

Searches for SUSY with jets + X + MET at the LHC

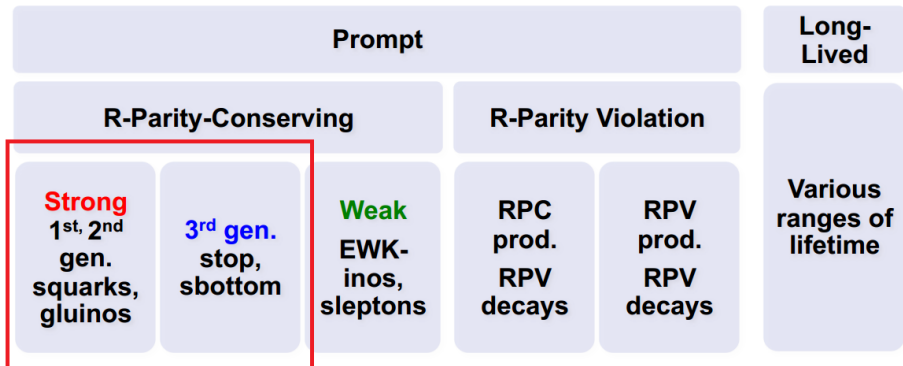
Albert Olariu¹

on behalf of the ATLAS and CMS Collaborations

¹ Horia Hulubei National Institute for Physics and Nuclear Engineering, IFIN-HH, Bucharest - Magurele, Romania

Higgs and Beyond 2013, 5-9 June, Sendai, Japan

Search strategy

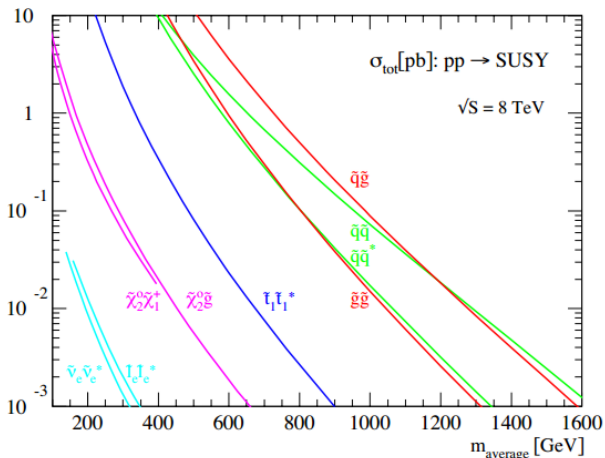


$$R = (-1)^{(L+3B+2J)}, \text{ where } \begin{cases} L = \text{leptonic number} \\ B = \text{baryonic number} \\ J = \text{spin} \end{cases}$$

Final states with jets + E_T^{miss} (+ leptons) \Rightarrow R-parity conserving models

- ▷ $\{\tilde{q}\tilde{q}, \tilde{g}\tilde{g}, \tilde{q}\tilde{g}\}$
- ▷ $\tilde{\chi}_1^0$ is the LSP $\Rightarrow E_T^{\text{miss}}$

Production of SUSY particles at the LHC



- ▷ The production cross-section at the LHC for 8 TeV versus the mass of the different types of SUSY particles

