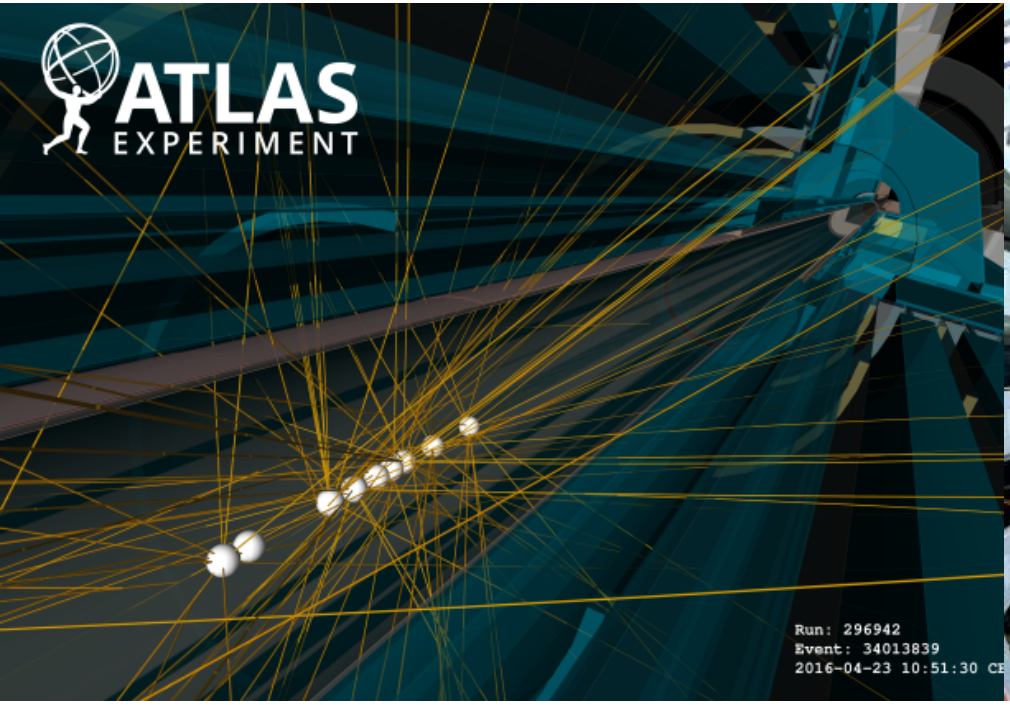
Overview of SUSY searches with ATLAS

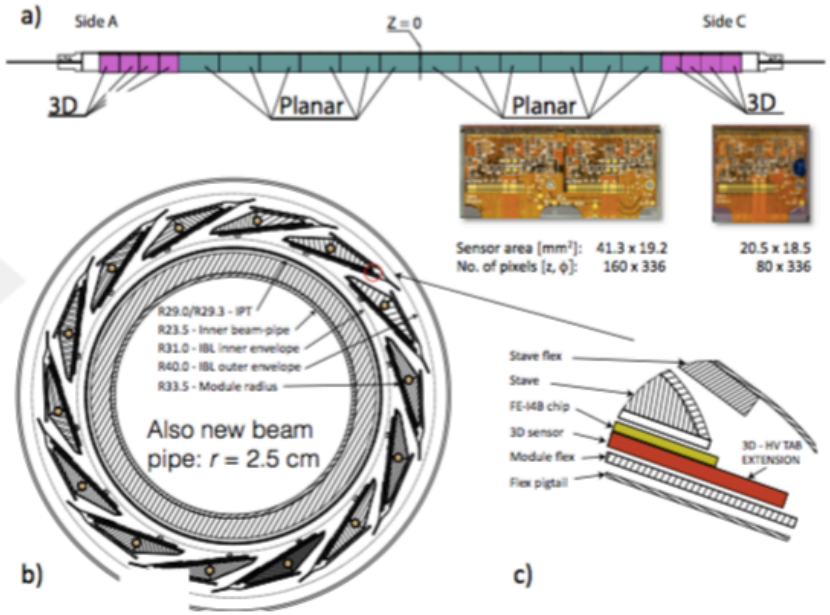
Davide Costanzo
(University of Sheffield, Leverhulme Trust)
On behalf of the ATLAS Collaboration

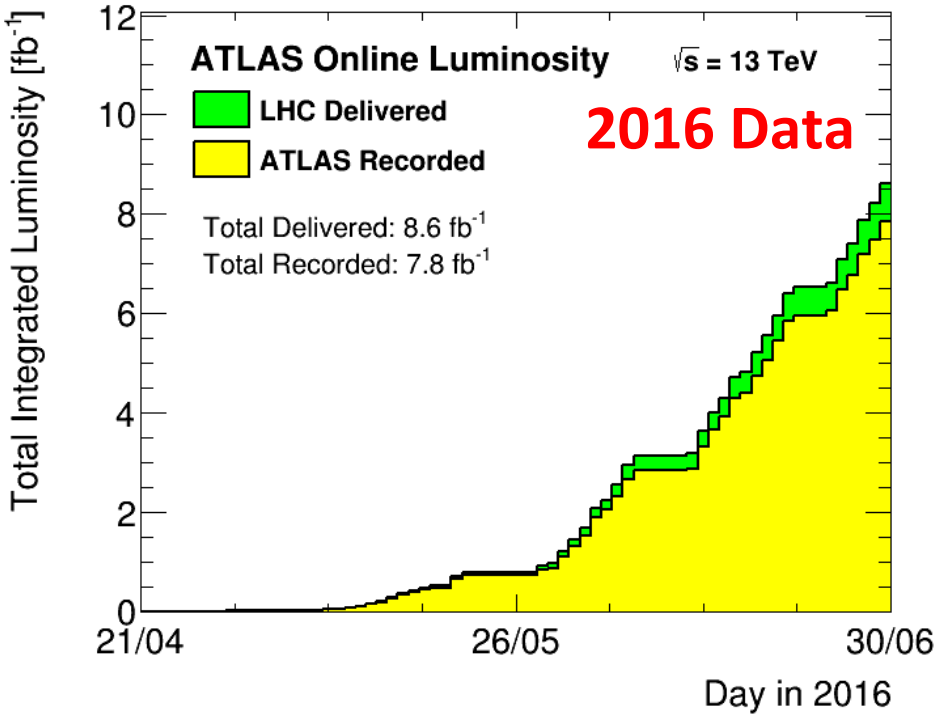


ATLAS and the LHC Run-2

- New pixel "Insertable B-layer"
  - Improved flavour tagging
- Higher centre-of-mass energy
- Reoptimization of analyses

- 2015: 13 TeV collisions. 3.2 fb^{-1}
  → main topic of this talk
- 2016: 7.8 fb^{-1} collected so far.
  Ongoing smooth operation

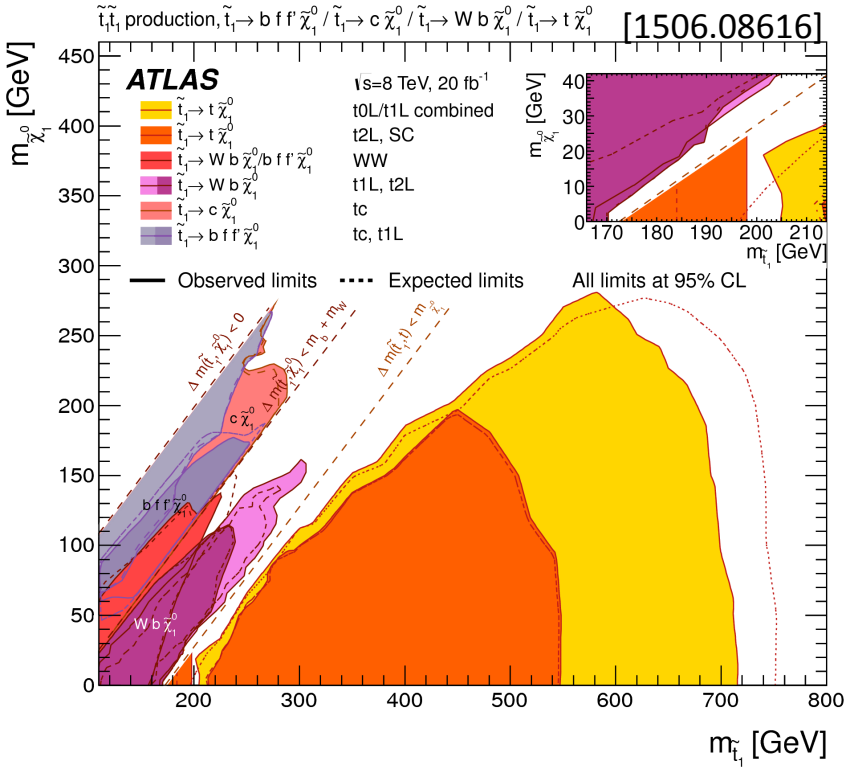


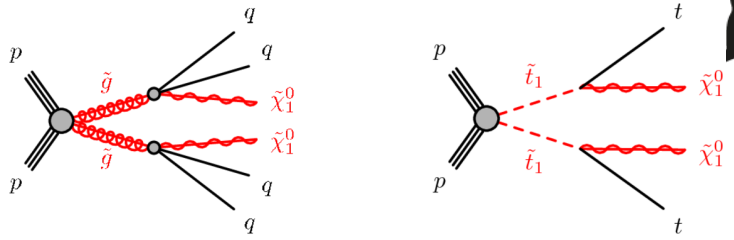


From 8 TeV to 13 TeV

Extensive search programme at 8 TeV with 20 fb^{-1} of data. **Nothing found**

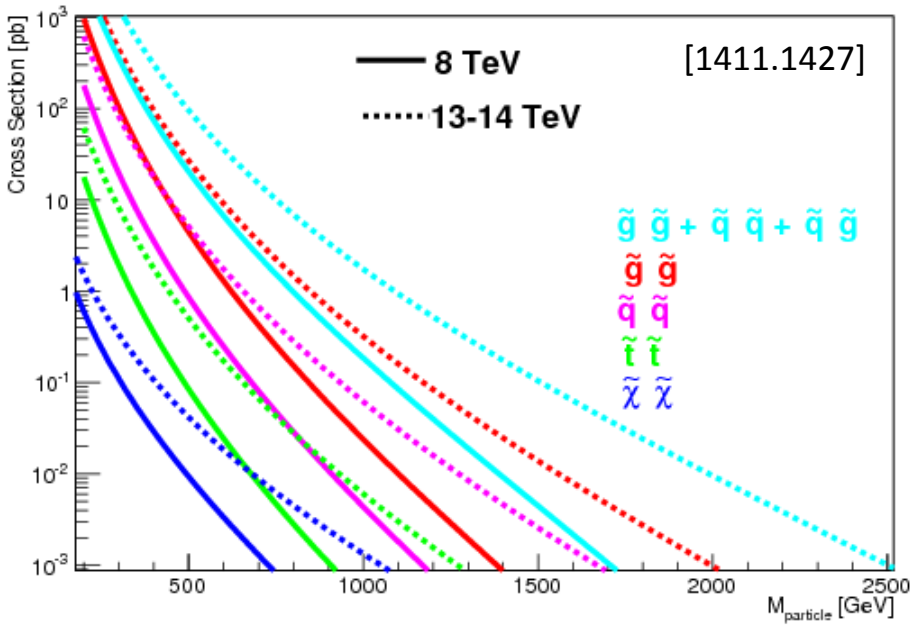
Example: $\tilde{t}_1$ pair production $m(\tilde{\chi}_1^0)$ vs $m(\tilde{t}_1)$ with various model assumptions





Large increase in 13 TeV cross section of massive particles

Improved limits with 2015 data (3.2 fb^{-1} vs 20fb^{-1})



