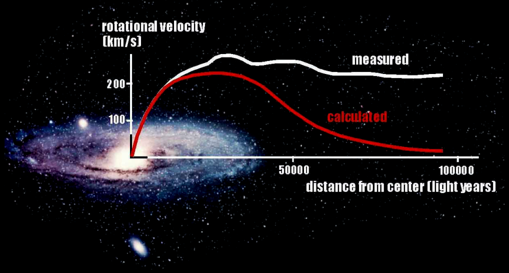
Latest news on Supersymmetry from the ATLAS experiment

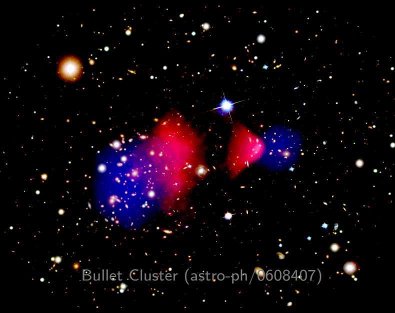
CERN LHC seminar, Sep 6, 2016

Christian Ohm, on behalf of
the ATLAS Collaboration

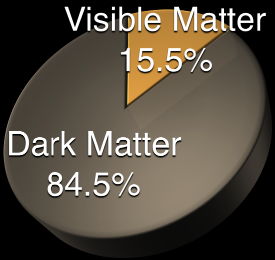
Outline

1. Introduction
    - Supersymmetry
    - Dataset & detector performance
    - Typical analysis strategy
2. Results
    - Inclusive $\tilde{q}/\tilde{g}$ production
    - 3rd generation $\tilde{q}$ production
    - Electroweak production
3. Summary & conclusions



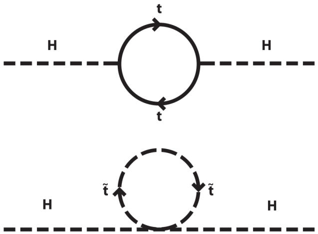

Bullet Cluster (astro-ph/0608407)

- Strong evidence for Dark Matter from astronomy and observational cosmology
- What is it made up of?
  We don't know.
- Can we produce it at the LHC?



(Planck: 1502.01589)

Theory



- “Unnatural” fine-tuning of m_H^2

  $\Rightarrow$ presence of scalar top partner would cancel quadratic radiative corrections and *protect* m_H^2

- No gauge coupling unification in the Standard Model

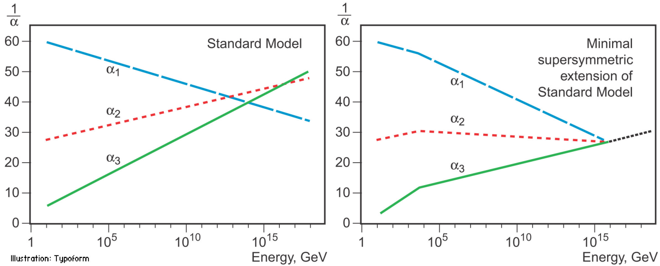


Illustration: Typoform

A brief introduction to Supersymmetry

SUSY can solve these problems

- Could explain Dark Matter
- Alleviates hierarchy problem
- Allows for gauge coupling unification

How?

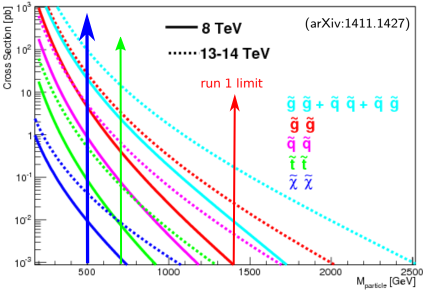
- Generalization of SM: symmetry between force and matter particles
- Introduces sfermions and gauginos $\Rightarrow$ doubles particle content wrt SM

  Sfermions: $q, \ell \longleftrightarrow \tilde{q}, \tilde{\ell}$
  Gauginos: e.g. $g \longleftrightarrow \tilde{g}$

But…

- With ~100 free parameters $\Rightarrow$ wide range of possible exp. signatures

So, SUSY is theoretically appealing, phenomenologically rich, and therefore experimentally challenging



$8\text{ TeV} \rightarrow 13\text{ TeV} \Rightarrow \sigma(\text{SUSY})$ grows:

- $\sigma(\tilde{g}\tilde{g}) \times 30$ for $m_{\tilde{g}} = 1.4\text{ TeV}$
- $\sigma(\tilde{t}\tilde{t}) \times 8$ for $m_{\tilde{t}} = 700\text{ GeV}$
- $\sigma(\tilde{\chi}\tilde{\chi}) \times 4$ for $m_{\tilde{\chi}} = 500\text{ GeV}$

In contrast: $\sigma(t\bar{t}) \times 3.3 \Rightarrow S/B$ boost

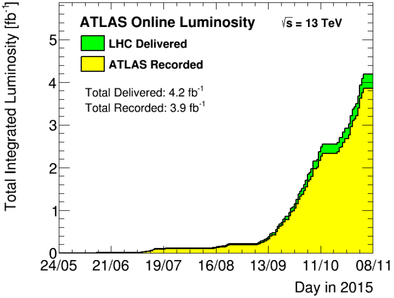
Early Run II priorities:

- Optimize for discovery, keep analyses simple and robust
- Target strong production of $\tilde{g}$ and $\tilde{q}$, then EW prod. with increased $\int \mathcal{L}dt$

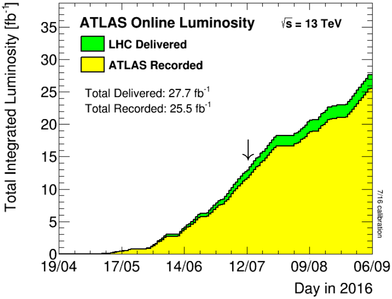
ATLAS Run II 13 TeV dataset

The LHC is performing extremely well in 2016!

2015



2016 (so far)



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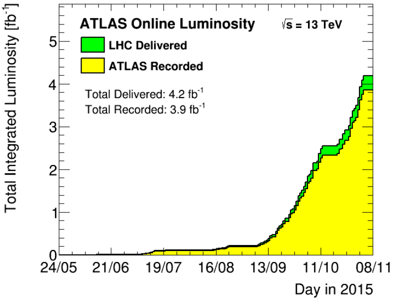
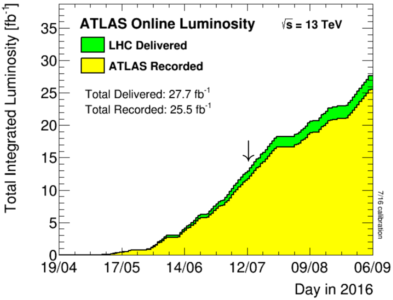


2016 (so far)



- Used for all 17 results shown today:

  $\int \mathcal{L}\, dt \;=\;$ 13-18 fb^{-1} at $\sqrt{s} = 13\ \mathrm{TeV}$

ATLAS Run II 13 TeV dataset

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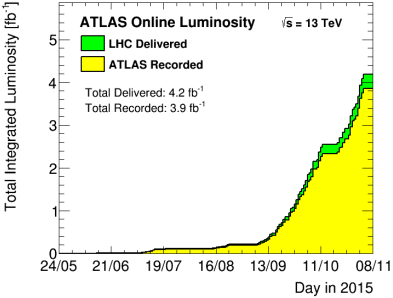
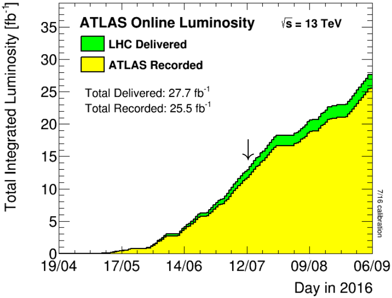
2015



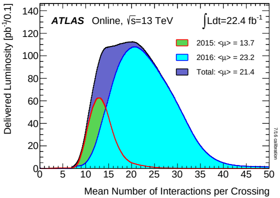
2016 (so far)



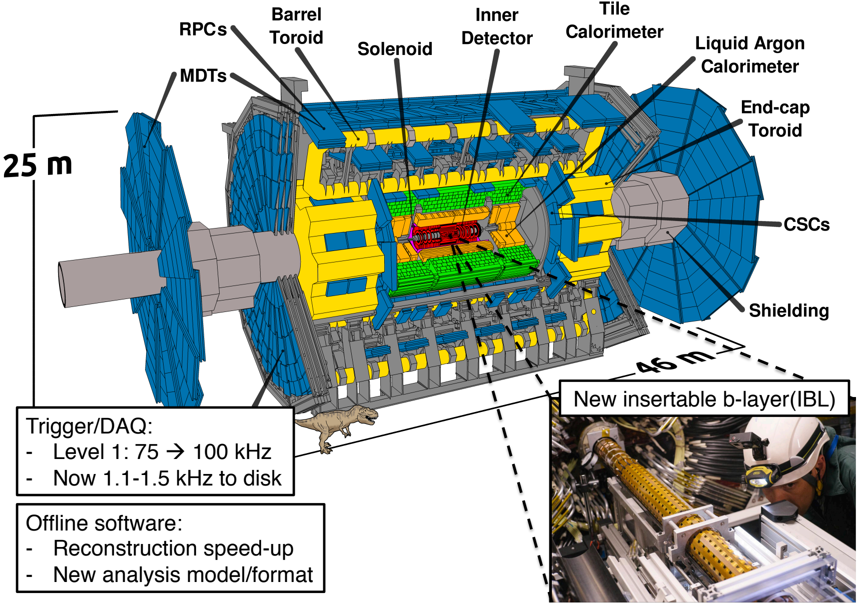
- Used for all 17 results shown today:

$$\int \mathcal{L}\, dt \;=\; 13\text{-}18\ \text{fb}^{-1} \text{ at } \sqrt{s} = 13\ \text{TeV}$$

- Pileup increased with luminosity



The ATLAS detector in Run II

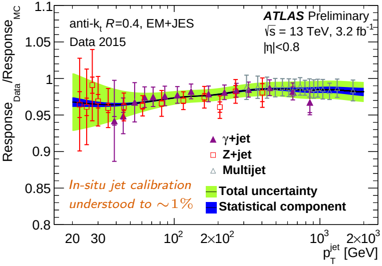


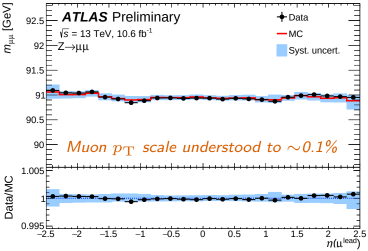
New insertable b-layer(IBL)

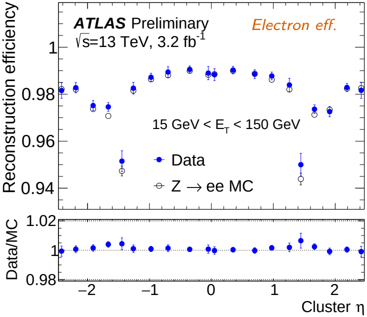
Trigger/DAQ:
- Level 1: 75 → 100 kHz
- Now 1.1-1.5 kHz to disk

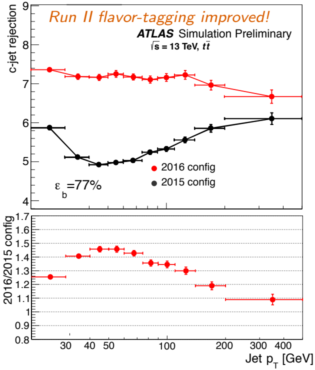
Offline software:
- Reconstruction speed-up
- New analysis model/format

Detector performance with 13 TeV data


In-situ jet calibration understood to $\sim 1\%$


Muon p_T scale understood to $\sim$0.1%


Electron eff.


Run II flavor-tagging improved!

Detector performance with 13 TeV data

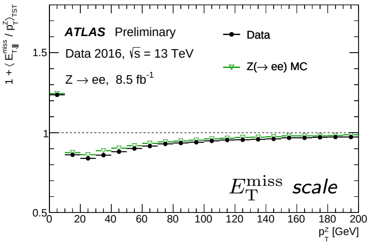
Missing transverse momentum:

$$E_{\mathrm{T}}^{\mathrm{miss}} = \sqrt{(E_x^{\mathrm{miss}})^2 + (E_y^{\mathrm{miss}})^2}$$

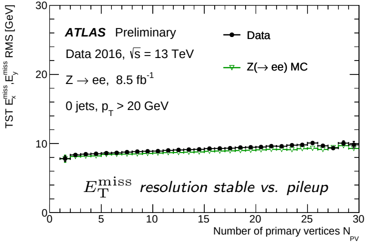
where $E_{x(y)}^{\mathrm{miss}} = -\sum E_{x(y)}$ summed over all calibrated e, γ, μ, τ and jets plus a track-based “soft” term (TST)

$E_{\mathrm{T}}^{\mathrm{miss}}$ is crucial, strong discrimination power for R-parity conserving SUSY with stable lightest SUSY particle (LSP) escaping detection (DM cand.)

