# SEARCHES FOR SUPERSYMMETRY WITH JETS + MET + X WITH THE ATLAS DETECTOR AT THE LHC

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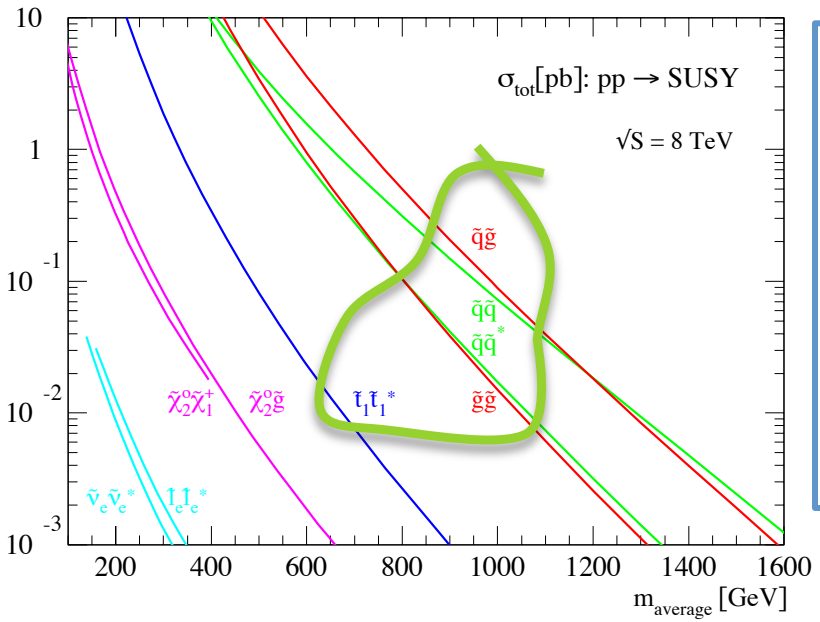
ATLAS EXPERIMENT http://atlas.ch

# Overview

General overview of Supersymmetry (SUSY) searches at ATLAS targeting final states with jets and missing transverse momentum (MET).

R-parity conservation → MET from escaping LSPs

Quarks from gluino and squark decays → jets in the final state

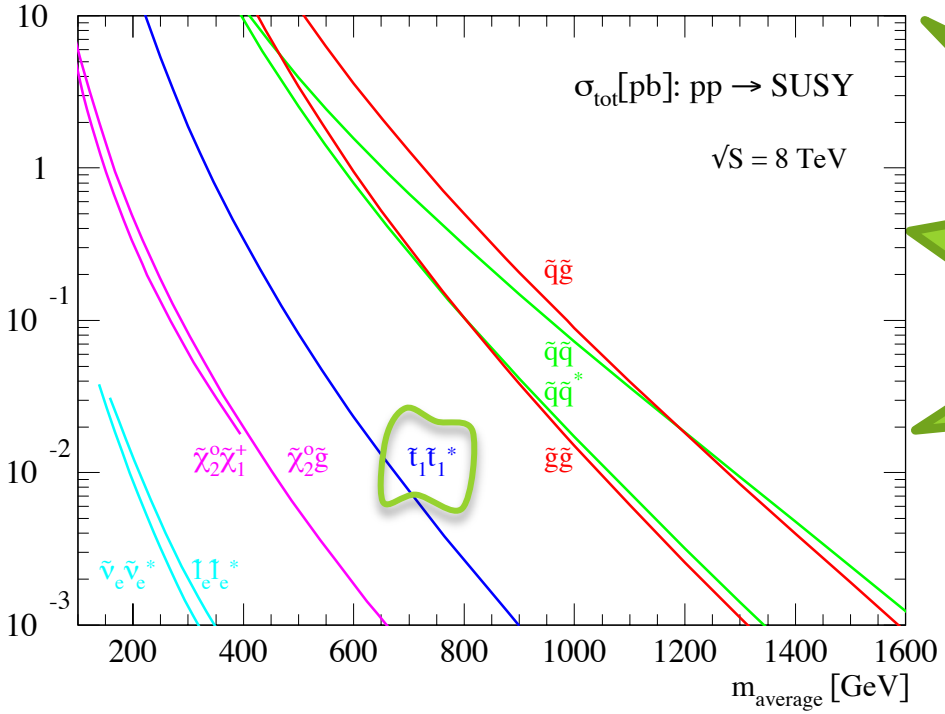



Presented here

Direct production of 3rd generation squarks
- 2 same-sign leptons *[ATLAS-CONF-2013-007]*
- 0/1-lepton, ≥3 b-jets *[ATLAS-CONF-2013-061]*

Gluino mediated production of 3rd generation squarks
- 1-lepton + b-jets *[ATLAS-CONF-2013-037]*

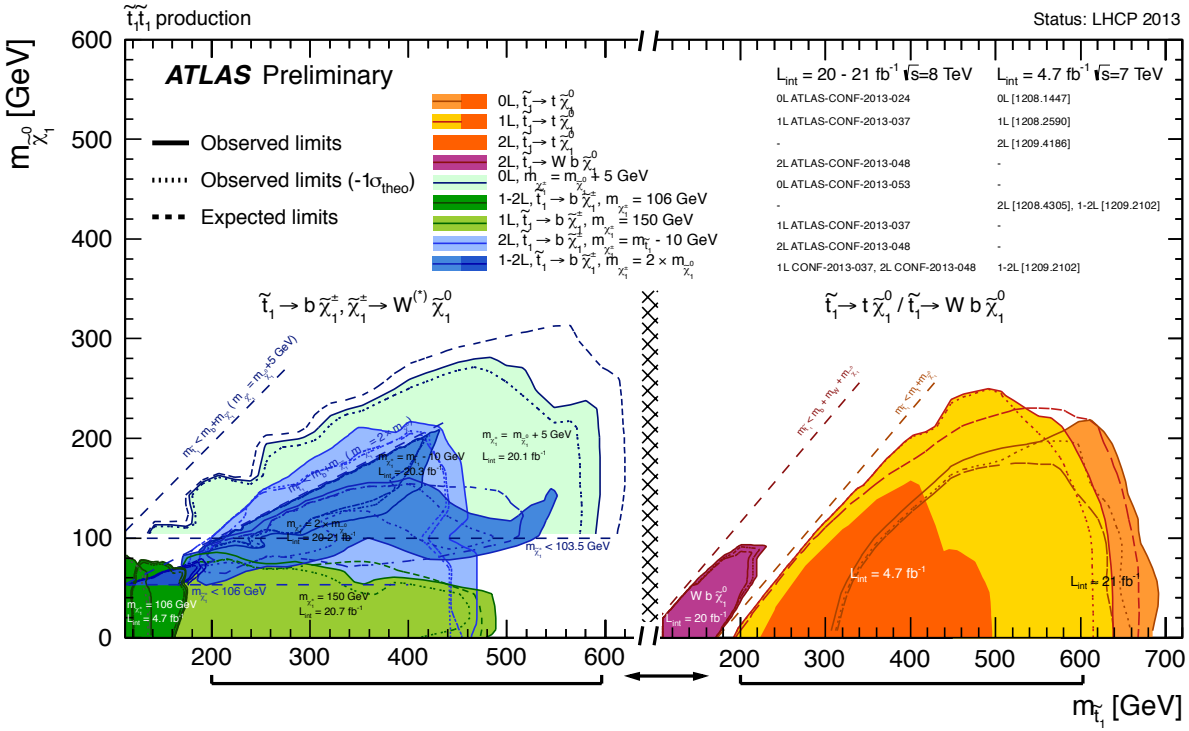
Inclusive strong production
- 0-lepton + 2-6 jets *[ATLAS-CONF-2013-047]*

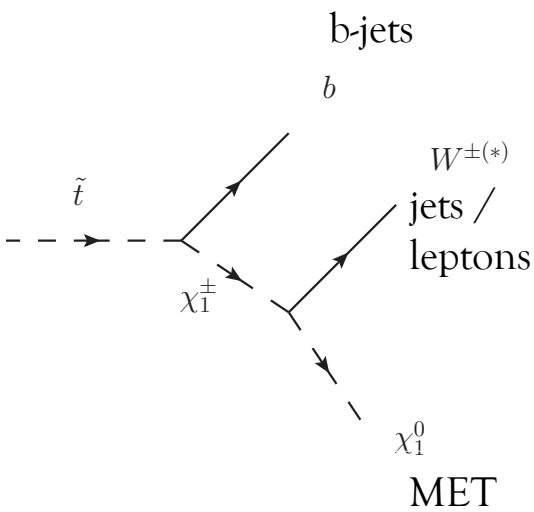



Stops / Sbottoms produced in pairs, with cross section more than a magnitude lower than 1st/2nd generation squarks.