ATLAS SUSY Searches* - 95% CL Lower Limits

Status: July 2016

ATLAS Preliminary

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

	Model	e, μ, τ, γ	Jets	E_T^{miss}	$\int \mathcal{L}\, dt$[fb^{-1}]	Mass limit	$\sqrt{s}$ = 7, 8 TeV	$\sqrt{s}$ = 13 TeV	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		1507.05525
	$\tilde{q}\tilde{q}, \tilde{q}\to q\tilde{\chi}_1^0$	0	2-6 jets	Yes	3.2	$\tilde{q}$	1.03 TeV		1605.03814
	$\tilde{q}\tilde{q}, \tilde{q}\to q\tilde{\chi}_1^0$ (compressed)	mono-jet	1-3 jets	Yes	3.2	$\tilde{q}$	608 GeV		1604.07773
	$\tilde{g}\tilde{g}, \tilde{g}\to q\bar{q}\tilde{\chi}_1^0$	0	2-6 jets	Yes	3.2	$\tilde{g}$	1.51 TeV		1605.03814
	$\tilde{g}\tilde{g}, \tilde{g}\to qq\tilde{\chi}_1^\pm\to qqW^\pm\tilde{\chi}_1^0$	1 e, μ	2-6 jets	Yes	3.3	$\tilde{g}$	1.6 TeV		1605.04285
	$\tilde{g}\tilde{g}, \tilde{g}\to qq(\ell\ell/\ell\nu/\nu\nu)\tilde{\chi}_1^0$	2 e, μ	0-3 jets	-	20	$\tilde{g}$	1.38 TeV		1501.03555
	$\tilde{g}\tilde{g}, \tilde{g}\to qqWZ\tilde{\chi}_1^0$	0	7-10 jets	Yes	3.2	$\tilde{g}$	1.4 TeV		1602.06194
	GMSB ($\tilde{\ell}$ NLSP)	1-2 τ + 0-1 ℓ	0-2 jets	Yes	3.2	$\tilde{g}$	2.0 TeV		*To appear*
	GGM (bino NLSP)	2 γ	-	Yes	3.2	$\tilde{g}$	1.65 TeV		1606.09150
	GGM (higgsino-bino NLSP)	γ	1 b	Yes	20.3	$\tilde{g}$	1.37 TeV		1507.05493
	GGM (higgsino-bino NLSP)	γ	2 jets	Yes	20.3	$\tilde{g}$	1.3 TeV		1507.05493
	GGM (higgsino NLSP)	2 e, μ (Z)	2 jets	Yes	20.3	$\tilde{g}$	900 GeV		1503.03290
	Gravitino LSP	0	mono-jet	Yes	20.3	$F^{1/2}$ scale	865 GeV		1502.01518
3rd gen. $\tilde{g}$ med.	$\tilde{g}\tilde{g}, \tilde{g}\to b\bar{b}\tilde{\chi}_1^0$	0	3 b	Yes	3.3	$\tilde{g}$	1.78 TeV		1605.09318
	$\tilde{g}\tilde{g}, \tilde{g}\to t\bar{t}\tilde{\chi}_1^0$	0-1 e, μ	3 b	Yes	3.3	$\tilde{g}$	1.8 TeV		1605.09318
	$\tilde{g}\tilde{g}, \tilde{g}\to b\bar{t}\tilde{\chi}_1^+$	0-1 e, μ	3 b	Yes	20.1	$\tilde{g}$	1.37 TeV		1407.0600
3rd 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		1606.08772
	$\tilde{b}_1\tilde{b}_1, \tilde{b}_1\to t\tilde{\chi}_1^\pm$	2 e, μ (SS)	0-3 b	Yes	3.2	$\tilde{b}_1$	325-540 GeV		1602.09058
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to b\tilde{\chi}_1^\pm$	1-2 e, μ	1-2 b	Yes	4.7/20.3	$\tilde{t}_1$ 117-170 GeV	200-500 GeV		1209.2102, 1407.0583
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to Wb\tilde{\chi}_1^0$ or $t\tilde{\chi}_1^0$	0-2 e, μ	0-2 jets/1-2 b	Yes	20.3	$\tilde{t}_1$ 90-198 GeV	205-715 GeV	745-785 GeV	1506.08616, 1606.03903
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to c\tilde{\chi}_1^0$	0	mono-jet/c-tag	Yes	20.3	$\tilde{t}_1$ 90-245 GeV			1407.0608
	$\tilde{t}_1\tilde{t}_1$ (natural GMSB)	2 e, μ (Z)	1 b	Yes	20.3	$\tilde{t}_1$	150-600 GeV		1403.5222
	$\tilde{t}_2\tilde{t}_2, \tilde{t}_2\to\tilde{t}_1+Z$	3 e, μ (Z)	1 b	Yes	20.3	$\tilde{t}_2$	290-610 GeV		1403.5222
	$\tilde{t}_2\tilde{t}_2, \tilde{t}_2\to\tilde{t}_1+h$	1 e, μ	6 jets + 2 b	Yes	20.3	$\tilde{t}_2$	320-620 GeV		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		1403.5294
	$\tilde{\chi}_1^\pm\tilde{\chi}_1^\mp, \tilde{\chi}_1^\pm\to\tilde{\ell}\nu(\ell\tilde{\nu})$	2 e, μ	0	Yes	20.3	$\tilde{\chi}_1^\pm$	140-475 GeV		1403.5294
	$\tilde{\chi}_1^\pm\tilde{\chi}_1^\mp, \tilde{\chi}_1^\pm\to\tilde{\tau}\nu(\tau\tilde{\nu})$	2 τ	-	Yes	20.3	$\tilde{\chi}_1^\pm$	355 GeV		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		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		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		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		1405.5086
	GGM (wino NLSP) weak prod.	1 $e, \mu + \gamma$	-	Yes	20.3	$\tilde{W}$	115-370 GeV		1507.05493
	GGM (bino NLSP) weak prod.	2 γ	-	Yes	20.3	$\tilde{W}$	590 GeV		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		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		1506.05332
	Stable, stopped $\tilde{g}$ R-hadron	0	1-5 jets	Yes	27.9	$\tilde{g}$	850 GeV		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	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		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		1409.5542
	$\tilde{g}\tilde{g}, \tilde{\chi}_1^0\to eev/e\mu\nu/\mu\mu\nu$	displ. $ee/e\mu/\mu\mu$	-	-	20.3	$\tilde{\chi}_1^0$		1.0 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	1504.05162
RPV	LFV $pp\to\tilde{\nu}_\tau+X, \tilde{\nu}_\tau\to e\mu/e\tau/\mu\tau$	$e\mu, e\tau, \mu\tau$	-	-	20.3	$\tilde{\nu}_\tau$		1.7 TeV	λ'_{311}=0.11, $\lambda_{132/133/233}$=0.07
	Bilinear RPV CMSSM	2 e, μ (SS)	0-3 b	Yes	20.3	$\tilde{q}, \tilde{g}$		1.45 TeV	1404.2500
	$\tilde{\chi}_1^\pm\tilde{\chi}_1^\mp, \tilde{\chi}_1^\pm\to W\tilde{\chi}_1^0, \tilde{\chi}_1^0\to ee\tilde{\nu}_\mu, e\mu\tilde{\nu}_e$	4 e, μ	-	Yes	20.3	$\tilde{\chi}_1^\pm$	760 GeV		1405.5086
	$\tilde{\chi}_1^\pm\tilde{\chi}_1^\mp, \tilde{\chi}_1^\pm\to W\tilde{\chi}_1^0, \tilde{\chi}_1^0\to\tau\tau\tilde{\nu}_e, e\tau\tilde{\nu}_\tau$	3 $e, \mu + \tau$	-	Yes	20.3	$\tilde{\chi}_1^\pm$	450 GeV		1405.5086
	$\tilde{g}\tilde{g}, \tilde{g}\to qqq$	0	6-7 jets	-	20.3	$\tilde{g}$	917 GeV		1502.05686
	$\tilde{g}\tilde{g}, \tilde{g}\to qq\tilde{\chi}_1^0, \tilde{\chi}_1^0\to qqq$	0	6-7 jets	-	20.3	$\tilde{g}$	980 GeV		1502.05686
	$\tilde{g}\tilde{g}, \tilde{g}\to\tilde{t}_1 t, \tilde{t}_1\to bs$	2 e, μ (SS)	0-3 b	Yes	20.3	$\tilde{g}$	880 GeV		1404.2500
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to bs$	0	2 jets + 2 b	-	3.2	$\tilde{t}_1$ 345 GeV			ATLAS-CONF-2016-022
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to b\ell$	2 e, μ	2 b	-	20.3	$\tilde{t}_1$	0.4-1.0 TeV		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			1501.01325

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

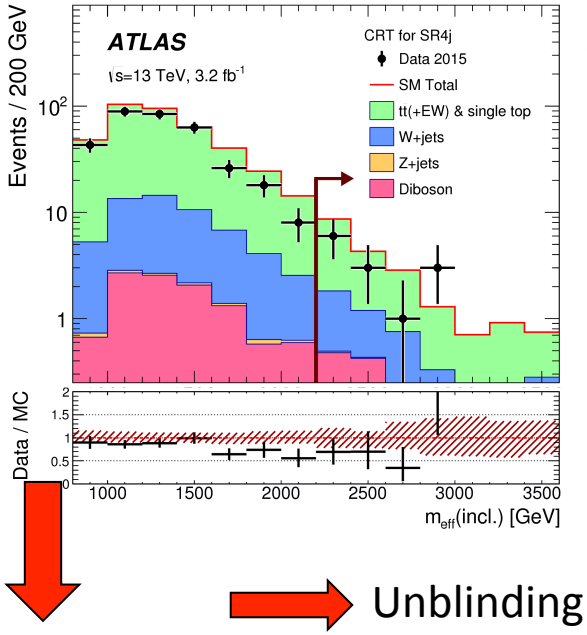
10^{-1} 1 Mass scale [TeV]

Search Strategy

Common search strategy: (HistFitter)

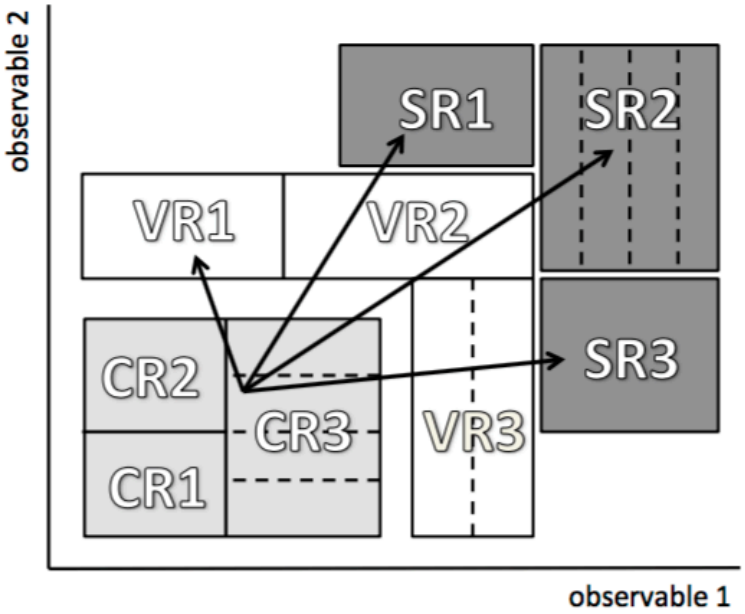
- Based on control regions
- Data driven approach for difficult backgrounds (eg multijet/Z+jets)
- Simultaneous fits to calculate final background estimates
- Signal regions are unblinded after agreement in validation regions

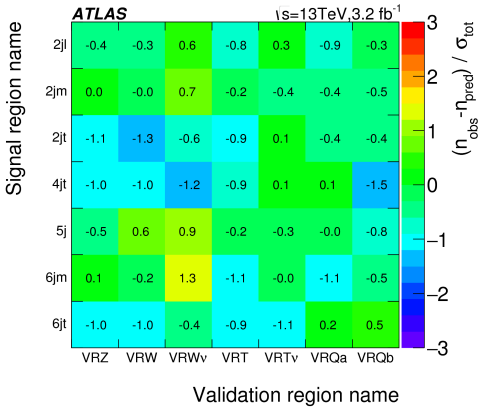
Example: Jets+E_T^{miss} search:

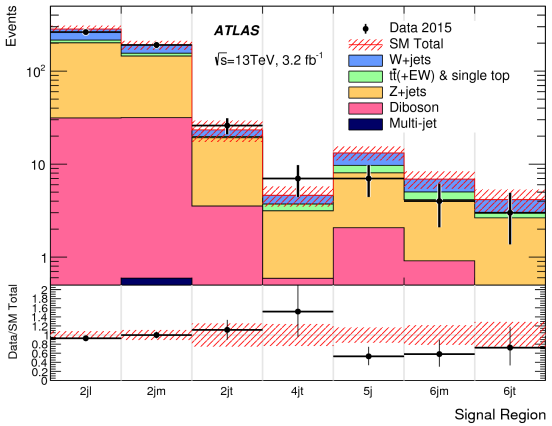


Top Control region

Unblinding







SUSY signatures at 13 TeV

Analyses based on the 2015 dataset

Jets (+ E_t^{miss})

- 2-6 Jets and E_T^{miss} . arXiv 1605.03814
- 7-10 Jets and E_T^{miss} . arXiv 1602.06194
- Monojet and E_T^{miss} . arXiv 1604.07773

} Squarks and gluons $(\tilde{q}, \tilde{g})$

- 2 b-jets and E_T^{miss} . arXiv 1606.08772
- ≥ 3 b-jets and E_T^{miss} . arXiv 1605.09318

} 3rd generation $(\tilde{t}_1, \tilde{b}_1)$

- 4 jets (2-jets). ATLAS-CONF-2016-022 $\tilde{t}_1 \to \bar{b}\bar{s}$ RPV decays

13 TeV
3.3 fb^{-1}

Jets + electrons/muons + E_T^{miss}

- 1 lepton, Jets and E_T^{miss} . arXiv 1604.04285
- 2 same-sign leptons or 3 leptons, arXiv 1602.09058
- Z -> ll, Jets and E_T^{miss} , ATLAS-CONF-2015-082

} Squarks and gluons $(\tilde{q}, \tilde{g})$

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- 2 leptons, b-jets and E_T^{miss} , ATLAS-CONF-2016-009

} 3rd generation $(\tilde{t}_1, \tilde{b}_1)$

Long Lived particles

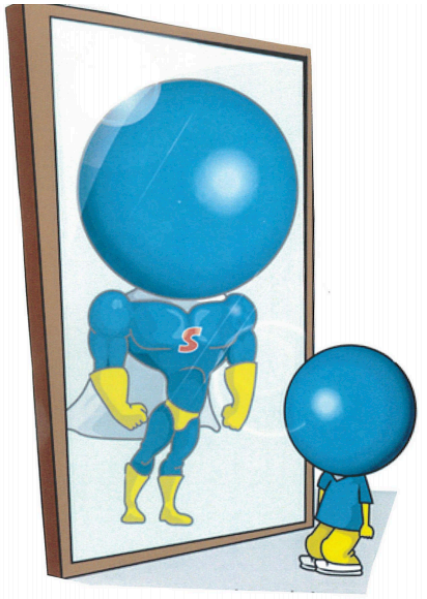
- dE/dx in the Pixel detector, arXiv 1604.04520
- Short Lived Particles, arXiv 1606.05129

} R-hadrons

Photon or tau + X

- Photons and E_T^{miss} , arXiv 1606.09150
- tau and E_T^{miss} , to appear

GMSB $\tilde{g} \to qq\tilde{\chi}_1^0, \tilde{\chi}_1^0 \to \gamma\tilde{G}$
GMSB, $\tilde{\chi}_1^{\pm}/\tilde{\chi}_2^0$ decays to $\tilde{\tau}/\tilde{\nu}_{\tau}$



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- tau and E_T^{miss} , to appear

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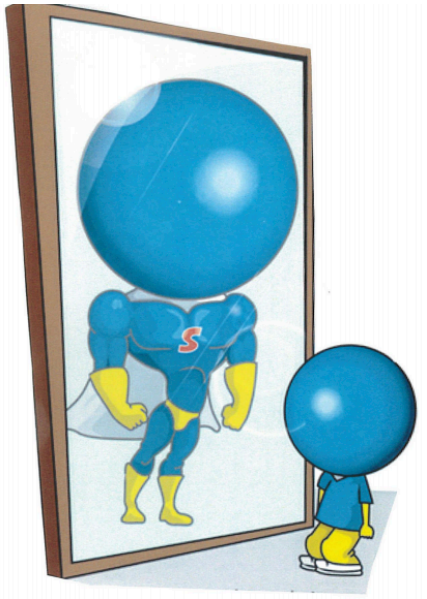


