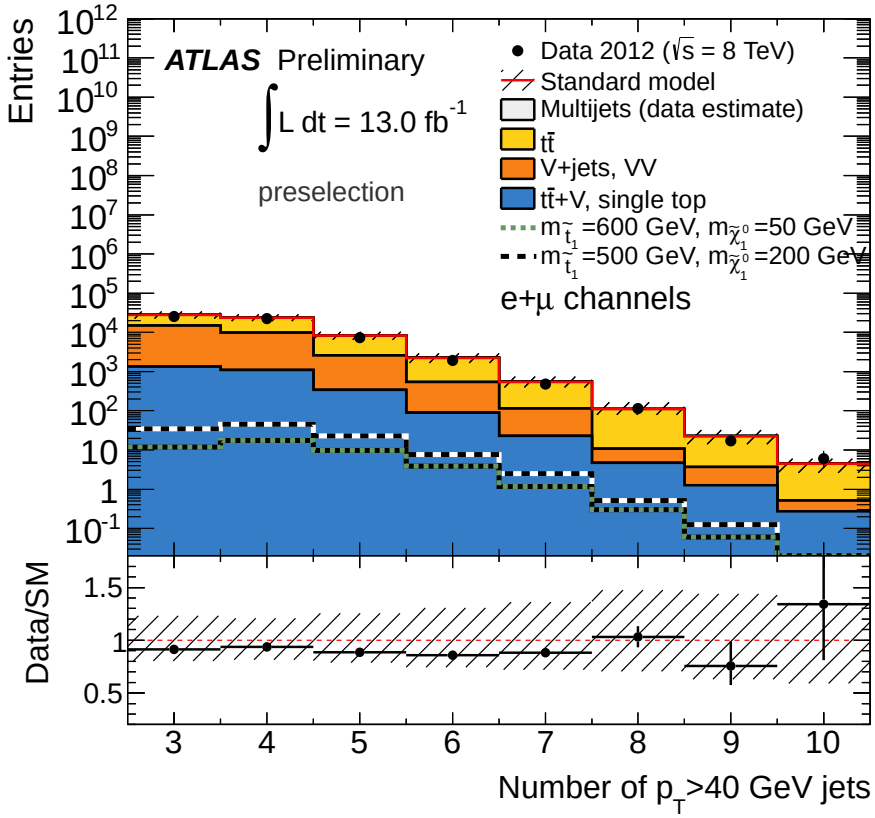
	SF	DF
Z/γ^*+jets	1.2 ± 0.5	-
(Z/γ^*+jets scale factor)	(1.27)	-
$t\bar{t}$	0.23 ± 0.23	0.4 ± 0.3
($t\bar{t}$ scale factor)	(1.21)	(1.10)
$t\bar{t}W + t\bar{t}Z$	0.11 ± 0.07	0.19 ± 0.12
WW	$0.01^{+0.02}_{-0.01}$	0.19 ± 0.18
$WZ + ZZ$	0.05 ± 0.05	0.03 ± 0.03
Wt	$0.00^{+0.17}_{-0.00}$	$0.10^{+0.18}_{-0.10}$
Fake leptons	$0.00^{+0.14}_{-0.00}$	$0.00^{+0.09}_{-0.00}$
Total SM	1.6 ± 0.6	0.9 ± 0.6
Observed	1	2
$m_{\tilde{t}_1} = 300$ GeV, $m_{\tilde{\chi}_1^0} = 50$ GeV	$2.2 \pm 0.3(\text{th.}) \pm 0.2(\text{exp.})$	$3.7 \pm 0.6(\text{th.}) \pm 0.3(\text{exp.})$
$m_T = 450$ GeV, $m_{A_0} = 100$ GeV	$3.1 \pm 0.4(\text{th.}) \pm 0.3(\text{exp.})$	$5.8 \pm 0.7(\text{th.}) \pm 0.5(\text{exp.})$
95% CL limit on σ^{obs}_{vis}[fb]	0.86	1.08
95% CL limit on σ^{exp}_{vis}[fb]	0.89	0.79

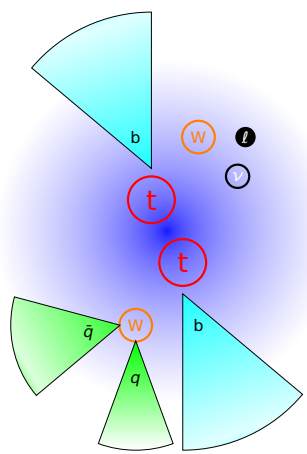
$t\tilde{\chi}_1^0$ Final State (September)



1-lepton Search







Requirement	SRD	SRE	SRtN1	SRtN2	SRtN3
$\Delta\phi(j_1, \vec{p}_T^{miss}) >$	0.8	0.8	0.8	-	0.8
$\Delta\phi(j_2, \vec{p}_T^{miss}) >$	0.8	0.8	0.8	0.8	0.8
E_T^{miss} [GeV] >	225	275	150	200	225
$E_T^{miss}/\sqrt{H_T}$ [GeV$^{1/2}$] >	11	11	8	13	11
m_T [GeV] >	130	140	140	140	180
m_T [GeV] <	-	-	250	-	-
am_{T2} [GeV] >	-	-	-	170	200
m_{T2}^{τ} [GeV] >	-	-	-	-	120
$N^{iso-trk} = 0$	-	-	-	-	-
$A \times \varepsilon$ benchmark point	-	-	0.06%	0.9%	2.8%

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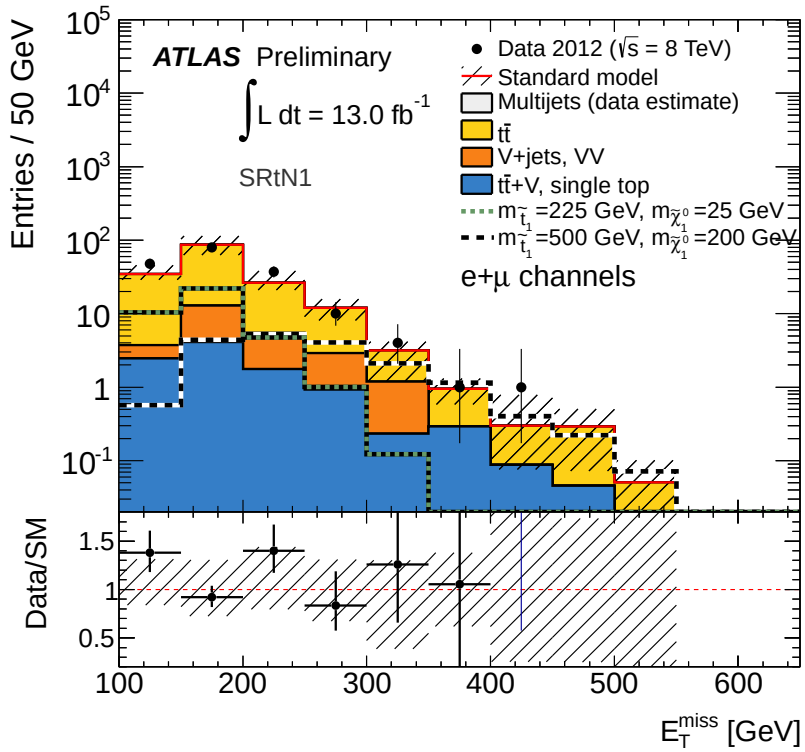
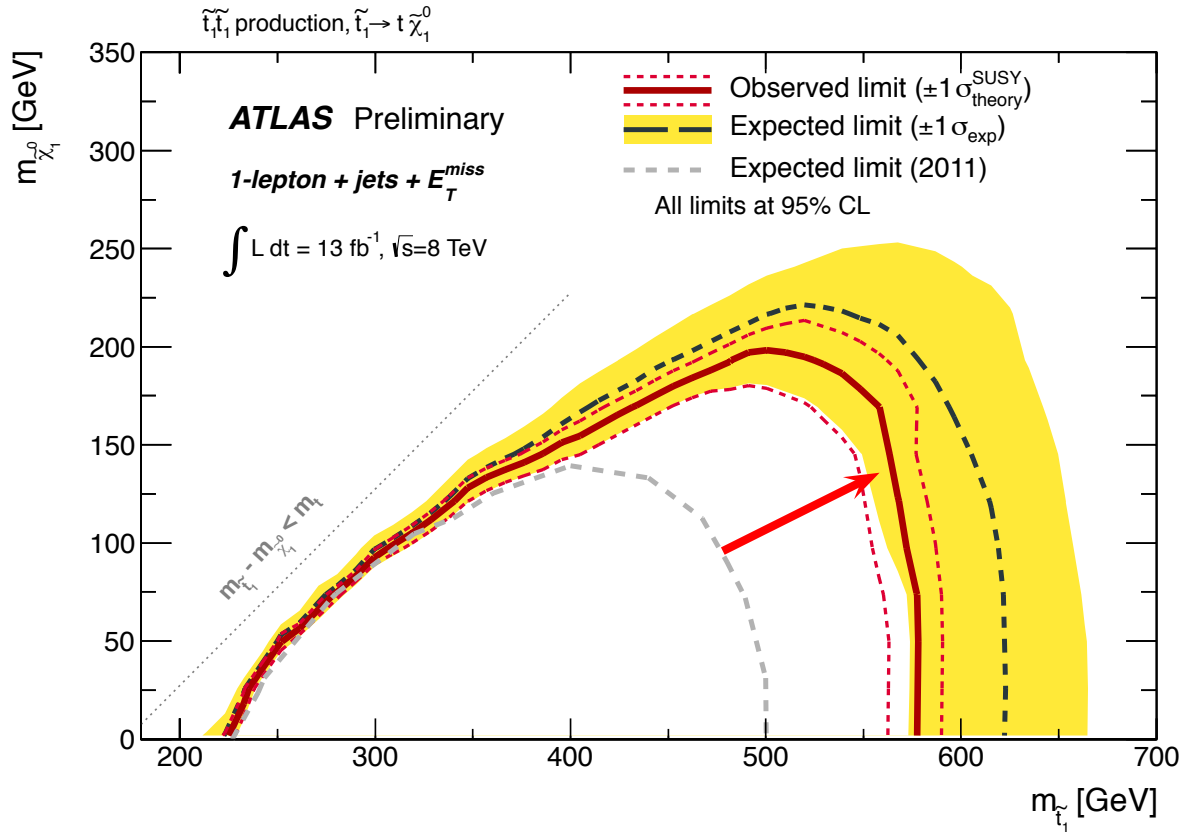
1-lepton Search