ATLAS SUSY Searches* - 95% CL Lower Limits

Status: LHCP 2013

ATLAS Preliminary

$$\int Ldt = (4.4 - 20.7) \text{ fb}^{-1} \quad \sqrt{s} = 7, 8 \text{ TeV}$$

Model	e, μ, τ, γ	Jets	E_T^{miss}	$\int Ldt \text{ [fb}^{-1}\text{]}$	Mass limit	Reference		
Inclusive searches	MSUGRA/CMSSM	0	2-6 jets	Yes	20.3	g, \tilde{g} $m_{\tilde{q}} = m_{\tilde{g}}$ 1.8 TeV	ATLAS-CONF-2013-047	
	MSUGRA/CMSSM	$1e, \mu$	4 jets	Yes	5.6	g, \tilde{g} 1.24 TeV	ATLAS-CONF-2012-104	
	MSUGRA/CMSSM	0	7-10 jets	Yes	20.3	g, \tilde{g} 1.1 TeV	ATLAS-CONF-2013-054	
	$\tilde{q}\tilde{q} \rightarrow q\tilde{q}^*$	0	2-6 jets	Yes	20.3	g, \tilde{g} 740 GeV	ATLAS-CONF-2013-047	
	$\tilde{g}\tilde{g} \rightarrow q\tilde{q}^*$	0	2-6 jets	Yes	20.3	g, \tilde{g} 1.3 TeV	ATLAS-CONF-2013-047	
	Gluino med. $\tilde{\chi}_1^0 \rightarrow \tilde{q}\tilde{q}^*$	$1e, \mu$	2-4 jets	Yes	4.7	g, \tilde{g} 900 GeV	1208-4688	
	$\tilde{g}\tilde{g} \rightarrow q\tilde{q}^*$	$2e, \mu$ (SS)	3 jets	Yes	20.7	g, \tilde{g} 1.1 TeV	ATLAS-CONF-2013-007	
	GMSB (I NLSP)	$2e, \mu$	2 jets	Yes	4.7	g, \tilde{g} 1.24 TeV	1208-4688	
	GMSB (II NLSP)	1.2τ	0-2 jets	Yes	20.7	g, \tilde{g} 1.4 TeV	ATLAS-CONF-2013-026	
	GGM (bino NLSP)	$2\tau, \gamma$	0	Yes	4.8	g, \tilde{g} 1.07 TeV	1209-0753	
	GGM (wino NLSP)	$1e, \mu, \tau$	0	Yes	4.8	g, \tilde{g} 619 GeV	ATLAS-CONF-2012-144	
	GGM (Higgsino-bino NLSP)	τ	1 b	Yes	4.8	g, \tilde{g} 900 GeV	1211-1167	
	GGM (Higgsino NLSP)	$2e, \mu$ (Z)	0-3 jets	Yes	5.8	g, \tilde{g} 800 GeV	ATLAS-CONF-2012-152	
	Gravitino LSP	0	mono-jet	Yes	10.5	g, \tilde{g} 645 GeV	ATLAS-CONF-2012-147	
	3 rd gen. \tilde{g} med.	$g \rightarrow b\tilde{z}_1^0$	0	3 b	Yes	12.8	g, \tilde{g} 1.24 TeV	ATLAS-CONF-2012-145
$g \rightarrow t\tilde{z}_1^0$		$2e, \mu$ (SS)	0-3 b	No	20.7	g, \tilde{g} 900 GeV	ATLAS-CONF-2013-007	
$g \rightarrow b\tilde{z}_2^0$		0	7-10 jets	Yes	20.3	g, \tilde{g} 1.14 TeV	ATLAS-CONF-2013-054	
$g \rightarrow t\tilde{z}_2^0$		0	3 b	Yes	12.8	g, \tilde{g} 1.15 TeV	ATLAS-CONF-2012-145	
3 rd gen. squarks direct production		$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\tilde{b}_1, \tilde{t}_1\tilde{d}_1$	0	2 b	Yes	20.1	$\tilde{t}_1, \tilde{b}_1, \tilde{d}_1$ 100-630 GeV	ATLAS-CONF-2013-053
	$\tilde{b}_1\tilde{b}_1, \tilde{b}_1\tilde{t}_1, \tilde{b}_1\tilde{d}_1$	$2e, \mu$ (SS)	0-3 b	Yes	20.7	$\tilde{b}_1, \tilde{t}_1, \tilde{d}_1$ 430 GeV	ATLAS-CONF-2013-007	
	$\tilde{t}_1\tilde{t}_1$ (light), $\tilde{t}_1\tilde{b}_1$	$1.2e, \mu$	1-2 b	Yes	4.7	\tilde{t}_1, \tilde{b}_1 167 GeV	1208-4305, 1209-2102	
	$\tilde{t}_1\tilde{t}_1$ (heavy), $\tilde{t}_1\tilde{b}_1$	$2e, \mu$	0-2 jets	Yes	20.3	\tilde{t}_1, \tilde{b}_1 220 GeV	ATLAS-CONF-2013-048	
	$\tilde{t}_1\tilde{t}_1$ (medium), $\tilde{t}_1\tilde{b}_1$	$2e, \mu$	0-2 jets	Yes	20.3	\tilde{t}_1, \tilde{b}_1 150-440 GeV	ATLAS-CONF-2013-048	
	$\tilde{t}_1\tilde{t}_1$ (medium), $\tilde{t}_1\tilde{d}_1$	0	2 b	Yes	20.1	\tilde{t}_1, \tilde{d}_1 150-580 GeV	ATLAS-CONF-2013-053	
	$\tilde{t}_1\tilde{t}_1$ (heavy), $\tilde{t}_1\tilde{d}_1$	$1e, \mu$	1 b	Yes	20.7	\tilde{t}_1, \tilde{d}_1 200-610 GeV	ATLAS-CONF-2013-007	
	$\tilde{t}_1\tilde{t}_1$ (heavy), $\tilde{t}_1\tilde{b}_1$	0	2 b	Yes	20.5	\tilde{t}_1, \tilde{b}_1 320-660 GeV	ATLAS-CONF-2013-024	
	$\tilde{t}_1\tilde{t}_1$ (natural GMSB)	$2e, \mu$ (Z)	1 b	Yes	20.7	\tilde{t}_1, \tilde{b}_1 500 GeV	ATLAS-CONF-2013-025	
	$\tilde{t}_1\tilde{b}_1, \tilde{t}_1\tilde{d}_1, \tilde{t}_1\tilde{t}_1+Z$	$3e, \mu$ (Z)	1 b	Yes	20.7	$\tilde{t}_1, \tilde{b}_1, \tilde{d}_1$ 520 GeV	ATLAS-CONF-2013-025	
	EW direct	$\tilde{W}\tilde{W}, \tilde{W}\tilde{Z}, \tilde{W}\tilde{A}$	$2e, \mu$	0	Yes	20.3	$\tilde{W}, \tilde{Z}, \tilde{A}$ 85-315 GeV	ATLAS-CONF-2013-049
		$\tilde{Z}\tilde{Z}, \tilde{Z}\tilde{A}, \tilde{Z}\tilde{W}$	$2e, \mu$	0	Yes	20.3	$\tilde{Z}, \tilde{A}, \tilde{W}$ 125-450 GeV	ATLAS-CONF-2013-049
		$\tilde{Z}\tilde{Z}, \tilde{Z}\tilde{A}, \tilde{Z}\tilde{W}$	2τ	0	Yes	20.7	$\tilde{Z}, \tilde{A}, \tilde{W}$ 180-330 GeV	ATLAS-CONF-2013-028
		$\tilde{Z}\tilde{Z}, \tilde{Z}\tilde{A}, \tilde{Z}\tilde{W}$	$3e, \mu$	0	Yes	20.7	$\tilde{Z}, \tilde{A}, \tilde{W}$ 600 GeV	ATLAS-CONF-2013-035
		$\tilde{Z}\tilde{Z}, \tilde{Z}\tilde{A}, \tilde{Z}\tilde{W}$	$3e, \mu$	0	Yes	20.7	$\tilde{Z}, \tilde{A}, \tilde{W}$ 315 GeV	ATLAS-CONF-2013-035
Long-lived particles	Direct $\tilde{\chi}_1^0\tilde{\chi}_1^0$ prod., long-lived $\tilde{\chi}_1^0$	0	1 jet	Yes	4.7	$\tilde{\chi}_1^0$ 220 GeV	$1 < \tau(\tilde{\chi}_1^0) < 10$ ns	
	Stable \tilde{g}, R -hadrons	$0.2e, \mu$	0	Yes	4.7	\tilde{g}, R 985 GeV	1211-1597	
	GMSB, stable $\tilde{\tau}$, low β	$2e, \mu$	0	Yes	4.7	$\tilde{\tau}$ 300 GeV	$5 < \tan\beta < 20$	
	GMSB, $\tilde{\chi}_1^0 \rightarrow \tilde{g}G$, long-lived $\tilde{\chi}_1^0$	$2\tau, \gamma$	0	Yes	4.7	$\tilde{\chi}_1^0$ 230 GeV	$0.4 < \tau(\tilde{\chi}_1^0) < 2$ ns	
	$\tilde{\chi}_1^0 \rightarrow q\tilde{q}$ (RPV)	$1e, \mu$	0	Yes	4.4	$\tilde{\chi}_1^0$ 700 GeV	$1 \text{ mm} < c\tau < 1 \text{ m}, \tilde{g} \text{ decoupled}$	
RPV	LFV $pp \rightarrow \tilde{\nu}_i + X, \tilde{\nu}_i \rightarrow e + \mu$	$2e, \mu$	0	-	4.6	$\tilde{\nu}_i$ 1.61 TeV	$\lambda_{21} = 0.10, \lambda_{32} = 0.05$	
	LFV $pp \rightarrow \tilde{\nu}_i + X, \tilde{\nu}_i \rightarrow e(\mu) + \tau$	$1e, \mu + \tau$	0	-	4.6	$\tilde{\nu}_i$ 1.1 TeV	$\lambda_{21} = 0.10, \lambda_{32} = 0.05$	
	Bilinear RPV CMSSM	$1e, \mu$	7 jets	Yes	4.7	g, \tilde{g} 1.2 TeV	$m_{\tilde{q}} = m_{\tilde{g}}, c_{\tilde{t}} < 1 \text{ mm}$	
	$\tilde{Z}\tilde{Z}, \tilde{Z}\tilde{A}, \tilde{Z}\tilde{W}, \tilde{Z}\tilde{Z} \rightarrow e\tilde{\nu}_e e\tilde{\nu}_e$	$3e, \mu$	0	Yes	20.7	$\tilde{Z}, \tilde{A}, \tilde{W}$ 760 GeV	$m_{\tilde{Z}} > 300 \text{ GeV}, \lambda_{23} > 0$	
	$\tilde{Z}\tilde{Z}, \tilde{Z}\tilde{A}, \tilde{Z}\tilde{W}, \tilde{Z}\tilde{Z} \rightarrow \tau\nu_e e\tilde{\nu}_e$	$3e, \mu + \tau$	0	Yes	20.7	$\tilde{Z}, \tilde{A}, \tilde{W}$ 350 GeV	$m_{\tilde{Z}} > 80 \text{ GeV}, \lambda_{23} > 0$	
	$g \rightarrow q\tilde{q}$	0	6 jets	-	4.6	g, \tilde{g} 666 GeV	1210-4813	
	$g \rightarrow t\tilde{t}, \tilde{t}_1\tilde{b}_1$	$2e, \mu$ (SS)	0-3 b	Yes	20.7	g, \tilde{g} 860 GeV	ATLAS-CONF-2013-007	
Other	Scalar gluon	0	4 jets	-	4.6	sgluon 100-287 GeV	incl. limit from 1110.2693	
	WIMP interaction (D5, Dirac $\tilde{\chi}$)	0	mono-jet	Yes	10.5	M^* scale 704 GeV	$m_{\tilde{\chi}} > 80 \text{ GeV}$, limit of $< 687 \text{ GeV}$ for D6	