# DIRECT STOP/SBOTTOM PRODUCTION

# Direct stop/sbottom overview




**Wide range of ATLAS analyses targeting direct stop / sbottom production**

*All analyses using full 2012 dataset*

- 0L + 2b + MET ($\tilde{b} \to b\tilde{\chi}_1^0$ and $\tilde{t} \to b\tilde{\chi}_1^{\pm}$) [*ATLAS-CONF-2013-053*]
- 0L + 6 (2 b-)jets + MET ($\tilde{t} \to t\tilde{\chi}_1^0$ with fully hadronic final state) [*ATLAS-CONF-2013-024*]
- **1L + 4(1 b-)jets + MET** [*ATLAS-CONF-2013-037*]
- 2L (+ jets) + MET ($\tilde{t} \to b\tilde{\chi}_1^{\pm}$ for large N1-C1 hierarchy) [*ATLAS-CONF-2013-048*]
- Z + b-jets + MET (stop in GMSB, stop2 pair production) [*ATLAS-CONF-2013-025*]

# 1 lepton + 4 jets (≥1 b-jet) + MET

Six signal regions catered towards:

- Direct stop: $\tilde{t} \to b\tilde{\chi}_1^{\pm}$ (SRbC1-3)
- Direct stop: $\tilde{t} \to t\tilde{\chi}_1^{0}$ (SRtN1-3)

- SRbC2/3 high $p_T$ b-jets
  → enhances sensitivity to high stop masses.
- SRtN1 shape fit in MET / $m_T$
  → models with a ~mass degenerate stop.

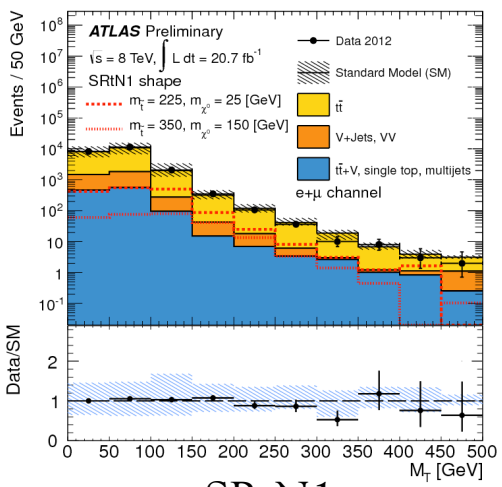
$m_{\tilde{t}_1} \gtrsim m_t + m_{\tilde{\chi}_1^0}$ large $m_{\tilde{\chi}_1^0}$ large $m_{\tilde{t}}$

SRtN1 *Loose* → SRtN2 → *Tight* SRtN3

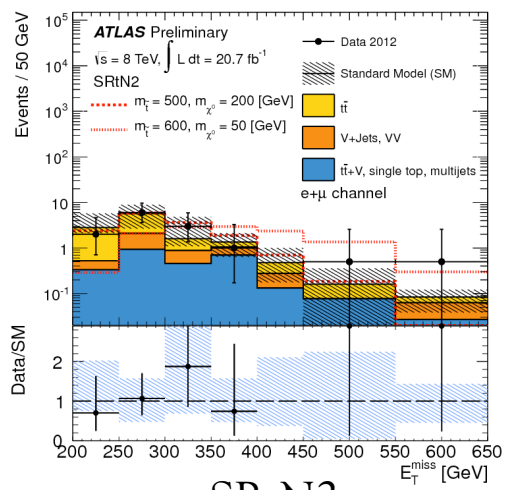
MET>100 GeV MET>200 GeV MET>275 GeV

$M_T$>60 GeV $M_T$>140 GeV $M_T$>200 GeV

**Dominant background:**
**SRtN** – dileptonic ttbar (1-lepton out of acceptance)
**SRbC** – dileptonic ttbar (W→ $\tau$ $\nu$ )




SRtN1




SRtN2

**SRtN** - Requirement on 3-jet mass 130<($m_{jjj}$)<205 GeV
→ Reconstruct hadronically decaying top quark
→ Reject dileptonic ttbar background with WW→l $\nu$ l $\nu$
**SRbC** - Veto events with isolated tracks (tau)

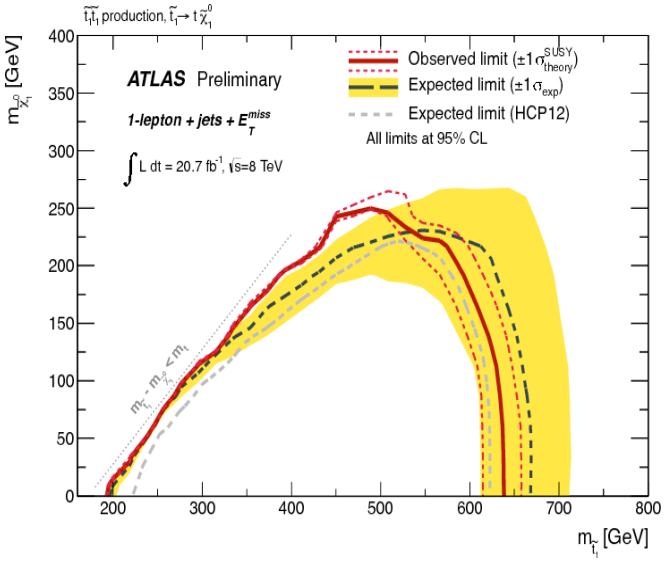
$$m_T = \sqrt{2p_T^{\ell}\mathrm{MET}(1 - cos[\Delta\phi(\ell, \mathrm{MET})])}$$

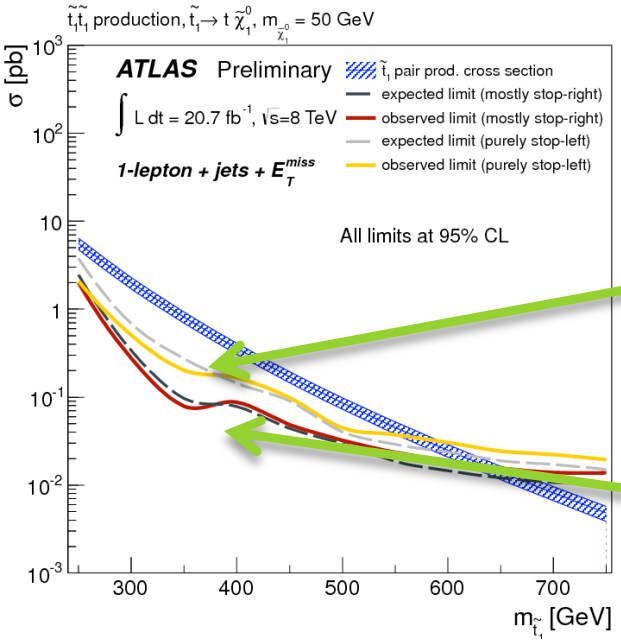
# 1 lepton + 4 jets (≥1 b-jet) + MET - Results

**Set limits at 95% C.L.**

Model:

- stop pair production with BR($\tilde{t} \rightarrow t\tilde{\chi}_1^0$) = 100 %
- $\tilde{t}_1$ mostly $\tilde{t}_R$ (~70%)




Dependence of limits on stop chirality!

purely left-handed stops

Lesser limit for $\tilde{t}_L$ mainly a consequence of reduced lepton acceptance.