Regions	SRtN1	WCR-SRtN1	TCR-SRtN1
$t\bar{t}$	104 ± 17	291 ± 89	1357 ± 68
$t\bar{t} + V$	4.6 ± 1.7	1.7 ± 0.7	8.1 ± 2.7
W+jets	11 ± 3	553 ± 75	175 ± 41
Single top	2.9 ± 1.4	21 ± 10	89 ± 22
Z+jets, VV, multijet	1.9 ± 1.5	31 ± 21	32 ± 21
Total background	125 ± 17	897 ± 41	1661 ± 43
Signal benchmark $m(\tilde{t}_1, \tilde{\chi}_1^0) = (250, 50)$	46.2		
Signal benchmark $m(\tilde{t}_1, \tilde{\chi}_1^0) = (500, 200)$	17.7		
Signal benchmark $m(\tilde{t}_1, \tilde{\chi}_1^0) = (650, 1)$	2.9		
Observed events	133	897	1661

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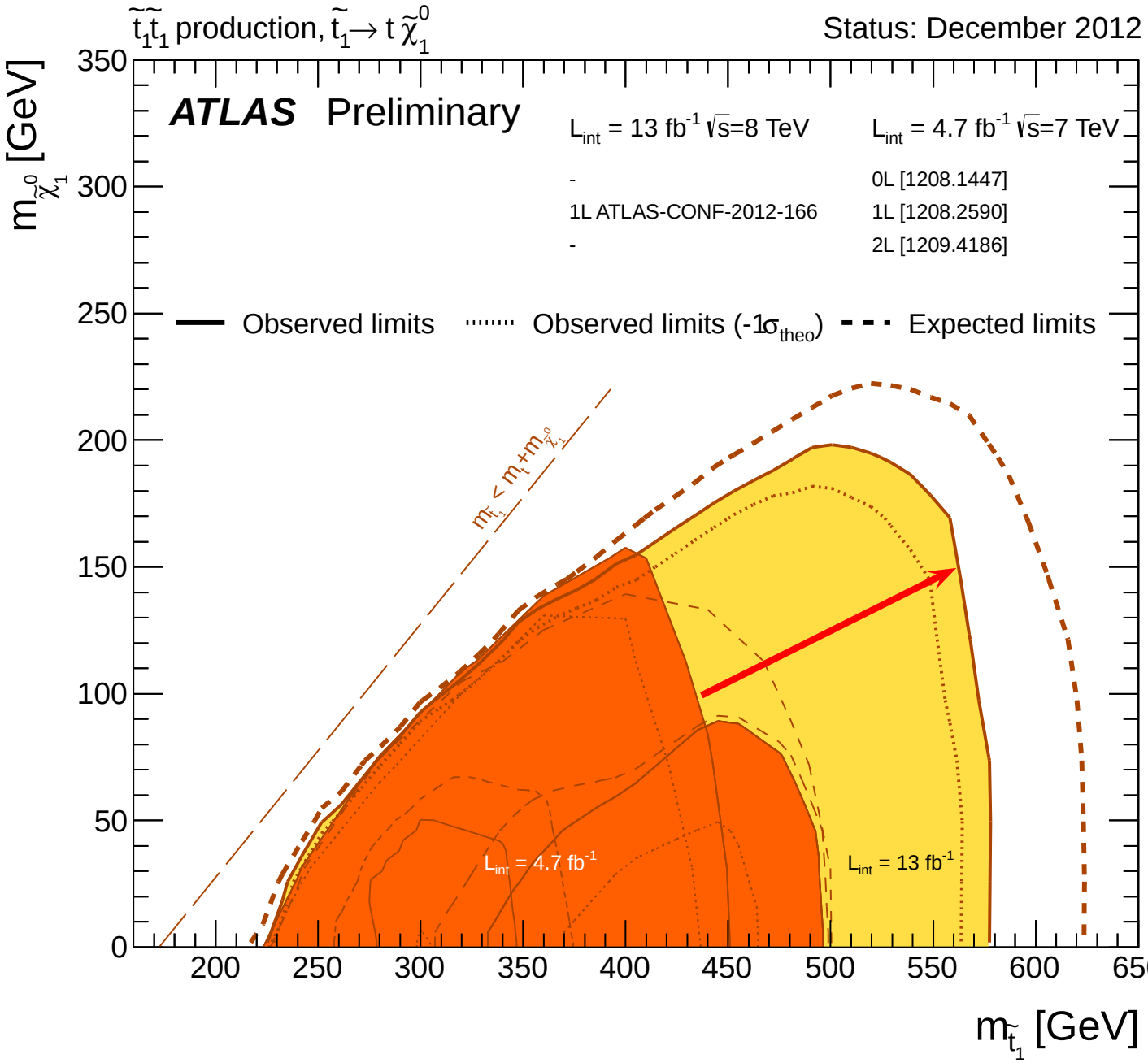
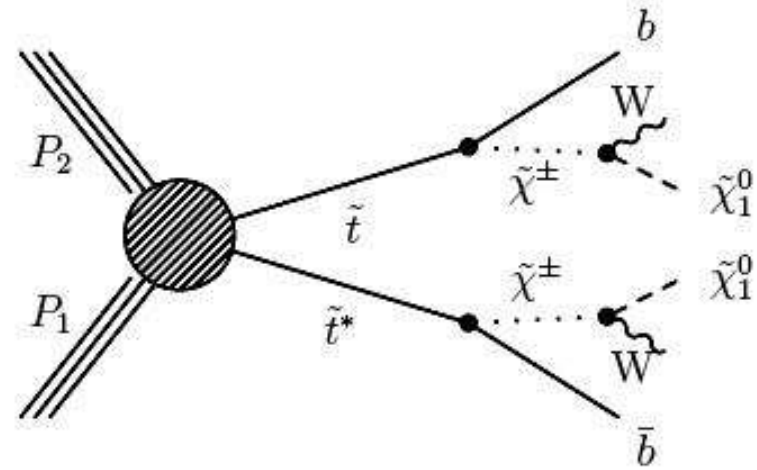
$t\tilde{\chi}_1^0$ Final State (December)

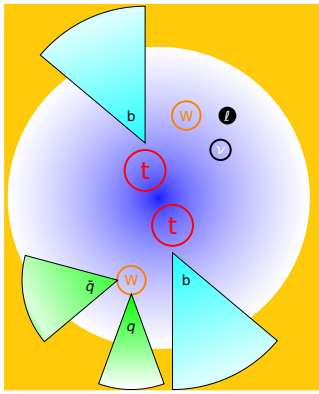


$b\tilde{\chi}_1^{\pm}$ Final State

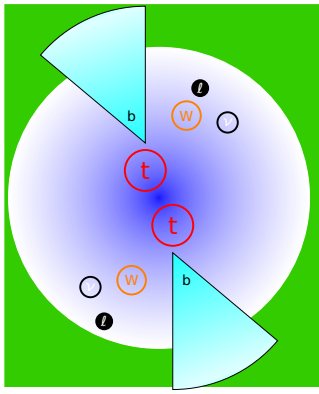
$b\tilde{\chi}_1^{\pm}$ Final State

- ***Consider $m_t \gtrsim m_{\tilde{t}_1} > m_{\tilde{\chi}_1^{\pm}}$ so that $\tilde{t}_1 \to b\tilde{\chi}_1^{\pm} \to W^{(\star)}\tilde{\chi}_1^0$***
- ***Interpreted in terms of benchmark MSSM scenarios:***
  - $m_{\tilde{\chi}_1^{\pm}} \sim 2 \times m_{\tilde{\chi}_1^0}$ (gaugino universality)
  - $m_{\tilde{\chi}_1^{\pm}} = 106$ GeV
  - $m_{\tilde{t}_1} = 180$ GeV and a grid of $m_{\tilde{\chi}_1^{\pm}}$ vs $m_{\tilde{\chi}_1^0}$





electron with $p_T > 25$ GeV or
muon with $p_T > 20$ GeV
≥ 4 jets with $p_T > 20$ GeV
≥ 2 b-tagged jet
$E_T^{miss} > 40$ GeV