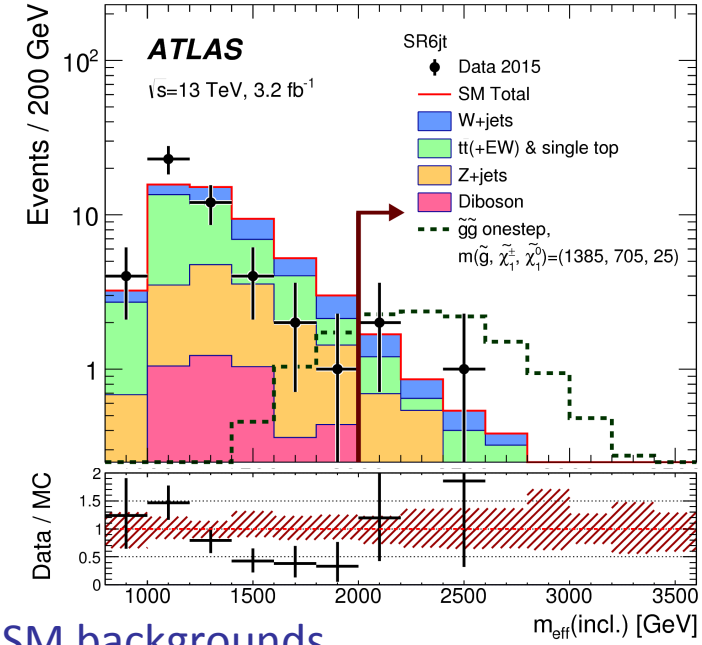
[1605.03814]

See M. Ronzani's talk: Monday

2-6 Jets and E_T^{miss}

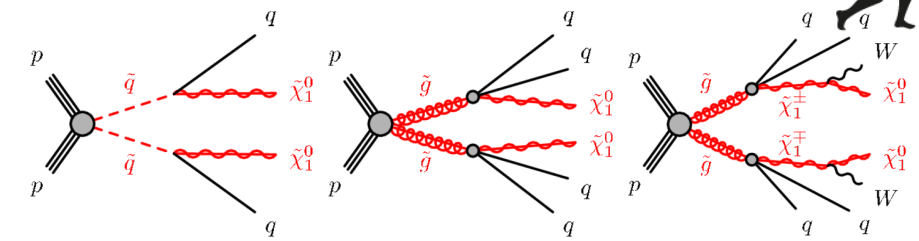
Selection strategy

- Trigger on E_T^{miss}
- Selections on jets and E_T^{miss}
- Use $m_{\text{eff}}(\text{incl.}) = \sum_{\text{jets}} p_T(i)$

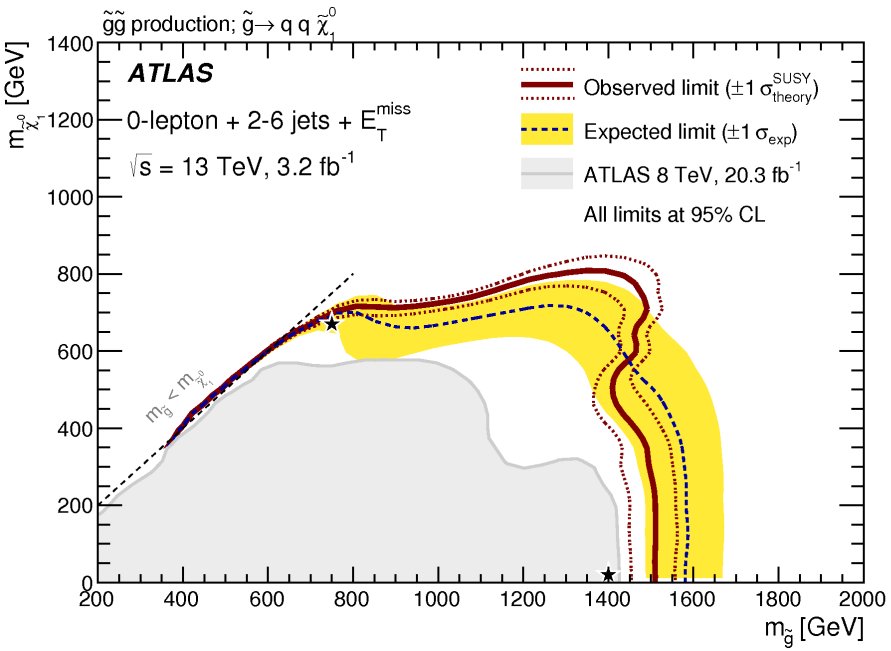


SM backgrounds

- Top, W+jets, Z+jets
- Multijet (est. jet smearing)

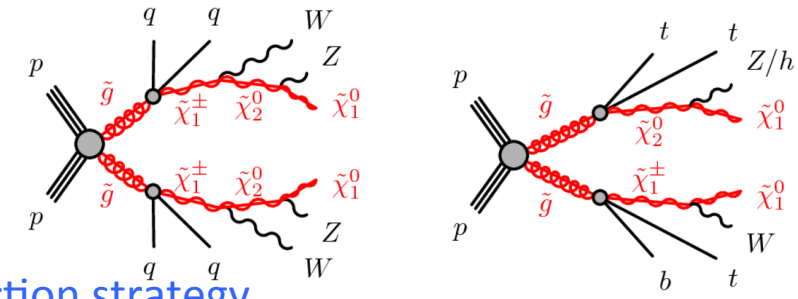


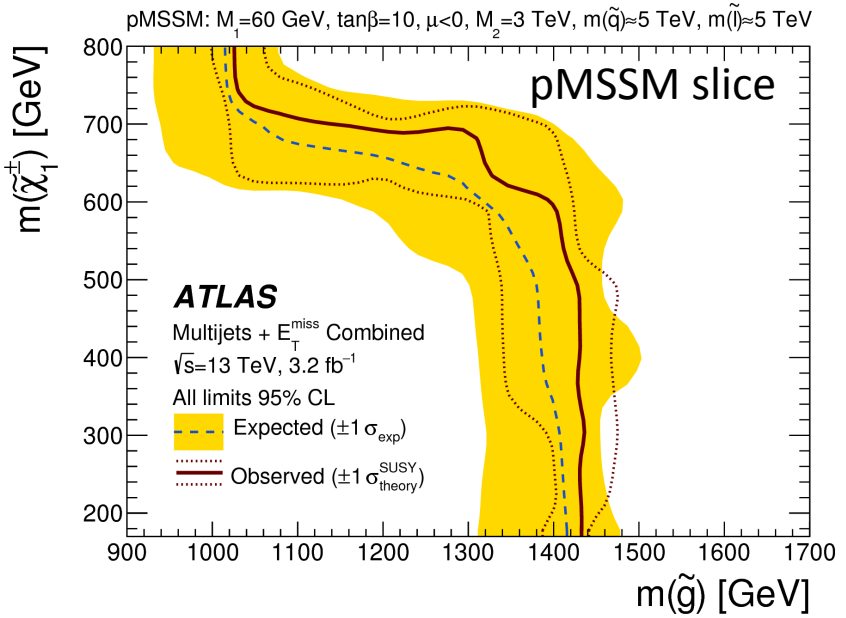
Direct production of squarks and gluinos



[1602.06194]

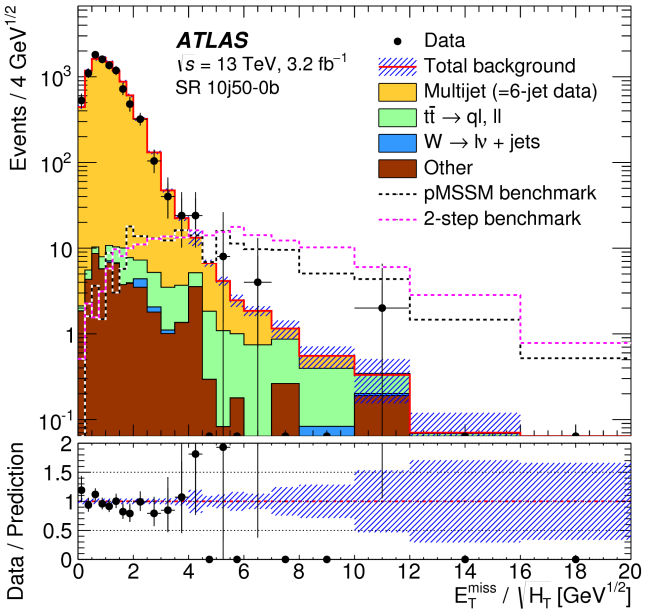
7-10 Jets and E_T^{miss}

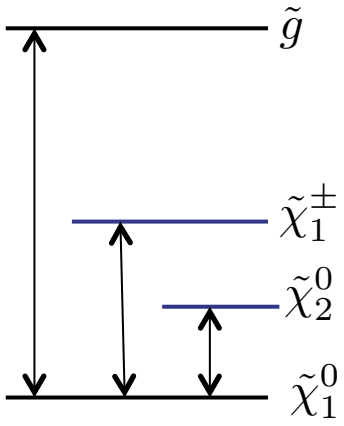


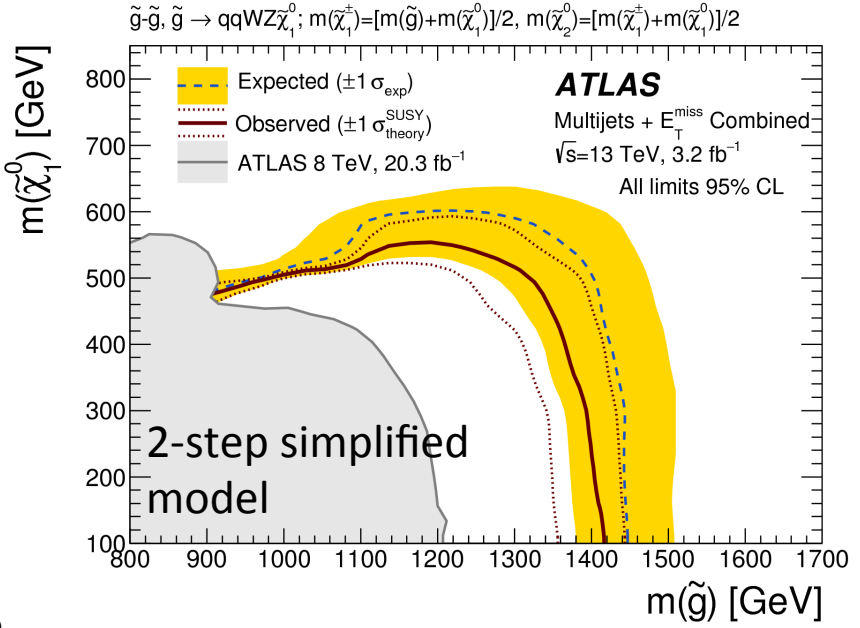


[Selection strategy](#)

- ✧ Multijet trigger
- ✧ Selections on n(jets), n(b-jets)
- ✧ Use $E_T^{\mathrm{miss}}/\sqrt{H_T} > 4$
- ✧ Main background: multijet







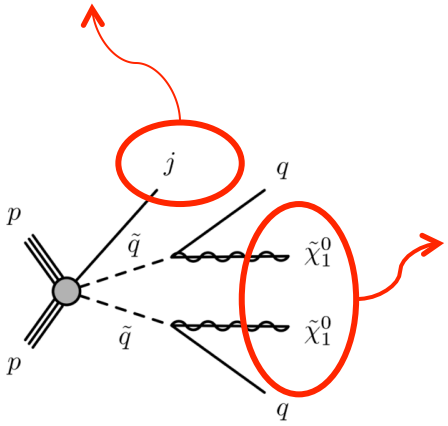
[1604.07773]

Monojet + E_T^{miss}

Direct production of squarks

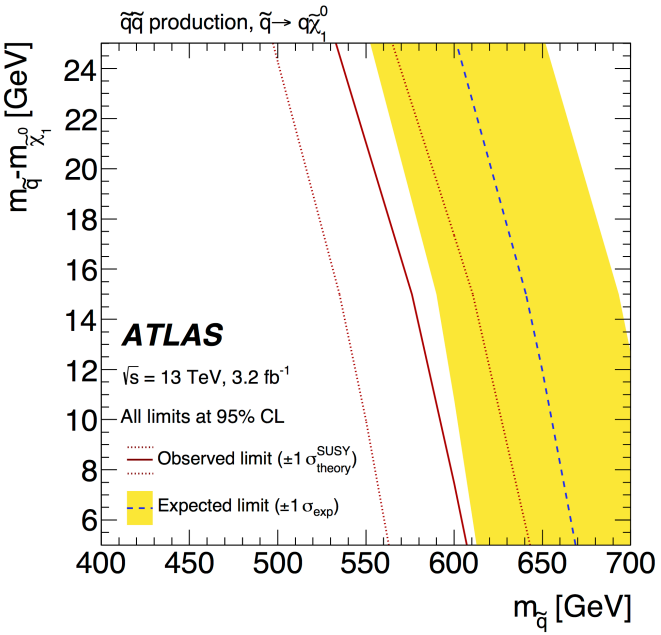
- Both 1st/2nd generation and 3rd generation
- Optimised for compressed signature: small $m(\tilde{q}) - m(\tilde{\chi}_1^0)$
- E_T^{miss} trigger
- Single jet (possibly b-tagged) + E_T^{miss} signature

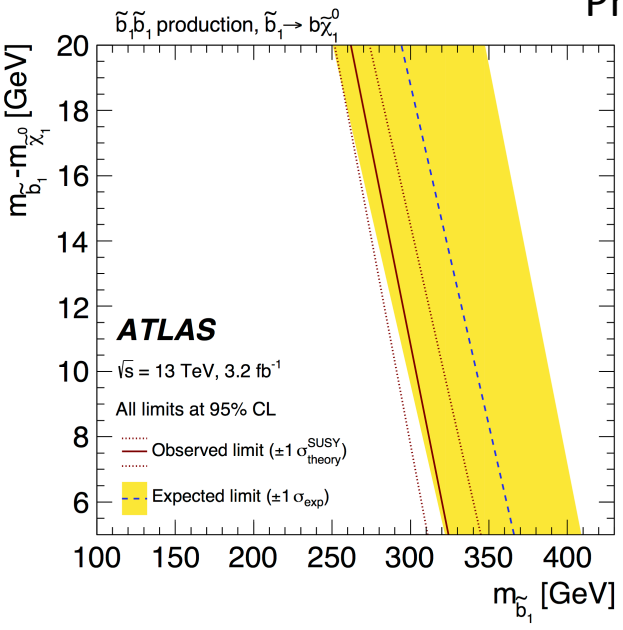
Initial state radiation



Recoiling against the SUSY system

Presence of E_T^{miss}





[1606.08772]