~70% right-handed stops

Exclusion reach in stop mass suffers by ~75 GeV for a given LSP mass

DIRECT STOP/SBOTTOM PRODUCTION

# 1 lepton + 4 jets (≥1 b-jet) + MET - Results

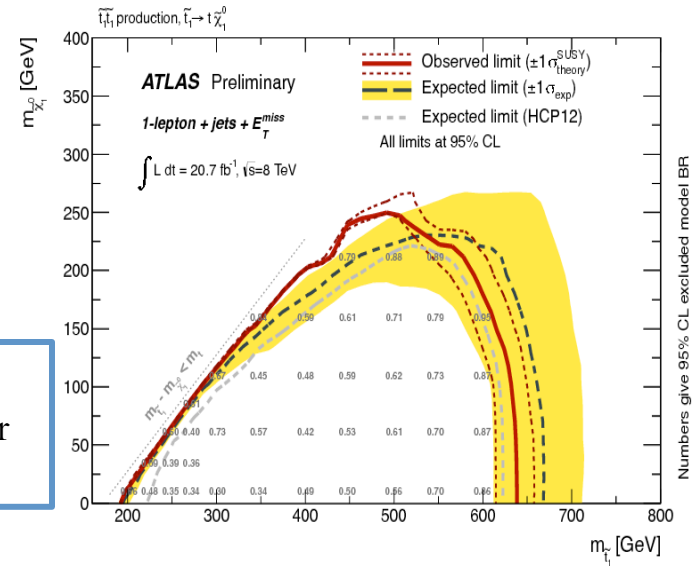


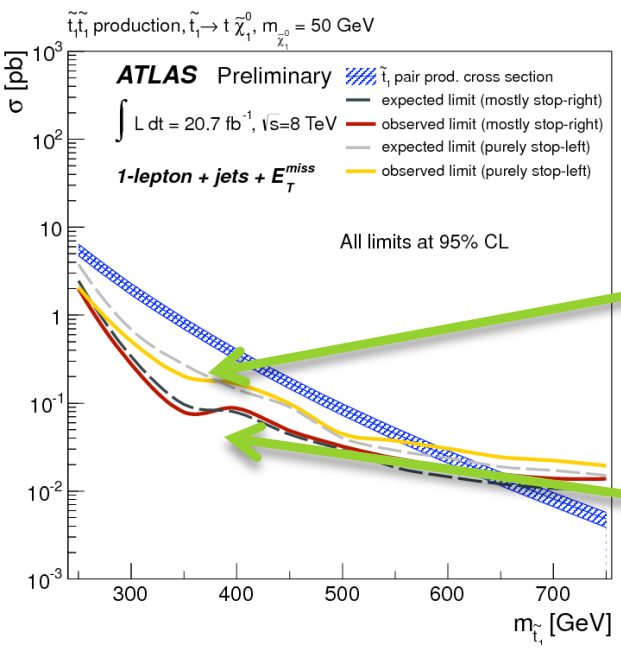
**Set limits at 95% C.L.**

Model:

- stop pair production with BR($\tilde{t} \rightarrow t\tilde{\chi}_1^0$) = 100 %
- $\tilde{t}_1$ mostly $\tilde{t}_R$ (~70%)

No? → Limits on BR (neglects contributions from other decay modes)



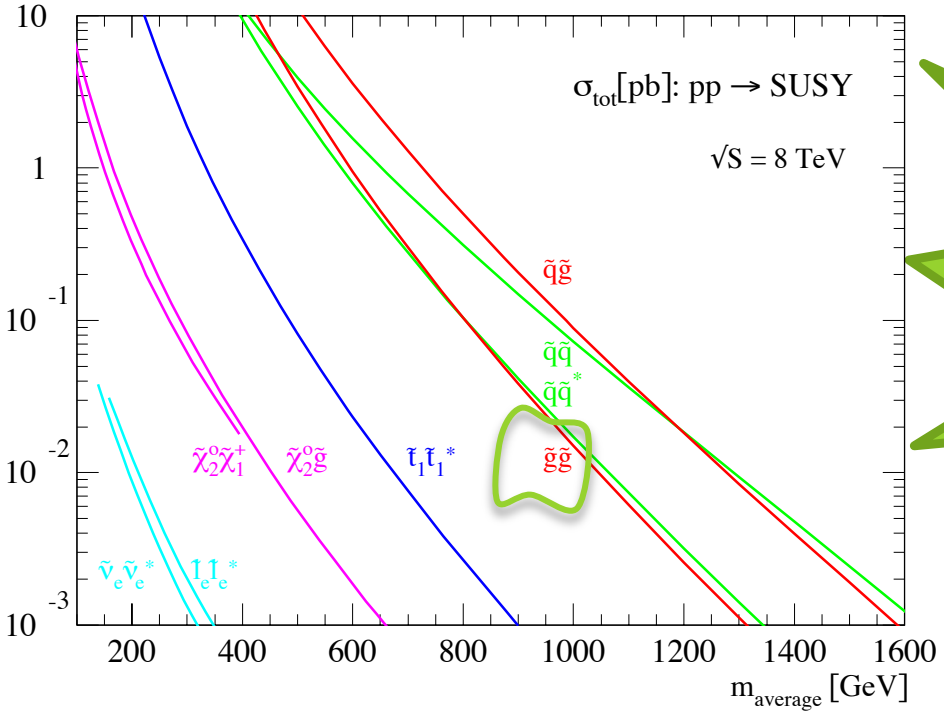

Dependence of limits on stop chirality!

purely left-handed stops

Lesser limit for $\tilde{t}_L$ mainly a consequence of reduced lepton acceptance.

~70% right-handed stops

Exclusion reach in stop mass suffers by ~75 GeV for a given LSP mass

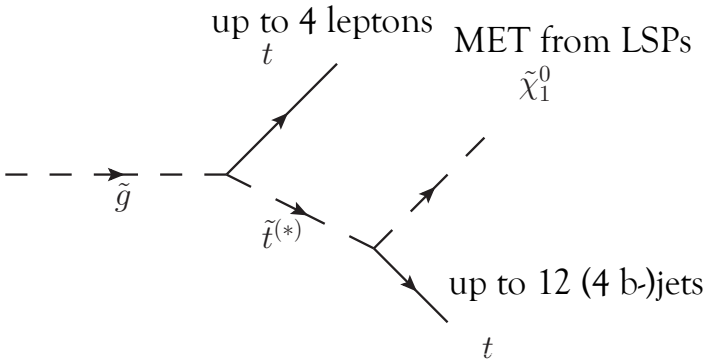


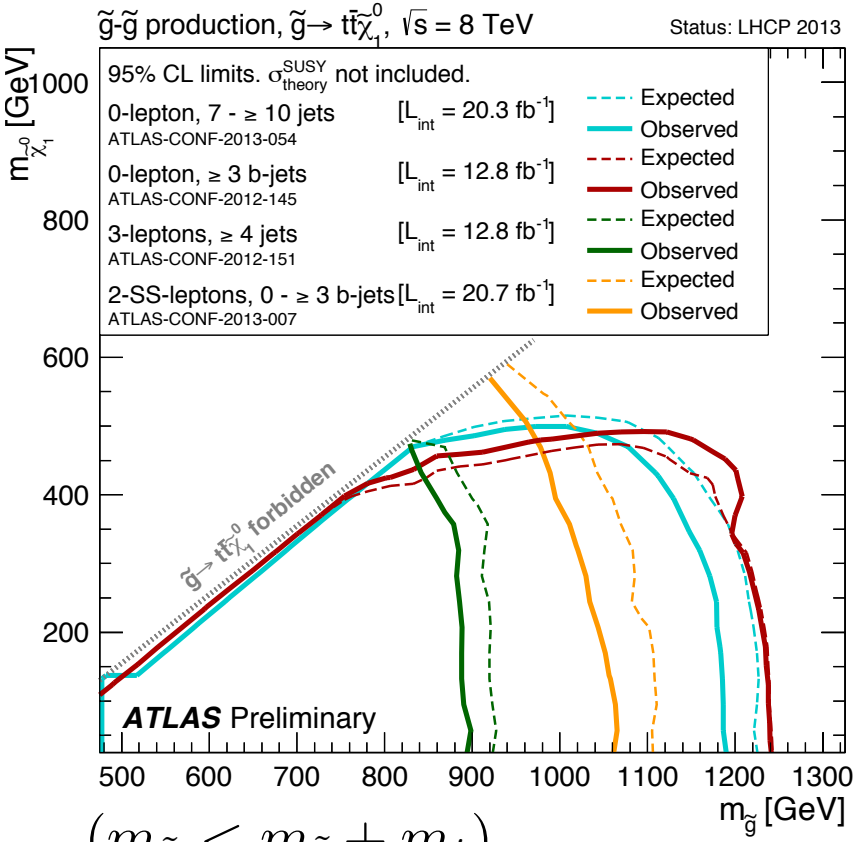

Gluinos produced in pairs
→ decay via on- and off-shell stops or sbottoms

# GLUINO MEDIATED STOP/ SBOTTOM PRODUCTION

# Gluino mediated stop/sbottom production - overview

**Limits set on simplified topologies with gluinos decaying via thrid generation squarks**
(Assume 100% BR)




$(m_{\tilde{g}} < m_{\tilde{t}} + m_t)$

## Several ATLAS analyses targeting this model

0-lepton + ≥ 3 b-jets [ATLAS-CONF-2012-145]
*(12.8fb$^{-1}$ – updated to fill 2012 dataset ATLAS-CONF-2013-061)*
→ high sensitivity for large gluino masses.

2 same-sign (SS) leptons [ATLAS-CONF-2013-007]
→ SS leptons resulting from gluino pair production (*Majorana fermions*).