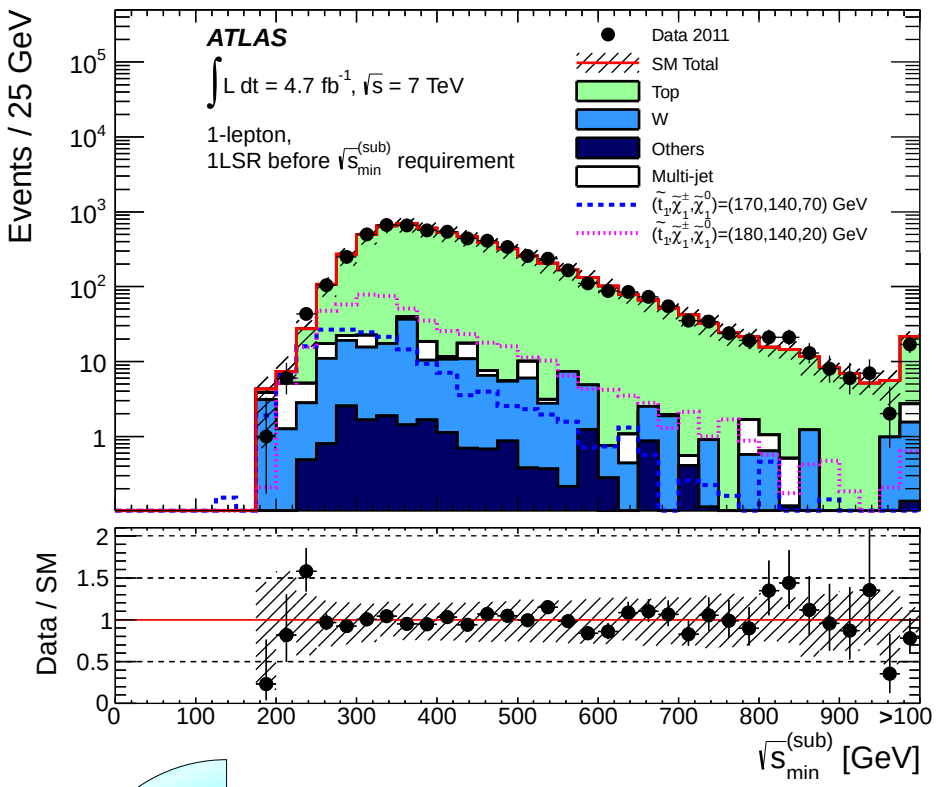


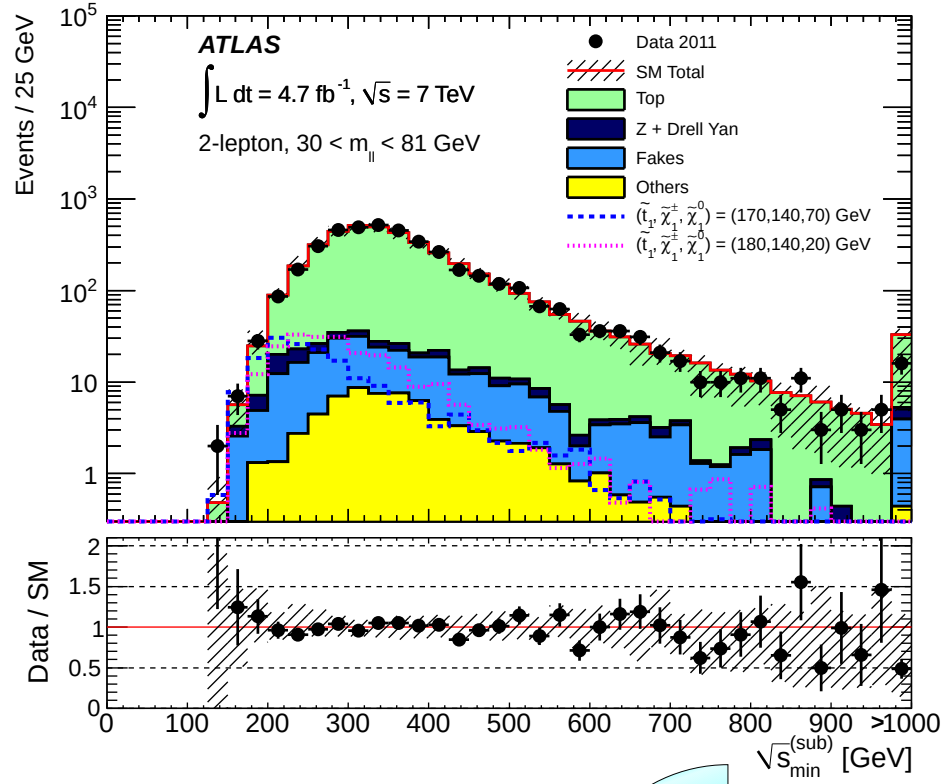
exactly two leptons
$30 < m_{\ell\ell} < 81$ GeV
≥ 2 jets with $p_T > 20$ GeV
≥ 1 b-tagged jet
$E_T^{miss} > 40$ GeV

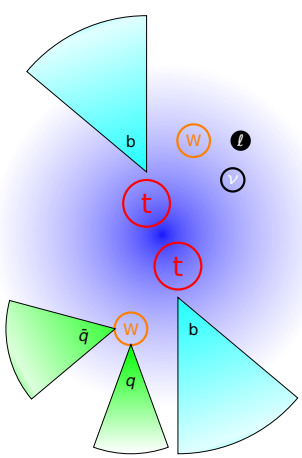
hep-ex/1209.2102

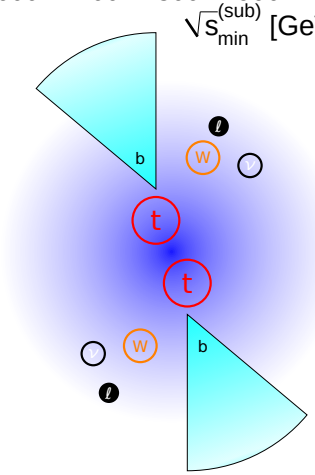
$b\tilde{\chi}_1^{\pm}$ Final State

$$\sqrt{s}_{min}^{(sub)} = \left\{ \left(\sqrt{m^2_{(sub)} + p_{T\,(sub)}^2} + \sqrt{(m^{miss})^2 + (E_T^{miss})^2} \right)^2 - \left(\boldsymbol{p}_{T\,(sub)} + \boldsymbol{p}_T^{miss} \right)^2 \right\}^{1/2}$$









hep-ex/1209.2102

$b\tilde{\chi}_1^{\pm}$ Final State

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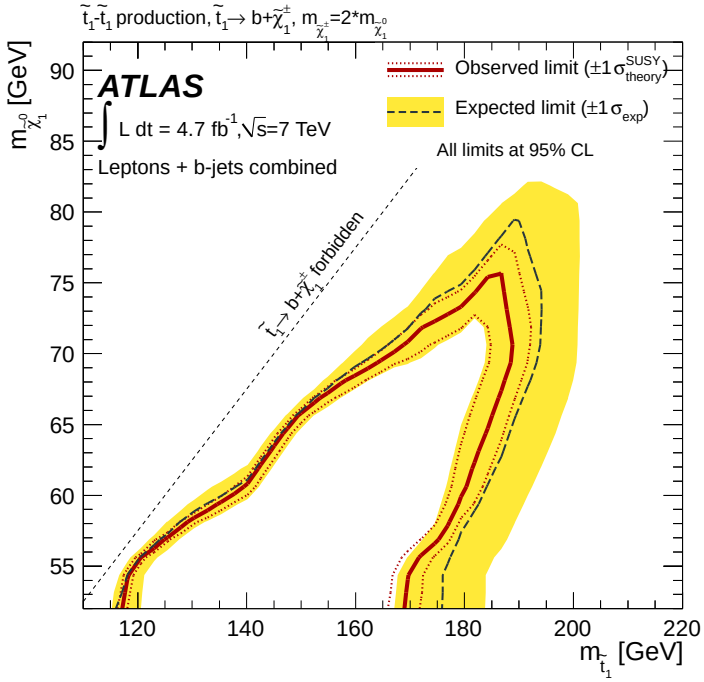
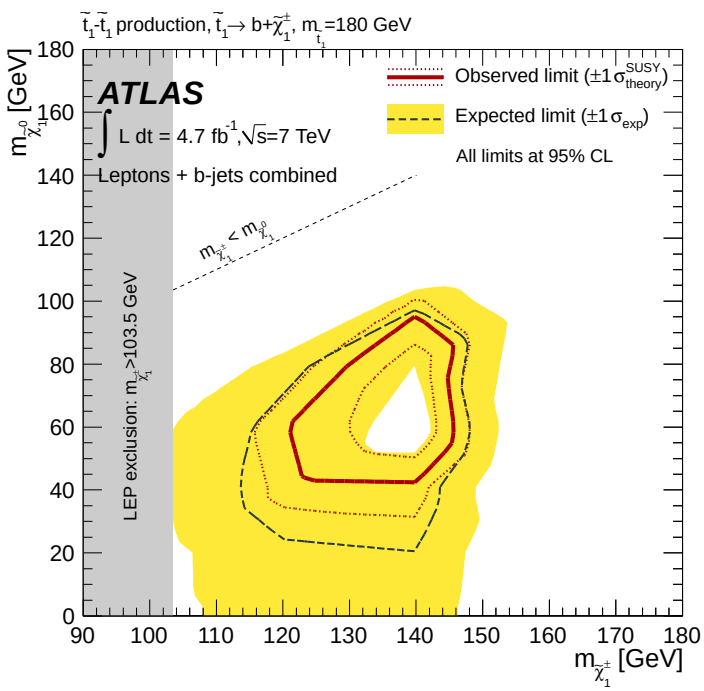
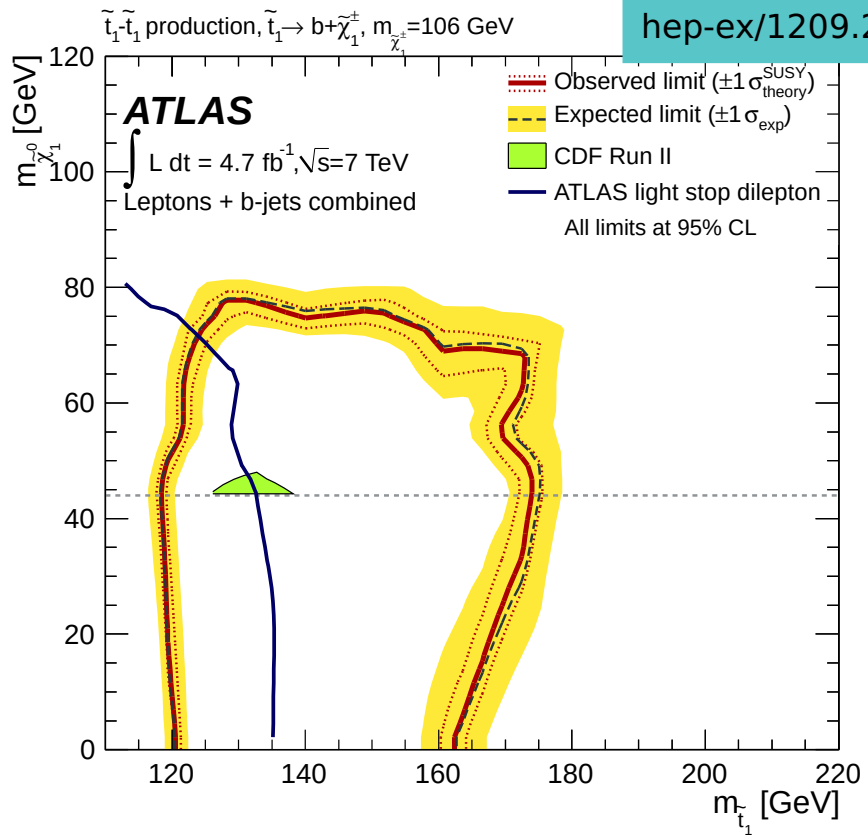
hep-ex/1209.2102