Most searches I show today use a $E_{\mathrm{T}}^{\mathrm{miss}}$-based trigger (plateau: 200 GeV)



$E_{\mathrm{T}}^{\mathrm{miss}}$ *scale*

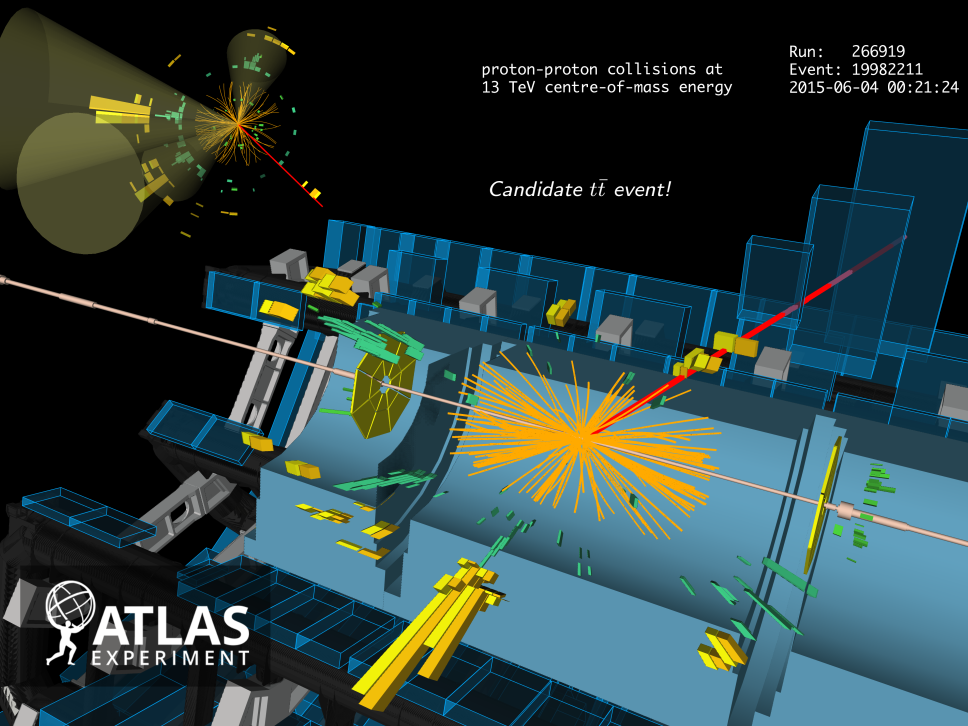


$E_{\mathrm{T}}^{\mathrm{miss}}$ *resolution stable vs. pileup*

Variables describing event-level kinematics and topology:

$$H_{\mathrm{T}} = \sum_{\mathrm{jets},\ell} p_{\mathrm{T}} \qquad m_{\mathrm{eff}}^{(\mathrm{incl})} = \sum_{\mathrm{jets},\ell} p_{\mathrm{T}} + E_{\mathrm{T}}^{\mathrm{miss}} \qquad m_{\mathrm{T}} = \sqrt{2 p_{\mathrm{T}}^{\ell} E_{\mathrm{T}}^{\mathrm{miss}} (1 - \cos[\Delta\phi(\vec{\ell}, E_{\mathrm{T}}^{\mathrm{miss}})])}$$

$$M_{\mathrm{J}}^{\Sigma} = \sum m_j^{R=1.0} \qquad m_{\mathrm{T2}} == \min_{\mathbf{q}_{\mathrm{T}}} \left[\max \left(m_{\mathrm{T}}(\mathbf{p}_{\mathrm{T}}^{\ell 1}, \mathbf{q}_{\mathrm{T}}), m_{\mathrm{T}}(\mathbf{p}_{\mathrm{T}}^{\ell 2}, \mathbf{p}_{\mathrm{T}}^{\mathrm{miss}} - \mathbf{q}_{\mathrm{T}}) \right) \right]$$



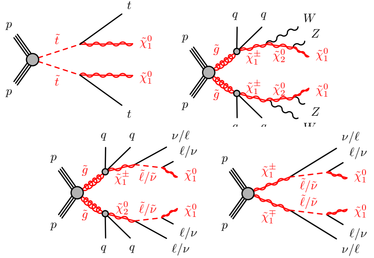
proton-proton collisions at
13 TeV centre-of-mass energy

Run: 266919
Event: 19982211
2015-06-04 00:21:24

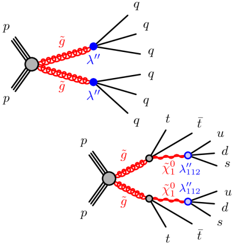
Candidate $t\bar{t}$ event!

Turning every stone

R-parity conserving



R-parity violating



(Not today: long-lived SUSY particles…)

Background modeling:

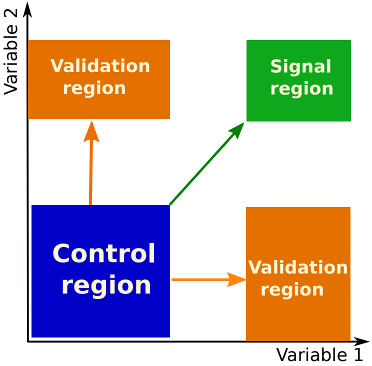
- **`Sherpa:`** $V/\gamma + \text{jets}$ VV $W\gamma$
- **`Powheg:`** tt Wt VV
- **`Pythia8:`** Multijet
- **`MadGraph:`** $t\bar{t}V$ $t\bar{t}\gamma$ $V + \text{jets}$

SUSY signals:

- Simplified models
- **`MG5_aMC@NLO+Py8`**

General strategy for Run II: typical workflow

- Define selections for targeted signals
- Optimize for $S/\sqrt{B}$ using variables describing topology & kinematics
- Can't rely on perfect modeling in MC out to tails in distributions
  ⇒ extract normalization from data *in signal-free* region



Variable 2

Validation region

Signal region

Control region

Validation region

Variable 1

For main irreducible BGs ($t\bar{t}, V$+jets):

1. High-purity control regions (CRs)
   ⇒ simultaneous fit of MC to data
   ⇒ normalization factors
2. Test extrapolation using validation regions (VRs)
3. Predict yields in blinded signal regions (SRs)

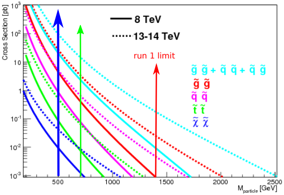
Considerations:

- Extrapolate along reliably modeled variables
- Uncertainties: trade-off between stat and syst.

Reducible backgrounds measured in data, for example:

- "Fake" $E_{\mathrm{T}}^{\mathrm{miss}}$, ℓ
- Charge mis-identification for ℓ

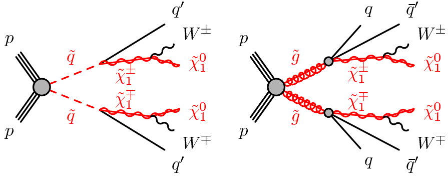
New results: inclusive $\tilde{q}/\tilde{g}$ production

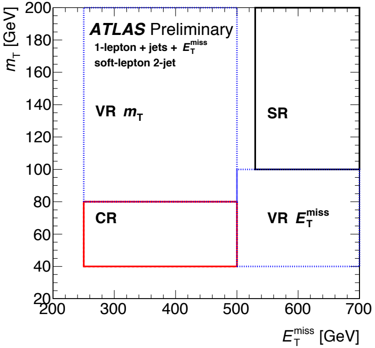


1ℓ + jets + $E_{\mathrm{T}}^{\mathrm{miss}}$ search

ATLAS-CONF-2016-054

Target: final states with jets, exactly one isolated e/μ, and significant $E_{\mathrm{T}}^{\mathrm{miss}}$





Design of SRs:

- Defined using $n_{\mathrm{jets}}, E_{\mathrm{T}}^{\mathrm{miss}}, m_{\mathrm{T}}, m_{\mathrm{eff}}^{\mathrm{incl}}$
- 6 for $\tilde{g}\tilde{g}$, 4 for $\tilde{q}\tilde{q}$ prod.
- Most for large $\Delta m(\tilde{\chi}_1^{\pm}, \tilde{\chi}_1^0)$, 2-jet "soft-$\ell$" SR for compressed spectra

Backgrounds: $t\bar{t}$ and W+jets dominate
$\Rightarrow$ normalize MC in CRs

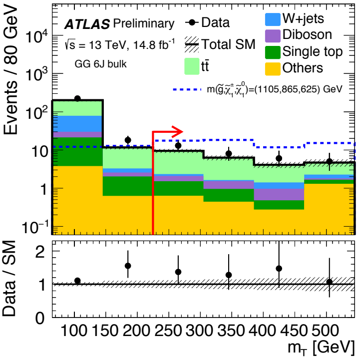
Ex: soft-lepton 2-jet

- Regions split by requirements on $E_{\mathrm{T}}^{\mathrm{miss}}$ and m_{T}
- $t\bar{t}$ CR: ≥ 1 b-jet
- W+jets CR: no b-jets

Simultaneous fit for $t\bar{t}$ & W CRs
$\Rightarrow$ normalization factors

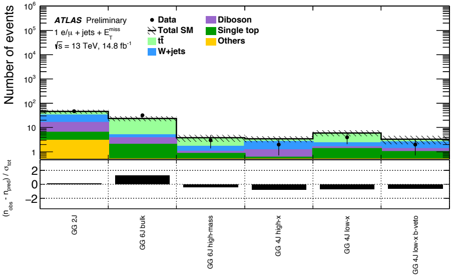
1ℓ + jets + $E_{\mathrm{T}}^{\mathrm{miss}}$: results

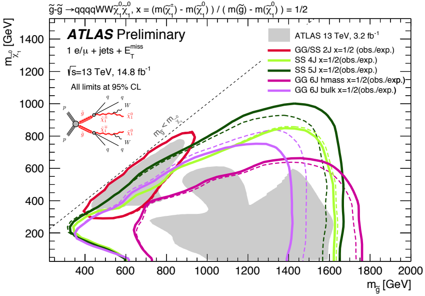
ATLAS-CONF-2016-054



- ← m_{T} in 6-jet $\tilde{g}\tilde{g}$ SR
- No significant excess seen in any SR
- Exclusion curves in $m_{\tilde{g}}$-$m_{\tilde{\chi}_1^0}$ plane ↓

Throughout: only showing example interpretations - many more available!

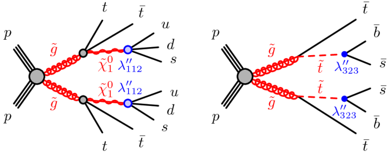




1ℓ + jets + $E_{\mathrm{T}}^{\mathrm{miss}}$: results

ATLAS-CONF-2016-054

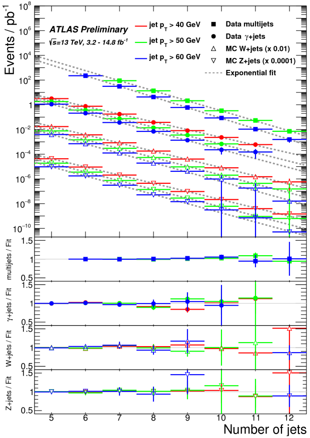
Brand new search for $\tilde{g}$ RPV decays in 1ℓ + jets NEW! ATLAS-CONF-2016-094



- R-parity violated ⇒ no sign. $E_{\mathrm{T}}^{\mathrm{miss}}$
- $\geq$1 e/μ, $\geq$(8-10) jets, (0-4) b-jets
- First look for SUSY in this final state!

Background estimation

- Don't trust MC for high n_{jets} ⇒ measure in data
- Assumes $P(\text{additional jet})$ constant ⇒ extrapolate from n to $n+1$ jets
- Global likelihood fits separately for W, Z, $t\bar{t}$ (templates incl. b-jet mult.)



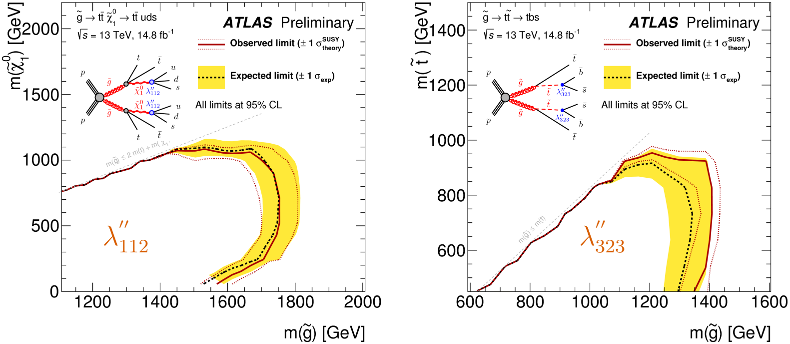
Validation of V+jets fits in γ+jets and multijet events

1ℓ + jets + E_T^{miss}: results

ATLAS-CONF-2016-054

Brand new search for $\tilde{g}$ RPV decays in 1ℓ + jets

NEW! ATLAS-CONF-2016-094

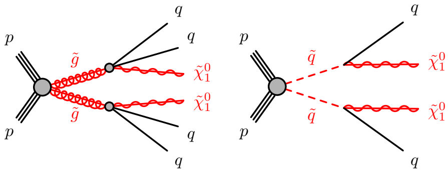


Also model-independent N_{events} limits for each of the SRs!