0-lepton + multijet (7 to 10 jets)
[ATLAS-CONF-2012-103]

3-leptons + jets + MET [ATLAS- CONF-2012-151]

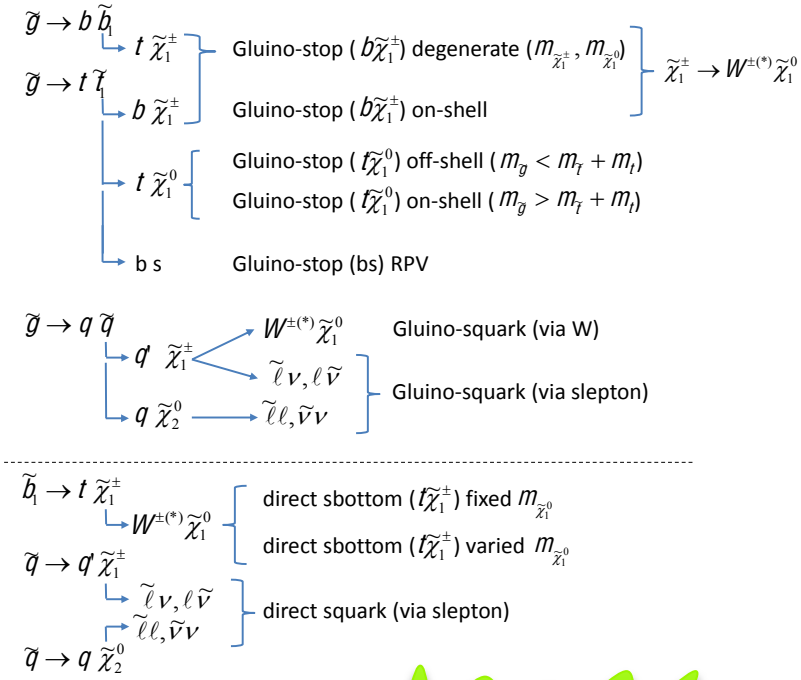
# 2 Same-sign (SS) leptons + (b-)jets + MET

**General signature for new physics!**
*Gluino pair production primary SS channel.*
Can extend signal region sensitivity to include:

- direct sbottom production
- direct squark production
- direct gluino production with additional decay modes

**Select events with two same sign leptons (e, $\mu$ )**
→ SM background suppressed
**Cut on:**

- effective mass, $m_{\rm eff} = \sum_j p_{\rm T}^j + \sum_l p_{\rm T}^l + {\rm MET}$
- missing transverse momentum (MET)
- $m_{\rm T}$ (between leading lepton + MET)
- (b-)jet multiplicity $m_T = \sqrt{2p_{\rm T}^{\ell}{\rm MET}(1 - cos[\Delta\phi(\ell, {\rm MET})])}$




| Signal region | $N_{b-jets}$ | Signal cuts (discovery case) | Signal cuts (exclusion case) |
|---|---|---|---|
| SR0b | 0 | $N_{\rm jets} \geq 3$, $E_{\rm T}^{\rm miss} > 150$ GeV | $N_{\rm jets} \geq 3$, $E_{\rm T}^{\rm miss} > 150$ GeV, $m_{\rm T} > 100$ GeV, |
| | | $m_{\rm T} > 100$ GeV, $m_{\rm eff} > 400$ GeV | binned shape fit in $m_{\rm eff}$ for $m_{\rm eff} > 300$ GeV |
| SR1b | ≥1 | $N_{\rm jets} \geq 3$, $E_{\rm T}^{\rm miss} > 150$ GeV | $N_{\rm jets} \geq 3$, $E_{\rm T}^{\rm miss} > 150$ GeV, $m_{\rm T} > 100$ GeV, |
| | | $m_{\rm T} > 100$ GeV, $m_{\rm eff} > 700$ GeV | binned shape fit in $m_{\rm eff}$ for $m_{\rm eff} > 300$ GeV |
| SR3b | ≥3 | $N_{\rm jets} \geq 4$ | $N_{\rm jets} \geq 5$, |
| | | - | $E_{\rm T}^{\rm miss} < 150$ GeV or $m_{\rm T} < 100$ GeV |

Main backgrounds

ttbar+V, dibosons
→ MC

Fake leptons
→ matrix method

Charge mis-identification
→ electron charge flip rate measured in Z-peak

GLUINO MEDIATED STOP/SBOTTOM PRODUCTION

# 2 SS leptons - Results



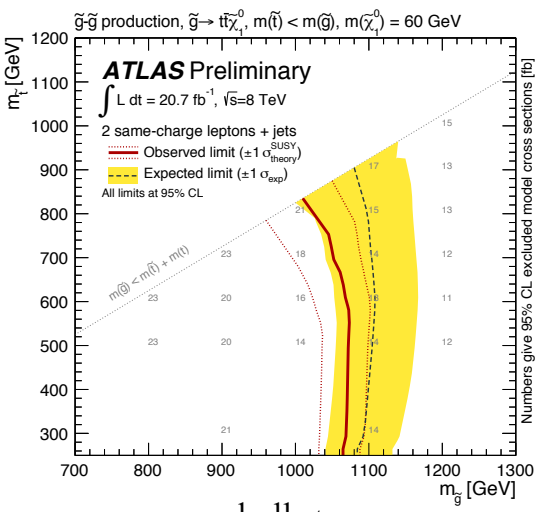
No excess observed over Standard Model (SM) expectation

Limits set on several simplified models with differing assumptions made on the chargino mass.

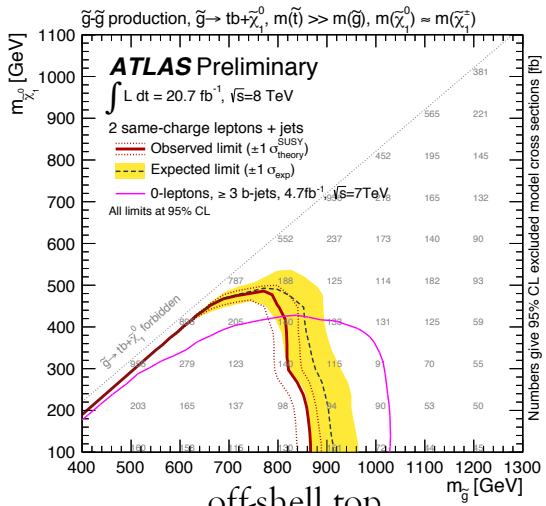
| B) Exclusion case | SR0b | SR1b | SR3b |
|---|---|---|---|
| Observed events | 5 | 11 | 1 |
| Expected background events | 7.5 ± 3.2 | 10.1 ± 3.9 | 1.8 ± 1.3 |
| Expected $t\bar{t} + V$ events | 0.5 ± 0.4 | 3.4 ± 1.5 | 0.6 ± 0.4 |
| Expected diboson events | 3.4 ± 1.1 | 1.4 ± 0.7 | < 0.1 |
| Expected fake lepton events | 3.4 ± 2.9 | 4.4 ± 3.1 | 1.0 ± 1.1 |
| Expected charge mis-measurement events | 0.2 ± 0.1 | 0.8 ± 0.3 | 0.1 ± 0.1 |
| $p_0$ | 0.5 | 0.39 | 0.5 |

$$\tilde{g} \rightarrow t\tilde{t} \rightarrow tt\tilde{\chi}_1^0$$

$$\tilde{g} \rightarrow t\tilde{t} \rightarrow tb\tilde{\chi}_1^{\pm}$$

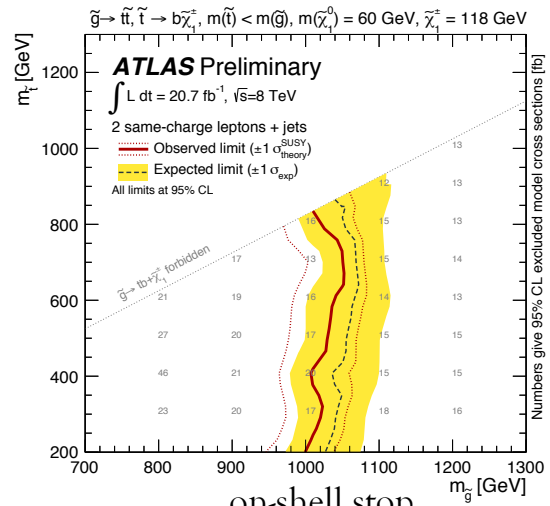



on-shell stop




off-shell top

$\Delta m(\tilde{\chi}_1^{\pm}, \tilde{\chi}_1^0) \sim 2$ GeV




on-shell stop

$\Delta m(\tilde{\chi}_1^{\pm}, \tilde{\chi}_1^0) \sim 60$ GeV

# 0-lepton + ≥3 b-jets

**Best sensitivity for gluino mediated stop/sbottom production over range of gluino masses**

*12.8 fb$^{-1}$ analysis*

*20.1 fb$^{-1}$ analysis*

sbottom production

Common criteria: lepton veto, $p_T^{j_1} > 90$ GeV, $E_T^{miss} > 200$ GeV, $\geq 3$ $b$-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 | $\geq 4$ jets | $> 50$ GeV | $m_{eff}^{4j} > 900/1100/1300$ GeV |
| SR6-L/M/T | $\geq 6$ jets | $> 30$ GeV | $m_{eff}^{incl} > 1100/1300/1500$ GeV |

Upped jet-multiplicity and $m_{eff}$ cuts on 0-lepton SRs → extend search reach.