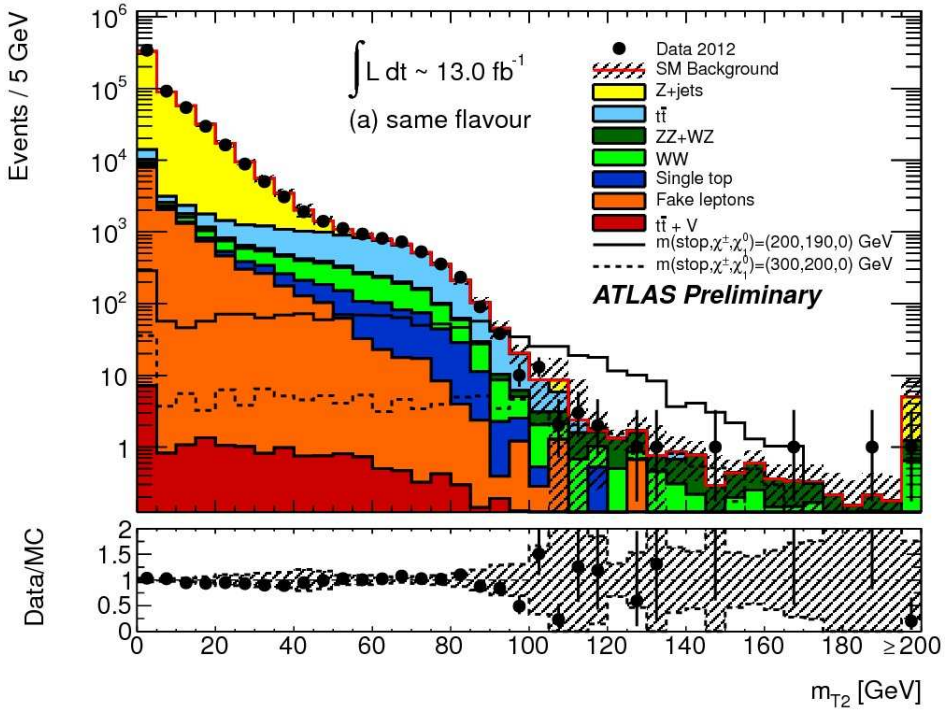


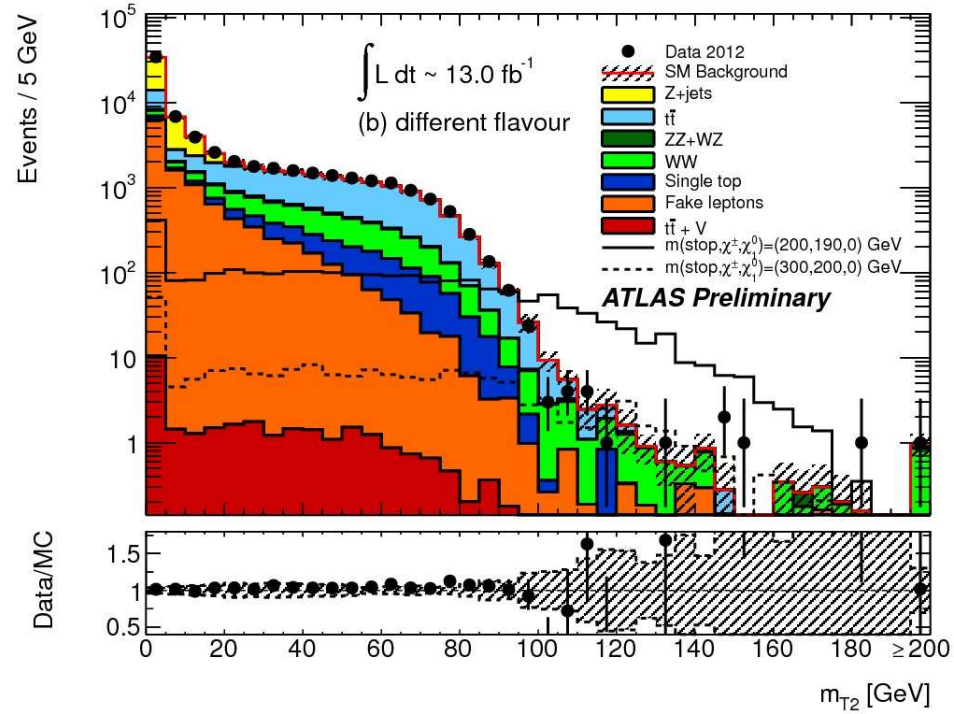


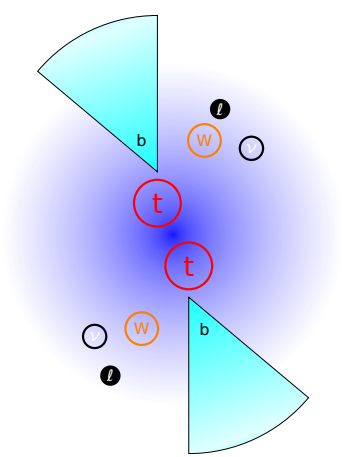
	Number of events		
Process	1LSR	2LSR1	2LSR2
Top	$24 \pm 3 \pm 5$	$89 \pm 6 \pm 10$	$36 \pm 2 \pm 5$
W+jets	$6 \pm 1 \pm 2$	—	—
Z+jets	$0.5 \pm 0.3 \pm 0.3$	$11 \pm 4 \pm 3$	$3 \pm 1 \pm 1$
Fake leptons	$7 \pm 1 \pm 2$	$12 \pm 5 \pm 11$	$6 \pm 4 \pm 4$
Others	$0.3 \pm 0.1 \pm 0.1$	$2.7 \pm 0.9 \pm 0.7$	$0.9 \pm 0.2 \pm 0.5$
Total SM	$38 \pm 3 \pm 7$	$115 \pm 8 \pm 15$	$46 \pm 4 \pm 7$
Data	50	123	47
$m_{\tilde{t}_1} = 170$ GeV, $m_{\tilde{\chi}_1^0} = 70$ GeV	$26 \pm 2 \pm 6$	$57 \pm 3 \pm 6$	$36 \pm 2 \pm 4$
$m_{\tilde{t}_1} = 180$ GeV, $m_{\tilde{\chi}_1^0} = 20$ GeV	$20 \pm 2 \pm 4$	$41 \pm 3 \pm 5$	$27 \pm 2 \pm 3$
	95% CL upper limits		
σ_{vis} (expected) [fb]	4.2	9.3	4.6
σ_{vis} (observed) [fb]	6.1	11	5.2

$b\tilde{\chi}_1^{\pm}$ Final State

$$m_{T2}(\boldsymbol{p}_T^{\ell 1}, \boldsymbol{p}_T^{\ell 2}, \boldsymbol{p}_T^{\text{miss}}) = \min_{\boldsymbol{q}_T + \boldsymbol{r}_T = \boldsymbol{p}_T^{\text{miss}}} \left\{ \max \left[m_T(\boldsymbol{p}_T^{\ell 1}, \boldsymbol{q}_T), m_T(\boldsymbol{p}_T^{\ell 2}, \boldsymbol{r}_T) \right] \right\}$$







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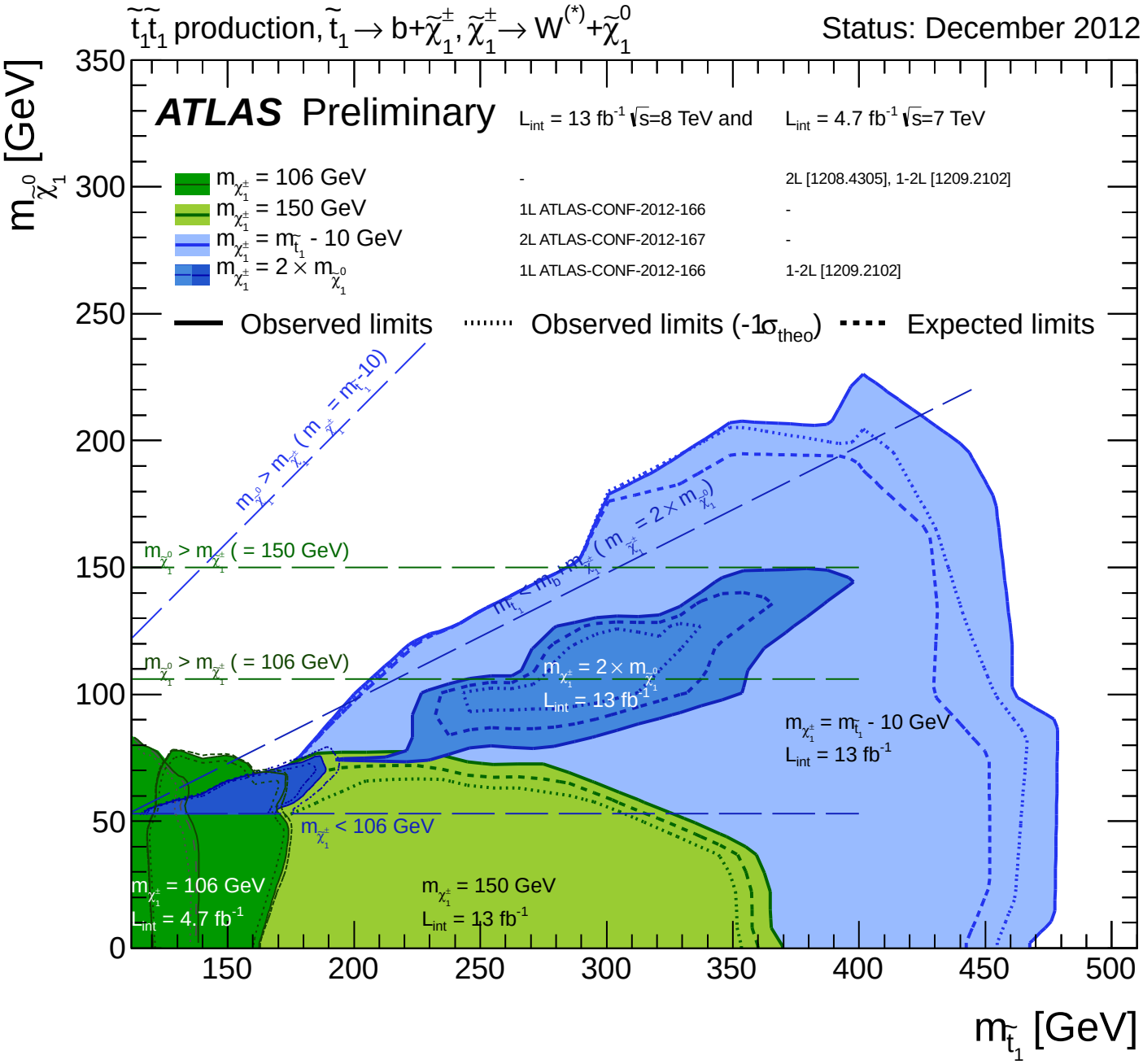
$b\tilde{\chi}_1^{\pm}$ Summary



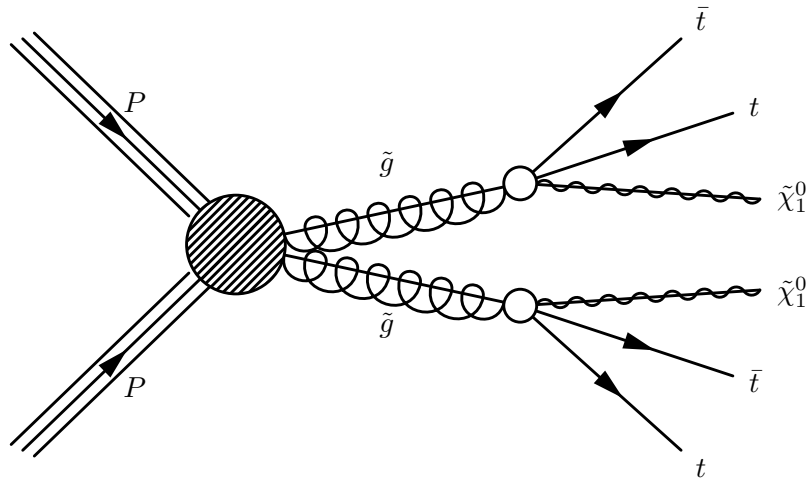
Gluino-Mediated Stop Production

Gluino-Mediated Stop

- ***If $m_{\tilde{g}} \lesssim m_{\tilde{t}_1}$ and the stop is the lightest squark, then $\tilde{g} \to t\tilde{t}_1^{(\star)} \to t\bar{t}\tilde{\chi}_1^0$***

Same-Sign Dilepton
2 SS leptons with $p_T > 20$ GeV
≥ 4 jets with $p_T > 50$ GeV
$E_T^{miss} > 150$ GeV