0ℓ + 4-6 jets + $E_{\mathrm{T}}^{\mathrm{miss}}$ search

ATLAS-CONF-2016-078

Target: Fully hadronic $\tilde{g}$ and $\tilde{q}$

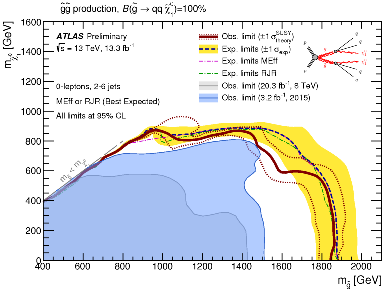


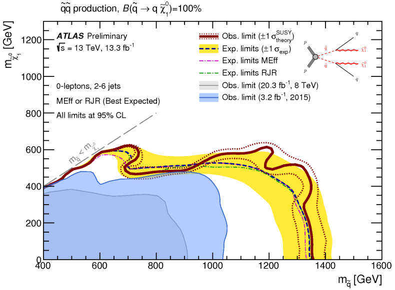
Two categories of SRs:

- 2–6 jets (no ℓ!), subdivided in m_{eff}
- New: *Recursive Jigsaw Reco* (RJR): creates full-kinematics hypothesis for each event using assumption on decay topologies incl. invisible particles (1607.08307)

Backgrounds:

- W+jets, $t\bar{t}$ from CRs
- $Z(\nu\nu)$+jets from γ+jets, VV in MC

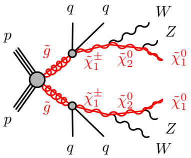




Similar results for m_{eff} and new RJR

0ℓ + 8-10 jets + $E_{\mathrm{T}}^{\mathrm{miss}}$ search

NEW! ATLAS-CONF-2016-095



Uses multijet trigger
$\Rightarrow$ looser $E_{\mathrm{T}}^{\mathrm{miss}}$ req.

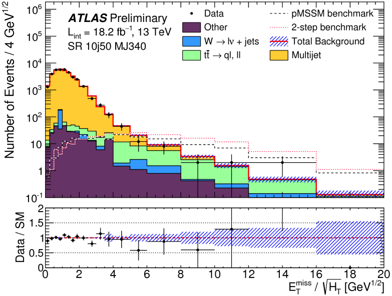
SRs for $\tilde{g}\tilde{g}$ with two-step decays:

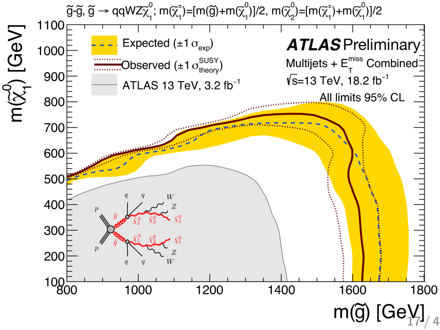
- $\geq$ 8–10 jets ($p_{\mathrm{T}} > 50$ GeV)
- $M_{\mathrm{J}}^{\Sigma} >$ 340 or 500 GeV
- $E_{\mathrm{T}}^{\mathrm{miss}}$ significance: $\frac{E_{\mathrm{T}}^{\mathrm{miss}}}{\sqrt{H_{\mathrm{T}}}} > 4\ \mathrm{GeV}^{1/2}$

Multijet bg estimation:

- $E_{\mathrm{T}}^{\mathrm{miss}}/\sqrt{H_{\mathrm{T}}}$ ~indep. of n_{jets}
- Extracted templates in 6j CR
  $\Rightarrow$ validate in 7j region
  $\Rightarrow$ predict in 8–10j SRs
- Top and W from 1ℓ CRs with ($N_{\mathrm{jets}}^{\mathrm{SR}} - 1$) jets to improve stats

No significant excess $\Rightarrow$
$m_{\tilde{g}} \lesssim 1.6$ TeV excluded



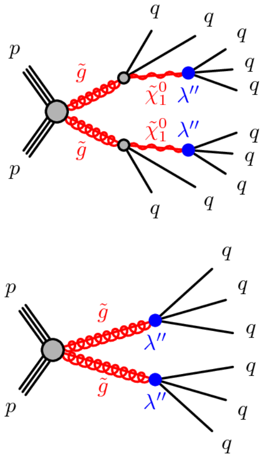


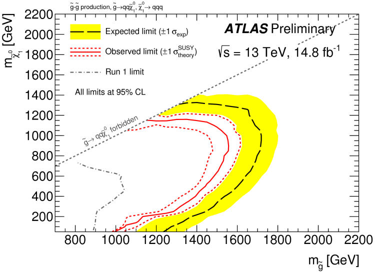
0ℓ + 8-10 jets + E_T^{miss} search

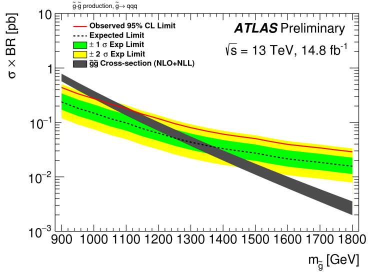
NEW! ATLAS-CONF-2016-095

New RPV multijet result:

- R-parity violated ⇒ no E_T^{miss}





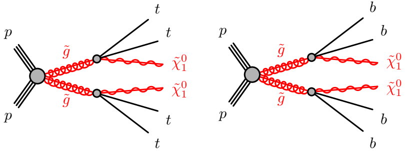


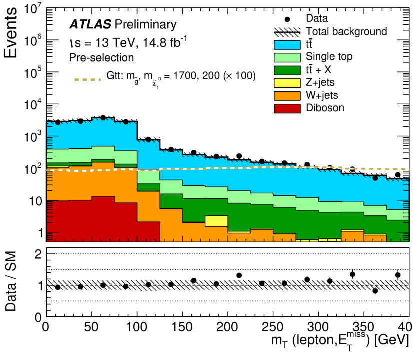
ATLAS-CONF-2016-057

3-4 b-jets + 0-1 ℓ + $E_{\mathrm{T}}^{\mathrm{miss}}$ search

ATLAS-CONF-2016-052

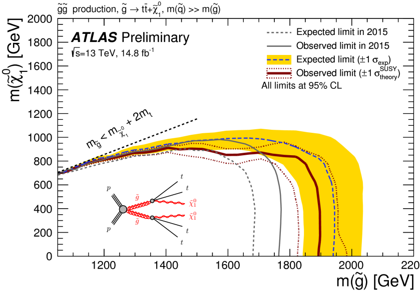
Target: Gtt & Gbb scenarios: $\tilde{g} \to t\bar{t}\tilde{\chi}$



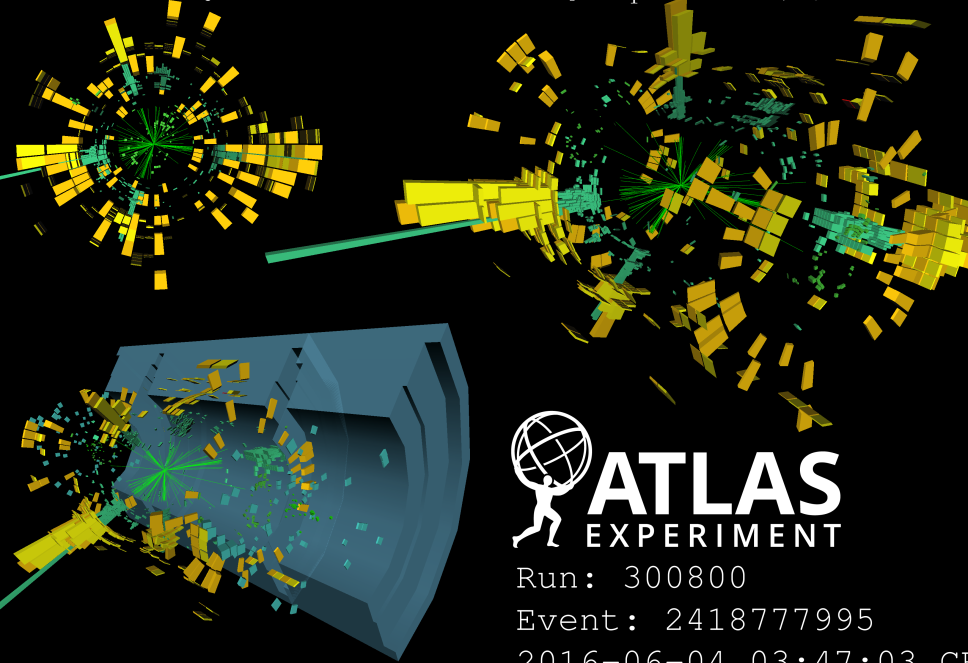


- SR design:
  - 0ℓ $(\tilde{b},\tilde{t})$ and 1ℓ $(\tilde{t})$
  - Subdivided in $E_{\mathrm{T}}^{\mathrm{miss}}$, m_{eff}, Gtt SRs use $\sum m_j^{R=1.0}$
- Backgrounds
  - All SRs dominated by $t\bar{t}$+jets, measured in low-m_{T} CRs
  - Other BGs from MC

No significant excess ⇒
Limits up to $m_{\tilde{g}} \sim 1.9$ TeV



Candidate $3b$ *event: jets with 774, 436, 312, and 180 GeV* p_{T}, $E_{\mathrm{T}}^{\mathrm{miss}} = 508\ \mathrm{GeV}, m_{\mathrm{eff}} = 2.2\ \mathrm{TeV}$



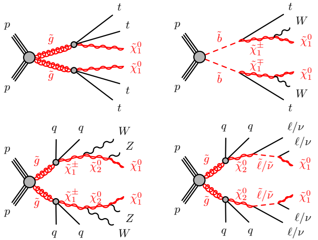
ATLAS
EXPERIMENT

Run: 300800
Event: 2418777995
2016-06-04 03:47:03 CE

2ℓ same-sign$/3\ell$ + $E_{\mathrm{T}}^{\mathrm{miss}}$ search

ATLAS-CONF-2016-037

$\tilde{g}/\tilde{q}$ with leptonic $\tilde{\ell}/\tilde{\chi}/W$ decays



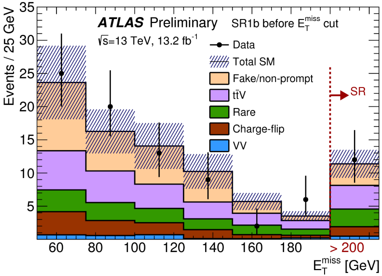
Sensitive to many types of mass spectra!

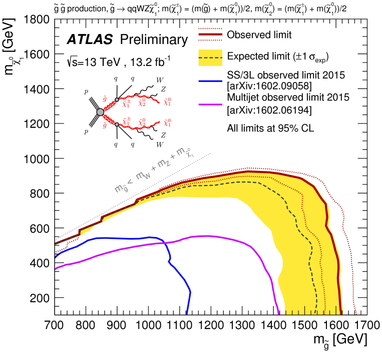
9 SRs (3 optimized for RPV):

- Object multiplicity: ℓ, b-jets, jets
- Event: $E_{\mathrm{T}}^{\mathrm{miss}}$, m_{eff}, ℓ charge config.

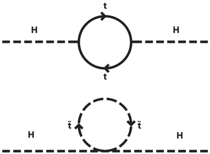
Backgrounds

- Real: SS$/3\ell$ from $t\bar{t}V$, VV
- Fake backgrounds:
  - Fake leptons relevant, measured in data
  - Charge mis-id $\Rightarrow$ measured in $Z \to \ell\ell$



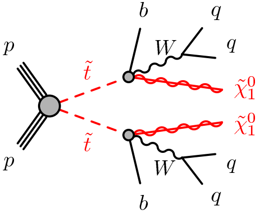


New results: direct $\tilde{t}/\tilde{b}$ production

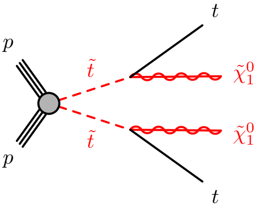


Direct $\tilde{t}\tilde{t}$ production in 0ℓ, 1ℓ and 2ℓ final states

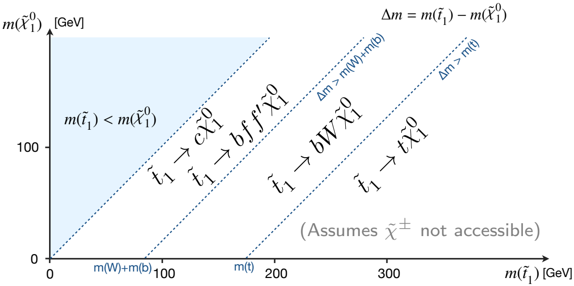
Covers several decay chains for different $\Delta m(\tilde{t}, \tilde{\chi}^0)$



3-body $\tilde{t} \to bW\tilde{\chi}^0$

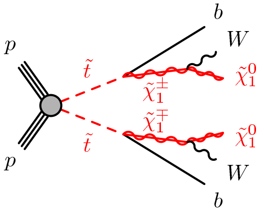


$\tilde{t} \to t\tilde{\chi}^0$

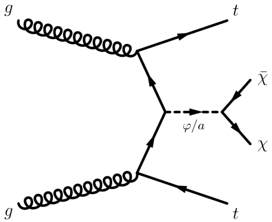


(Assumes $\tilde{\chi}^\pm$ not accessible)

If $\tilde{\chi}^\pm$ accessible:



$\tilde{t} \to b\tilde{\chi}^\pm$



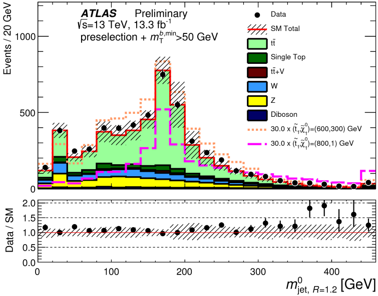
0ℓ, 1ℓ and 2ℓ also sensitive to associated DM+$t\bar{t}$ prod.