Addition of 1-lepton SRs → combination increases sensitivity for stop searches

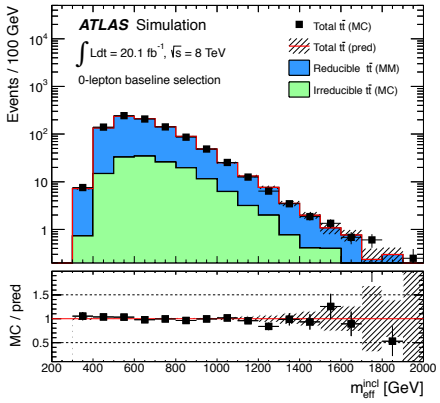
stop production

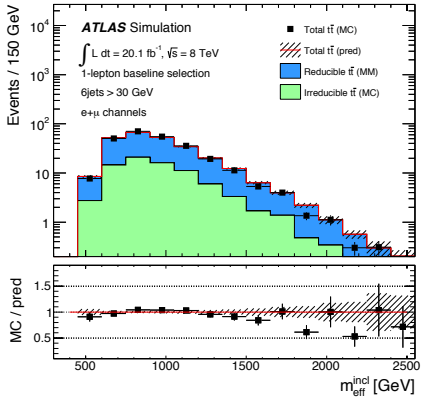
MET

MET/$\sqrt{H_T^{4j}}$

$m_{eff}$

**Dominant background: reducible ttbar+jets**
(c-jet / tau-lepton mistagged as a b-jet)




Reducible backgrounds simultaneously estimated using data-driven technique

mistag rate

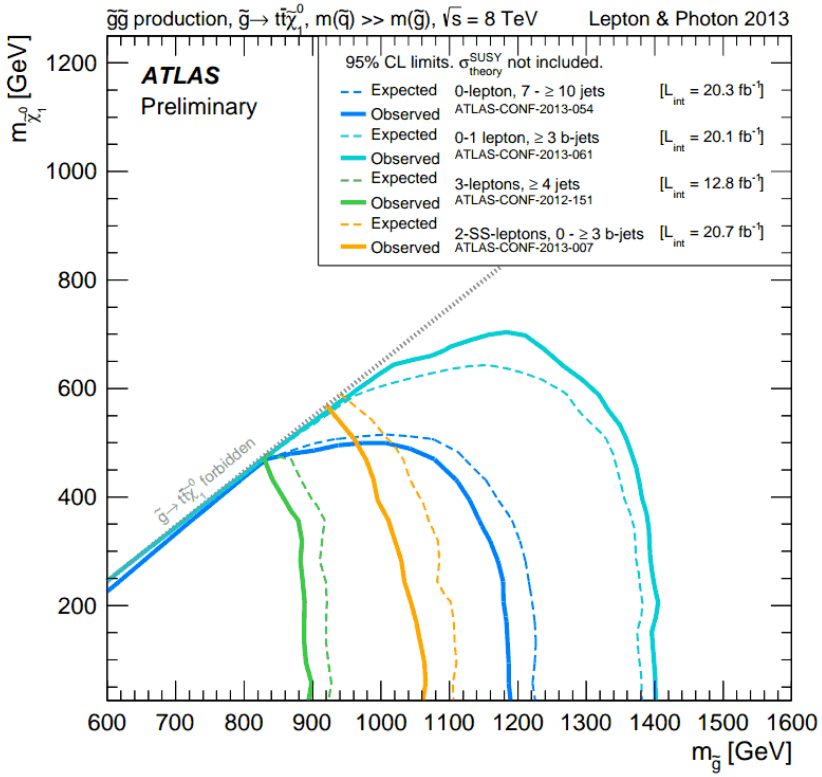
number of (non-)b-jets

tagging efficiency

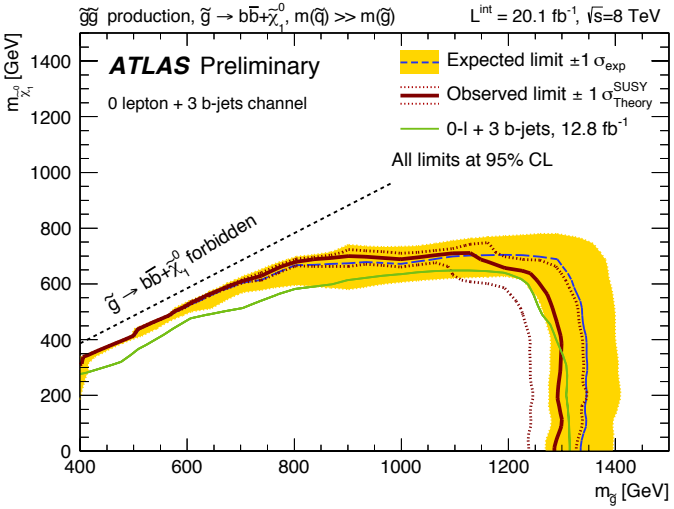
# 0/1-lepton, ≥ 3 b-jets + MET

**Exclusion limits at 95% C.L.:**

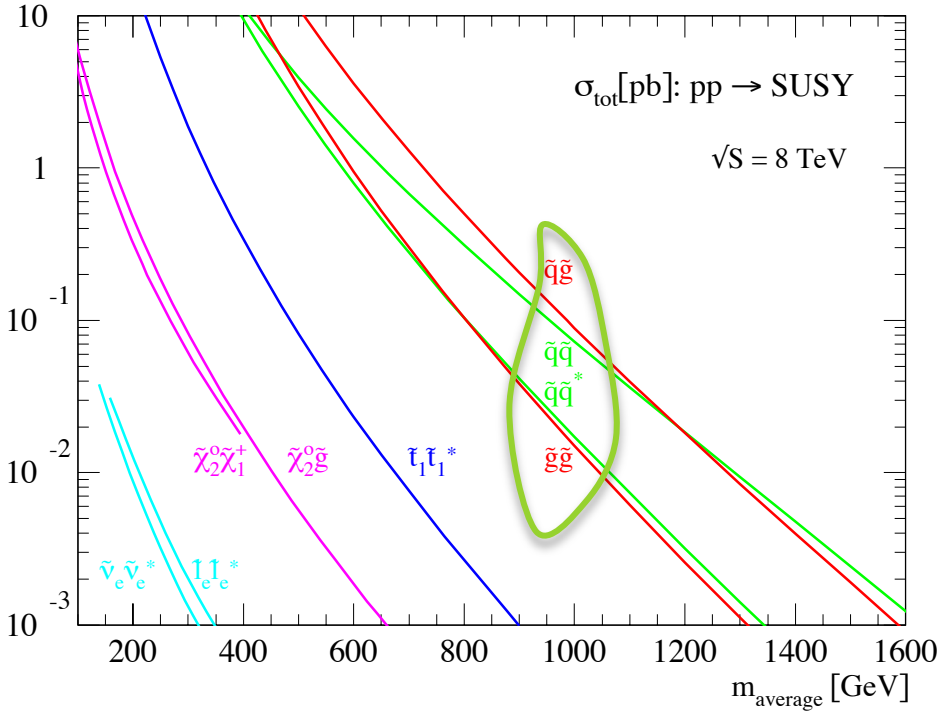
- gluino pair production with BR( $\tilde{g} \rightarrow b\bar{b}\tilde{\chi}_1^0$ ) = 100%
- gluino pair production with BR( $\tilde{g} \rightarrow t\bar{t}\tilde{\chi}_1^0$ ) = 100%
- gluino pair production with BR( $\tilde{g} \rightarrow b\bar{t}\tilde{\chi}_1^0$ ) = 100%




Significant improvement in reach for gluino-mediated stop/sbottom simplified models