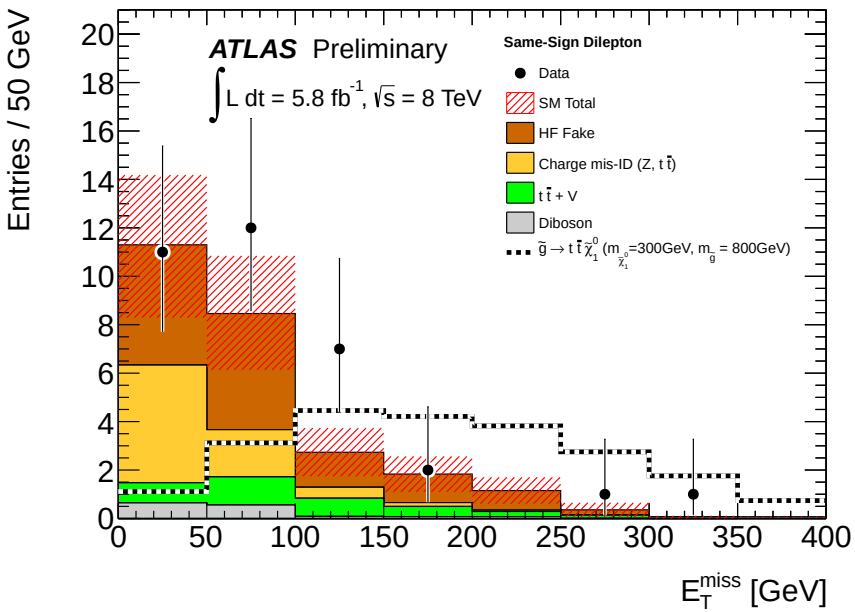
Trilepton
3 leptons with $p_T > 15$ GeV
≥ 4 jets with $p_T > 20$ GeV
$E_T^{miss} > 50$ GeV

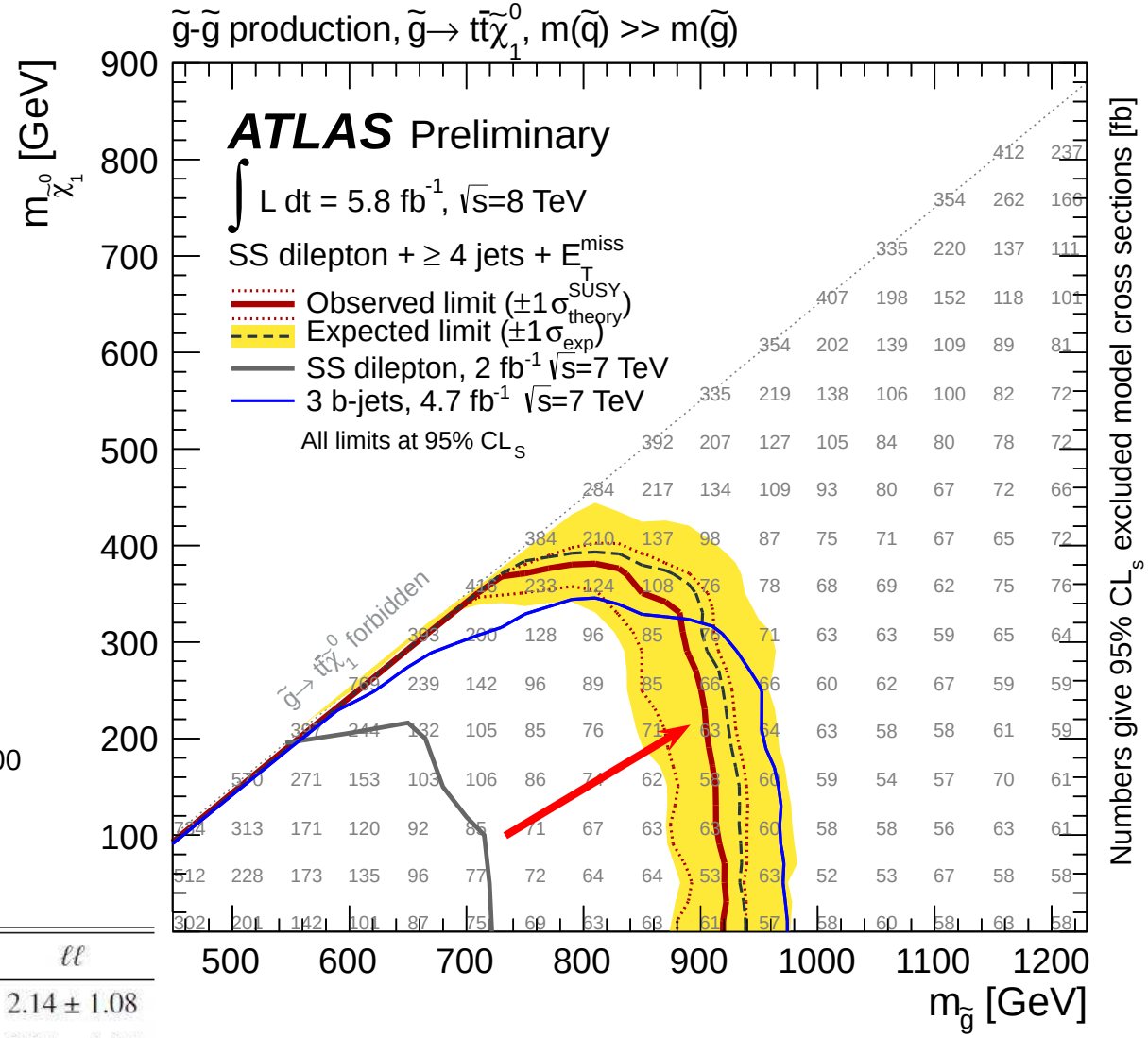


Multi-b-jets
no leptons
≥ 4 jets with $p_T > 50$ GeV
≥ 3 *b*-tagged jets
$E_T^{miss} > 200$ GeV

Multijets
no leptons
≥ 7 jets with $p_T > 55$ GeV *or*
≥ 6 jets with $p_T > 80$ GeV
$E_T^{miss}/\sqrt{H_T} > 4$ GeV$^{1/2}$

Same-Sign Dilepton





Category	ee	$e\mu$	$\mu\mu$	$\ell\ell$
HF fake	0.74 ± 0.53	1.16 ± 0.70	$0.25^{+0.30}_{-0.25}$	2.14 ± 1.08
$t\bar{t} + V$	0.17 ± 0.08	0.44 ± 0.18	0.23 ± 0.10	0.84 ± 0.34
Charge mis-ID (Z,$t\bar{t}$)	0.13 ± 0.06	0.14 ± 0.06	–	0.27 ± 0.10
Diboson	0.04 ± 0.04	0.10 ± 0.05	0.03 ± 0.03	0.18 ± 0.07
Total background	1.1 ± 0.5	1.8 ± 0.7	0.5 ± 0.3	3.4 ± 1.1
Observed in data	1	2	1	4

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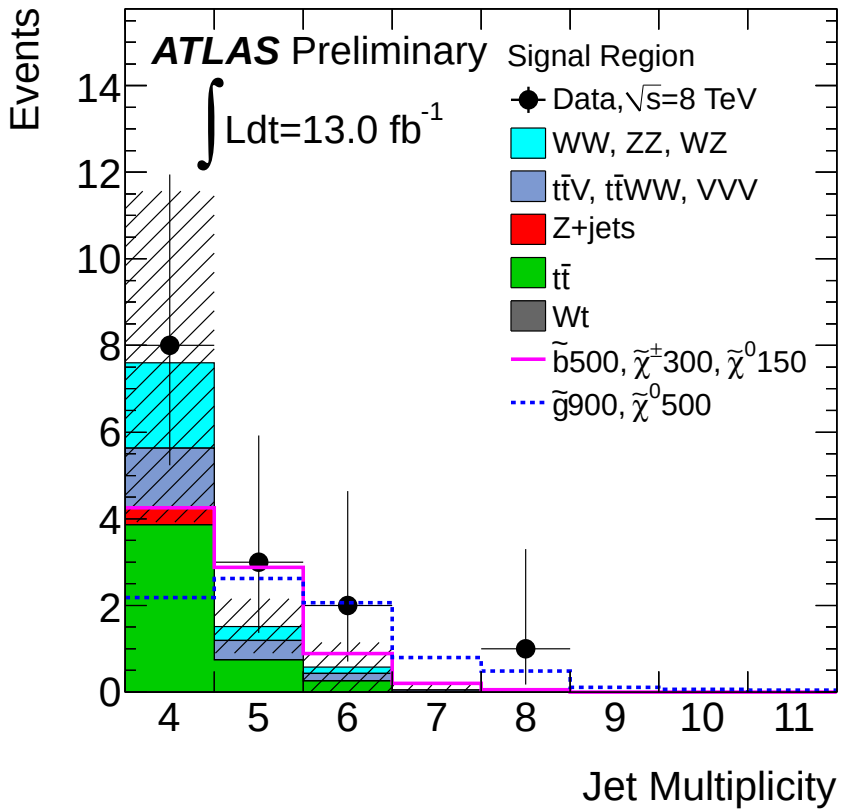
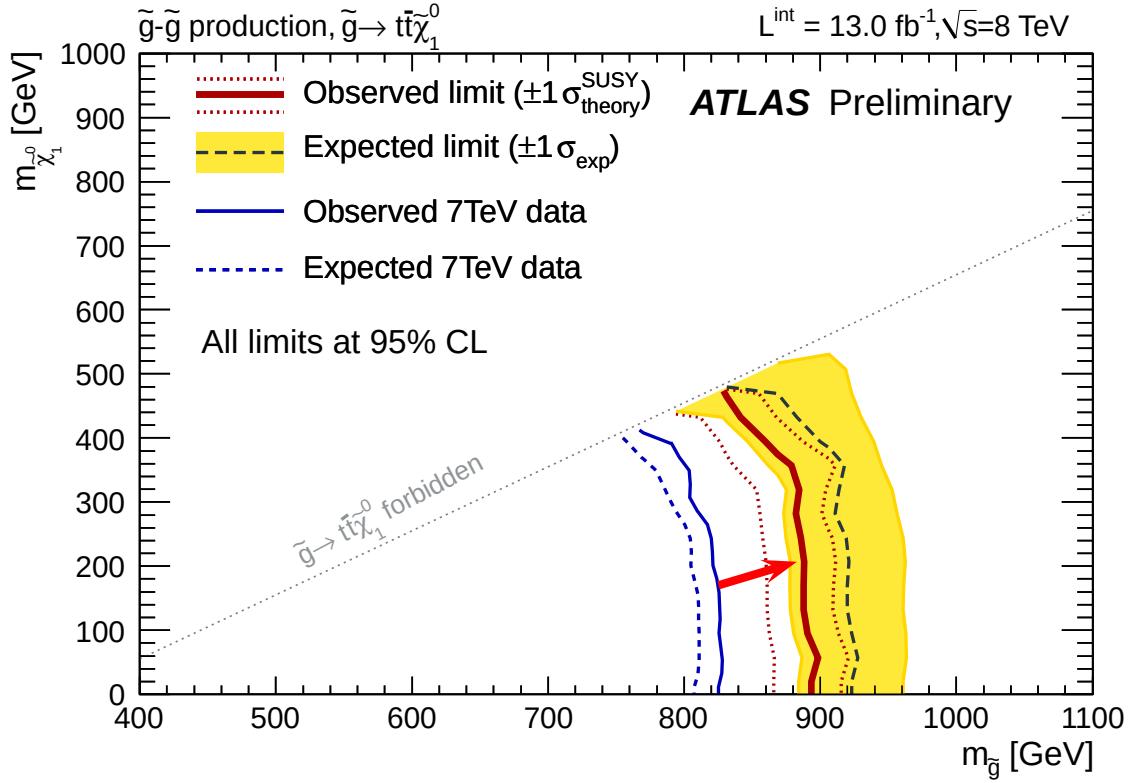
Trilepton