See S. Fracchia's talk. Tuesday

2 b-jets and E_T^{miss}

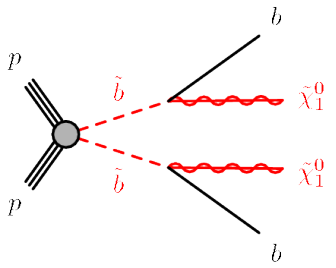
Selection strategy

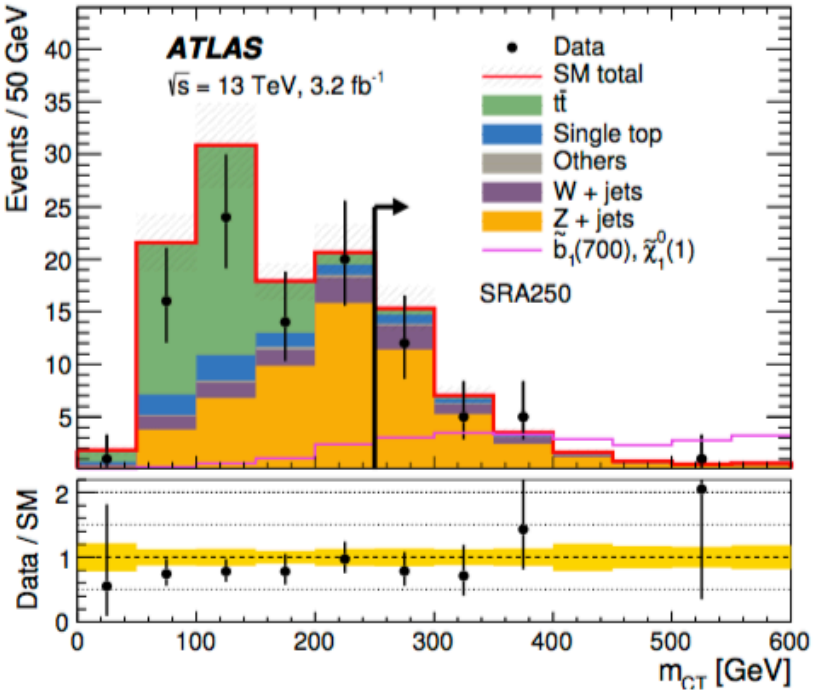
- E_T^{miss} trigger
- 2 b-jets and E_T^{miss}:

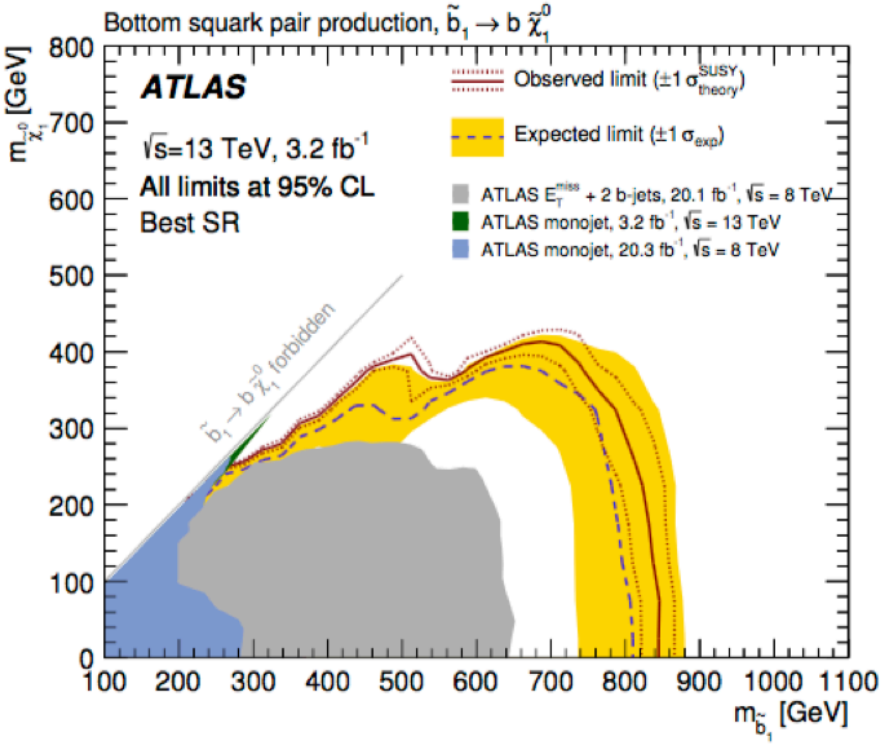
$$m_{\mathrm{CT}}^2 = [E_T(j_1) + E_T(j_2)]^2 - [\mathbf{p}_T(j_1) - \mathbf{p}_T(j_2)]^2$$

- Initial state radiation for $m(\tilde{b}_1) \lesssim m(\tilde{\chi}_1^0)$

Direct production of sbottom pairs







[1605.09318]

See M. Swiatlowski talk. Tuesday

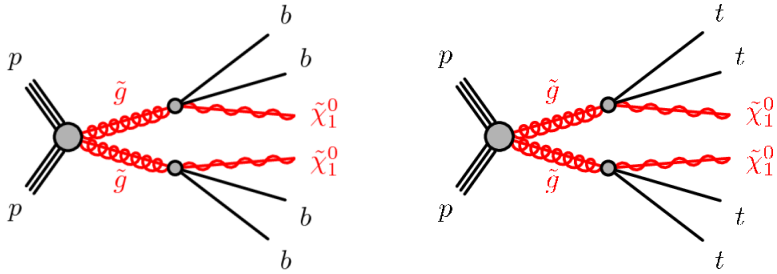
≥ 3 bjets and E_T^{miss}

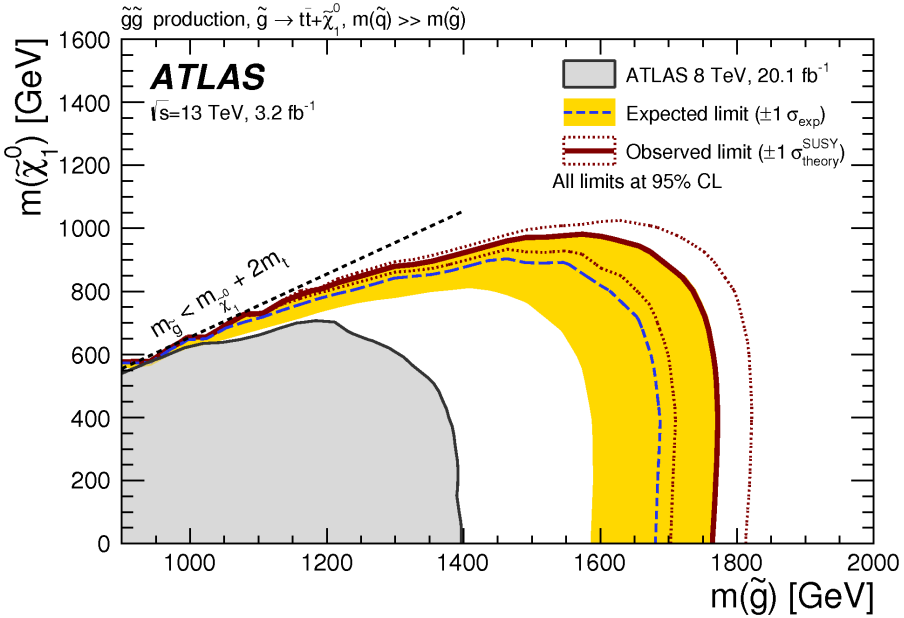
Selection strategy

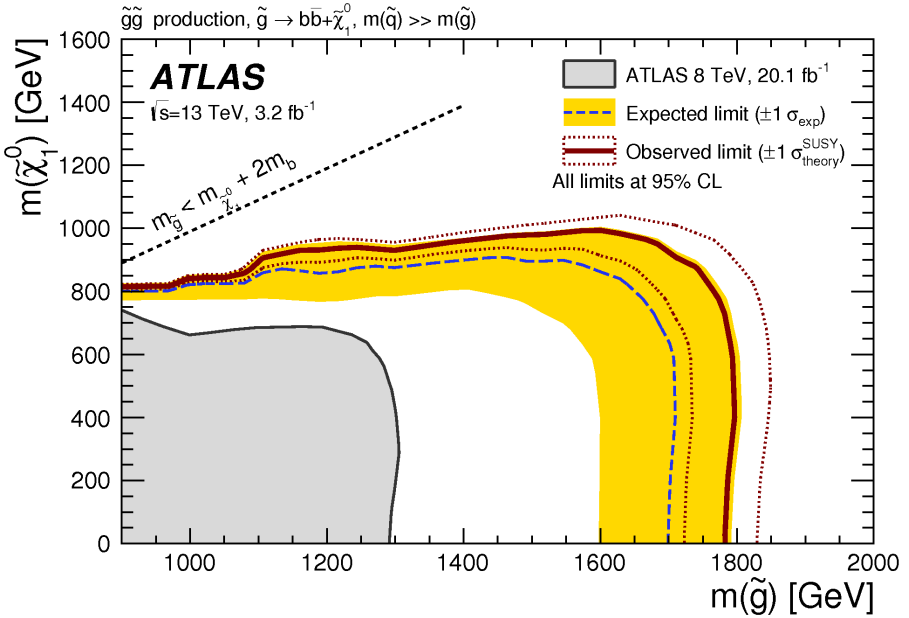
- E_T^{miss} trigger
- 3(or more) b-jets and E_t^{miss}
- 0/1 leptons (e or μ)
- Jets reclustered with R=1.2 to reconstruct boosted tops

Gluino pair production

Decay to either sbottom or stop (gbb, gtt)







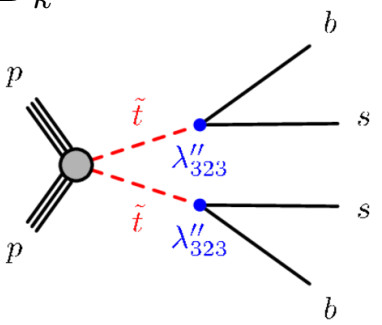
Multijet, NO E_T^{miss}

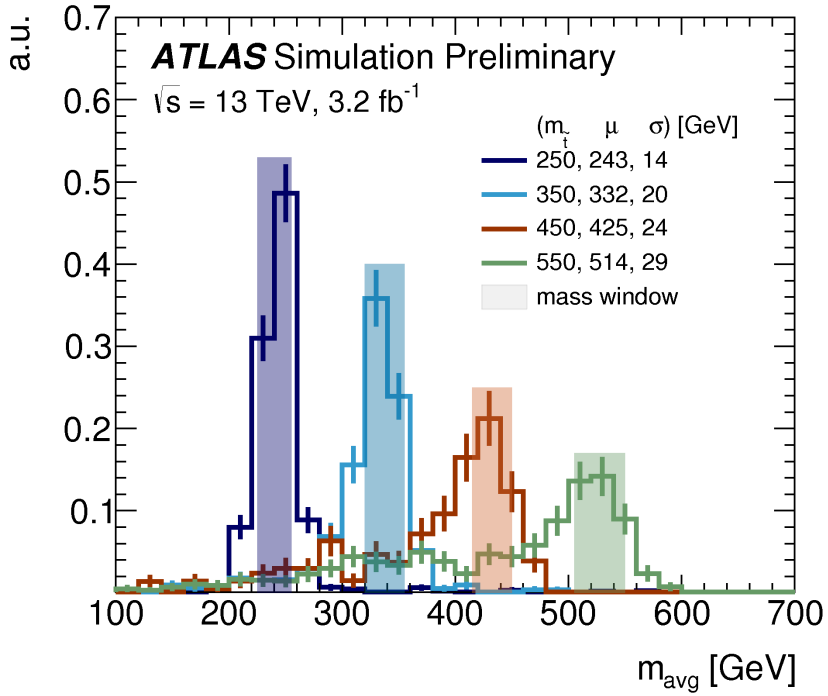
Selection strategy

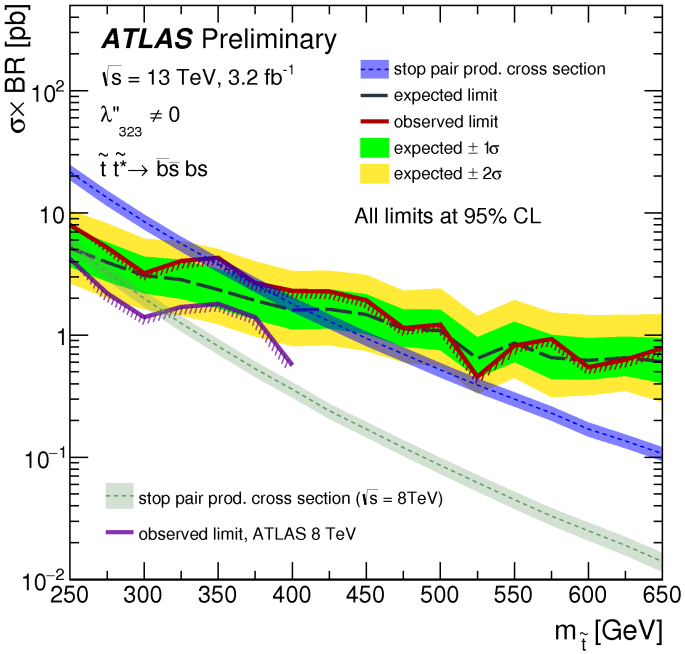
- ✧ multijet trigger
- ✧ 4 jets (2 b-tagged)
- ✧ inv. mass of jet pairs
- ✧ Use m_{avg} and mass asymmetry (A)

RPV term

- ✧ $\mathcal{W}_{RPV} = \lambda''_{ijk}\bar{U}_i\bar{D}_j\bar{D}_k$
- ✧ Decay $\tilde{t}_1 \rightarrow \bar{b}\bar{s}$







SUSY signatures at 13 TeV

Jets (+ E_t^{miss})

- 2-6 Jets and E_T^{miss} . arXiv 1605.03814
- 7-10 Jets and E_T^{miss} . arXiv 1602.06194
- Monojet and E_T^{miss} . arXiv 1604.07773

} Squarks and gluons $(\tilde{q}, \tilde{g})$

- 2 b-jets and E_T^{miss} . arXiv 1606.08772
- ≥ 3 b-jets and E_T^{miss} . arXiv 1605.09318

} 3rd generation $(\tilde{t}_1, \tilde{b}_1)$

- 4 jets (2-jets). ATLAS-CONF-2016-022 $\tilde{t}_1 \rightarrow \bar{b}\bar{s}$ RPV decays

Jets + electrons/muons + E_T^{miss}

- 1 lepton, Jets and E_T^{miss} . arXiv 1604.04285
- 2 same-sign leptons or 3 leptons, arXiv 1602.09058
- Z -> ll, Jets and E_T^{miss} , ATLAS-CONF-2015-082

} Squarks and gluons $(\tilde{q}, \tilde{g})$

- 1 lepton, b-jets and E_T^{miss} arXiv 1603.03903
- 2 leptons, b-jets and E_T^{miss} , ATLAS-CONF-2016-009

} 3rd generation $(\tilde{t}_1, \tilde{b}_1)$

Long Lived particles

- dE/dx in the Pixel detector, arXiv 1604.04520
- Short Lived Particles, arXiv 1606.05129