$\sqrt{s} = 7 \text{ TeV}$
full data

$\sqrt{s} = 8 \text{ TeV}$
partial data

$\sqrt{s} = 8 \text{ TeV}$
full data

10^{-1}

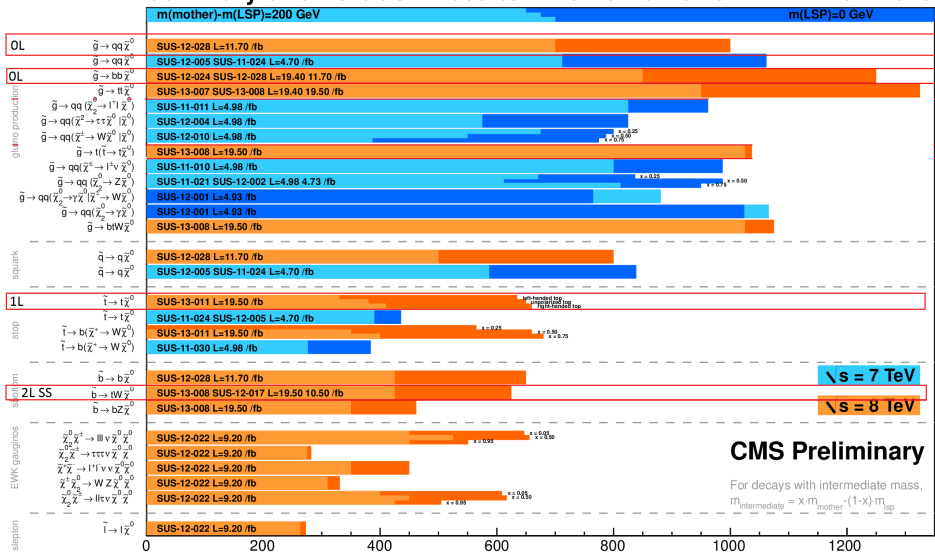
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Mass scale [TeV]

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

Summary of CMS SUSY Results* in SMS framework

LHCP 2013



CMS Preliminary

For decays with intermediate mass,

$$m_{\text{intermediate}} = x \cdot m_{\text{mother}} - (1-x) \cdot m_{\text{LSP}}$$

*Observed limits, theory uncertainties not included

Only a selection of available mass limits

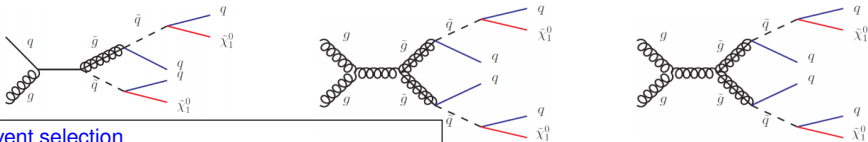
Probe *up to* the quoted mass limit

▷ CMS-PAS-SUS-018: single and di-photon+jets+MET GMSB analysis

Strong production of 1st generation squarks and gluinos

- ▷ 0 lepton, jets, MET
- ▷ 2 same-sign leptons, jets, MET

Targeting models where squarks and gluinos can be produced in pairs and can decay through $\tilde{q} \rightarrow q\tilde{\chi}_1^0$ and $\tilde{g} \rightarrow q\bar{q}\tilde{\chi}_1^0$; $\tilde{\chi}_1^0$ is the LSP $\Rightarrow E_T^{\text{miss}}$



Event selection

reject events with high p_T leptons (e or μ)