Direct $\tilde{t}\tilde{t}$ production in jets + $E_{\mathrm{T}}^{\mathrm{miss}}$ channel

ATLAS-CONF-2016-077

Flexible search for all fully hadronic decays

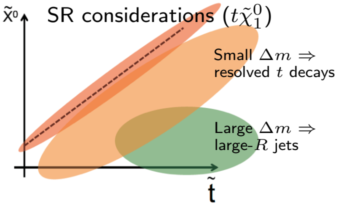
- Boosted $\tilde{t} \to t\tilde{\chi}^0$: classify events using mass of two large-R jets:

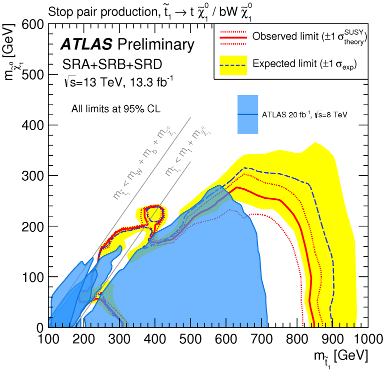


- Exploit ISR for sensitivity to near-diagonal $t\tilde{\chi}^0$:

$$R_{\mathrm{ISR}} = \frac{E_{\mathrm{T}}^{\mathrm{miss}}}{p_{\mathrm{T}}^{\mathrm{ISR}}} \sim \frac{m_{\tilde{\chi}^0}}{m_{\tilde{t}}}$$

- Main backgrounds: Z+jets, $t\bar{t} + V$

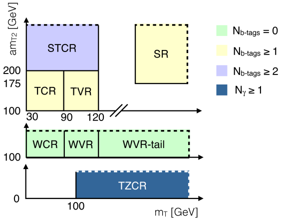

SR considerations $(t\tilde{\chi}_1^0)$

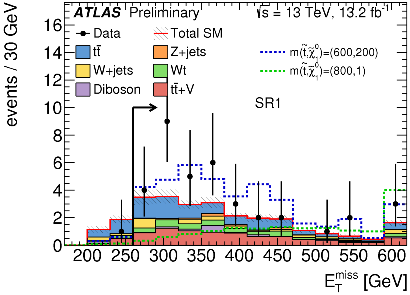


Direct $\tilde{t}\tilde{t}$ production in jets + $E_{\mathrm{T}}^{\mathrm{miss}}$ + 1ℓ channel

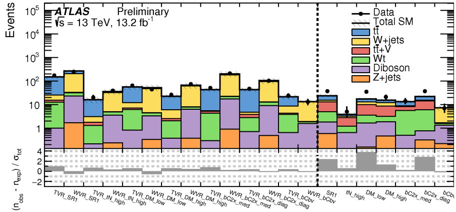
ATLAS-CONF-2016-050

$t\bar{t}$, $t\bar{t}Z$, single-top, W+jets from CRs:

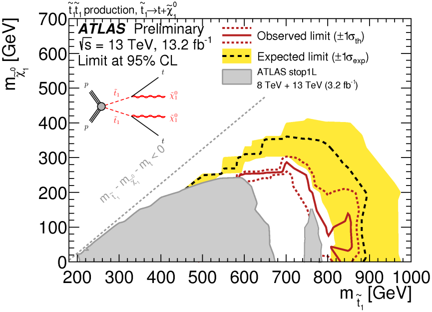




7 SRs for $t\tilde{\chi}^0$, $b\tilde{\chi}^\pm$ and DM+$t\bar{t}$



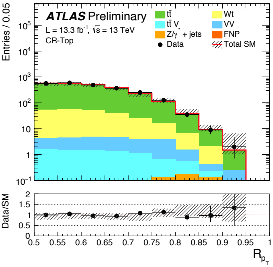
Modest excesses in a few SRs



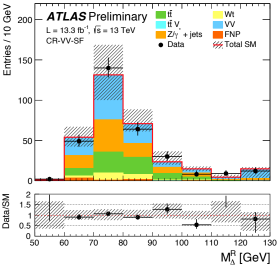
Direct $\tilde{t}\tilde{t}$ production in jets + $E_\mathrm{T}^\mathrm{miss}$ + 2ℓ channel

ATLAS-CONF-2016-076

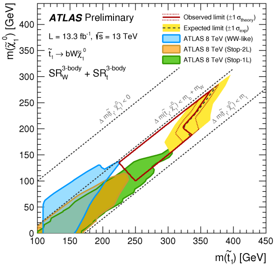
- 3-body decay highlighted here, also $b\tilde{\chi}^\pm$ with had. $m_{\mathrm{T}2}$, dedicated DM SRs
- Selection: 2ℓ + 2 b-jets + $E_\mathrm{T}^\mathrm{miss}$
- Backgrounds: $t\bar{t}$ and Wt, normalization extracted from CRs
- Super-razor variables (1310.4827) used to identify events with two heavy particles decaying into a set of leptons and invisible particles (shown in CRs)



$$R_{p_\mathrm{T}} = \frac{|\vec{J}_\mathrm{T}|}{|\vec{J}_\mathrm{T}|+\sqrt{\hat{s}_R/4}}$$

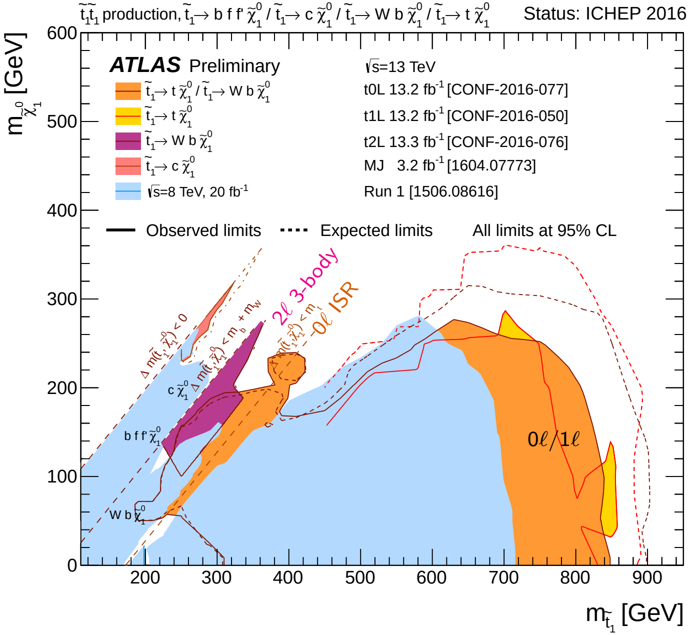


$$M_\Delta^R = \frac{\sqrt{\hat{s}_R}}{\gamma_{R+1}}$$

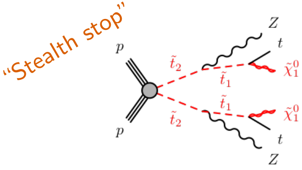


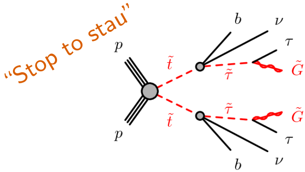
3-body decay mode excluded for $m_{\tilde{t}} \lesssim 350$ GeV

Summary of $\tilde{t} \to t\tilde{\chi}^0$ exclusions



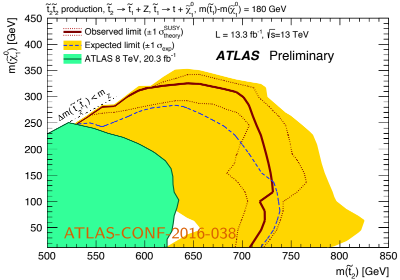
Targeting specific topologies for direct $\tilde{t}\tilde{t}$ production

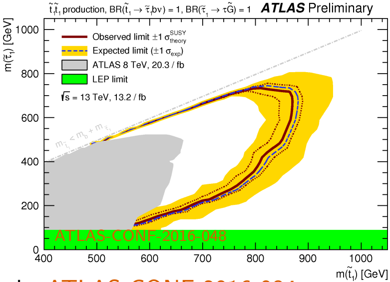




- If $\Delta m(\tilde{t}_1, \tilde{\chi}_0) \sim m_t$, consider direct $\tilde{t}_2\tilde{t}_2$ prod, $\tilde{t}_2 \to Z\tilde{t}_1$
- 3ℓ, on-shell $Z \to \ell\ell$: alternative approach for challenging diagonal

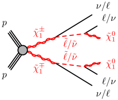
- Important natural GMSB scenarios with $\tilde{\tau}$ NLSP
- Large $E_{\mathrm{T}}^{\mathrm{miss}}$, high m_{T2}, b-jets

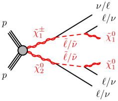


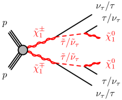


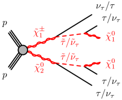
More RPV in 2x2 jet resonance search: ATLAS-CONF-2016-084

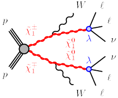
New results: electroweak production of $\tilde{\chi}^{\pm}$ and/or $\tilde{\chi}^{0}$







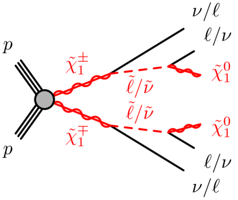




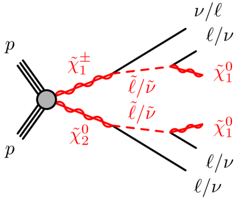
Direct EW production in 2ℓ OS and 3ℓ channels

ATLAS-CONF-2016-096

2ℓ OS



3ℓ



SR2ℓ

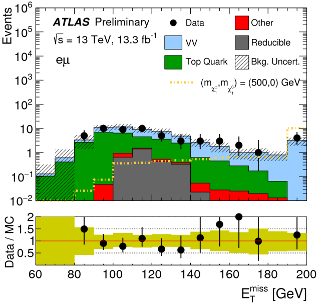
- No jets!
- $Z \to \ell\ell$ veto
- m_{T2} over $90,\ 120,\ 150\ \mathrm{GeV}$
- SF and DF

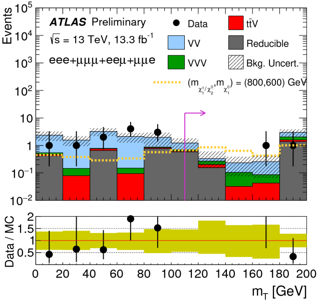
SR3ℓ-H(I)

- No b-jets!
- $Z \to \ell\ell$ veto
- $m_{\mathrm{T}} > 110\ \mathrm{GeV}$
- $E_{\mathrm{T}}^{\mathrm{miss}} > 60(120)\ \mathrm{GeV}$
- $p_{\mathrm{T}}(\ell_3) > 80(30)\ \mathrm{GeV}$

Best ATLAS sensitivity to EW production

with $\tilde{\ell}$-mediated decays!



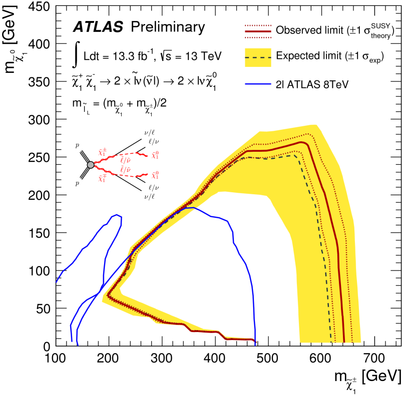


Direct EW production in 2ℓ OS and 3ℓ channels

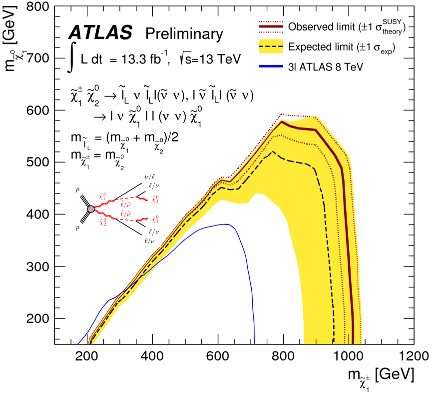
ATLAS-CONF-2016-096

Observed yields consistent with predicted background levels ⇒ exclusion limits

$\tilde{\chi}_1^{\pm}\tilde{\chi}_1^{\mp}$ (2ℓ OS)



$\tilde{\chi}_1^{\pm}\tilde{\chi}_2^{0}$ (3ℓ)

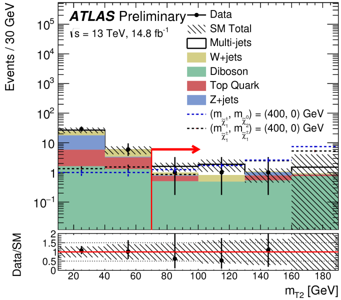


Direct EW production in di-tau channel

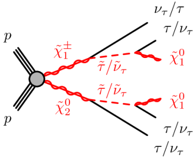
ATLAS-CONF-2016-093

Signal region definition:

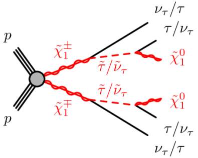
- $\geq 2\tau_{\text{had}}$ (OS), $E_T^{\text{miss}} > 150$ GeV
- Z veto, b-jet veto
- $m_{\text{T2}} > 70$ GeV

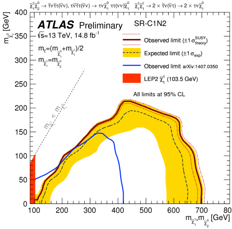


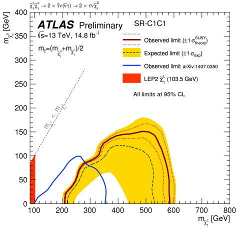
$\tilde{\chi}_1^\pm \tilde{\chi}_2^0$



$\tilde{\chi}_1^\pm \tilde{\chi}_1^\mp$





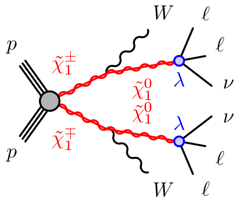


If only $\tilde{\tau}$ accessible in $\tilde{\chi}^0/\tilde{\chi}^\pm$ decay, hadronic τ final states gain sensitivity!