	3μ	$1e2SS\mu$	$1e2OS\mu$	$2SSe1\mu$	$2OSe1\mu$	$3e$	3ℓ
Z+jets and $Z+b\bar{b}$+jets	-	-	-	-	-	$0.4^{+0.4}_{-0.4}$	$0.4^{+0.4}_{-0.4}$
$t\bar{t}$ and Wt	0.7±0.8	0.5±0.5	$1.5^{+0.9}_{-0.8}$	$0.9^{+1.0}_{-0.9}$	$1.0^{+0.9}_{-0.8}$	$0.2^{+0.4}_{-0.2}$	$4.9^{+2.6}_{-2.0}$
WW, WZ, and ZZ	$0.7^{+0.4}_{-0.3}$	-	$0.8^{+0.3}_{-0.5}$	-	$0.3^{+0.3}_{-0.2}$	0.6±0.6	$2.4^{+1.3}_{-1.2}$
$t\bar{t}+W$ and $t\bar{t}+Z$, and VVV	0.3±0.2	0.2 ±0.2	0.6±0.5	0.3±0.2	0.4±0.3	0.2±0.1	2.0±1.0
Total SM	1.8±1.0	0.8±0.5	2.9±1.2	$1.2^{+1.2}_{-1.0}$	$1.7^{+1.1}_{-1.0}$	$1.4^{+0.9}_{-0.8}$	$9.7^{+3.8}_{-3.4}$
Signal1	$1.3^{+0.4}_{-0.5}$	$1.2^{+0.3}_{-0.4}$	$2.2^{+0.6}_{-0.7}$	$1.2^{+0.3}_{-0.4}$	$2.2^{+0.6}_{-0.8}$	$0.7^{+0.2}_{-0.3}$	$8.9^{+2.2}_{-3.0}$
Signal2	0.9±0.3	$1.2^{+0.3}_{-0.4}$	$2.0^{+0.5}_{-0.6}$	$1.4^{+0.4}_{-0.5}$	2.0±0.6	$0.8^{+0.3}_{-0.3}$	$8.3^{+1.9}_{-2.3}$
Data	1	2	3	1	4	3	14

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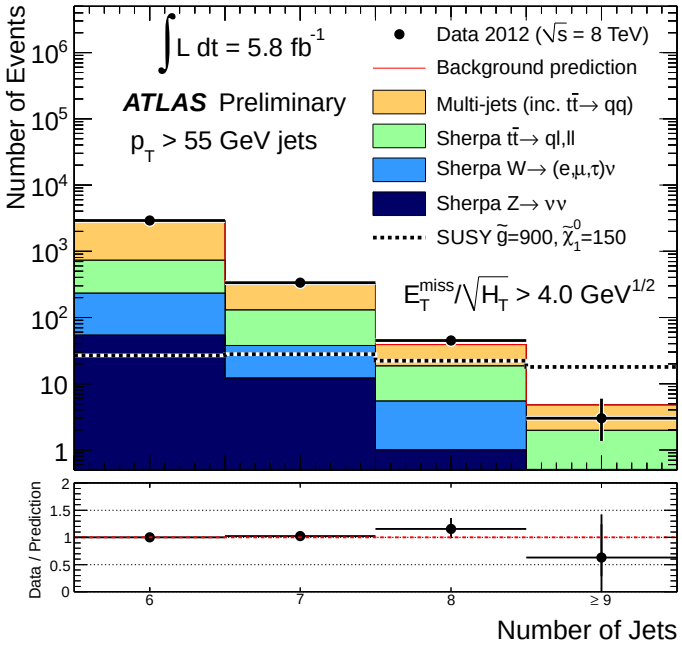
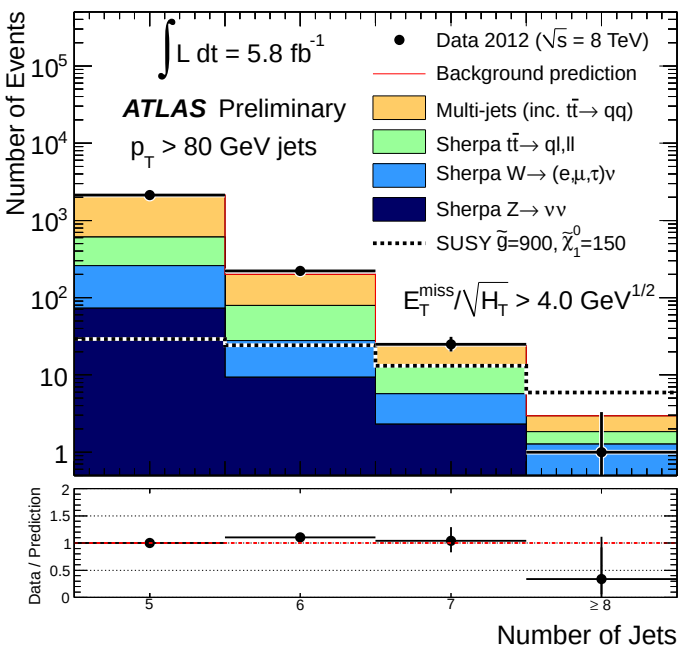
Multijet





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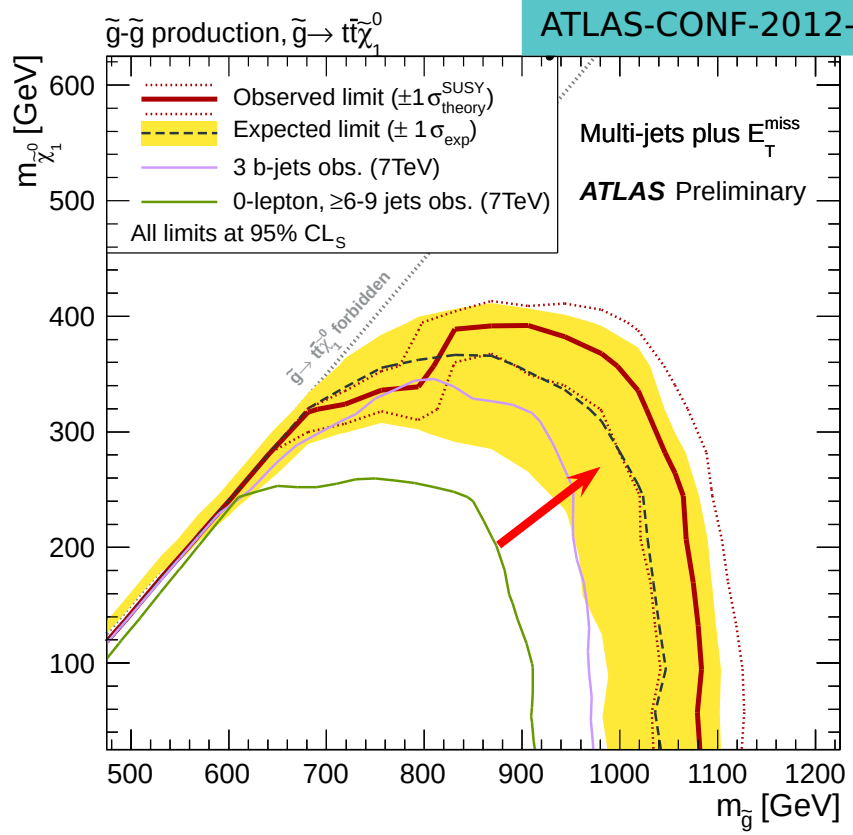
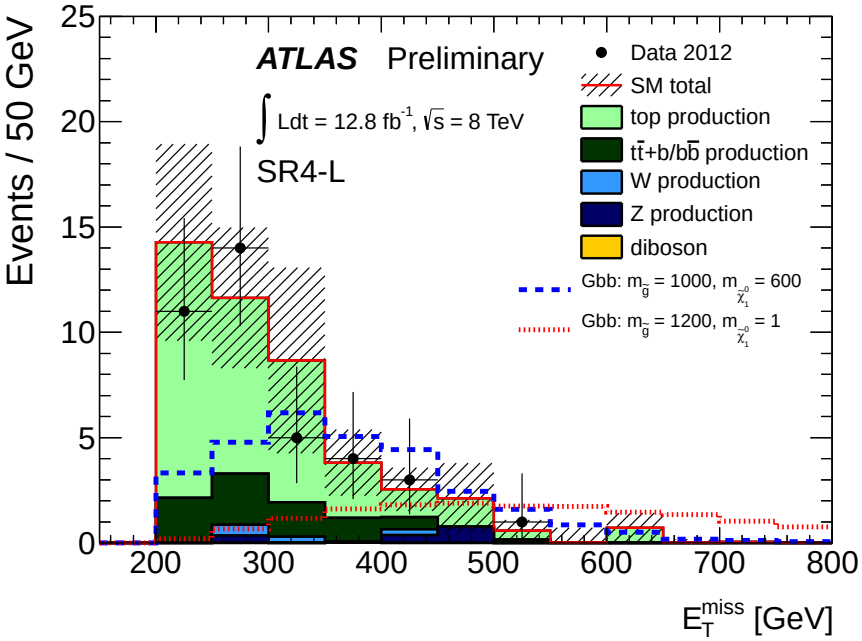
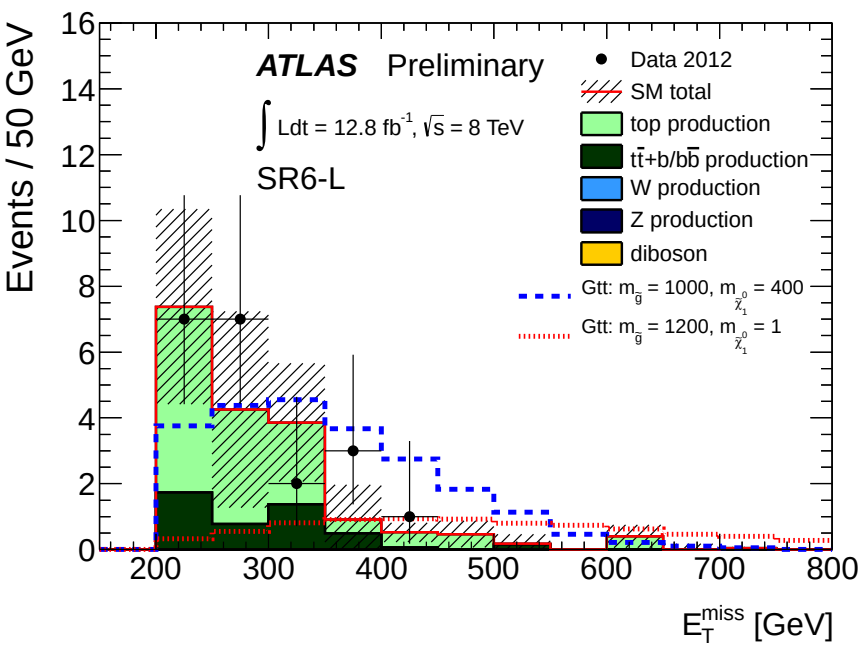
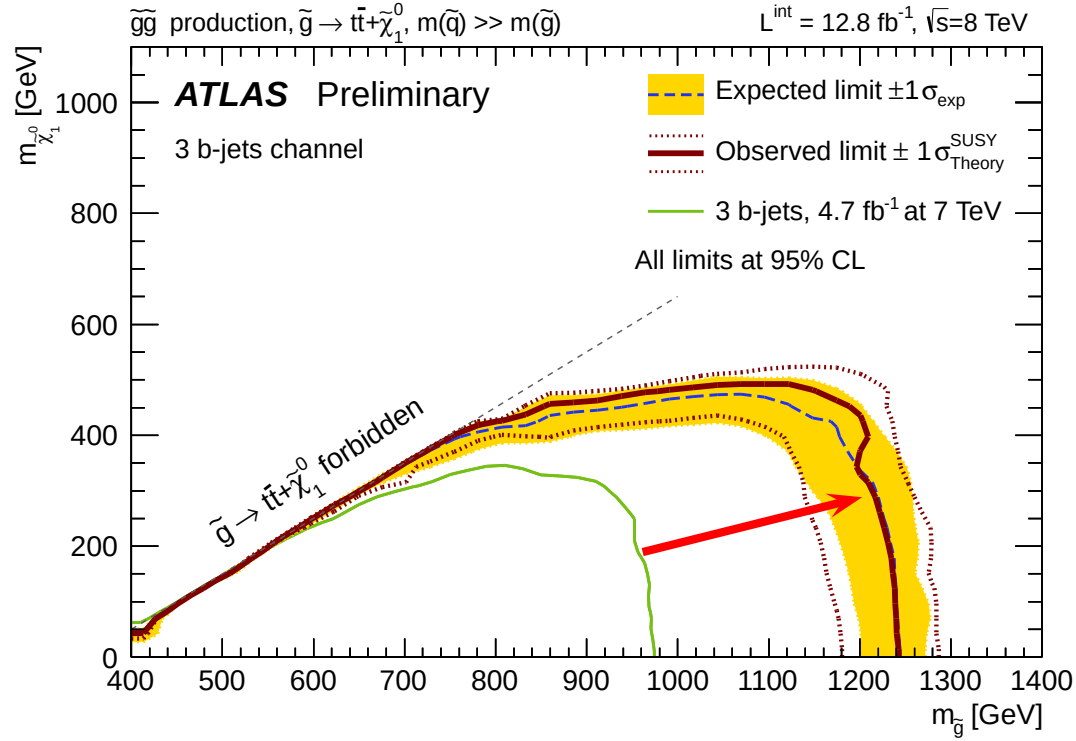