$\text{MET} > 160 \text{ GeV}$

$p_T(\text{jet1}) > 130 \text{ GeV}$

$p_T(\text{jet2}) > 60 \text{ GeV}$

- ▶ discriminant signal / SM backgrounds

$m_{\text{eff}}(\text{incl})$

- ▶ multijet background

$E_T^{\text{miss}} / m_{\text{eff}}(Nj)$

$m_{\text{eff}}(Nj)$

$\Delta\phi(\mathbf{E}_T^{\text{miss}}, \text{jet}_i)_{\text{min}}$

$$m_{\text{eff}}(\text{incl}) = E_T^{\text{miss}} + \sum p_T^{\text{jet}, p_T > 40 \text{ GeV}}$$

$m_{\text{eff}}(Nj)$ computed with N leading jets

\Rightarrow 5 inclusive channels with at least 2-6 jets and different requirements on $E_T^{\text{miss}} / m_{\text{eff}}$ and $m_{\text{eff}}^{\text{inc}}$

Backgrounds

- $Z(\rightarrow \nu\bar{\nu}) + \text{jets} \Rightarrow$ large E_T^{miss}
- $W + \text{jets}$

$$\begin{cases} W \rightarrow \tau + \nu \\ W \rightarrow e(\mu) + \nu \text{ with no reco } e \text{ or } \mu \end{cases}$$

- $t\bar{t}$ semileptonic decays
 $t\bar{t} \rightarrow b\bar{b}\tau\nu qq'$ with τ decaying to hadrons
- single top
- multiple jets \Rightarrow data-driven

Selection criteria (signal region)

- ▷ veto events with high pT leptons (e or μ)
- ▷ veto events with high pT photons to ensure an all-jet final-state
- ▷ jets: $p_T > 50$ GeV; the 2 highest E_T jets > 100 GeV
- ▷ $H_T = \sum p_T^{jet} > 275$ GeV
- ▷ Multijet background
 - $\alpha_T > 0.55$
 - (reject multijet events without significant MET, or with MET mismeasurement, while retaining good sensitivity to new physics)
- ▷ signal region divided into bins in H_T
- ▷ events are further categorised according to the:
 - jet multiplicity: 2-3 jets or ≥ 4 jets
 - b-jet multiplicity: 0, 1, 2, 3 or ≥ 4

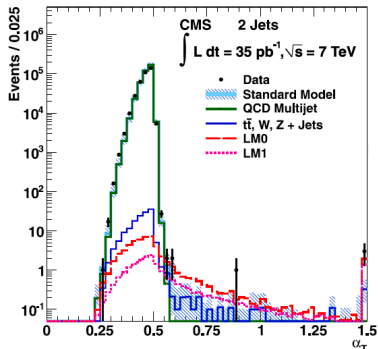
Dijet events: $\alpha_T = \sum \frac{E_T^{j2}}{M_T}$

$$M_T = \sqrt{(\sum E_T^i)^2 - (\sum p_x^i)^2 - (\sum p_y^i)^2}$$

Backgrounds

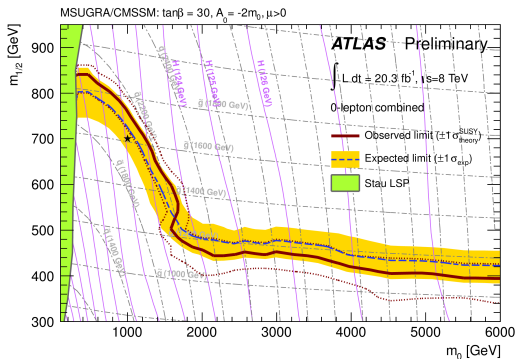
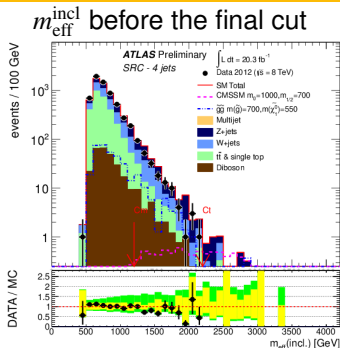
- ▷ W +jets, Z +jets
- ▷ semileptonic $t\bar{t}$
- ▷ multijet

Phys. Lett. B 698 (2011) (CMS SUSY 0L)



0-lepton, jets: Results

ATLAS-CONF-2013-047



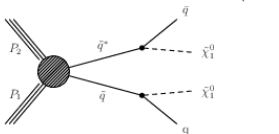
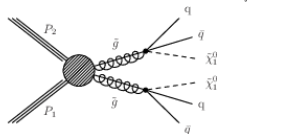
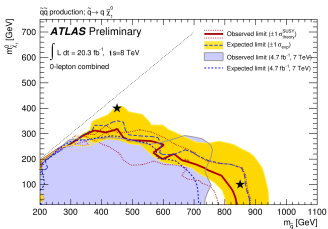
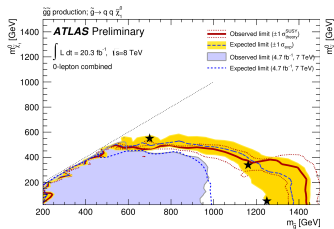
Signal region	Expected	Observed
A-loose	4700 ± 500	5333
A-medium	122 ± 18	135
B-medium	33 ± 7	29
B-tight	2.4 ± 1.4	4
C-medium	210 ± 40	228
C-tight	1.6 ± 1.4	0
D	15 ± 5	18
E-loose	113 ± 21	166
E-medium	30 ± 8	41
E-tight	2.9 ± 1.8	5

MSUGRA/CMSSM model with $\tan\beta = 30$,
 $A_0 = -2m_0$ and $\mu > 0$

- ▷ values of $m_{1/2} < 340$ GeV are excluded at the 95% confidence level for $m_0 < 7$ TeV

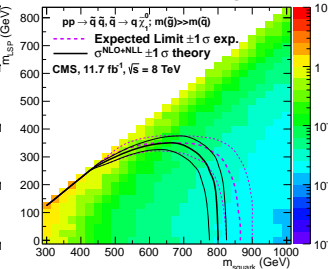
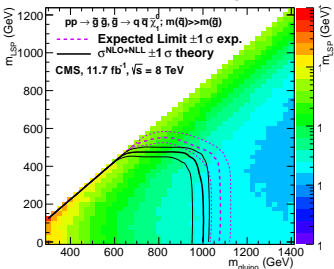
- ▷ Good agreement between the number of events observed in the data and the number of events from MC sources