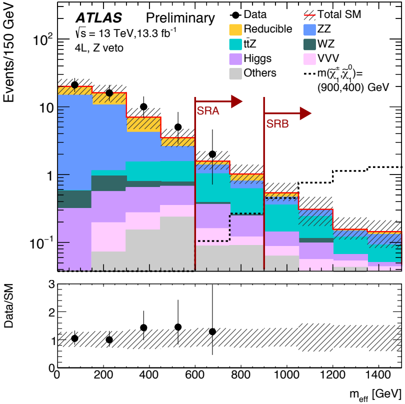
Background estimation:

- Fake τ: multijet from data (ABCD), W+jets from MC norm. to CR
- Real τ: $VV \to \tau\tau\nu\nu$, Z+jets, top ($t\bar{t}$ + jets/V, Wt) from MC

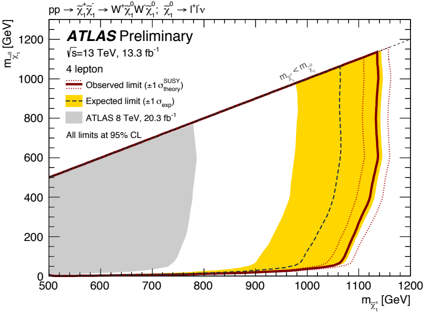
EW production in 4ℓ channel



- SRs defined by Z veto, m_{eff} cuts
- Reducible backgrounds:
  - WZ, WWW, $t\bar{t}W$ + 1 fake ℓ (MC)
  - $t\bar{t}$, Z+jets + 2 fake ℓ $\Rightarrow$ from data using fake-factor method
- Irreducible backgrounds:
  - ZZ, $t\bar{t}Z$, ...



Data consistent with bg $\Rightarrow$
Limits up to $m_{\tilde{\chi}^\pm} \sim 1.1$ TeV



Global summary of excluded mass ranges

ATLAS SUSY Searches* - 95% CL Lower Limits

Status: August 2016

ATLAS Preliminary

$\sqrt{s}$ = 7, 8, 13 TeV

	Model	e,μ,τ,γ	Jets	E_T^{miss}	$\int\mathcal{L}\,dt[\mathrm{fb}^{-1}]$	Mass limit		Reference
Inclusive Searches	MSUGRA/CMSSM	0-3 e,μ/1-2 τ	2-10 jets/3 b	Yes	20.3	🟩 $\tilde{q},\tilde{g}$ 1.85 TeV	m($\tilde{q}$)=m($\tilde{g}$)	1507.05525
	$\tilde{q}\tilde{q}$, $\tilde{q}\to q\tilde{\chi}_1^0$	0	2-6 jets	Yes	13.3	🟦 $\tilde{q}$ 1.35 TeV	m($\tilde{\chi}_1^0$)<200 GeV, m(1st gen. $\tilde{q}$)=m(2nd gen. $\tilde{q}$)	ATLAS-CONF-2016-078
	$\tilde{q}\tilde{q}$, $\tilde{q}\to q\tilde{\chi}_1^0$ (compressed)	mono-jet	1-3 jets	Yes	3.2	🟦 $\tilde{q}$ 608 GeV	m($\tilde{q}$)-m($\tilde{\chi}_1^0$)<5 GeV	1604.07773
	$\tilde{g}\tilde{g}$, $\tilde{g}\to q\bar{q}\tilde{\chi}_1^0$	0	2-6 jets	Yes	13.3	🟦 $\tilde{g}$ 1.86 TeV	m($\tilde{\chi}_1^0$)=0 GeV	ATLAS-CONF-2016-078
	$\tilde{g}\tilde{g}$, $\tilde{g}\to qq\tilde{\chi}_1^\pm\to qqW^\pm\tilde{\chi}_1^0$	0	2-6 jets	Yes	13.3	🟦 $\tilde{g}$ 1.83 TeV	m($\tilde{\chi}_1^0$)<400 GeV, m($\tilde{\chi}^\pm$)=0.5(m($\tilde{\chi}_1^0$)+m($\tilde{g}$))	ATLAS-CONF-2016-078
	$\tilde{g}\tilde{g}$, $\tilde{g}\to qq(\ell\ell/\nu\nu)\tilde{\chi}_1^0$	3 e,μ	4 jets	-	13.2	🟦 $\tilde{g}$ 1.7 TeV	m($\tilde{\chi}_1^0$)<400 GeV	ATLAS-CONF-2016-037
	$\tilde{g}\tilde{g}$, $\tilde{g}\to qqWZ\tilde{\chi}_1^0$	2 e,μ (SS)	0-3 jets	Yes	13.2	🟦 $\tilde{g}$ 1.6 TeV	m($\tilde{\chi}_1^0$) <500 GeV	ATLAS-CONF-2016-037
	GMSB ($\tilde{\ell}$ NLSP)	1-2 τ + 0-1 ℓ	0-2 jets	Yes	3.2	🟦 $\tilde{g}$ 2.0 TeV		1607.05979
	GGM (bino NLSP)	2 γ	-	Yes	3.2	🟦 $\tilde{g}$ 1.65 TeV	$c\tau$(NLSP)<0.1 mm	1606.09150
	GGM (higgsino-bino NLSP)	γ	1 b	Yes	20.3	🟩 $\tilde{g}$ 1.37 TeV	m($\tilde{\chi}_1^0$)<950 GeV, $c\tau$(NLSP)<0.1 mm, μ<0	1507.05493
	GGM (higgsino-bino NLSP)	γ	2 jets	Yes	13.3	🟦 $\tilde{g}$ 1.8 TeV	m($\tilde{\chi}_1^0$)>680 GeV, $c\tau$(NLSP)<0.1 mm, μ>0	ATLAS-CONF-2016-066
	GGM (higgsino NLSP)	2 e,μ (Z)	2 jets	Yes	20.3	🟩 $\tilde{g}$ 900 GeV	m(NLSP)>430 GeV	1503.03290
	Gravitino LSP	0	mono-jet	Yes	20.3	🟩 $F^{1/2}$ scale 865 GeV	m($\tilde{G}$)>1.8×10^{-4} eV, m($\tilde{g}$)=m($\tilde{q}$)=1.5 TeV	1502.01518
3^{rd} gen. $\tilde{g}$ med.	$\tilde{g}\tilde{g}$, $\tilde{g}\to b\bar{b}\tilde{\chi}_1^0$	0	3 b	Yes	14.8	🟦 $\tilde{g}$ 1.89 TeV	m($\tilde{\chi}_1^0$)=0 GeV	ATLAS-CONF-2016-052
	$\tilde{g}\tilde{g}$, $\tilde{g}\to t\bar{t}\tilde{\chi}_1^0$	0-1 e,μ	3 b	Yes	14.8	🟦 $\tilde{g}$ 1.89 TeV	m($\tilde{\chi}_1^0$)=0 GeV	ATLAS-CONF-2016-052
	$\tilde{g}\tilde{g}$, $\tilde{g}\to b\bar{t}\tilde{\chi}_1^+$	0-1 e,μ	3 b	Yes	20.1	🟩 $\tilde{g}$ 1.37 TeV	m($\tilde{\chi}_1^0$)<300 GeV	1407.0600
3^{rd} gen. squarks direct production	$\tilde{b}_1\tilde{b}_1$, $\tilde{b}_1\to b\tilde{\chi}_1^0$	0	2 b	Yes	3.2	🟦 $\tilde{b}_1$ 840 GeV	m($\tilde{\chi}_1^0$)<100 GeV	1606.08772
	$\tilde{b}_1\tilde{b}_1$, $\tilde{b}_1\to t\tilde{\chi}_1^\pm$	2 e,μ (SS)	1 b	Yes	13.2	🟦 $\tilde{b}_1$ 325-685 GeV	m($\tilde{\chi}_1^0$)<150 GeV, m($\tilde{\chi}_1^\pm$)= m($\tilde{\chi}_1^0$)+100 GeV	ATLAS-CONF-2016-037
	$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\to b\tilde{\chi}_1^\pm$	0-2 e,μ	1-2 b	Yes	4.7/13.3	$\tilde{t}_1$ 🟩 117-170 GeV 🟦 200-720 GeV	m($\tilde{\chi}_1^\pm$) = 2m($\tilde{\chi}_1^0$), m($\tilde{\chi}_1^0$)=55 GeV	1209.2102, ATLAS-CONF-2016-077
	$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\to Wb\tilde{\chi}_1^0$ or $t\tilde{\chi}_1^0$	0-2 e,μ	0-2 jets/1-2 b	Yes	4.7/13.3	$\tilde{t}_1$ 🟩 90-198 GeV 🟦 205-850 GeV	m($\tilde{\chi}_1^0$)=1 GeV	1506.08616, ATLAS-CONF-2016-077
	$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\to c\tilde{\chi}_1^0$	0	mono-jet	Yes	3.2	🟦 $\tilde{t}_1$ 90-323 GeV	m($\tilde{t}_1$)-m($\tilde{\chi}_1^0$)=5 GeV	1604.07773
	$\tilde{t}_1\tilde{t}_1$(natural GMSB)	2 e,μ (Z)	1 b	Yes	20.3	🟩 $\tilde{t}_1$ 150-600 GeV	m($\tilde{\chi}_1^0$)>150 GeV	1403.5222
	$\tilde{t}_2\tilde{t}_2$, $\tilde{t}_2\to\tilde{t}_1+Z$	3 e,μ (Z)	1 b	Yes	13.3	🟦 $\tilde{t}_2$ 290-700 GeV	m($\tilde{\chi}_1^0$)<300 GeV	ATLAS-CONF-2016-038
	$\tilde{t}_2\tilde{t}_2$, $\tilde{t}_2\to\tilde{t}_1+h$	1 e,μ	6 jets + 2 b	Yes	20.3	🟩 $\tilde{t}_2$ 320-620 GeV	m($\tilde{\chi}_1^0$)=0 GeV	1506.08616
EW direct	$\tilde{\ell}_{L,R}\tilde{\ell}_{L,R}$, $\tilde{\ell}\to\ell\tilde{\chi}_1^0$	2 e,μ	0	Yes	20.3	🟩 $\tilde{\ell}$ 90-335 GeV	m($\tilde{\chi}_1^0$)=0 GeV	1403.5294
	$\tilde{\chi}_1^+\tilde{\chi}_1^-$, $\tilde{\chi}_1^+\to\tilde{\ell}\nu(\ell\tilde{\nu})$	2 e,μ	0	Yes	20.3	🟩 $\tilde{\chi}_1^\pm$ 140-475 GeV	m($\tilde{\chi}_1^0$)=0 GeV, m($\tilde{\ell},\tilde{\nu}$)=0.5(m($\tilde{\chi}_1^\pm$)+m($\tilde{\chi}_1^0$))	1403.5294
	$\tilde{\chi}_1^+\tilde{\chi}_1^-$, $\tilde{\chi}_1^+\to\tilde{\tau}\nu(\tau\tilde{\nu})$	2 τ	-	Yes	20.3	🟩 $\tilde{\chi}_1^\pm$ 355 GeV	m($\tilde{\chi}_1^0$)=0 GeV, m($\tilde{\tau},\tilde{\nu}$)=0.5(m($\tilde{\chi}_1^\pm$)+m($\tilde{\chi}_1^0$))	1407.0350
	$\tilde{\chi}_1^\pm\tilde{\chi}_2^0\to\tilde{\ell}_L\nu\tilde{\ell}_L\ell(\tilde{\nu}\nu)$, $\ell\tilde{\nu}\tilde{\ell}_L\ell(\tilde{\nu}\nu)$	3 e,μ	0	Yes	20.3	🟩 $\tilde{\chi}_1^\pm,\tilde{\chi}_2^0$ 715 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($\tilde{\chi}_1^0$))	1402.7029
	$\tilde{\chi}_1^\pm\tilde{\chi}_2^0\to W\tilde{\chi}_1^0Z\tilde{\chi}_1^0$	2-3 e,μ	0-2 jets	Yes	20.3	🟩 $\tilde{\chi}_1^\pm,\tilde{\chi}_2^0$ 425 GeV	m($\tilde{\chi}_1^\pm$)=m($\tilde{\chi}_2^0$), m($\tilde{\chi}_1^0$)=0, $\tilde{\ell}$ decoupled	1403.5294, 1402.7029
	$\tilde{\chi}_1^\pm\tilde{\chi}_2^0\to W\tilde{\chi}_1^0h\tilde{\chi}_1^0$, $h\to b\bar{b}/WW/\tau\tau/\gamma\gamma$	e,μ,γ	0-2 b	Yes	20.3	🟩 $\tilde{\chi}_1^\pm,\tilde{\chi}_2^0$ 270 GeV	m($\tilde{\chi}_1^\pm$)=m($\tilde{\chi}_2^0$), m($\tilde{\chi}_1^0$)=0, $\tilde{\ell}$ decoupled	1501.07110
	$\tilde{\chi}_2^0\tilde{\chi}_3^0$, $\tilde{\chi}_{2,3}^0\to\tilde{\ell}_R\ell$	4 e,μ	0	Yes	20.3	🟩 $\tilde{\chi}_{2,3}^0$ 635 GeV	m($\tilde{\chi}_2^0$)=m($\tilde{\chi}_3^0$), m($\tilde{\chi}_1^0$)=0, m($\tilde{\ell},\tilde{\nu}$)=0.5(m($\tilde{\chi}_2^0$)+m($\tilde{\chi}_1^0$))	1405.5086
	GGM (wino NLSP) weak prod.	1 $e,\mu+\gamma$	-	Yes	20.3	🟩 $\tilde{W}$ 115-370 GeV	$c\tau$<1 mm	1507.05493
	GGM (bino NLSP) weak prod.	2 γ	-	Yes	20.3	🟩 $\tilde{W}$ 590 GeV	$c\tau$<1 mm	1507.05493
Long-lived particles	Direct $\tilde{\chi}_1^+\tilde{\chi}_1^-$ prod., long-lived $\tilde{\chi}_1^\pm$	Disapp. trk	1 jet	Yes	20.3	🟩 $\tilde{\chi}_1^\pm$ 270 GeV	m($\tilde{\chi}_1^\pm$)-m($\tilde{\chi}_1^0$)~160 MeV, τ($\tilde{\chi}_1^\pm$)=0.2 ns	1310.3675
	Direct $\tilde{\chi}_1^+\tilde{\chi}_1^-$ prod., long-lived $\tilde{\chi}_1^\pm$	dE/dx trk	-	Yes	18.4	🟩 $\tilde{\chi}_1^\pm$ 495 GeV	m($\tilde{\chi}_1^\pm$)-m($\tilde{\chi}_1^0$)~160 MeV, τ($\tilde{\chi}_1^\pm$)<15 ns	1506.05332
	Stable, stopped $\tilde{g}$ R-hadron	0	1-5 jets	Yes	27.9	🟩 $\tilde{g}$ 850 GeV	m($\tilde{\chi}_1^0$)=100 GeV, 10 μs<τ($\tilde{g}$)<1000 s	1310.6584
	Stable $\tilde{g}$ R-hadron	trk	-	-	3.2	🟦 $\tilde{g}$ 1.58 TeV		1606.05129
	Metastable $\tilde{g}$ R-hadron	dE/dx trk	-	-	3.2	🟦 $\tilde{g}$ 1.57 TeV	m($\tilde{\chi}_1^0$)=100 GeV, τ>10 ns	1604.04520
	GMSB, stable $\tilde{\tau}$, $\tilde{\chi}_1^0\to\tilde{\tau}(\tilde{e},\tilde{\mu})+\tau(e,\mu)$	1-2 μ	-	-	19.1	🟩 $\tilde{\chi}_1^0$ 537 GeV	10<tanβ<50	1411.6795
	GMSB, $\tilde{\chi}_1^0\to\gamma\tilde{G}$, long-lived $\tilde{\chi}_1^0$	2 γ	-	Yes	20.3	🟩 $\tilde{\chi}_1^0$ 440 GeV	1<τ($\tilde{\chi}_1^0$)<3 ns, SPS8 model	1409.5542
	$\tilde{g}\tilde{g}$, $\tilde{\chi}_1^0\to ee\nu/e\mu\nu/\mu\mu\nu$	displ. $ee/e\mu/\mu\mu$	-	-	20.3	🟩 $\tilde{\chi}_1^0$ 1.0 TeV	7 <$c\tau$($\tilde{\chi}_1^0$)< 740 mm, m($\tilde{g}$)=1.3 TeV	1504.05162
	GGM $\tilde{g}\tilde{g}$, $\tilde{\chi}_1^0\to Z\tilde{G}$	displ. vtx + jets	-	-	20.3	🟩 $\tilde{\chi}_1^0$ 1.0 TeV	6 <$c\tau$($\tilde{\chi}_1^0$)< 480 mm, m($\tilde{g}$)=1.1 TeV	1504.05162
RPV	LFV $pp\to\tilde{\nu}_\tau+X$, $\tilde{\nu}_\tau\to e\mu/e\tau/\mu\tau$	$e\mu$,$e\tau$,$\mu\tau$	-	-	3.2	🟦 $\tilde{\nu}_\tau$ 1.9 TeV	λ'_{311}=0.11, $\lambda_{132/133/233}$=0.07	1607.08079
	Bilinear RPV CMSSM	2 e,μ (SS)	0-3 b	Yes	20.3	🟩 $\tilde{q},\tilde{g}$ 1.45 TeV	m($\tilde{q}$)=m($\tilde{g}$), $c\tau_{LSP}$<1 mm	1404.2500
	$\tilde{\chi}_1^+\tilde{\chi}_1^-$, $\tilde{\chi}_1^+\to W\tilde{\chi}_1^0$, $\tilde{\chi}_1^0\to ee\nu, e\mu\nu, \mu\mu\nu$	4 e,μ	-	Yes	13.3	🟦 $\tilde{\chi}_1^\pm$ 1.14 TeV	m($\tilde{\chi}_1^0$)>400GeV, $\lambda_{12k}\neq0$ ($k=1,2$)	ATLAS-CONF-2016-075
	$\tilde{\chi}_1^+\tilde{\chi}_1^-$, $\tilde{\chi}_1^+\to W\tilde{\chi}_1^0$, $\tilde{\chi}_1^0\to\tau\tau\nu_e, e\tau\nu_\tau$	3 $e,\mu+\tau$	-	Yes	20.3	🟩 $\tilde{\chi}_1^\pm$ 450 GeV	m($\tilde{\chi}_1^0$)>0.2×m($\tilde{\chi}_1^\pm$), $\lambda_{133}\neq0$	1405.5086
	$\tilde{g}\tilde{g}$, $\tilde{g}\to qqq$	0	4-5 large-R jets	-	14.8	🟦 $\tilde{g}$ 1.08 TeV	BR(t)=BR(b)=BR(c)=0%	ATLAS-CONF-2016-057
	$\tilde{g}\tilde{g}$, $\tilde{g}\to qq\tilde{\chi}_1^0$, $\tilde{\chi}_1^0\to qqq$	0	4-5 large-R jets	-	14.8	🟦 $\tilde{g}$ 1.55 TeV	m($\tilde{\chi}_1^0$)=800 GeV	ATLAS-CONF-2016-057
	$\tilde{g}\tilde{g}$, $\tilde{g}\to\tilde{t}_1t$, $\tilde{t}_1\to bs$	2 e,μ (SS)	0-3 b	Yes	13.2	🟦 $\tilde{g}$ 1.3 TeV	m($\tilde{t}_1$)<750 GeV	ATLAS-CONF-2016-037
	$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\to bs$	0	2 jets + 2 b	-	15.4	🟦 $\tilde{t}_1$ 410 GeV 450-510 GeV		ATLAS-CONF-2016-022, ATLAS-CONF-2016-084
	$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\to b\ell$	2 e,μ	2 b	-	20.3	🟩 $\tilde{t}_1$ 0.4-1.0 TeV	BR($\tilde{t}_1\to be/\mu$)>20%	ATLAS-CONF-2015-015
Other	Scalar charm, $\tilde{c}\to c\tilde{\chi}_1^0$	0	2 c	Yes	20.3	🟩 $\tilde{c}$ 510 GeV	m($\tilde{\chi}_1^0$)<200 GeV	1501.01325