Signal region	7j55	8j55	9j55	6j80	7j80	8j80
Multi-jets	219 ± 39	23 ± 7	2.8 ± 0.9	134 ± 32	12 ± 4	1.1 ± 0.4
$t\bar{t}\to q\ell,\ell\ell$ and $W(\to\ell\nu)$ + jets	121^{+23}_{-25}	18 ± 8	$2.0^{+2.2}_{-1.3}$	97 ± 24	14^{+10}_{-12}	$1.8^{+1.7}_{-1.4}$
$Z(\to\nu\nu)$ + jets	13 ± 13	1 ± 1	$0^{+0.4}$	12 ± 12	2 ± 2	$0^{+0.4}$
Total Standard Model	353 ± 48	42 ± 10	$4.8^{+2.4}_{-1.6}$	243 ± 42	28^{+11}_{-12}	$2.9^{+1.8}_{-1.5}$
Data	381	48	3	248	26	1
$N^{95\%}_{BSM,max}$ (exp)	101	24	7.3	88	26	5.5
$N^{95\%}_{BSM,max}$ (obs)	122	29	5.4	91	25	4
$\sigma^{95\%}_{BSM,max}\cdot A\cdot\epsilon$ (exp) [fb]	17.5	4.1	1.3	15.2	4.5	0.9
$\sigma^{95\%}_{BSM,max}\cdot A\cdot\epsilon$ (obs) [fb]	21	5	0.9	15.7	4.3	0.7

Multi-*b*-jet







Common criteria: lepton veto, $p_T^{j1} > 90$ GeV, $E_T^{miss} > 200$ GeV, ≥ 3 *b*-jets, $E_T^{miss}/m_{eff}^{4j} > 0.2$, $\Delta\phi_{min}^{4j} > 0.4$			
SR	N_j ($p_T > 50$ GeV)	p_T *b*-jets	m_{eff}
SR4-L/M/T	≥ 4 jets	> 50 GeV	$m_{eff}^{4j} > 900/1100/1300$ GeV
SR6-L/M/T	≥ 6 jets	> 30 GeV	$m_{eff}^{incl} > 1100/1300/1500$ GeV

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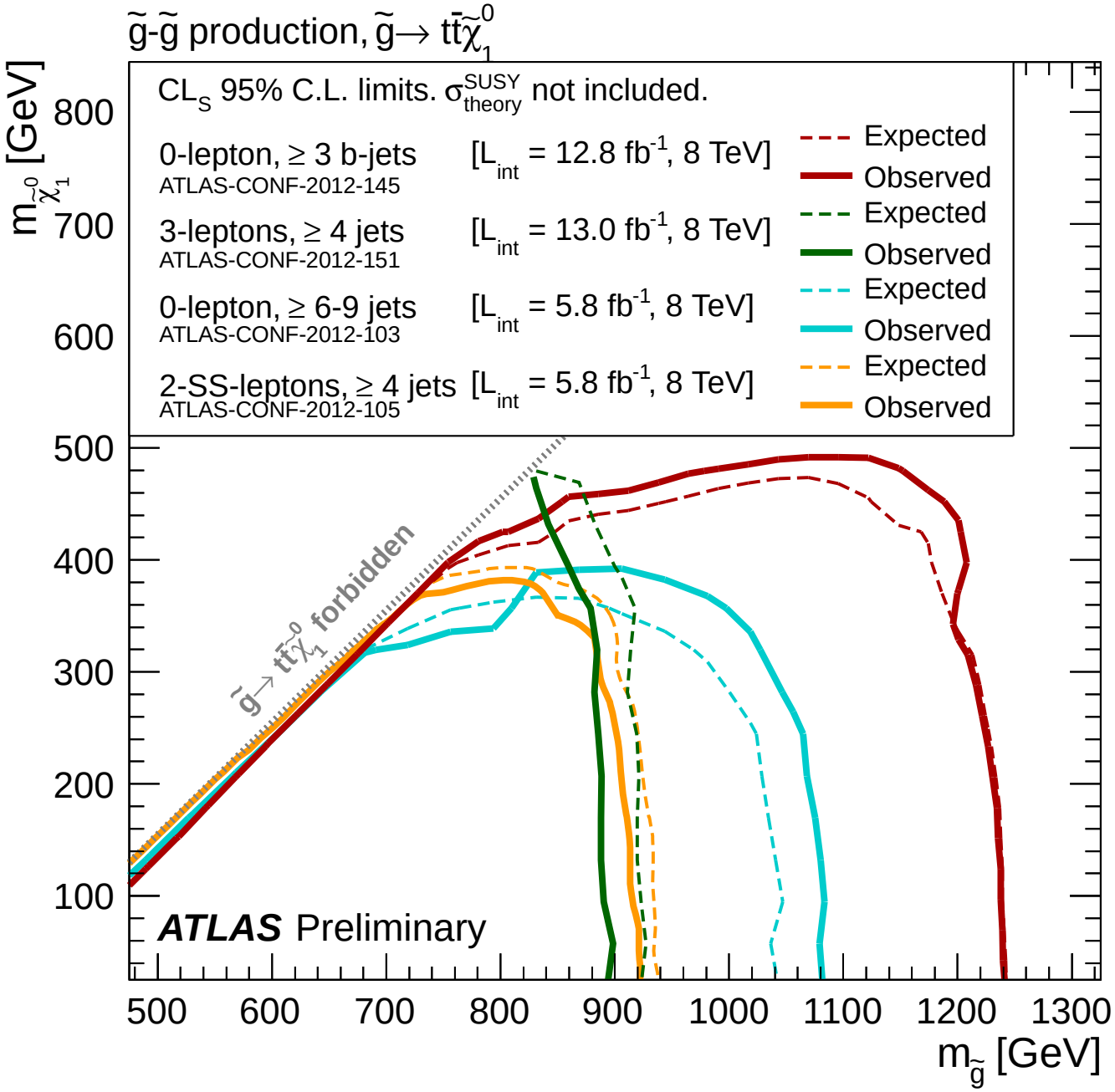
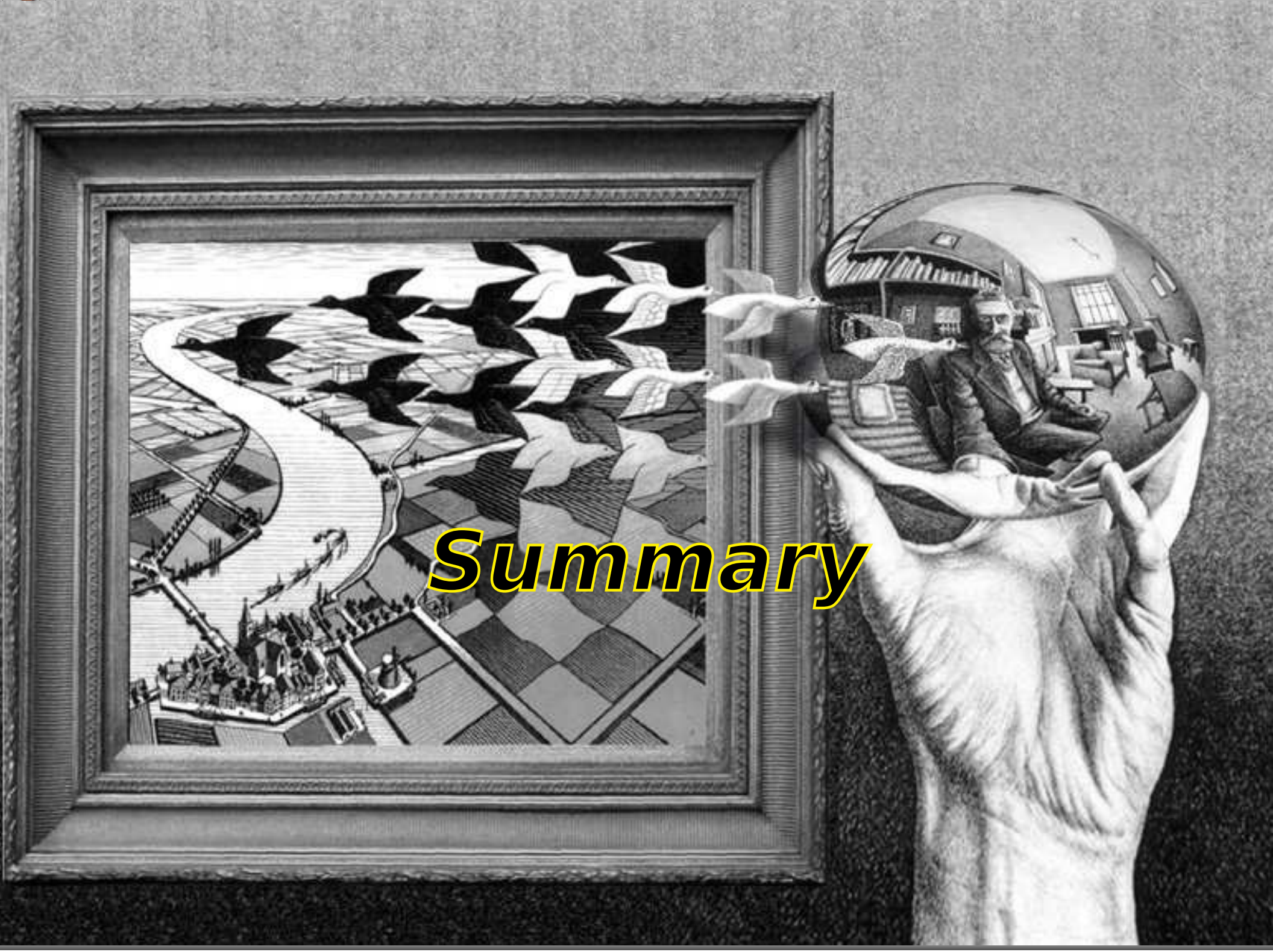
Gluino Mediated Summary