0-lepton, jets: Results



ATLAS-CONF-2013-047

- ▷ gluino masses below 1350 GeV are excluded
- ▷ squark masses below 780 GeV are excluded



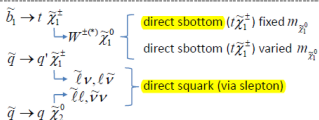
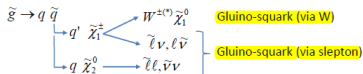
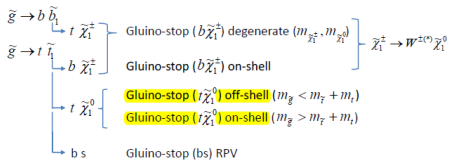
CMS-SUS-12-028

- ▷ gluino masses below 1 TeV are excluded
- ▷ squarks masses below 775 GeV are excluded

Two same-sign leptons

ATLAS-CONF-2013-007

- ▷ Search for same-sign lepton pairs (ee , $e\mu$, $\mu\mu$) in final states with MET, b-jets, multiple jets
- ▷ same-sign leptons: gluino-mediated top squark production \rightarrow 4 top quarks in final states for $t\bar{t}$ semileptonic decay
- ▷ generic analysis that targets many different models with strong pair production: $pp \rightarrow \tilde{g}\tilde{g}, \tilde{q}\tilde{q}, \tilde{b}\tilde{b}$



Baseline selection

- ▷ same-sign leading leptons

Signal regions

SR0b	SR1b	SR2b
(direct squark)	(majority of models)	
b-jet veto	≥ 1 b-jet	≥ 3 b-jets
≥ 3 jets	≥ 3 jets	≥ 4 jets

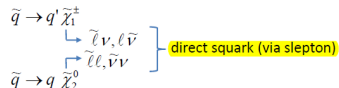
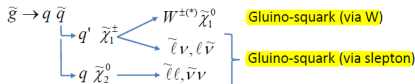
- ▷ E_T^{miss}
- ▷ $m_{\text{eff}} = p_T^{l_1} + p_T^{l_2} + \sum p_T^{\text{jet}} + E_T^{\text{miss}}$
- ▷ $m_T = \sqrt{p_T^{l_1} E_T^{\text{miss}} (1 - \cos[\Delta\Phi(l, E_T^{\text{miss}})])}$

Backgrounds

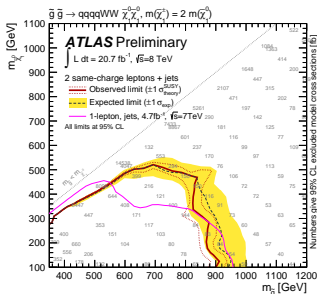
- ▷ very low backgrounds
- ▷ W/Z decaying leptonically + $t\bar{t}$ where at least one top decays leptonically
- ▷ diboson background + jets
- ▷ charge mismeasurement: OS leptons \Rightarrow misidentified charge due to the radion of a hard photon followed by asymmetric conversion
- ▷ fake leptons

Two same-sign leptons

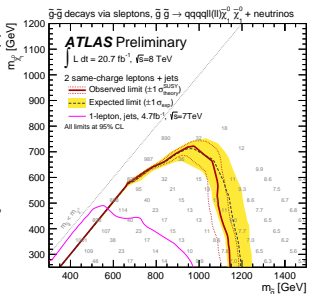
ATLAS-CONF-2013-007



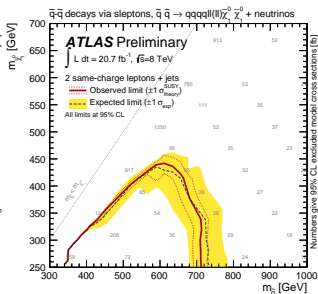
Glino-squark (via W)




Glino-squark (via slepton)



Direct squark (via slepton)





Glauino-mediated production of 3rd generation squarks

- ▷ 0-lepton, jets, MET
- ▷ 2 same-sign leptons, jets, MET

ATLAS 0-lepton, multijets, b-jets, MET

- ▷ targeting models where $\tilde{g} \rightarrow \tilde{t} + \bar{\tilde{t}} \rightarrow t + \bar{t} + \tilde{\chi}_1^0$
- ▷ final states: large number of jets + MET + no leptons

Event selection

- ▷ veto events with high pT electrons or muons
- ▷ large jet multiplicity: from ≥ 7 to ≥ 10

Multi-jet + flavour stream

- ▷ **b-jet multiplicity** ($=0, =1, \geq 2$)

Multi-jet + M_J^Σ stream

- ▷ M_J^Σ

Final cut on $E_T^{\text{miss}} / \sqrt{H_T} > 4 \text{ GeV}^{1/2}$

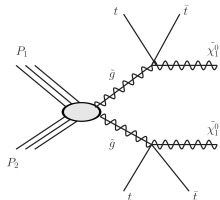
$$H_T = \sum_{\text{jet}, p_T > 40 \text{ GeV}} p_T$$

$$M_J^\Sigma = \sum_j m_j^{R=1.0} \text{ (composites jets)}$$

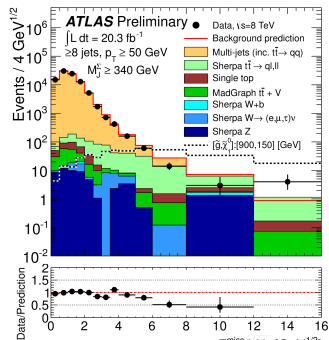
Backgrounds

- multijets : fully hadronic decays of $\tilde{t}\bar{\tilde{t}}$ and hadronic decay of W and Z bosons + jets
- semi and fully leptonic decays of $\tilde{t}\bar{\tilde{t}}$
- leptonically decaying W or Z + jets

ATLAS-CONF-2013-054

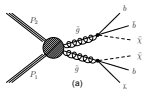
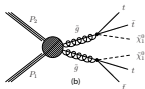
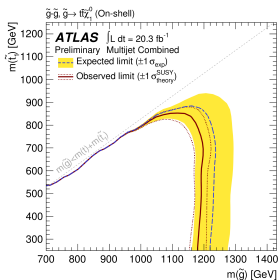
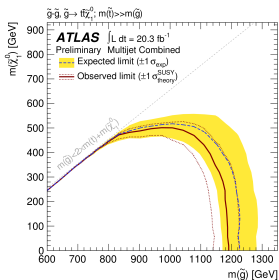


multijet + $M_J^\Sigma \geq 8$ jets SR



0-lepton, multijets, b-jets, MET

ATLAS-CONF-2013-054



▷ Gluino-stop (off-shell)