*Only a selection of the available mass limits on new states or phenomena is shown.

To be updated . . .

Summary & conclusions

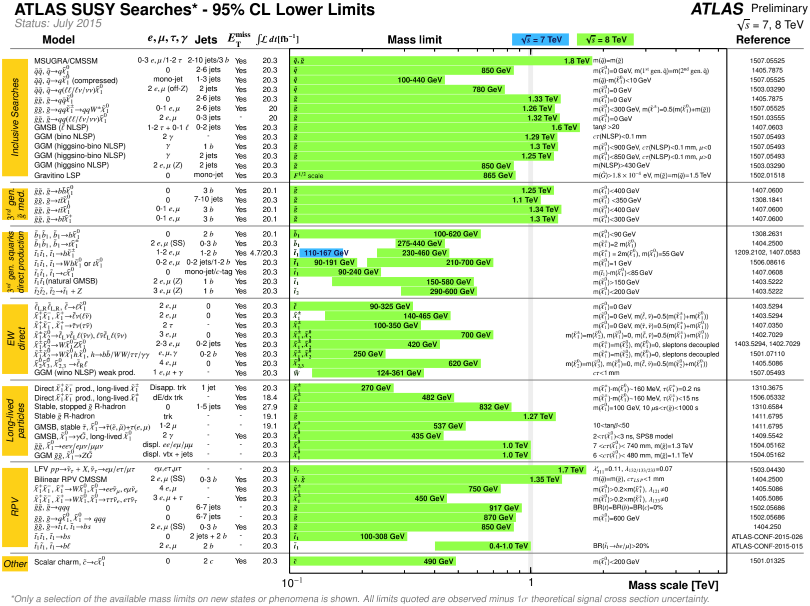
- In the past month, 17 new results from searches for SUSY have been made public by ATLAS, using 13-18 fb^{-1} of $\sqrt{13}$ TeV data from 2015+2016
- Eight analyses are new in Run II, and many improvements have been made for the nine that were also released in March
- In general the data agree well with the background expectations
  $\Rightarrow$ significant increase in excluded SUSY particle mass ranges
- The 1ℓ $\tilde{t}$ search observes a modest excess
  $\Rightarrow$ the rest of 2016 data will show if this persists or goes away.
- Increased integrated lumi $\Rightarrow$ several analyses becoming affected by systematic uncertainties (e.g. MC modeling of $t\bar{t}$, Wt, $t\bar{t}V$ vs $t\bar{t}\gamma$)
  $\Rightarrow$ work ahead for results with full 2015+2016 dataset

Enormous thanks to the LHC for a very successful 2016!

Looking forward to analyzing many more fb^{-1} for the winter conferences!