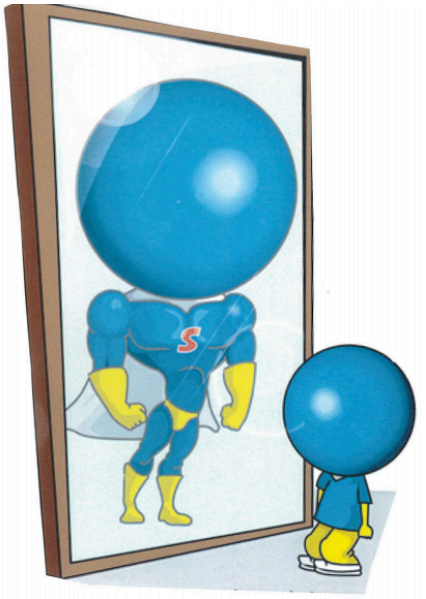
} R-hadrons

Photon or tau + X

- Photons and E_T^{miss} , arXiv 1606.09150
- tau and E_T^{miss} , to appear

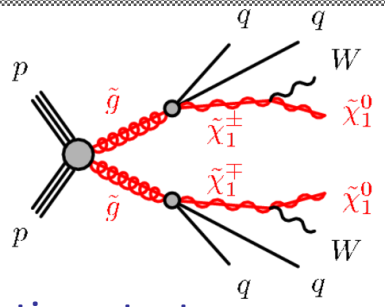
GMSB $\tilde{g} \rightarrow qq\tilde{\chi}_1^0, \tilde{\chi}_1^0 \rightarrow \gamma\tilde{G}$

GMSB, $\tilde{\chi}_1^{\pm}/\tilde{\chi}_2^0$ decays to $\tilde{\tau}/\tilde{\nu}_{\tau}$



[1604.04285]

1 lepton (e or μ), jets and E_T^{miss}

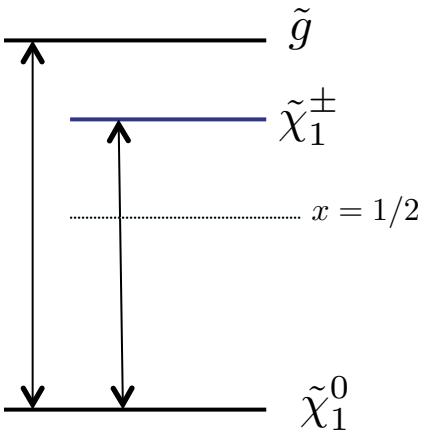


See M. Backes talk: Monday

Gluino decay via chargino

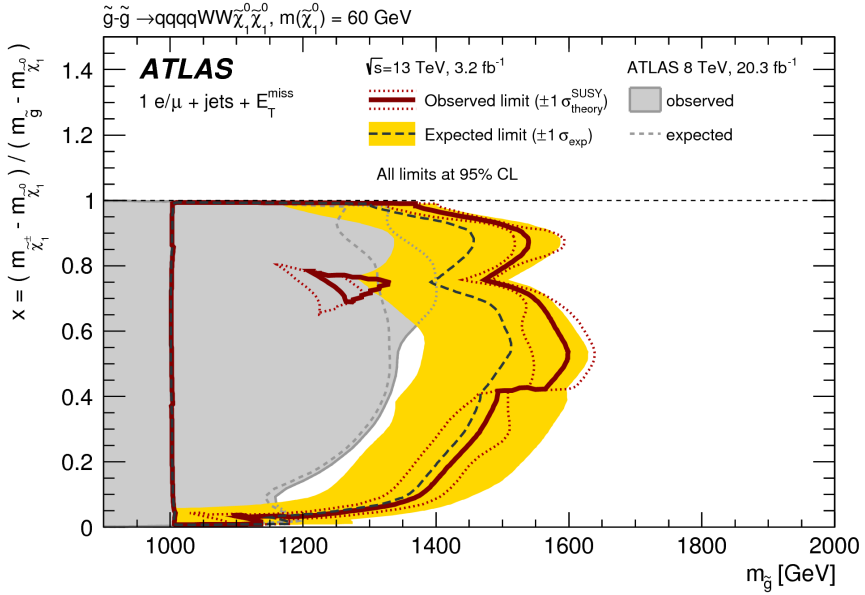
Two different scenario for the mass differences

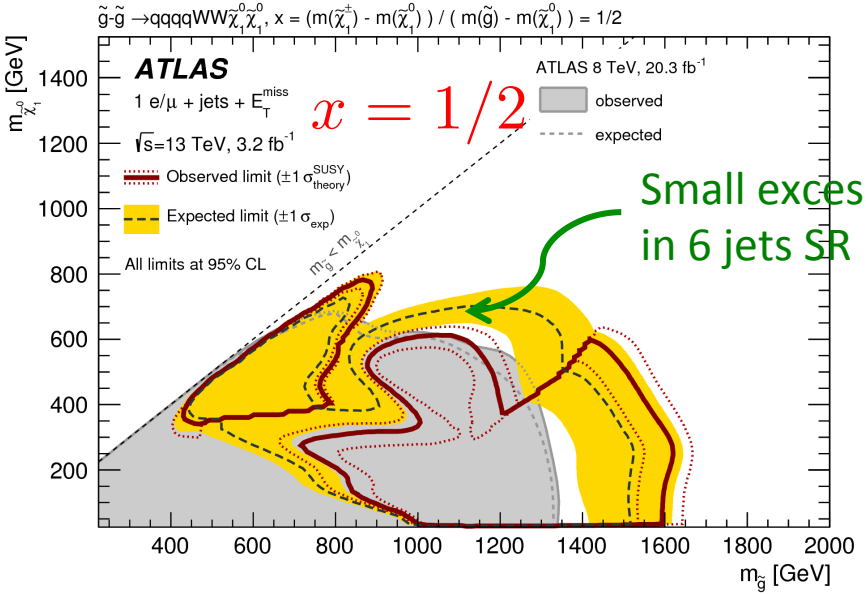
$$x = \frac{m(\tilde{\chi}_1^{\pm}) - m(\tilde{\chi}_1^0)}{m(\tilde{g}) - m(\tilde{\chi}_1^0)}$$



Selection strategy

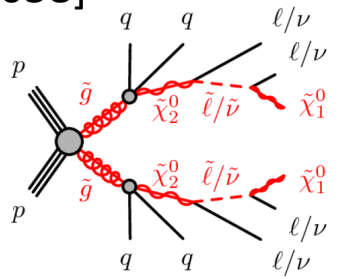
- 1 electron or muon
- Different signal regions based on lepton p_T and n(jets)
- Use E_T^{miss}, m_T and m_{eff}

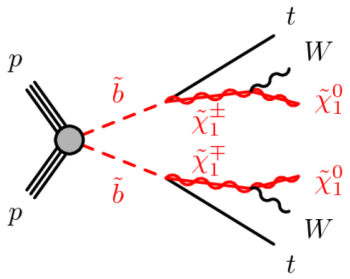


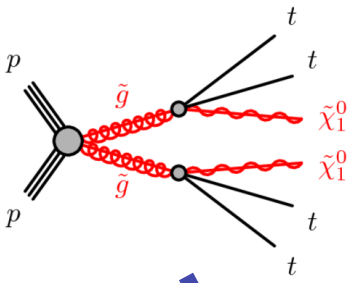


2 same-sign - 3 leptons (e or μ), jets and E_T^{miss}

[1602.09058]



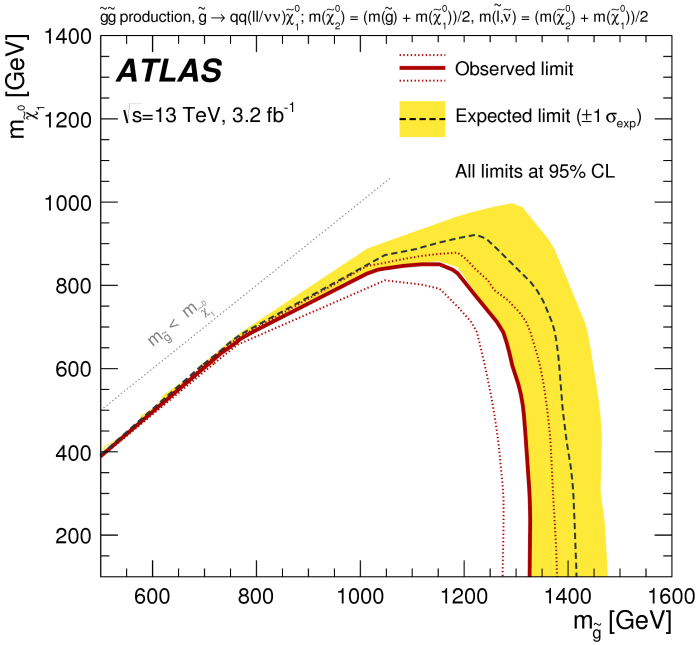


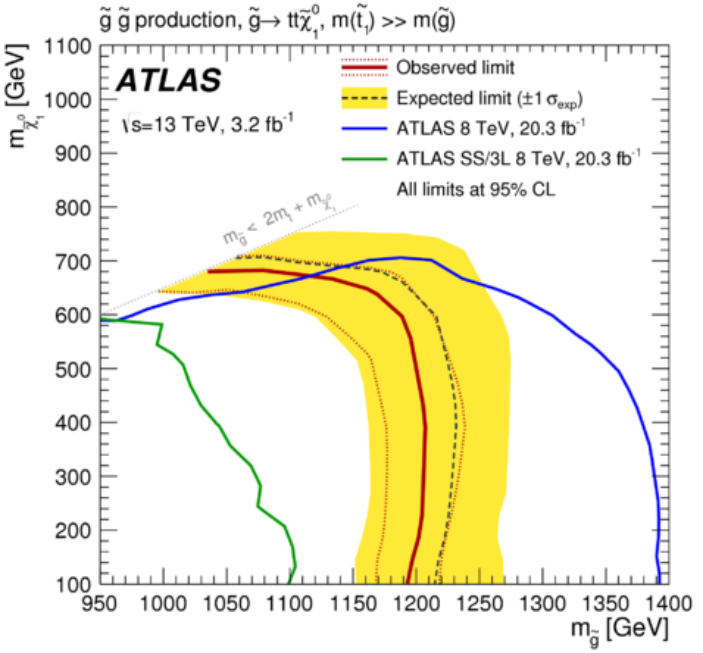


[2 same-sign or 3 leptons](#)

More complex gluino decays

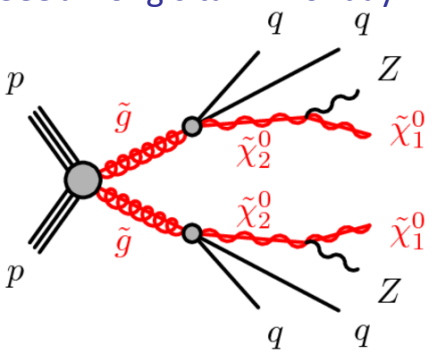
3rd generation studies (using b-tagged jets)





2 opposite-sign leptons (Z->ll), jets and E_T^{miss}

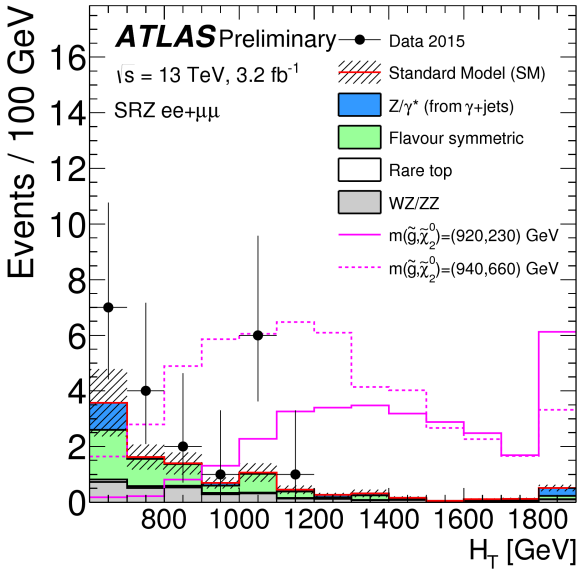
See J. Long's talk. Monday



ATLAS-CONF-2015-082

2 opposite sign leptons

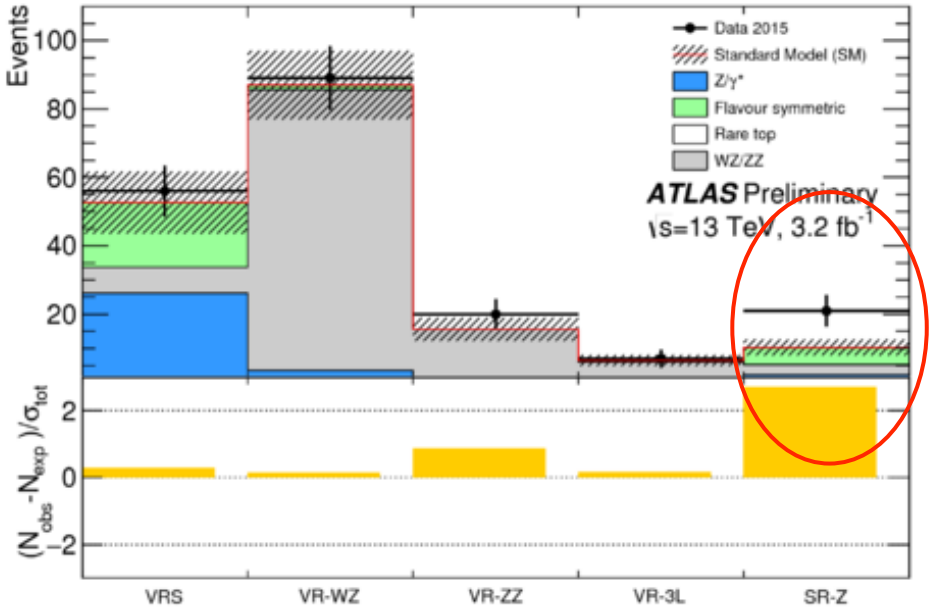
- ≥2 jets
- Reconstruct the Z mass
- E_T^{miss}>225 GeV, H_T>600 GeV