$\tilde{g} \rightarrow t + \bar{t} + \tilde{\chi}_1^0$ with unit probability via an off-shell \tilde{t}

- $m(\tilde{g}) \leq 1.1$ TeV excluded for $m(\tilde{\chi}_1^0) \leq 350$ GeV

▷ Gluino-stop (on-shell) with fixed $m(\tilde{\chi}_1^0) = 60$ GeV

- $m(\tilde{g}) \leq 1.1$ TeV are excluded for $m(\tilde{t}) \leq 750$ GeV

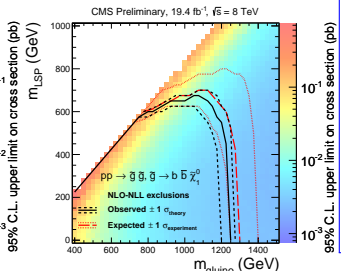
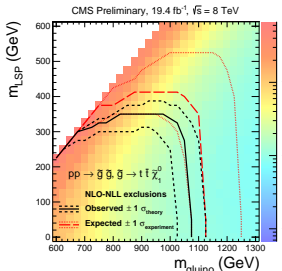
CMS-SUS-12-024

▷ T1tttt scenario

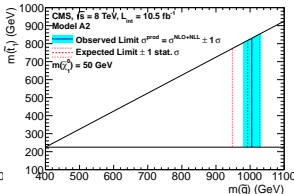
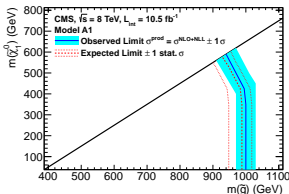
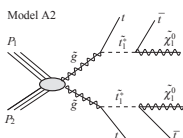
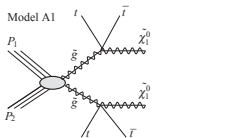
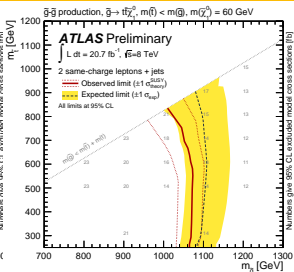
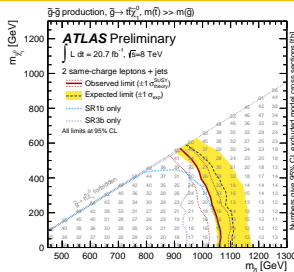
- $m(\tilde{g}) \leq 1000$ GeV excluded for LSP masses ≤ 250 GeV

▷ T1bbbb scenario

- $m(\tilde{g}) \leq 1150$ GeV excluded for LSP masses ≤ 250 GeV



Two same-sign leptons



ATLAS-CONF-2013-007

▷ Gluino-stop off-shell

gluinos are excluded up to masses of 900-1020 GeV for LSP masses below 550 GeV

▷ Gluino-stop on-shell

gluinos are excluded up to masses of about 1 TeV for stop masses below 750 GeV


CMS-PAS-SUS-12-017 Event selection

▷ 2 SS leptons with $m_{ll} > 8 \text{ GeV}$

▷ ≥ 2 b-tagged jets

▷ reject events with third lepton $p_T > 10 \text{ GeV}$

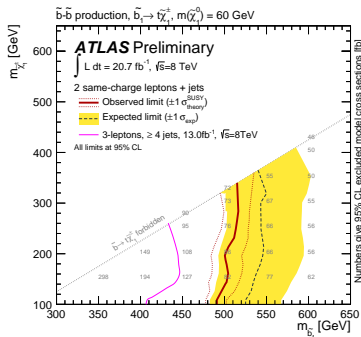
gluinos are excluded up to 1 TeV



Direct production of 3rd generation squarks

- ▷ 2 same-sign leptons
- ▷ 0 lepton, direct stop search
- ▷ 1 lepton, direct stop search
- ▷ 2 lepton, direct stop search

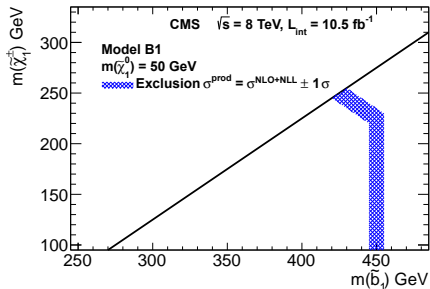
Two same-sign leptons



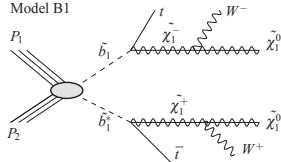
ATLAS-CONF-2013-007

direct sbottom, $m(\tilde{\chi}_1^0) = 60$ GeV

- ▷ only direct production of sbottom quarks is relevant
- ▷ limit of sbottom mass at 470-480 GeV for chargino masses below 280 GeV



Model B1



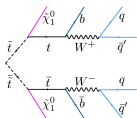
CMS-PAS-SUS-12-017

direct sbottom, $m(\tilde{\chi}_1^0) = 50$ GeV

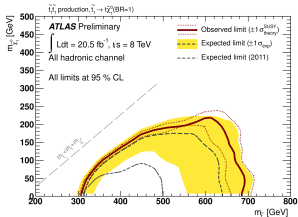
- ▷ limit on the sbottom mass at 450 GeV

Direct stop searches

0L

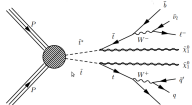


ATLAS-CONF-2013-024

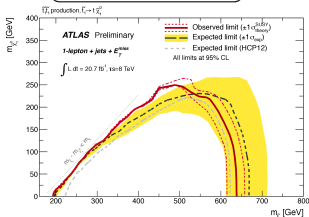


- ▷ search in the all-hadronic $t\bar{t}$ decay
- ▷ top squarks with masses between 320 and 660 GeV excluded for a nearly massless LSP

1L



ATLAS-CONF-2013-037

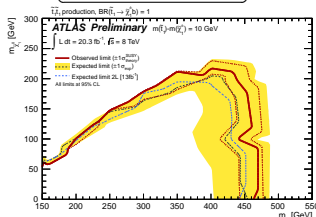


- ▷ final state with $t\bar{t}$
- ▷ top squark masses between 200 and 610 GeV are excluded at 95% CL for massless LSP