GLUINO MEDIATED STOP/SBOTTOM PRODUCTION

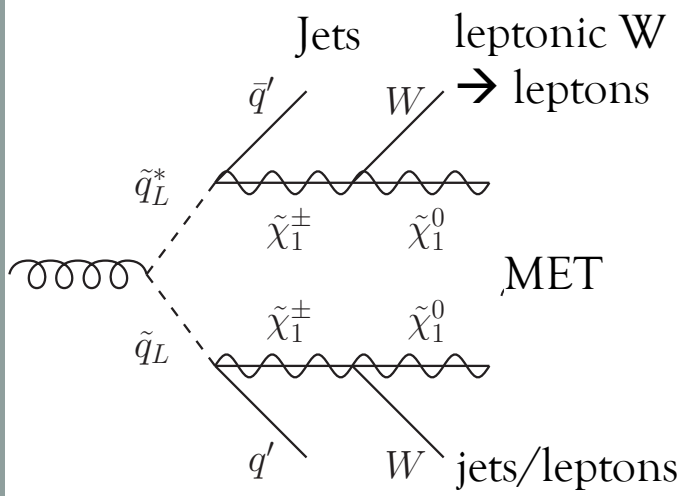



Gluinos / squarks produced in pairs → decay to jets and X

# INCLUSIVE STRONG PRODUCTION

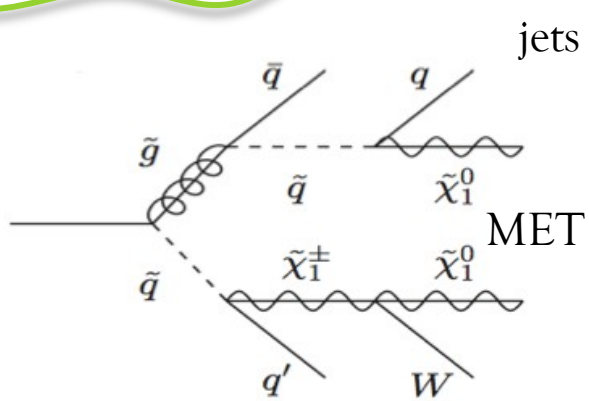
# Inclusive strong production - overview

**Analyses targeting models with direct production of gluinos/squarks**




Powerful reach with fully hadronic final state

Lepton veto (e, $\mu$ )
High MET (>160 GeV)
Jet $p_T$>130, 60 GeV
Jet + MET triggers




hadronic W
→ more jets

Leptons can be produced in decay chains with W's, Z's and sleptons

Multijet analysis targets longer decay chains

Remember me?

- 2 same-sign (SS) leptons [ATLAS-CONF-2013-007]
- 1-(soft/hard) lepton + jets + MET [ATLAS-CONF-2013-062]

- 0L + 2-6 jets + MET [ATLAS-CONF-2013-047]
- 0L + 7-10 jets + MET [ATLAS-CONF-2013-054]

# 0-lepton, 2-6 jets + MET

**Search channels catered towards a range of SUSY models**

$\tilde{q}\,\tilde{q}$ ≥2 jets  $\tilde{q}\,\tilde{g}$ ≥3 jets  $\tilde{g}\,\tilde{g}$ ≥4 jets

Inclusive search channels: ≥2,3,4,5,6 jets

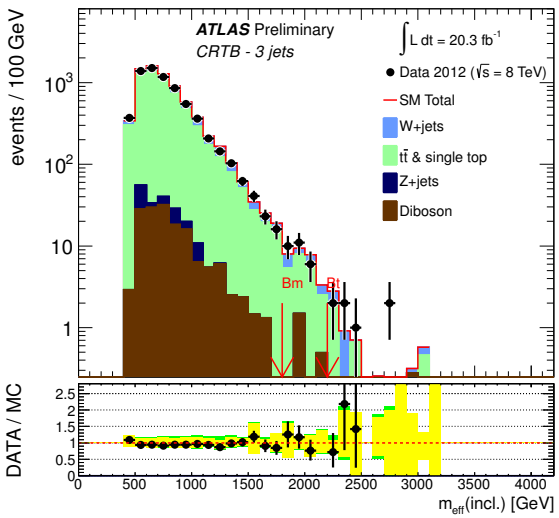
$m_{\mathrm{eff}}$

$\mathrm{MET}/m_{\mathrm{eff}}(N_j)$

$\Delta\phi(\mathrm{jet}_i, \mathrm{MET})_{\mathrm{min}}$

one control region per background per SR

| Z+jets $Z \rightarrow \nu\bar{\nu}$ (high MET) | W+jets (hadronic tau / lepton out of acc.) | ttbar / single top | multijets |
|---|---|---|---|
| Isolated photon + jets | 1 isolated lepton $p_T$>25 GeV 30<$m_T$(l,MET)<100 GeV | | Reverse QCD rejection cuts |



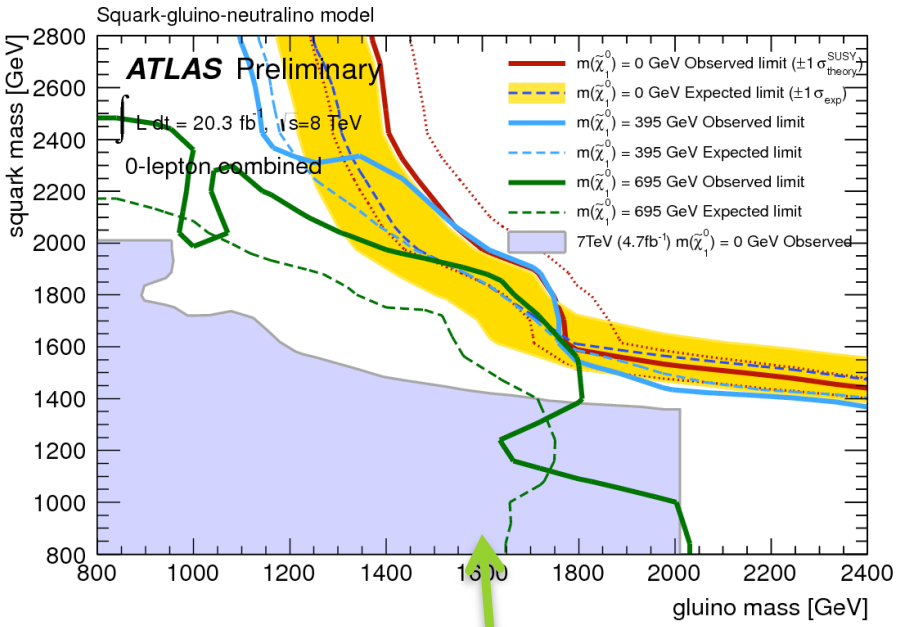

Data-MC agreement in the top CR for the 4 jet channel

CR → SR transfer factors from MC (data for multijets)

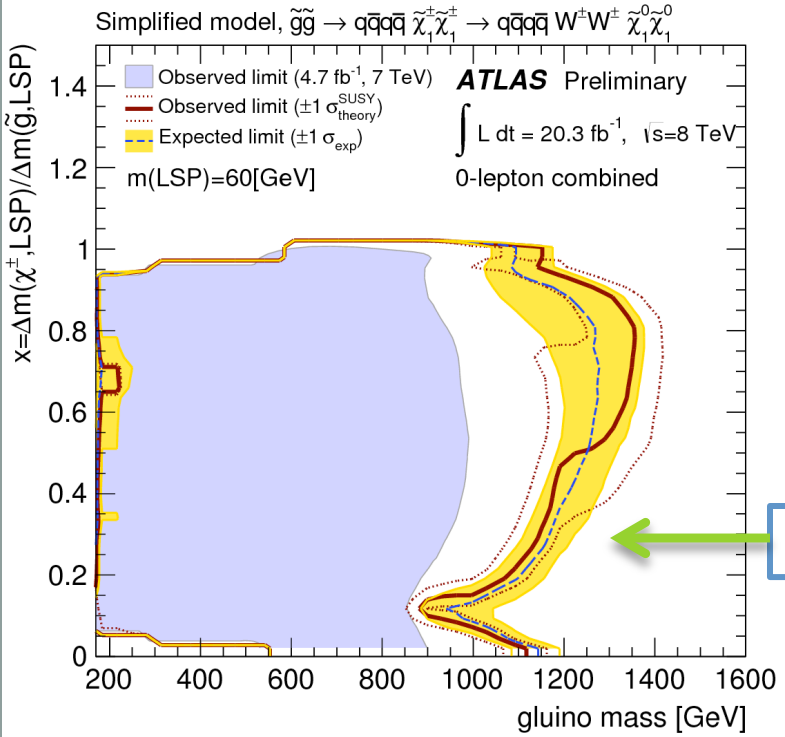
Background estimations are cross-checked using dedicated VALIDATION regions

# 0-lepton, 2-6 Jets + MET - results

Good agreement between SM expectation and data in the signal regions
→ Exclusion limits set on a variety of simplified model grids.