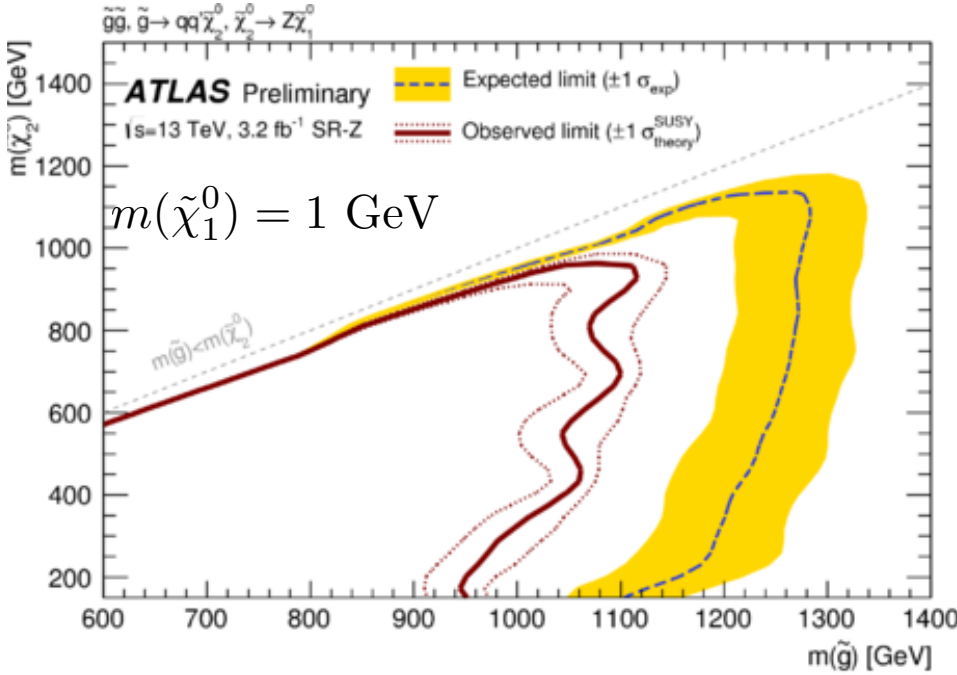


2.4 σ excess in Signal Region (3 σ in Run-1)

21 events observed in SR (10 ee, 11 μμ)

p-value: 0.0079



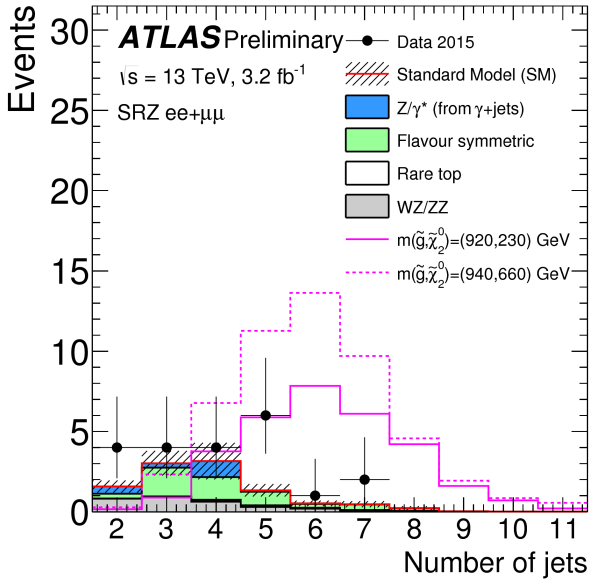


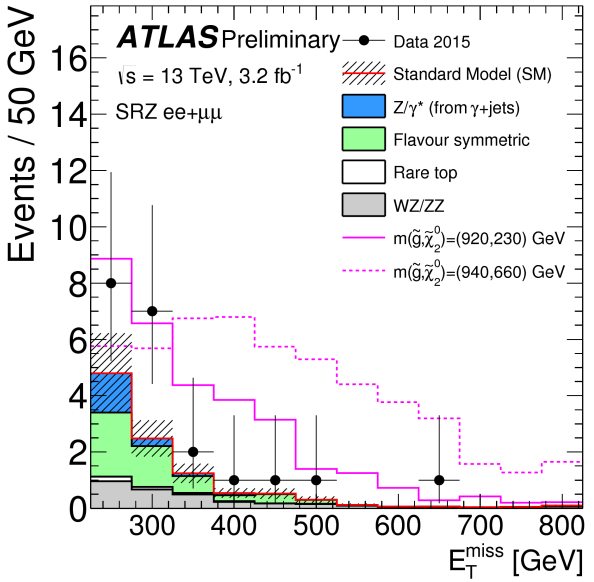
2 opposite-sign leptons, jets and E_T^{miss}

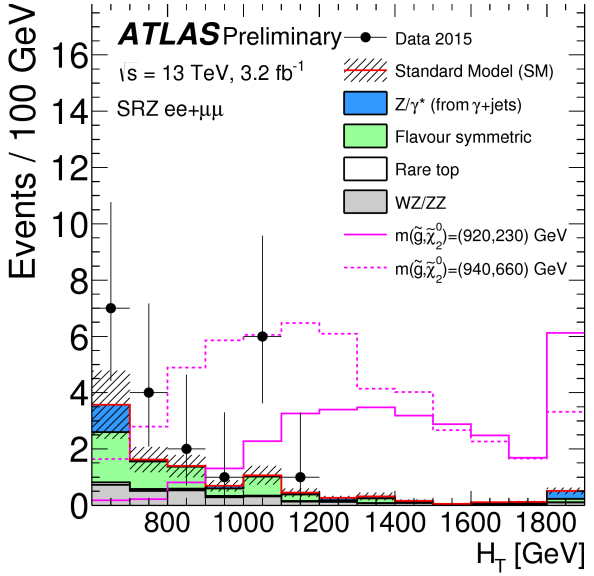
Some numbers:

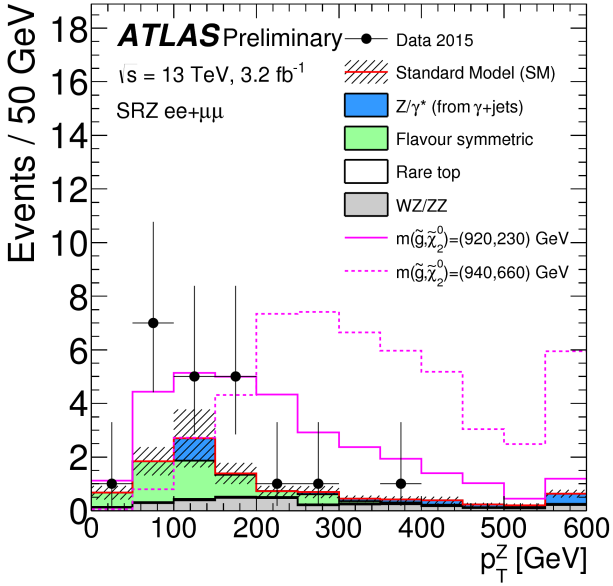
- 21 events observed in SR (10 ee, 11 μμ)
- 10.3 ± 2.3 expected
- p-value: 0.013
- Significance: 2.2 σ

Note: CMS does not see a similar effect



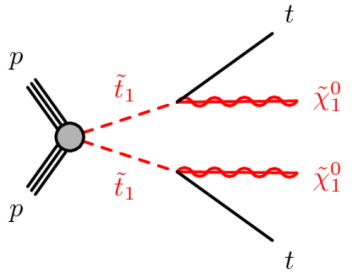






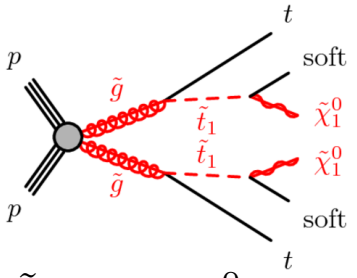
[1603.03903]

One Lepton, b-jets and ETmiss



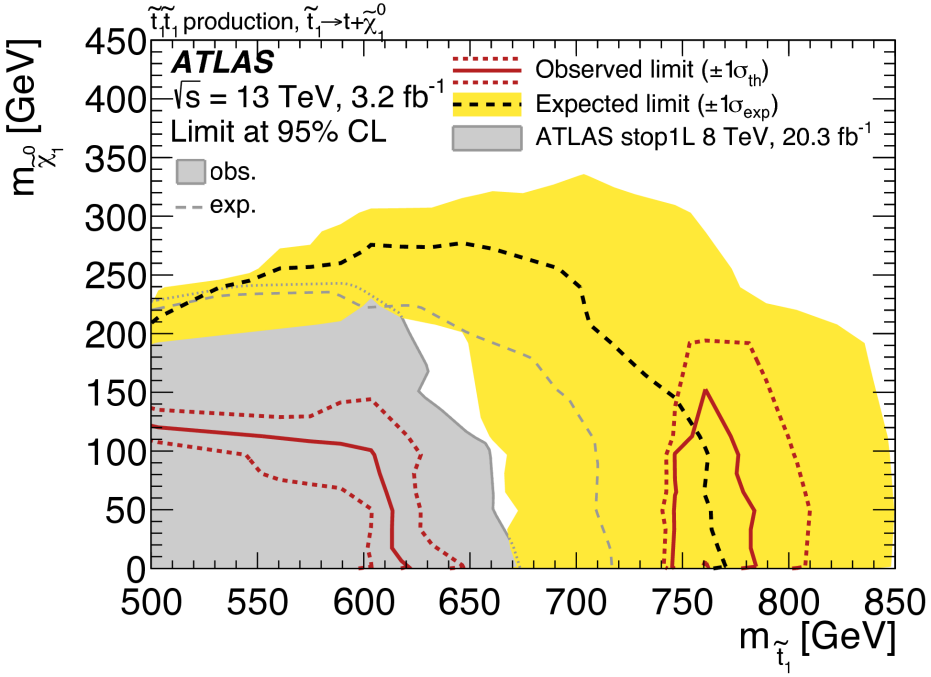
Targeting stop production

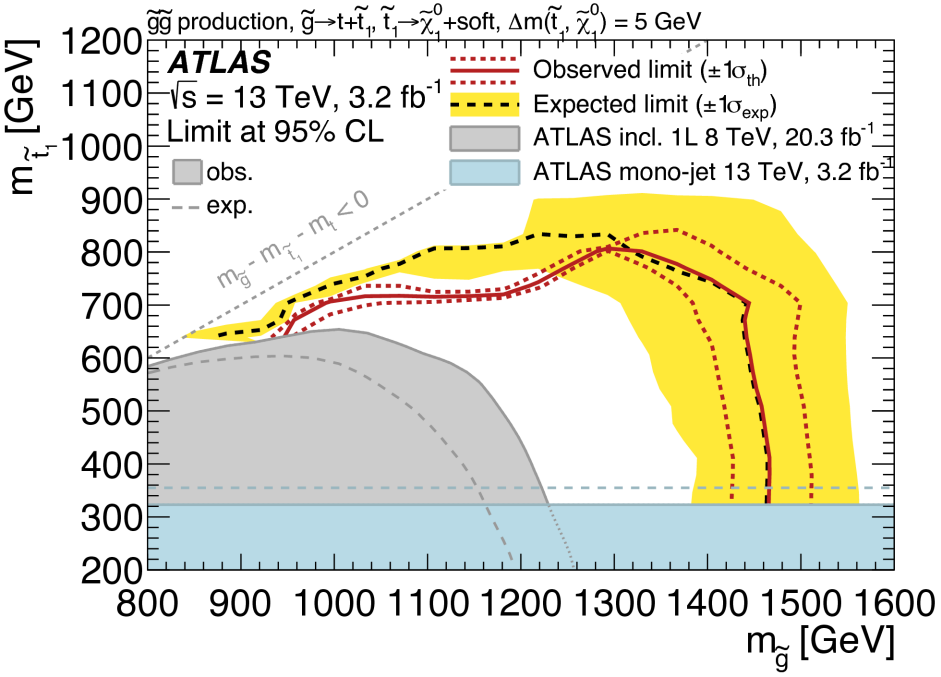
- ✧ tt + E_T^{miss} signature
- ✧ 3 signal regions



$$m(\tilde{t}_1) - m(\tilde{\chi}_1^0) = 5 \text{ GeV}$$

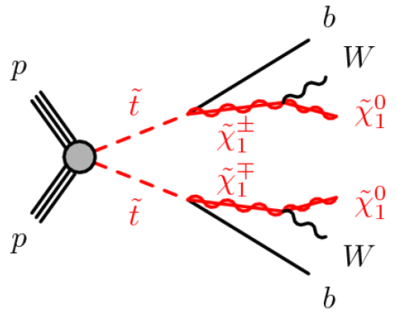
Excess in one of the Signal Regions





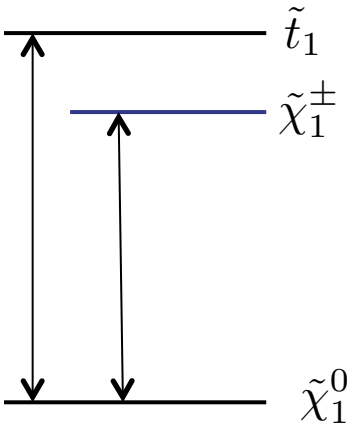
Two Leptons, b-jets and ETmiss

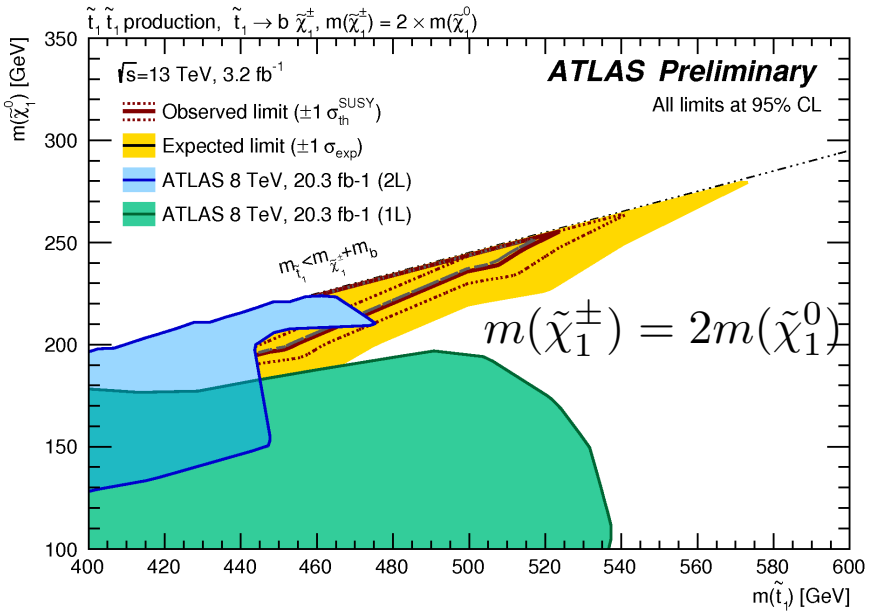
ATLAS-CONF-2016-009

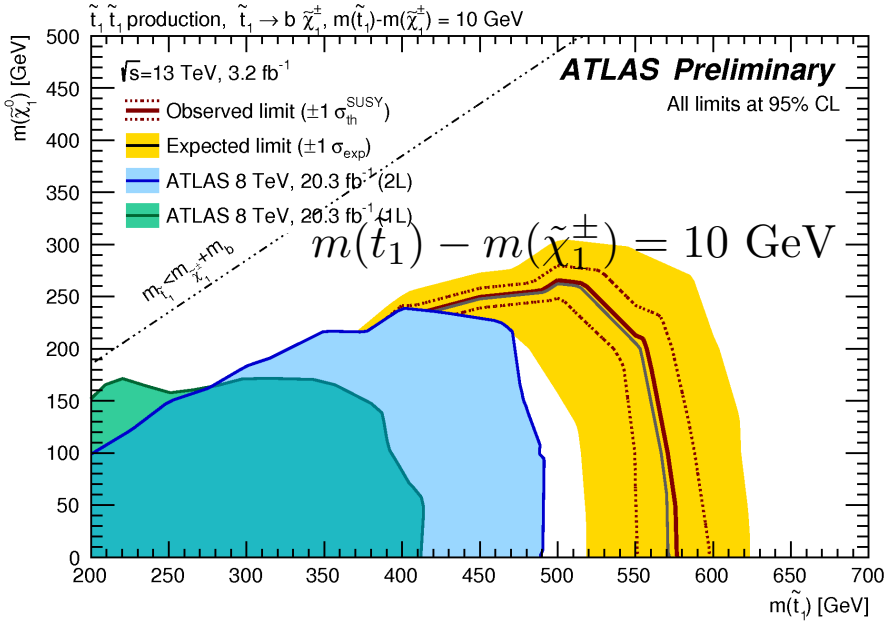


Targeting stop production

- e/mu and $E_t$miss
- $\tilde{t}_1 \rightarrow b\chi_1^{\pm}$
- Two hypotheses for the chargino mass