Back-up material

Run I SUSY results



ATLAS SUSY Searches* - 95% CL Lower Limits

Status: July 2015

ATLAS Preliminary

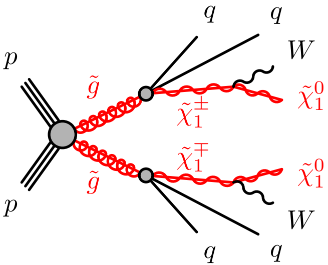
$\sqrt{s}$ = 7, 8 TeV

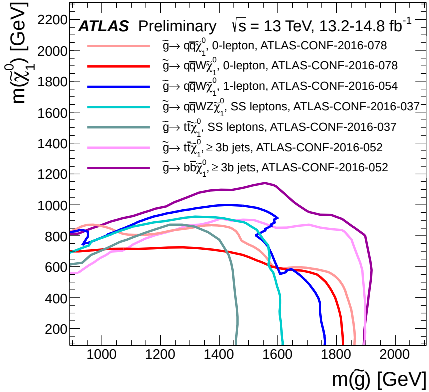
🟦 $\sqrt{s}$ = 7 TeV 🟩 $\sqrt{s}$ = 8 TeV

	Model	e,μ,τ,γ	Jets	E_T^{miss}	$\int\mathcal{L}\,dt[\mathrm{fb}^{-1}]$	Mass limit		Reference
Inclusive Searches	MSUGRA/CMSSM	0-3 e,μ/1-2 τ	2-10 jets/3 b	Yes	20.3	$\tilde{q},\tilde{g}$ 1.8 TeV	m($\tilde{q}$)=m($\tilde{g}$)	1507.05525
	$\tilde{q}\tilde{q}$, $\tilde{q}\rightarrow q\tilde{\chi}_1^0$	0	2-6 jets	Yes	20.3	$\tilde{q}$ 850 GeV	m($\tilde{\chi}_1^0$)=0 GeV, m(1st gen. $\tilde{q}$)=m(2nd gen. $\tilde{q}$)	1405.7875
	$\tilde{q}\tilde{q}$, $\tilde{q}\rightarrow q\tilde{\chi}_1^0$ (compressed)	mono-jet	1-3 jets	Yes	20.3	$\tilde{q}$ 100-440 GeV	m($\tilde{q}$)-m($\tilde{\chi}_1^0$)<10 GeV	1507.05525
	$\tilde{q}\tilde{q}$, $\tilde{q}\rightarrow q(\ell\ell/\ell\nu/\nu\nu)\tilde{\chi}_1^0$	2 e,μ (off-Z)	2 jets	Yes	20.3	$\tilde{q}$ 780 GeV	m($\tilde{\chi}_1^0$)=0 GeV	1503.03290
	$\tilde{g}\tilde{g}$, $\tilde{g}\rightarrow q\bar{q}\tilde{\chi}_1^0$	0	2-6 jets	Yes	20.3	$\tilde{g}$ 1.33 TeV	m($\tilde{\chi}_1^0$)=0 GeV	1405.7875
	$\tilde{g}\tilde{g}$, $\tilde{g}\rightarrow qq\tilde{\chi}_1^{\pm}\rightarrow qqW^{\pm}\tilde{\chi}_1^0$	0-1 e,μ	2-6 jets	Yes	20	$\tilde{g}$ 1.26 TeV	m($\tilde{\chi}_1^0$)<300 GeV, m($\tilde{\chi}^{\pm}$)=0.5(m($\tilde{\chi}_1^0$)+m($\tilde{g}$))	1507.05525
	$\tilde{g}\tilde{g}$, $\tilde{g}\rightarrow qq(\ell\ell/\ell\nu/\nu\nu)\tilde{\chi}_1^0$	2 e,μ	0-3 jets	-	20	$\tilde{g}$ 1.32 TeV	m($\tilde{\chi}_1^0$)=0 GeV	1501.03555
	GMSB ($\tilde{\ell}$ NLSP)	1-2 τ + 0-1 ℓ	0-2 jets	Yes	20.3	$\tilde{g}$ 1.6 TeV	tanβ >20	1407.0603
	GGM (bino NLSP)	2 γ	-	Yes	20.3	$\tilde{g}$ 1.29 TeV	$c\tau$(NLSP)<0.1 mm	1507.05493
	GGM (higgsino-bino NLSP)	γ	1 b	Yes	20.3	$\tilde{g}$ 1.3 TeV	m($\tilde{\chi}_1^0$)<900 GeV, $c\tau$(NLSP)<0.1 mm, μ<0	1507.05493
	GGM (higgsino-bino NLSP)	γ	2 jets	Yes	20.3	$\tilde{g}$ 1.25 TeV	m($\tilde{\chi}_1^0$)<850 GeV, $c\tau$(NLSP)<0.1 mm, μ>0	1507.05493
	GGM (higgsino NLSP)	2 e,μ (Z)	2 jets	Yes	20.3	$\tilde{g}$ 850 GeV	m(NLSP)>430 GeV	1503.03290
	Gravitino LSP	0	mono-jet	Yes	20.3	$F^{1/2}$ scale 865 GeV	m($\tilde{G}$)>1.8×10^{-4} eV, m($\tilde{g}$)=m($\tilde{q}$)=1.5 TeV	1502.01518
3rd gen. $\tilde{g}$ med.	$\tilde{g}\tilde{g}$, $\tilde{g}\rightarrow b\bar{b}\tilde{\chi}_1^0$	0	3 b	Yes	20.1	$\tilde{g}$ 1.25 TeV	m($\tilde{\chi}_1^0$)<400 GeV	1407.0600
	$\tilde{g}\tilde{g}$, $\tilde{g}\rightarrow t\bar{t}\tilde{\chi}_1^0$	0	7-10 jets	Yes	20.3	$\tilde{g}$ 1.1 TeV	m($\tilde{\chi}_1^0$) <350 GeV	1308.1841
	$\tilde{g}\tilde{g}$, $\tilde{g}\rightarrow t\bar{t}\tilde{\chi}_1^0$	0-1 e,μ	3 b	Yes	20.1	$\tilde{g}$ 1.34 TeV	m($\tilde{\chi}_1^0$)<400 GeV	1407.0600
	$\tilde{g}\tilde{g}$, $\tilde{g}\rightarrow b\bar{t}\tilde{\chi}_1^+$	0-1 e,μ	3 b	Yes	20.1	$\tilde{g}$ 1.3 TeV	m($\tilde{\chi}_1^0$)<300 GeV	1407.0600
3rd gen. squarks direct production	$\tilde{b}_1\tilde{b}_1$, $\tilde{b}_1\rightarrow b\tilde{\chi}_1^0$	0	2 b	Yes	20.1	$\tilde{b}_1$ 100-620 GeV	m($\tilde{\chi}_1^0$)<90 GeV	1308.2631
	$\tilde{b}_1\tilde{b}_1$, $\tilde{b}_1\rightarrow t\tilde{\chi}_1^{\pm}$	2 e,μ (SS)	0-3 b	Yes	20.3	$\tilde{b}_1$ 275-440 GeV	m($\tilde{\chi}_1^{\pm}$)=2 m($\tilde{\chi}_1^0$)	1404.2500
	$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\rightarrow b\tilde{\chi}_1^{\pm}$	1-2 e,μ	1-2 b	Yes	4.7/20.3	$\tilde{t}_1$ 110-167 GeV 230-460 GeV	m($\tilde{\chi}_1^{\pm}$) = 2m($\tilde{\chi}_1^0$), m($\tilde{\chi}_1^0$)=55 GeV	1209.2102, 1407.0583
	$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\rightarrow Wb\tilde{\chi}_1^0$ or $t\tilde{\chi}_1^0$	0-2 e,μ	0-2 jets/1-2 b	Yes	20.3	$\tilde{t}_1$ 90-191 GeV 210-700 GeV	m($\tilde{\chi}_1^0$)=1 GeV	1506.08616
	$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\rightarrow c\tilde{\chi}_1^0$	0	mono-jet/c-tag	Yes	20.3	$\tilde{t}_1$ 90-240 GeV	m($\tilde{t}_1$)-m($\tilde{\chi}_1^0$)<85 GeV	1407.0608
	$\tilde{t}_1\tilde{t}_1$(natural GMSB)	2 e,μ (Z)	1 b	Yes	20.3	$\tilde{t}_1$ 150-580 GeV	m($\tilde{\chi}_1^0$)>150 GeV	1403.5222
	$\tilde{t}_2\tilde{t}_2$, $\tilde{t}_2\rightarrow\tilde{t}_1+Z$	3 e,μ (Z)	1 b	Yes	20.3	$\tilde{t}_2$ 290-600 GeV	m($\tilde{\chi}_1^0$)<200 GeV	1403.5222
EW direct	$\tilde{\ell}_{L,R}\tilde{\ell}_{L,R}$, $\tilde{\ell}\rightarrow\ell\tilde{\chi}_1^0$	2 e,μ	0	Yes	20.3	$\tilde{\ell}$ 90-325 GeV	m($\tilde{\chi}_1^0$)=0 GeV	1403.5294
	$\tilde{\chi}_1^+\tilde{\chi}_1^-$, $\tilde{\chi}_1^+\rightarrow\tilde{\ell}\nu(\ell\tilde{\nu})$	2 e,μ	0	Yes	20.3	$\tilde{\chi}_1^{\pm}$ 140-465 GeV	m($\tilde{\chi}_1^0$)=0 GeV, m($\tilde{\ell},\tilde{\nu}$)=0.5(m($\tilde{\chi}_1^{\pm}$)+m($\tilde{\chi}_1^0$))	1403.5294
	$\tilde{\chi}_1^+\tilde{\chi}_1^-$, $\tilde{\chi}_1^+\rightarrow\tilde{\tau}\nu(\tau\tilde{\nu})$	2 τ	-	Yes	20.3	$\tilde{\chi}_1^{\pm}$ 100-350 GeV	m($\tilde{\chi}_1^0$)=0 GeV, m($\tilde{\tau},\tilde{\nu}$)=0.5(m($\tilde{\chi}_1^{\pm}$)+m($\tilde{\chi}_1^0$))	1407.0350
	$\tilde{\chi}_1^{\pm}\tilde{\chi}_2^0\rightarrow\tilde{\ell}_L\nu\tilde{\ell}_L\ell(\tilde{\nu}\nu)$, $\ell\tilde{\nu}\tilde{\ell}_L\ell(\tilde{\nu}\nu)$	3 e,μ	0	Yes	20.3	$\tilde{\chi}_1^{\pm},\tilde{\chi}_2^0$ 700 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($\tilde{\chi}_1^0$))	1402.7029
	$\tilde{\chi}_1^{\pm}\tilde{\chi}_2^0\rightarrow W\tilde{\chi}_1^0 Z\tilde{\chi}_1^0$	2-3 e,μ	0-2 jets	Yes	20.3	$\tilde{\chi}_1^{\pm},\tilde{\chi}_2^0$ 420 GeV	m($\tilde{\chi}_1^{\pm}$)=m($\tilde{\chi}_2^0$), m($\tilde{\chi}_1^0$)=0, sleptons decoupled	1403.5294, 1402.7029
	$\tilde{\chi}_1^{\pm}\tilde{\chi}_2^0\rightarrow W\tilde{\chi}_1^0 h\tilde{\chi}_1^0$, $h\rightarrow b\bar{b}/WW/\tau\tau/\gamma\gamma$	e,μ,γ	0-2 b	Yes	20.3	$\tilde{\chi}_1^{\pm},\tilde{\chi}_2^0$ 250 GeV	m($\tilde{\chi}_1^{\pm}$)=m($\tilde{\chi}_2^0$), m($\tilde{\chi}_1^0$)=0, sleptons decoupled	1501.07110
	$\tilde{\chi}_2^0\tilde{\chi}_3^0$, $\tilde{\chi}_{2,3}^0\rightarrow\tilde{\ell}_R\ell$	4 e,μ	0	Yes	20.3	$\tilde{\chi}_{2,3}^0$ 620 GeV	m($\tilde{\chi}_2^0$)=m($\tilde{\chi}_3^0$), m($\tilde{\chi}_1^0$)=0, m($\tilde{\ell},\tilde{\nu}$)=0.5(m($\tilde{\chi}_2^0$)+m($\tilde{\chi}_1^0$))	1405.5086
	GGM (wino NLSP) weak prod.	1 e,μ + γ	-	Yes	20.3	$\tilde{W}$ 124-361 GeV	$c\tau$<1 mm	1507.05493
Long-lived particles	Direct $\tilde{\chi}_1^+\tilde{\chi}_1^-$ prod., long-lived $\tilde{\chi}_1^{\pm}$	Disapp. trk	1 jet	Yes	20.3	$\tilde{\chi}_1^{\pm}$ 270 GeV	m($\tilde{\chi}_1^{\pm}$)-m($\tilde{\chi}_1^0$)~160 MeV, τ($\tilde{\chi}_1^{\pm}$)=0.2 ns	1310.3675
	Direct $\tilde{\chi}_1^+\tilde{\chi}_1^-$ prod., long-lived $\tilde{\chi}_1^{\pm}$	dE/dx trk	-	Yes	18.4	$\tilde{\chi}_1^{\pm}$ 482 GeV	m($\tilde{\chi}_1^{\pm}$)-m($\tilde{\chi}_1^0$)~160 MeV, τ($\tilde{\chi}_1^{\pm}$)<15 ns	1506.05332
	Stable, stopped $\tilde{g}$ R-hadron	0	1-5 jets	Yes	27.9	$\tilde{g}$ 832 GeV	m($\tilde{\chi}_1^0$)=100 GeV, 10 μs<τ($\tilde{g}$)<1000 s	1310.6584
	Stable $\tilde{g}$ R-hadron	trk	-	-	19.1	$\tilde{g}$ 1.27 TeV		1411.6795
	GMSB, stable $\tilde{\tau}$, $\tilde{\chi}_1^0\rightarrow\tilde{\tau}(\tilde{e},\tilde{\mu})+\tau(e,\mu)$	1-2 μ	-	-	19.1	$\tilde{\chi}_1^0$ 537 GeV	10<tanβ<50	1411.6795
	GMSB, $\tilde{\chi}_1^0\rightarrow\gamma\tilde{G}$, long-lived $\tilde{\chi}_1^0$	2 γ	-	Yes	20.3	$\tilde{\chi}_1^0$ 435 GeV	2<τ($\tilde{\chi}_1^0$)<3 ns, SPS8 model	1409.5542
	$\tilde{g}\tilde{g}$, $\tilde{\chi}_1^0\rightarrow ee\nu/e\mu\nu/\mu\mu\nu$	displ. $ee/e\mu/\mu\mu$	-	-	20.3	$\tilde{\chi}_1^0$ 1.0 TeV	7 <$c\tau$($\tilde{\chi}_1^0$)< 740 mm, m($\tilde{g}$)=1.3 TeV	1504.05162
	GGM $\tilde{g}\tilde{g}$, $\tilde{\chi}_1^0\rightarrow Z\tilde{G}$	displ. vtx + jets	-	-	20.3	$\tilde{\chi}_1^0$ 1.0 TeV	6 <$c\tau$($\tilde{\chi}_1^0$)< 480 mm, m($\tilde{g}$)=1.1 TeV	1504.05162
RPV	LFV $pp\rightarrow\tilde{\nu}_\tau+X$, $\tilde{\nu}_\tau\rightarrow e\mu/e\tau/\mu\tau$	$e\mu$,$e\tau$,$\mu\tau$	-	-	20.3	$\tilde{\nu}_\tau$ 1.7 TeV	λ'_{311}=0.11, $\lambda_{132/133/233}$=0.07	1503.04430
	Bilinear RPV CMSSM	2 e,μ (SS)	0-3 b	Yes	20.3	$\tilde{q},\tilde{g}$ 1.35 TeV	m($\tilde{q}$)=m($\tilde{g}$), $c\tau_{LSP}$<1 mm	1404.2500
	$\tilde{\chi}_1^+\tilde{\chi}_1^-$, $\tilde{\chi}_1^+\rightarrow W\tilde{\chi}_1^0$, $\tilde{\chi}_1^0\rightarrow ee\tilde{\nu}_\mu$, $e\mu\tilde{\nu}_e$	4 e,μ	-	Yes	20.3	$\tilde{\chi}_1^{\pm}$ 750 GeV	m($\tilde{\chi}_1^0$)>0.2×m($\tilde{\chi}_1^{\pm}$), $\lambda_{121}\neq0$	1405.5086
	$\tilde{\chi}_1^+\tilde{\chi}_1^-$, $\tilde{\chi}_1^+\rightarrow W\tilde{\chi}_1^0$, $\tilde{\chi}_1^0\rightarrow\tau\tau\tilde{\nu}_e$, $e\tau\tilde{\nu}_\tau$	3 e,μ + τ	-	Yes	20.3	$\tilde{\chi}_1^{\pm}$ 450 GeV	m($\tilde{\chi}_1^0$)>0.2×m($\tilde{\chi}_1^{\pm}$), $\lambda_{133}\neq0$	1405.5086
	$\tilde{g}\tilde{g}$, $\tilde{g}\rightarrow qqq$	0	6-7 jets	-	20.3	$\tilde{g}$ 917 GeV	BR(t)=BR(b)=BR(c)=0%	1502.05686
	$\tilde{g}\tilde{g}$, $\tilde{g}\rightarrow q\tilde{\chi}_1^0$, $\tilde{\chi}_1^0\rightarrow qqq$	0	6-7 jets	-	20.3	$\tilde{g}$ 870 GeV	m($\tilde{\chi}_1^0$)=600 GeV	1502.05686
	$\tilde{g}\tilde{g}$, $\tilde{g}\rightarrow\tilde{t}_1 t$, $\tilde{t}_1\rightarrow bs$	2 e,μ (SS)	0-3 b	Yes	20.3	$\tilde{g}$ 850 GeV		1404.250
	$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\rightarrow bs$	0	2 jets + 2 b	-	20.3	$\tilde{t}_1$ 100-308 GeV		ATLAS-CONF-2015-026
	$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\rightarrow b\ell$	2 e,μ	2 b	-	20.3	$\tilde{t}_1$ 0.4-1.0 TeV	BR($\tilde{t}_1\rightarrow be/\mu$)>20%	ATLAS-CONF-2015-015
Other	Scalar charm, $\tilde{c}\rightarrow c\tilde{\chi}_1^0$	0	2 c	Yes	20.3	$\tilde{c}$ 490 GeV	m($\tilde{\chi}_1^0$)<200 GeV	1501.01325