Simplified MSSM scenario
- production gluinos and first/second generation squarks only
- direct decays to jets and LSP




Gluino → qq' + chargino → W + LSP

$$x = \frac{(m_{\tilde{\chi}_1^\pm} - m_{\mathrm{LSP}})}{(m_{\tilde{g}} - m_{\mathrm{LSP}})}$$

## Conclusions



- Many SUSY searches completed and ongoing within ATLAS
- Searches targeting final states with MET and jets constitute a large portion of these analyses (though there are many more!)
- More results expected for the Summer
- Many results are interpreted for simplified models with BR(*specific decay*) =100% (*upper limit on* $\sigma_{vis}$ *available for all points)*
  - Input from wider community most welcome!
- Scope for further R&D, combinations and reinterpretations of analyses this year, and in preparation for 2015

# ATLAS SUSY Summary



## ATLAS SUSY Searches* - 95% CL Lower Limits

Status: LP 2013

**ATLAS** Preliminary

$\int \mathcal{L}\, dt = (4.4 - 22.9)\ \mathrm{fb}^{-1}$ $\sqrt{s} = 7, 8$ TeV

| | Model | $e, \mu, \tau, \gamma$ | Jets | $E_T^{miss}$ | $\int \mathcal{L}\, dt [\mathrm{fb}^{-1}]$ | Mass limit | | Reference |
|---|---|---|---|---|---|---|---|---|
| Inclusive Searches | MSUGRA/CMSSM | 1 $e, \mu$ | 3-6 jets | Yes | 20.3 | $\tilde{q}$ 1.2 TeV | any $m(\tilde{q})$ | ATLAS-CONF-2013-062 |
| | MSUGRA/CMSSM | 0 | 7-10 jets | Yes | 20.3 | $\tilde{g}$ 1.1 TeV | any $m(\tilde{q})$ | ATLAS-CONF-2013-054 |
| | $\tilde{q}\tilde{q}, \tilde{q}\to q\tilde{\chi}_1^0$ | 0 | 2-6 jets | Yes | 20.3 | $\tilde{q}$ 740 GeV | $m(\tilde{\chi}_1^0)$=0 GeV | ATLAS-CONF-2013-047 |
| | $\tilde{g}\tilde{g}, \tilde{g}\to q\bar{q}\tilde{\chi}_1^0$ | 0 | 2-6 jets | Yes | 20.3 | $\tilde{g}$ 1.3 TeV | $m(\tilde{\chi}_1^0)$=0 GeV | ATLAS-CONF-2013-047 |
| | $\tilde{g}\tilde{g}, \tilde{g}\to qq\tilde{\chi}_1^\pm\to qqW^\pm\tilde{\chi}_1^0$ | 1 $e, \mu$ | 3-6 jets | Yes | 20.3 | $\tilde{g}$ 1.18 TeV | $m(\tilde{\chi}_1^0)$<200 GeV, $m(\tilde{\chi}^\pm)$=0.5($m(\tilde{\chi}_1^0)$+$m(\tilde{g})$) | ATLAS-CONF-2013-062 |
| | $\tilde{g}\tilde{g}\to qqqq\ell\ell(\ell\ell)\tilde{\chi}_1^0\tilde{\chi}_1^0$ | 2 $e, \mu$ (SS) | 3 jets | Yes | 20.7 | $\tilde{g}$ 1.1 TeV | $m(\tilde{\chi}_1^0)$<650 GeV | ATLAS-CONF-2013-007 |
| | GMSB ($\tilde{\ell}$ NLSP) | 2 $e, \mu$ | 2-4 jets | Yes | 4.7 | $\tilde{\tau}_1$ 1.24 TeV | tan$\beta$<15 | 1208.4688 |
| | GMSB ($\tilde{\ell}$ NLSP) | 1-2 $\tau$ | 0-2 jets | Yes | 20.7 | $\tilde{g}$ 1.4 TeV | tan$\beta$ >18 | ATLAS-CONF-2013-026 |
| | GGM (bino NLSP) | 2 $\gamma$ | 0 | Yes | 4.8 | $\tilde{B}_1$ 1.07 TeV | $m(\tilde{\chi}_1^0)$>50 GeV | 1209.0753 |
| | GGM (wino NLSP) | 1 $e, \mu + \gamma$ | 0 | Yes | 4.8 | $\tilde{B}_1$ 619 GeV | $m(\tilde{\chi}_1^0)$>50 GeV | ATLAS-CONF-2012-144 |
| | GGM (higgsino-bino NLSP) | $\gamma$ | 1 $b$ | Yes | 4.8 | $\tilde{B}_1$ 900 GeV | $m(\tilde{\chi}_1^0)$>220 GeV | 1211.1167 |
| | GGM (higgsino NLSP) | 2 $e, \mu$ ($Z$) | 0-3 jets | Yes | 5.8 | $\tilde{B}_1$ 690 GeV | $m(\tilde{H})$>200 GeV | ATLAS-CONF-2012-152 |
| | Gravitino LSP | 0 | mono-jet | Yes | 10.5 | $F^{1/2}$ scale 645 GeV | $m(\tilde{G})$>$10^{-4}$ eV | ATLAS-CONF-2012-147 |
| 3rd gen. $\tilde{g}$ med. | $\tilde{g}\to b\bar{b}\tilde{\chi}_1^0$ | 0 | 3 $b$ | Yes | 20.1 | $\tilde{g}$ 1.2 TeV | $m(\tilde{\chi}_1^0)$<600 GeV | ATLAS-CONF-2013-061 |
| | $\tilde{g}\to t\bar{t}\tilde{\chi}_1^0$ | 0 | 7-10 jets | Yes | 20.3 | $\tilde{g}$ 1.14 TeV | $m(\tilde{\chi}_1^0)$ <200 GeV | ATLAS-CONF-2013-054 |
| | $\tilde{g}\to t\bar{t}\tilde{\chi}_1^0$ | 0-1 $e, \mu$ | 3 $b$ | Yes | 20.1 | $\tilde{g}$ 1.34 TeV | $m(\tilde{\chi}_1^0)$<400 GeV | ATLAS-CONF-2013-061 |
| | $\tilde{g}\to b\bar{t}\tilde{\chi}_1^+$ | 0-1 $e, \mu$ | 3 $b$ | Yes | 20.1 | $\tilde{g}$ 1.3 TeV | $m(\tilde{\chi}_1^0)$<300 GeV | ATLAS-CONF-2013-061 |
| 3rd gen. squarks direct production | $\tilde{b}_1\tilde{b}_1, \tilde{b}_1\to b\tilde{\chi}_1^0$ | 0 | 2 $b$ | Yes | 20.1 | $\tilde{b}_1$ 100-630 GeV | $m(\tilde{\chi}_1^0)$<100 GeV | ATLAS-CONF-2013-053 |
| | $\tilde{b}_1\tilde{b}_1, \tilde{b}_1\to t\tilde{\chi}_1^\pm$ | 2 $e, \mu$ (SS) | 0-3 $b$ | Yes | 20.7 | $\tilde{b}_1$ 430 GeV | $m(\tilde{\chi}_1^0)$=2 $m(\tilde{\chi}_1^0)$ | ATLAS-CONF-2013-007 |
| | $\tilde{t}_1\tilde{t}_1$(light), $\tilde{t}_1\to b\tilde{\chi}_1^\pm$ | 1-2 $e, \mu$ | 1-2 $b$ | Yes | 4.7 | $\tilde{t}_1$ 167 GeV | $m(\tilde{\chi}_1^0)$=55 GeV | 1208.4305, 1209.2102 |
| | $\tilde{t}_1\tilde{t}_1$(light), $\tilde{t}_1\to Wb\tilde{\chi}_1^0$ | 2 $e, \mu$ | 0-2 jets | Yes | 20.3 | $\tilde{t}_1$ 220 GeV | $m(\tilde{\chi}_1^0)$ =$m(\tilde{t}_1)$-$m(W)$-50 GeV, $m(\tilde{t}_1)$<<$m(\tilde{\chi}_1^\pm)$ | ATLAS-CONF-2013-048 |
| | $\tilde{t}_1\tilde{t}_1$(medium), $\tilde{t}_1\to b\tilde{\chi}_1^\pm$ | 2 $e, \mu$ | 0-2 jets | Yes | 20.3 | $\tilde{t}_1$ 150-440 GeV | $m(\tilde{\chi}_1^0)$=0 GeV, $m(\tilde{t}_1)$-$m(\tilde{\chi}_1^\pm)$=10 GeV | ATLAS-CONF-2013-048 |
| | $\tilde{t}_1\tilde{t}_1$(medium), $\tilde{t}_1\to b\tilde{\chi}_1^\pm$ | 0 | 2 $b$ | Yes | 20.1 | $\tilde{t}_1$ 150-580 GeV | $m(\tilde{\chi}_1^0)$<200 GeV, $m(\tilde{\chi}_1^\pm)$-$m(\tilde{\chi}_1^0)$=5 GeV | ATLAS-CONF-2013-053 |