SUSY signatures at 13 TeV

Jets (+ E_t^{miss})

- 2-6 Jets and E_T^{miss} . arXiv 1605.03814
- 7-10 Jets and E_T^{miss} . arXiv 1602.06194

} Squarks and gluons $(\tilde{q}, \tilde{g})$

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- 2 b-jets and E_T^{miss} . arXiv 1606.08772
- ≥ 3 b-jets and E_T^{miss} . arXiv 1605.09318

} 3rd generation $(\tilde{t}_1, \tilde{b}_1)$

- 4 jets (2-jets). ATLAS-CONF-2016-022 $\tilde{t}_1 \rightarrow \bar{b}\bar{s}$ RPV decays

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} 3rd generation $(\tilde{t}_1, \tilde{b}_1)$

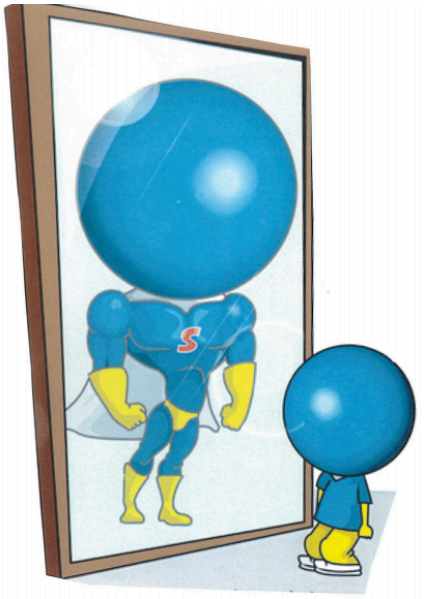
Long Lived particles

- dE/dx in the Pixel detector, arXiv 1604.04520
- Short Lived Particles, arXiv 1606.05129

} R-hadrons

Photon or tau + X

- Photons and E_T^{miss} , arXiv 1606.09150 GMSB $\tilde{g} \rightarrow qq\tilde{\chi}_1^0, \tilde{\chi}_1^0 \rightarrow \gamma\tilde{G}$
- tau and E_T^{miss} , arXiv GMSB, $\tilde{\chi}_1^{\pm}/\tilde{\chi}_2^0$ decays to $\tilde{\tau}/\tilde{\nu}_{\tau}$



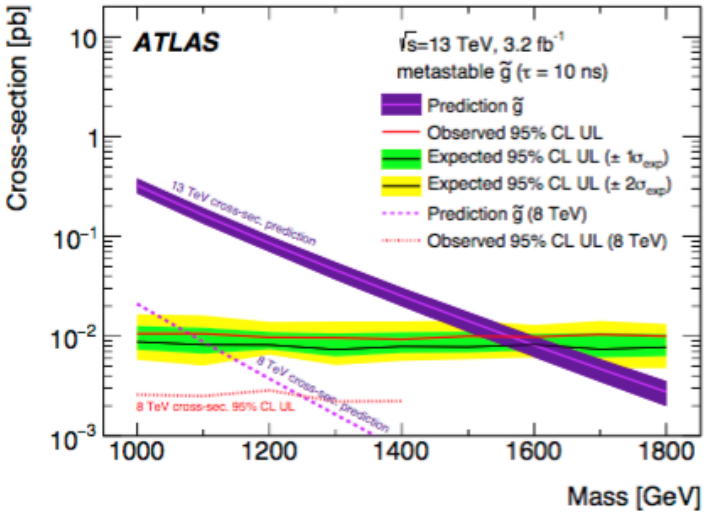
[1604.04520]

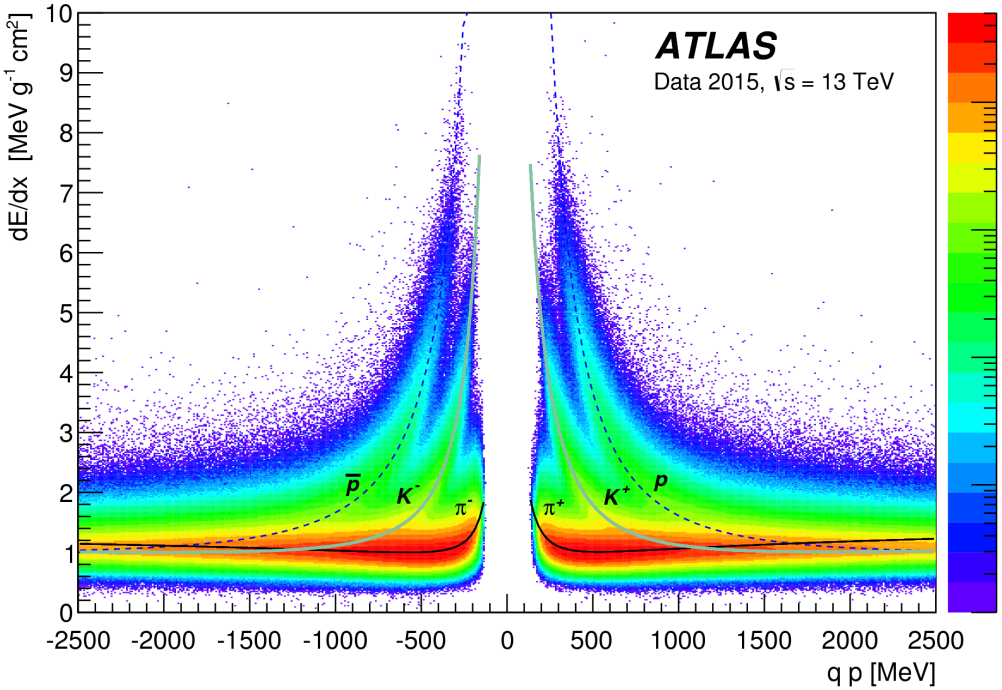
Long Lived Particles. dE/dx

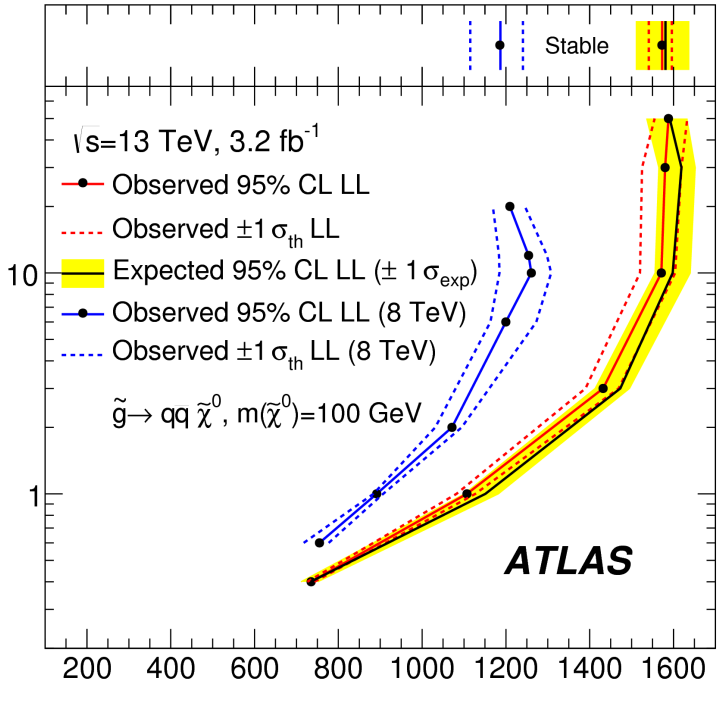
See J. Heinrich's talk. Thursday

Search for R-hadrons:

- ✧ Slow moving particles (β<1)
- ✧ dE/dX measured in Pixel
- ✧ High-pT high-ionising particles







[1606.05129]

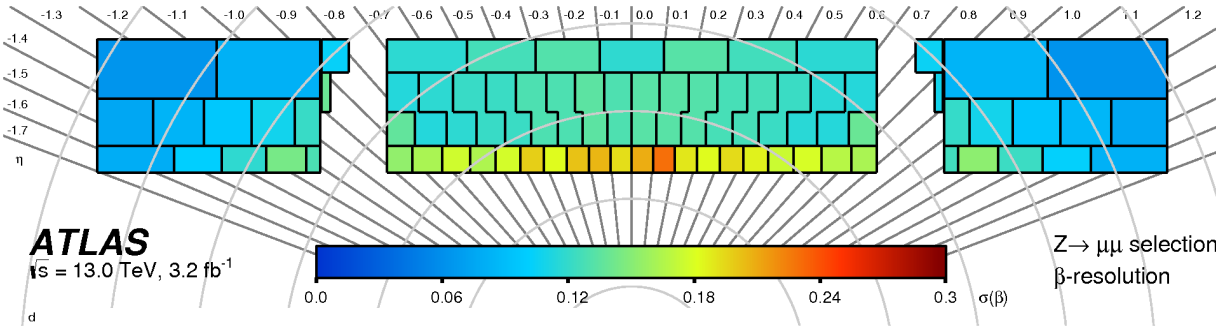
Long Lived Particles. beta

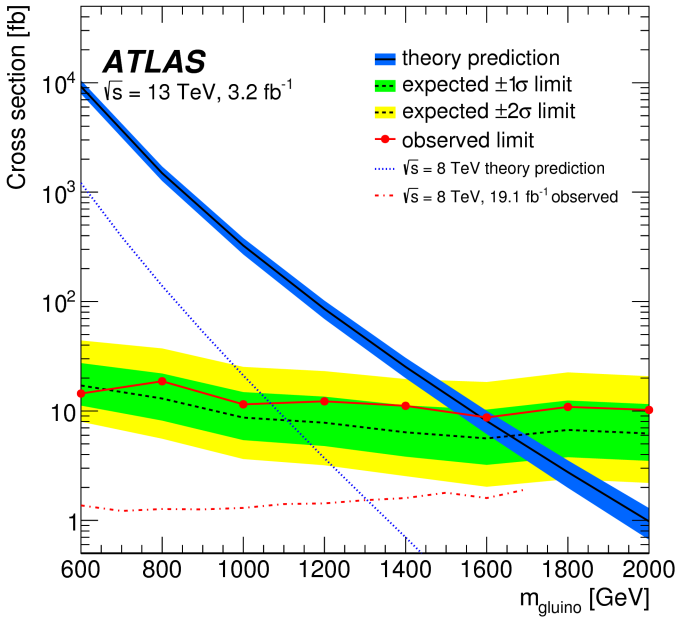
NEW

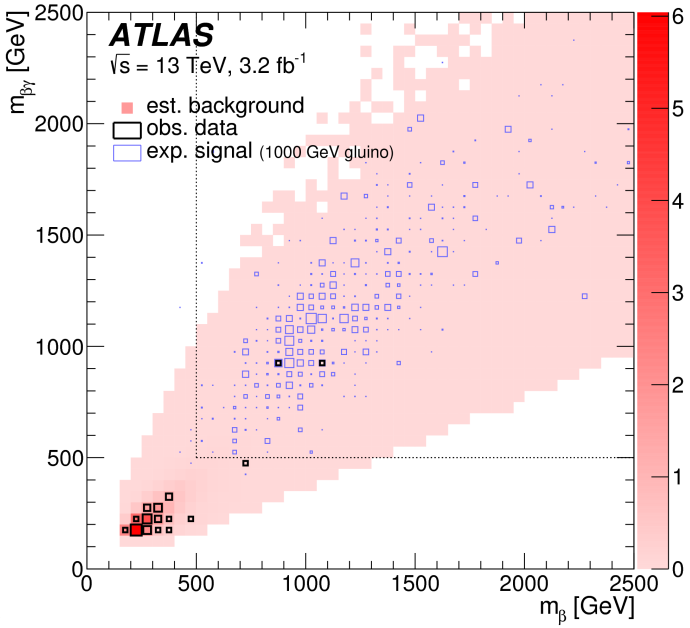
See J. Heinrich's talk. Thursday

Search for R-hadrons:

- ✧ Slow moving particles (β<1)
- ✧ Flight time measurement in calorimeter







Correlation between mass measured using dE/dx and beta

Limits on R-hadrons:

- gluino: 1590 GeV
- stop: 935 GeV
- sbottom: 820 GeV

SUSY signatures at 13 TeV

Jets (+ E_t^{miss})

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- 7-10 Jets and E_T^{miss} . arXiv 1602.06194
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- 1 lepton, Jets and E_T^{miss} . arXiv 1604.04285
- 2 same-sign leptons or 3 leptons, arXiv 1602.09058
- Z -> ll, Jets and E_T^{miss} , ATLAS-CONF-2015-082

} Squarks and gluons $(\tilde{q}, \tilde{g})$

- 1 lepton, b-jets and E_T^{miss} arXiv 1603.03903
- 2 leptons, b-jets and E_T^{miss} , ATLAS-CONF-2016-009