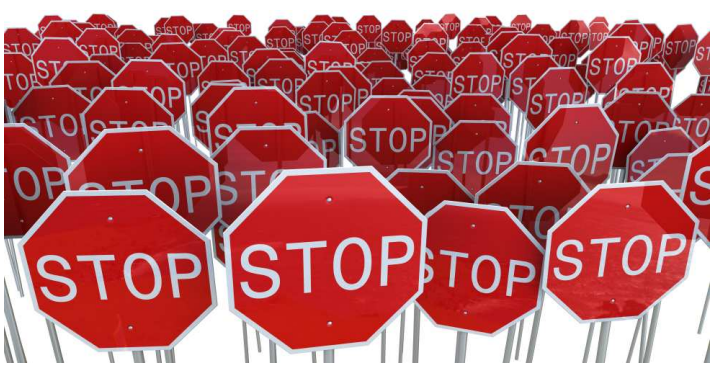


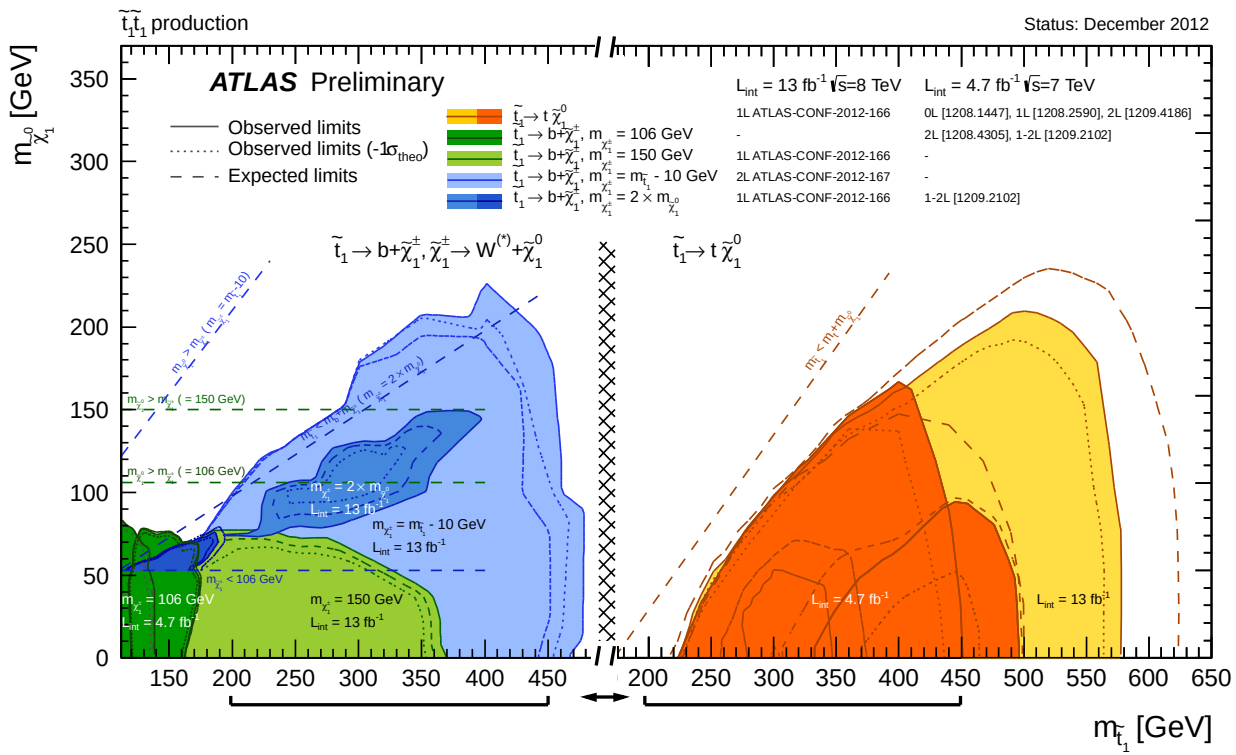


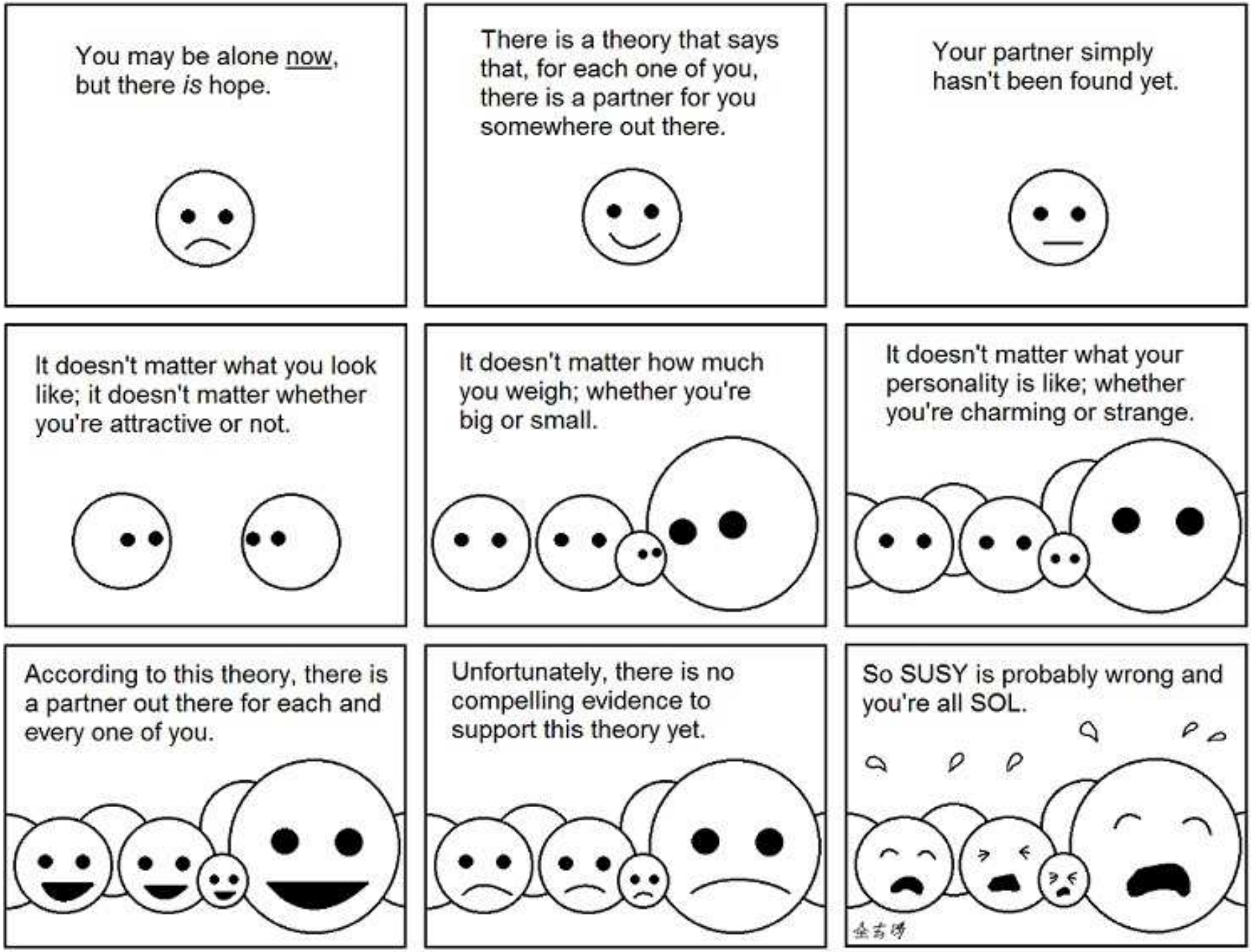
Summary

Summary

- ***This has been an amazing year for stop searches***
  - first exclusions in $\tilde{t}_1 \to t\tilde{\chi}_1^0$
  - $\approx$ 15 ATLAS results in 2012
- ***Unfortunately, we haven't discovered stop***
  - increases pressure on naturalness and fine tuning
- ***The search continues. . .***
  - increased luminosity (and $\sqrt{s}$ in a few years)
  - investigating additional decay channels
- ***. . .stay tuned!***






You may be alone now, but there *is* hope.
There is a theory that says that, for each one of you, there is a partner for you somewhere out there.
Your partner simply hasn't been found yet.
It doesn't matter what you look like; it doesn't matter whether you're attractive or not.
It doesn't matter how much you weigh; whether you're big or small.
It doesn't matter what your personality is like; whether you're charming or strange.
According to this theory, there is a partner out there for each and every one of you.
Unfortunately, there is no compelling evidence to support this theory yet.
So SUSY is probably wrong and you're all SOL.