| | $\tilde{t}_1\tilde{t}_1$(heavy), $\tilde{t}_1\to t\tilde{\chi}_1^0$ | 1 $e, \mu$ | 1 $b$ | Yes | 20.7 | $\tilde{t}_1$ 200-610 GeV | $m(\tilde{\chi}_1^0)$=0 GeV | ATLAS-CONF-2013-037 |
| | $\tilde{t}_1\tilde{t}_1$(heavy), $\tilde{t}_1\to t\tilde{\chi}_1^0$ | 0 | 2 $b$ | Yes | 20.5 | $\tilde{t}_1$ 320-660 GeV | $m(\tilde{\chi}_1^0)$=0 GeV | ATLAS-CONF-2013-024 |
| | $\tilde{t}_1\tilde{t}_1$(natural GMSB) | 2 $e, \mu$ ($Z$) | 1 $b$ | Yes | 20.7 | $\tilde{t}_1$ 500 GeV | $m(\tilde{\chi}_1^0)$>150 GeV | ATLAS-CONF-2013-025 |
| | $\tilde{t}_2\tilde{t}_2, \tilde{t}_2\to\tilde{t}_1 + Z$ | 3 $e, \mu$ ($Z$) | 1 $b$ | Yes | 20.7 | $\tilde{t}_2$ 520 GeV | $m(\tilde{t}_2)$=$m(\tilde{t}_1^0)$+180 GeV | ATLAS-CONF-2013-025 |
| EW direct | $\tilde{\ell}_{L,R}\tilde{\ell}_{L,R}, \tilde{\ell}\to\ell\tilde{\chi}_1^0$ | 2 $e, \mu$ | 0 | Yes | 20.3 | $\tilde{\ell}$ 85-315 GeV | $m(\tilde{\chi}_1^0)$=0 GeV | ATLAS-CONF-2013-049 |
| | $\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to\tilde{\ell}\nu(\ell\tilde{\nu})$ | 2 $e, \mu$ | 0 | Yes | 20.3 | $\tilde{\chi}_1^\pm$ 125-450 GeV | $m(\tilde{\chi}_1^0)$=0 GeV, $m(\tilde{\ell},\tilde{\nu})$=0.5($m(\tilde{\chi}_1^\pm)$+$m(\tilde{\chi}_1^0)$) | ATLAS-CONF-2013-049 |
| | $\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to\tilde{\tau}\nu(\tau\tilde{\nu})$ | 2 $\tau$ | 0 | Yes | 20.7 | $\tilde{\chi}_1^\pm$ 180-330 GeV | $m(\tilde{\chi}_1^0)$=0 GeV, $m(\tilde{\tau},\tilde{\nu})$=0.5($m(\tilde{\chi}_1^\pm)$+$m(\tilde{\chi}_1^0)$) | ATLAS-CONF-2013-028 |
| | $\tilde{\chi}_1^\pm\tilde{\chi}_2^0\to\tilde{\ell}_L\nu\tilde{\ell}_L\ell(\tilde{\nu}\nu), \ell\tilde{\nu}\tilde{\ell}_L\ell(\tilde{\nu}\nu)$ | 3 $e, \mu$ | 0 | Yes | 20.7 | $\tilde{\chi}_1^\pm, \tilde{\chi}_2^0$ 600 GeV | $m(\tilde{\chi}_1^\pm)$=$m(\tilde{\chi}_2^0)$, $m(\tilde{\chi}_1^0)$=0, $m(\tilde{\ell},\tilde{\nu})$=0.5($m(\tilde{\chi}_1^\pm)$+$m(\tilde{\chi}_1^0)$) | ATLAS-CONF-2013-035 |
| | $\tilde{\chi}_1^\pm\tilde{\chi}_2^0\to W^\pm\tilde{\chi}_1^0 Z^*\tilde{\chi}_1^0$ | 3 $e, \mu$ | 0 | Yes | 20.7 | $\tilde{\chi}_1^\pm, \tilde{\chi}_2^0$ 315 GeV | $m(\tilde{\chi}_1^\pm)$=$m(\tilde{\chi}_2^0)$, $m(\tilde{\chi}_1^0)$=0, sleptons decoupled | ATLAS-CONF-2013-035 |
| Long-lived particles | Direct $\tilde{\chi}_1^+\tilde{\chi}_1^-$ prod., long-lived $\tilde{\chi}_1^\pm$ | 0 | 1 jet | Yes | 4.7 | $\tilde{\chi}_1^\pm$ 220 GeV | 1<$\tau(\tilde{\chi}_1^\pm)$<10 ns | 1210.2852 |
| | Stable, stopped $\tilde{g}$ R-hadron | 0 | 1-5 jets | Yes | 22.9 | $\tilde{g}$ 857 GeV | $m(\tilde{\chi}_1^0)$=100 GeV, 10 $\mu$s<$\tau(\tilde{g})$<100 s | ATLAS-CONF-2013-057 |
| | GMSB, stable $\tilde{\tau}$ | 1-2 $\mu$ | 0 | - | 15.9 | $\tilde{\tau}$ 385 GeV | 5<tan$\beta$<50 | ATLAS-CONF-2013-058 |
| | Direct $\tilde{\tau}\tilde{\tau}$ prod., stable $\tilde{\tau}$ or $\tilde{\ell}$ | 1-2 $\mu$ | 0 | - | 15.9 | $\tilde{\tau}$ 395 GeV | $m(\tilde{\tau})$=$m(\tilde{\ell})$ | ATLAS-CONF-2013-058 |
| | GMSB, $\tilde{\chi}_1^0\to\gamma\tilde{G}$, long-lived $\tilde{\chi}_1^0$ | 2 $\gamma$ | 0 | Yes | 4.7 | $\tilde{\chi}_1^0$ 230 GeV | 0.4<$\tau(\tilde{\chi}_1^0)$<2 ns | 1304.6310 |
| | $\tilde{\chi}_1^0\to qq\mu$ (RPV) | 1 $\mu$ | 0 | Yes | 4.4 | $\tilde{\chi}_1^0$ 700 GeV | 1 mm<$c\tau$<1 m, $\tilde{g}$ decoupled | 1210.7451 |
| RPV | LFV $pp\to\tilde{\nu}_\tau + X, \tilde{\nu}_\tau\to e + \mu$ | 2 $e, \mu$ | 0 | - | 4.6 | $\tilde{\nu}_\tau$ 1.61 TeV | $\lambda'_{311}$=0.10, $\lambda_{132}$=0.05 | 1212.1272 |
| | LFV $pp\to\tilde{\nu}_\tau + X, \tilde{\nu}_\tau\to e(\mu) + \tau$ | 1 $e, \mu + \tau$ | 0 | - | 4.6 | $\tilde{\nu}_\tau$ 1.1 TeV | $\lambda'_{311}$=0.10, $\lambda_{1(2)33}$=0.05 | 1212.1272 |
| | Bilinear RPV CMSSM | 1 $e, \mu$ | 7 jets | Yes | 4.7 | $\tilde{q}, \tilde{g}$ 1.2 TeV | $m(\tilde{q})$=$m(\tilde{g})$, $c\tau_{LSP}$<1 mm | ATLAS-CONF-2012-140 |
| | $\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to W\tilde{\chi}_1^0, \tilde{\chi}_1^0\to ee\tilde{\nu}_\mu, e\mu\tilde{\nu}_e$ | 4 $e, \mu$ | 0 | Yes | 20.7 | $\tilde{\chi}_1^\pm$ 760 GeV | $m(\tilde{\chi}_1^0)$>300 GeV, $\lambda_{121}$>0 | ATLAS-CONF-2013-036 |
| | $\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to W\tilde{\chi}_1^0, \tilde{\chi}_1^0\to\tau\tau\tilde{\nu}_e, e\tau\tilde{\nu}_\tau$ | 3 $e, \mu + \tau$ | 0 | Yes | 20.7 | $\tilde{\chi}_1^\pm$ 350 GeV | $m(\tilde{\chi}_1^0)$>80 GeV, $\lambda_{133}$>0 | ATLAS-CONF-2013-036 |
| | $\tilde{g}\to qqq$ | 0 | 6 jets | - | 4.6 | $\tilde{b}_1$ 666 GeV | | 1210.4813 |
| | $\tilde{g}\to\tilde{t}_1 t, \tilde{t}_1\to bs$ | 2 $e, \mu$ (SS) | 0-3 $b$ | Yes | 20.7 | $\tilde{g}$ 880 GeV | | ATLAS-CONF-2013-007 |
| Other | Scalar gluon | 0 | 4 jets | - | 4.6 | sgluon 100-287 GeV | incl. limit from 1110.2693 | 1210.4826 |
| | WIMP interaction (D5, Dirac $\chi$) | 0 | mono-jet | Yes | 10.5 | $M^*$ scale 704 GeV | $m(\chi)$<80 GeV, limit of<687 GeV for D8 | ATLAS-CONF-2012-147 |

$\sqrt{s}$ = 7 TeV full data | $\sqrt{s}$ = 8 TeV partial data | $\sqrt{s}$ = 8 TeV full data

$10^{-1}$ 1 **Mass scale [TeV]**

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



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