2L

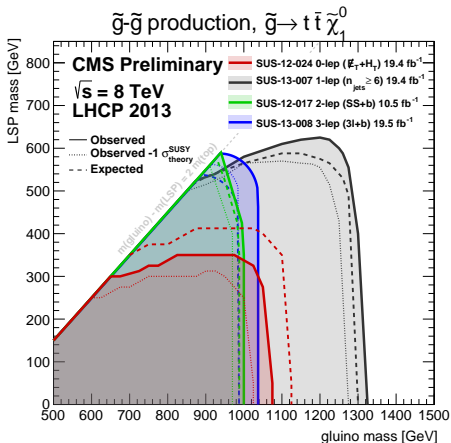
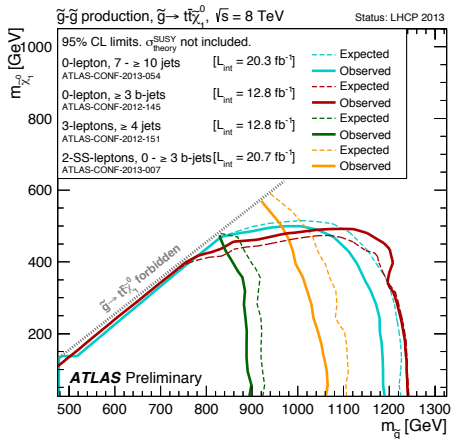
- ▷ $\tilde{t}_1 \rightarrow \tilde{\chi}_1^\pm b \rightarrow \tilde{\chi}_1^0 W^{(*)} b$
- ▷ final states with 2 $W^{(*)}$, 2 b-quarks, 2 $\tilde{\chi}_1^0$

ATLAS-CONF-2013-048

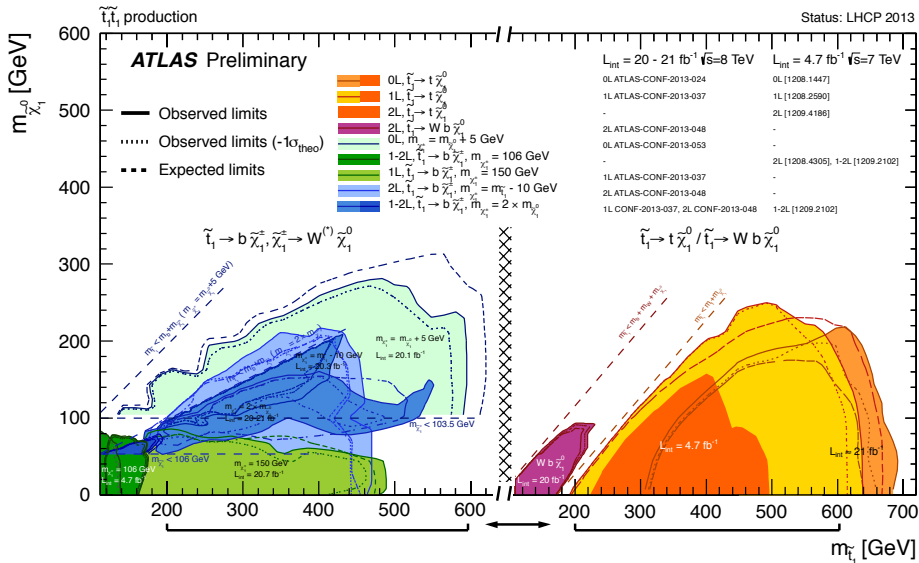


- ▷ fixed $m(\tilde{t}_1) - m(\tilde{\chi}_1^\pm) = 10$ GeV and assuming $BR(\tilde{t}_1 \rightarrow b\tilde{\chi}_1^\pm) = 100\%$
- ▷ stop quark mass excluded between 150 GeV and 442 GeV

Summary plots



Summary plots



Conclusions

The latest SUSY searches from ATLAS and CMS with jets, missing transverse energy and other objects (leptons, photons) are presented.

- ▷ no evidence on SUSY with the 2012 dataset, analyses have placed limits on SUSY cross-section and constrained model parameters
- ▷ most analyses have moved to the complete 2012 dataset
- ▷ data analysis is still continuing, more to come!

All supersymmetry results can be found here:

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

CMS: <https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsSUS>

List of notes presented

- ▷ [ATLAS-CONF-2013-047](#) "Search for squarks and gluinos with the ATLAS detector in final states with jets and missing transverse momentum and 20.3 fb⁻¹ of $\sqrt{s} = 8$ TeV proton-proton collision data"
- ▷ [ATLAS-CONF-2013-054](#) "Search for new phenomena using final states with large jet multiplicities and missing transverse momentum with ATLAS in 20 fb⁻¹ of $\sqrt{s} = 8$ TeV proton-proton collisions"
- ▷ [ATLAS-CONF-2013-007](#) "Search for strongly produced supersymmetric particles in final states with two same-sign leptons and jets with the ATLAS detector using 21 fb⁻¹ of proton-proton collisions at $\sqrt{s} = 8$ TeV"
- ▷ [ATLAS-CONF-2013-026](#) "Search for Supersymmetry in Events with Large Missing Transverse Momentum, Jets, and at Least One Tau Lepton in 21 fb⁻¹ of $\sqrt{s} = 8$ TeV Proton-Proton Collision Data with the ATLAS Detector"
- ▷ [ATLAS-CONF-2013-024](#) "Search for direct production of the top squark in the all-hadronic $t\bar{t} + E_T^{\text{miss}}$ final state in 21 fb⁻¹ of p-p collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector"
- ▷ [ATLAS-CONF-2013-037](#) "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 21 fb⁻¹ of ATLAS data"
- ▷ [ATLAS-CONF-2013-048](#) "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 21 fb⁻¹ of ATLAS data"

List of notes presented

- [CMS-PAS-SUS-12-028](#) "Search for supersymmetry in hadronic final states with missing transverse energy using the variables α_T and b-quark multiplicity in pp collisions at $\sqrt{s} = 8$ TeV"
- [CMS-PAS-SUS-12-017](#) "Search for new physics in events with same-sign dileptons and b-tagged jets in pp collisions at $\sqrt{s} = 8$ TeV"
- [CMS-PAS-SUS-12-018](#) "Search for supersymmetry in events with photons and missing energy"
- [CMS-PAS-SUS-13-011](#) "Search for top-squark pair production in the single lepton final state in pp collisions at $\sqrt{s} = 8$ TeV"