*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.

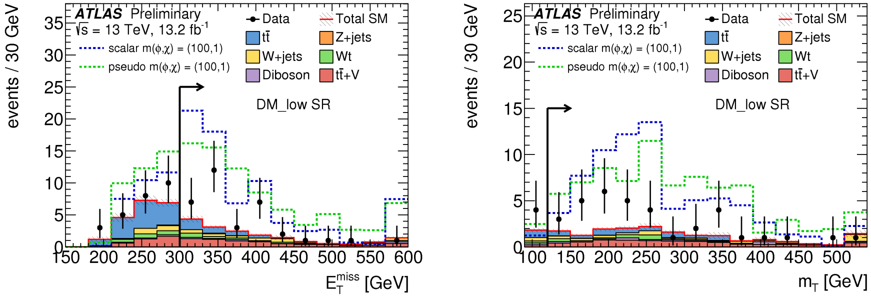
Sensitivity of inclusive strong production searches to $\tilde{g}\tilde{g}$, $\tilde{g} \rightarrow qqW\tilde{\chi}^0$





Stop 1ℓ details

3.3σ excess seen in `SR_DMlow` (35 events observed, 17±2 expected):



Many checks done on background estimates, no obvious problems found.

More data already collected, will tell us whether this is a background fluctuation

Stop 1ℓ details

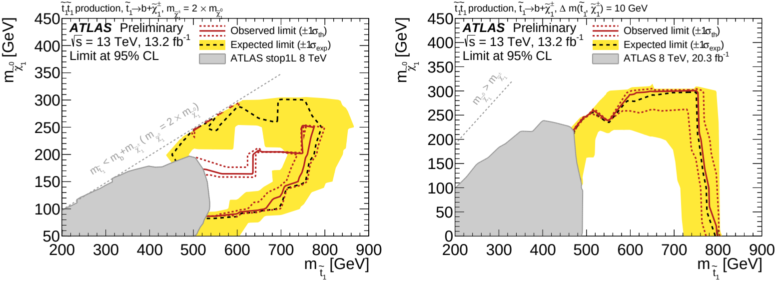


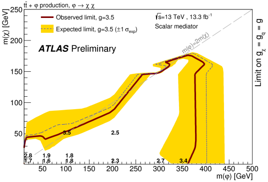
Figure 12: Expected (black dashed) and observed (red solid) 95% excluded regions in the plane of $m_{\tilde{t}_1}$ versus $m_{\tilde{\chi}_1^0}$ for direct stop pair production assuming $b\tilde{\chi}_1^\pm$ decay with a branching ratio of 100%. The chargino mass is assumed to be twice the neutralino mass (left) or close to the stop mass, $m_{\tilde{\chi}_1^\pm} = m_{\tilde{t}_1} - 10\,\mathrm{GeV}$(right). The excluded regions (gray shaded area) from previous publications, stop search in the one-lepton channel at 8TeV (left) [24] and ATLAS stop search at 8TeV (right) [25], are obtained under the hypothesis of mostly-left-handed stops, while new results are obtained with an unpolarized signal assumption.

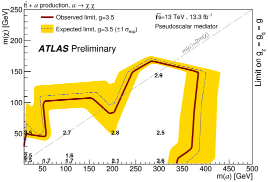
Summary of $t\bar{t}$+DM exclusion limits

Similar limits for DM+$t\bar{t}$ for 0ℓ, 1ℓ and 2ℓ stop searches:

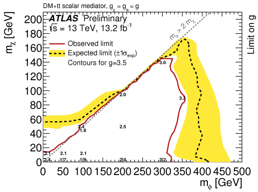
- Scalar mediator up to ~ 350 GeV
- …and for a pseudo-scalar mediator up to ~ 350 GeV

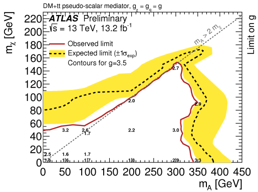
0ℓ:



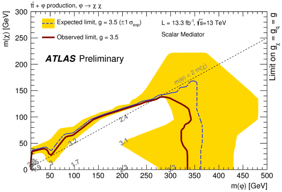


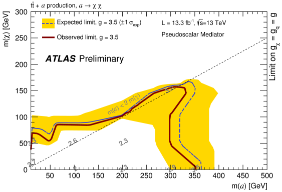
1ℓ:



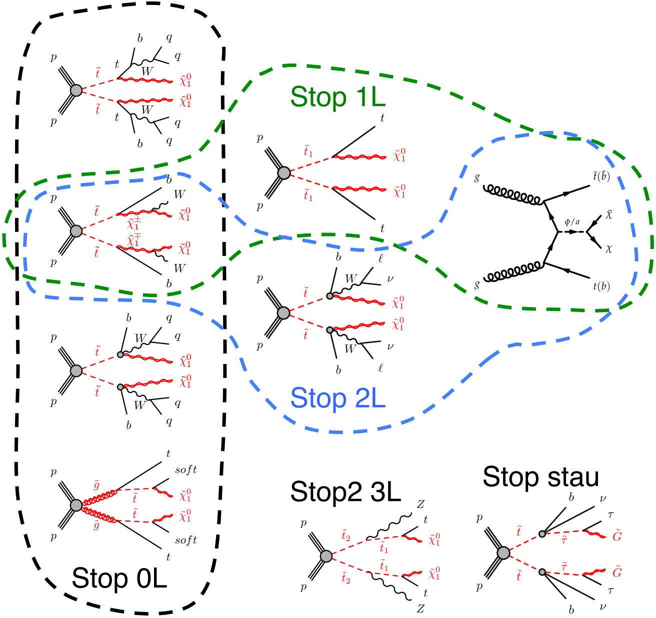


2ℓ:





Direct $\tilde{t}$ coverage for the five new results



Stop 1L

Stop 2L

Stop 0L

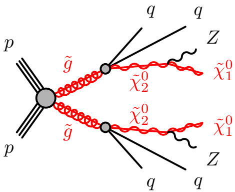
Stop2 3L

Stop stau

Dec 2015 (no update yet): $Z(\ell\ell)$ + jets + $E_{\mathrm{T}}^{\mathrm{miss}}$ search

ATLAS-CONF-2015-082

Target: $\tilde{g}\tilde{g}$ or $\tilde{q}\tilde{q}$ with $Z \to \ell\ell$ in decay



Background estimation:

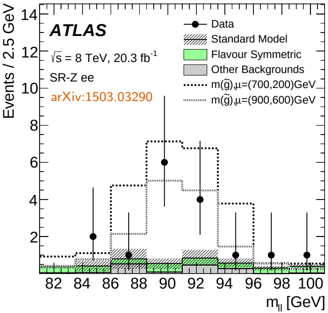
- $t\bar{t}$, WW, Wt: flavor-symmetric (1:1:2 ratio for ee:$\mu\mu$:$e\mu$), estimated from $e\mu$ data:

$$N_{ee/\mu\mu}^{\mathrm{bg\ est.}} = \frac{1}{2} N_{e\mu}^{\mathrm{CR}} \times k_{ee/\mu\mu}$$

- WZ, ZZ, $t\bar{t}V$ from MC, checked in VR
- Z+jets: estimated from γ+jets events in data

Excess in 8 TeV Run I search:

- ee: 3σ, $\mu\mu$: 1.7σ

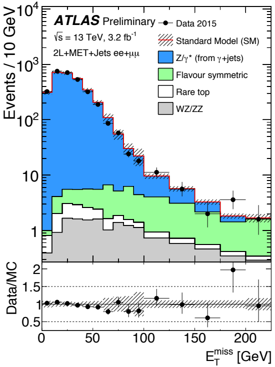


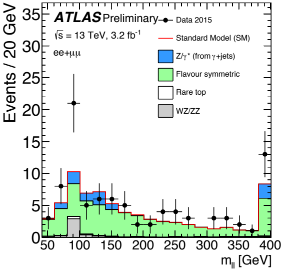
Reproduce Run I SR:

- SFOS $ee/\mu\mu$ with $81\ \mathrm{GeV} < m_{\ell\ell} < 101\ \mathrm{GeV}$
- 2 jets with $\Delta\phi_{\min}(E_{\mathrm{T}}^{\mathrm{miss}}, j) > 0.4$
- $E_{\mathrm{T}}^{\mathrm{miss}} > 225\ \mathrm{GeV}$, $H_{\mathrm{T}} > 600\ \mathrm{GeV}$

Dec 2015 (no update yet): $Z(\ell\ell) + \text{jets} + E_{\mathrm{T}}^{\mathrm{miss}}$: results

ATLAS-CONF-2015-082

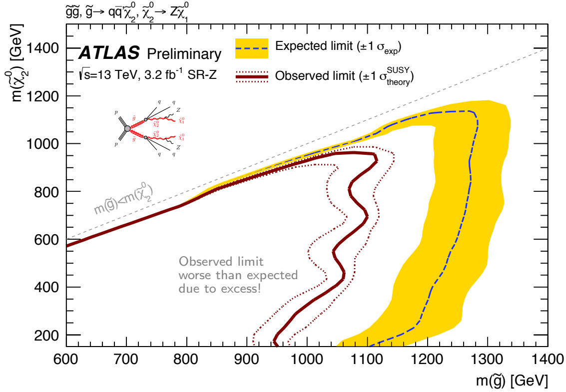




Final event yield for 2015 data:

- Expected: 10.3 ± 2.3
- Observed: 21 ($10\ ee$, $11\ \mu\mu$)

  $\Rightarrow$ 2.2σ excess



Observed limit worse than expected due to excess!

CMS observes 12 with $12^{+4.0}_{-2.8}$ expected (CMS-PAS-SUS-15-011)