Gauge-mediated Susy Breaking

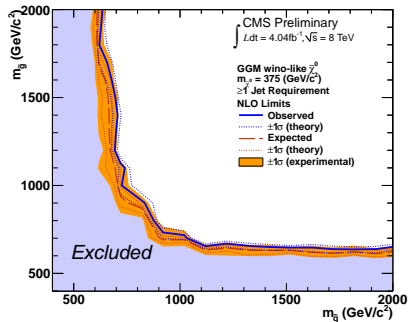
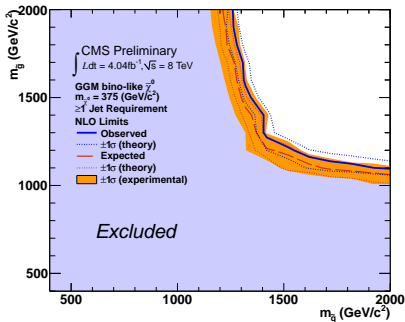
1 or 2 photons, jets, MET

1 or ≥ 2 taus, jets, MET

Di-photon analysis

CMS-PAS-SUS-12-018

- ▷ search for evidence of GGM SUSY production in di-photon events using MET spectrum spectrum beyond 100 GeV
- ▷ no evidence of SUSY GGM production



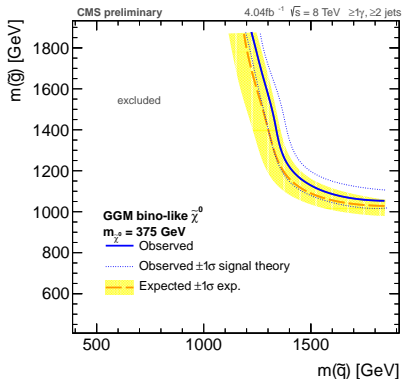
▷ bino-like neutralino

▷ wino-like neutralino

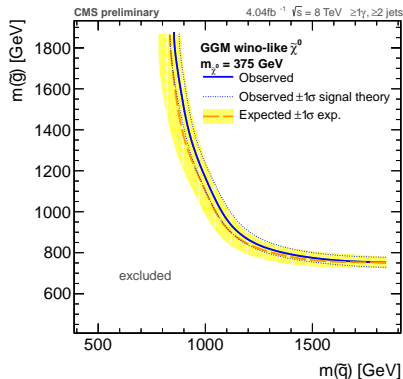
Single photon analysis

CMS-PAS-SUS-12-018

- ▷ search for evidence of GGM SUSY production in di-photon events using MET spectrum spectrum beyond 100 GeV
- ▷ no evidence of SUSY GGM production



- ▷ bino-like neutralino



- ▷ wino-like neutralino

1 or ≥ 2 taus, jets and MET

ATLAS-CONF-2013-026

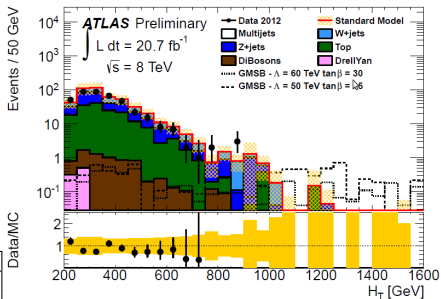
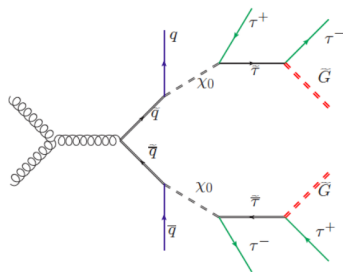
events
with taus produced in the neutralino decay

pre-selection

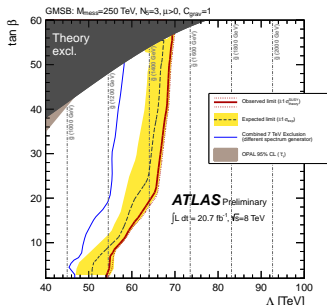
- 0 additional leptons (e, μ)
- $p_T^{\text{jet1}} > 130 \text{ GeV}, p_T^{\text{jet2}} > 30 \text{ GeV}$
- $\text{MET} > 150 \text{ GeV}$
- ≥ 1 medium tau with $p_T > 30 \text{ GeV}$
- ≥ 2 loose taus with $p_T > 20 \text{ GeV}$
- $\Delta\phi(\text{jets}, \text{MET})$ and $E_T^{\text{miss}}/m_{\text{eff}}$ cuts

backgrounds

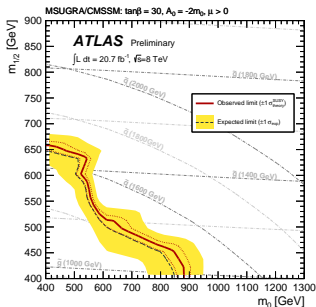
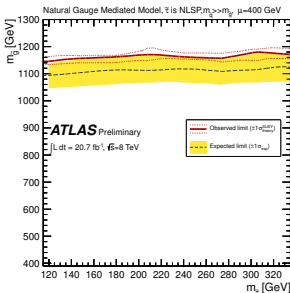
- Z and W + jets, top production
- multijet production estimated from data



Signal region	1 tau	2 tau GMSB	2 tau nGM
$M_T^T (M_T^{T1} + M_T^{T2})$	140 GeV	150 GeV	250 GeV
H_T	800 GeV	900 GeV	600 GeV



	Expected	Observed
1 τ	$4.9 \pm 1.5 \pm 1.3$	3
2 τ GMSB	$7.2 \pm 1.3 \pm 1.6$	5
2 τ nGM	$3.5 \pm 1.1 \pm 1.9$	1



no excess above the SM background is observed

GMSB model: limit on the SUSY breaking scale Λ of 54 TeV, independent of $\tan \beta$

mSUGRA/CMSSM: result of the 1 τ analysis

nGM: the result of the 2 τ analysis can be translated into a limit on the gluino mass of 1140 GeV independent of $\tilde{\tau}$ mass