} 3rd generation $(\tilde{t}_1, \tilde{b}_1)$

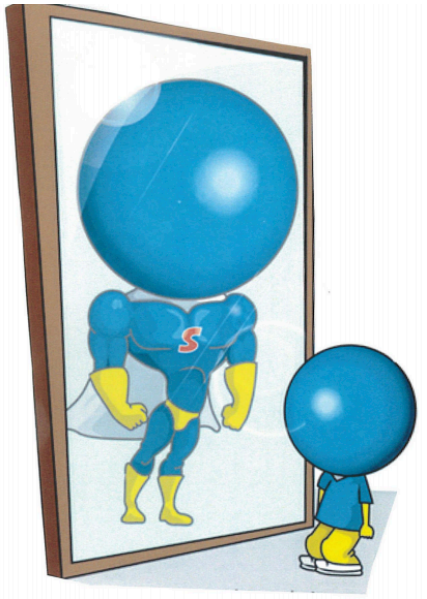
Long Lived particles

- dE/dx in the Pixel detector, arXiv 1604.04520
- Short Lived Particles, arXiv 1606.05129

} R-hadrons

Photon or tau + X

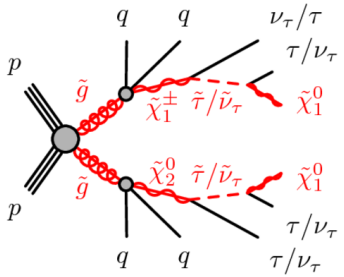
- Photons and E_T^{miss} , arXiv 1606.09150 GMSB $\tilde{g} \to qq\tilde{\chi}_1^0, \tilde{\chi}_1^0 \to \gamma\tilde{G}$
- tau and E_T^{miss} , to appear GMSB, $\tilde{\chi}_1^{\pm}/\tilde{\chi}_2^0$ decays to $\tilde{\tau}/\tilde{\nu}_{\tau}$



Tau and E_T^{miss}

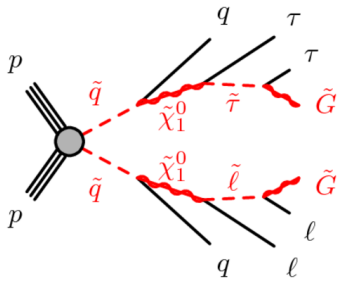
See J. Mitrevski's talk. Tuesday

NEW



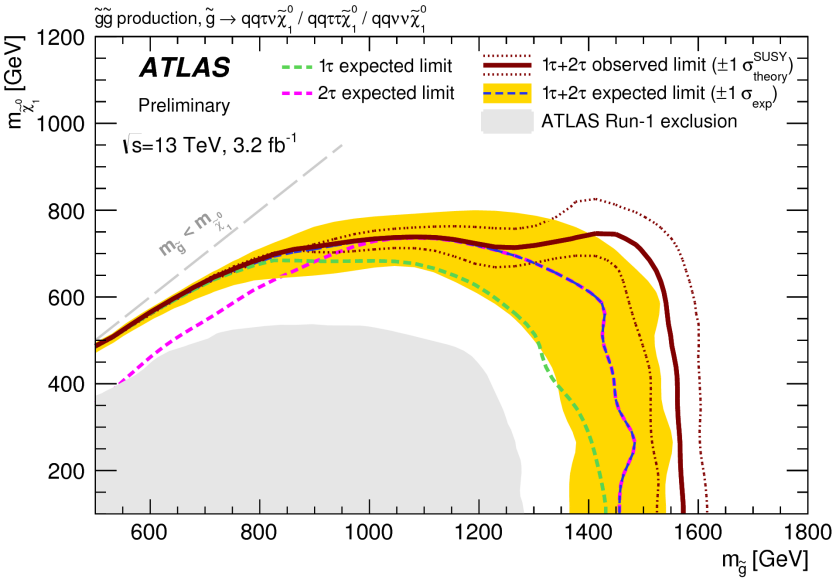
Event Selection:

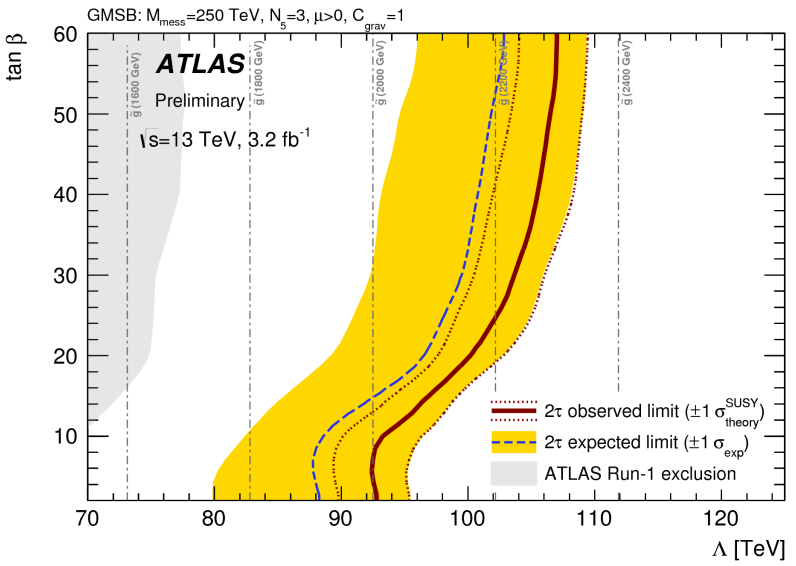
- E_T^{miss} + jet trigger
- 1 or 2 τ -> had.
- Transverse masses



$\tilde{g}\tilde{g}$ production

GMSB



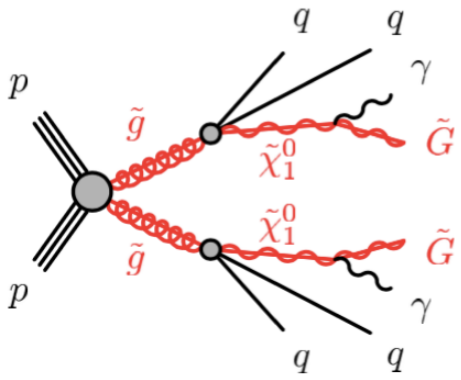


[1606.09150]

See J. Mitrevski's talk. Tuesday

Photons and E_T^{miss}

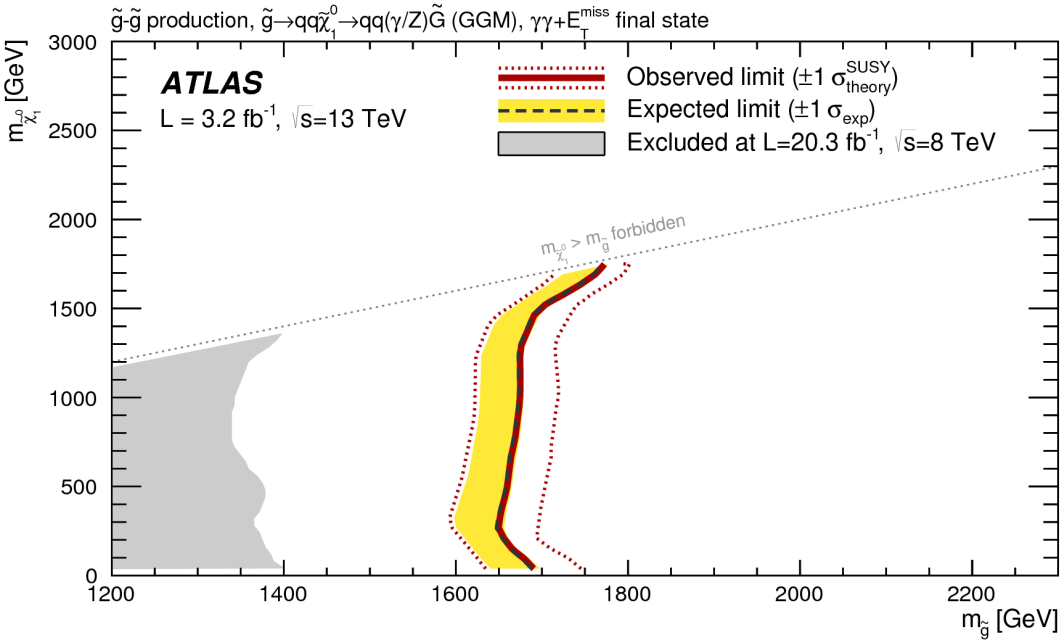
NEW

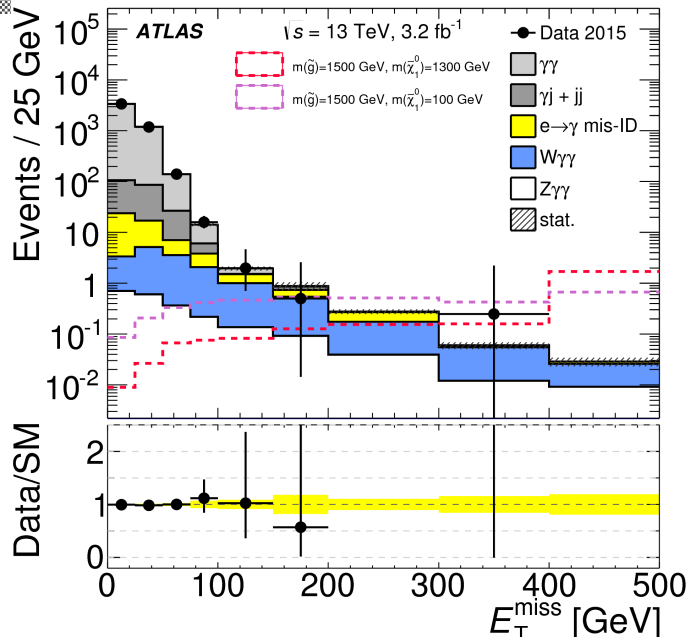


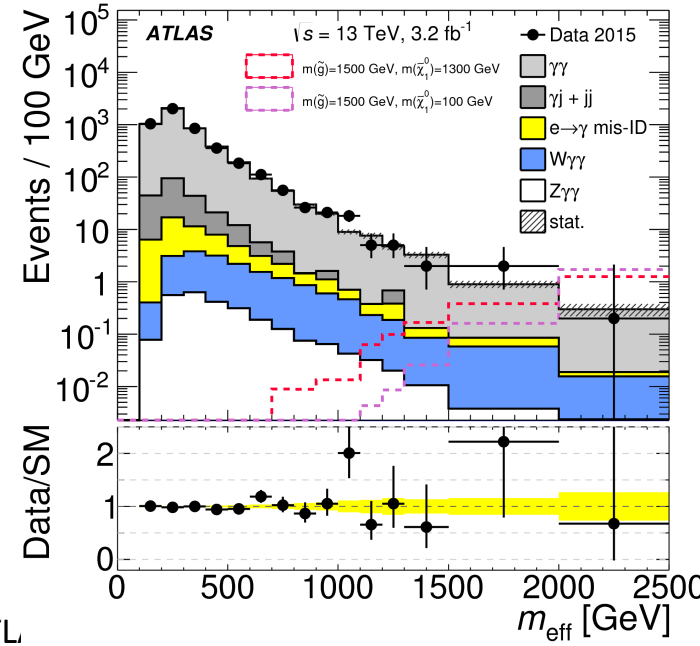
Event Selection:

- Two photons p_T>75 GeV (trigger)
- E_T^{miss} > 175 GeV
- m_{eff} >1500 GeV

bino-like $\tilde{\chi}_1^0$ $\tilde{\chi}_1^0 \to \tilde{G}\gamma$ predominant

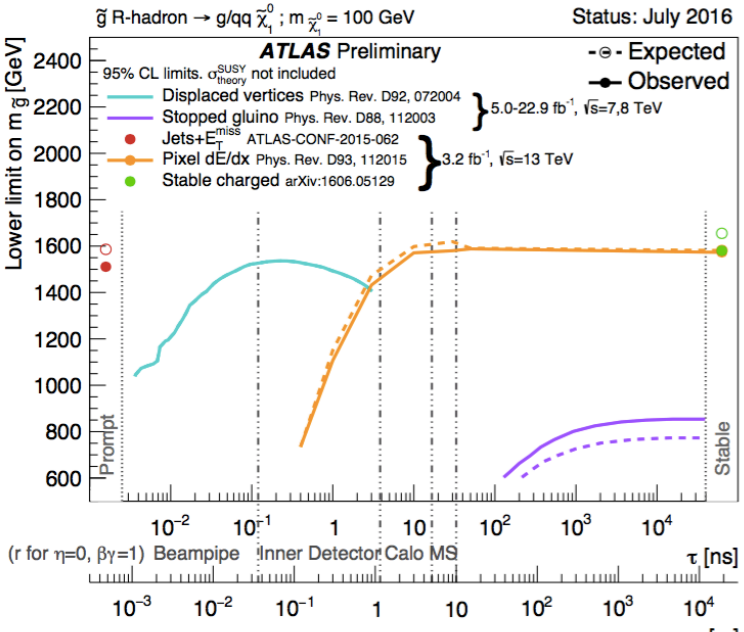


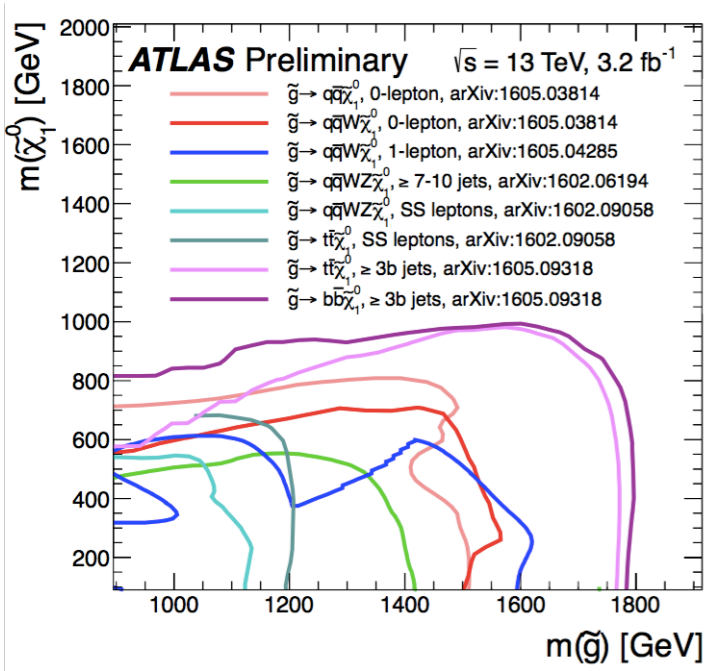




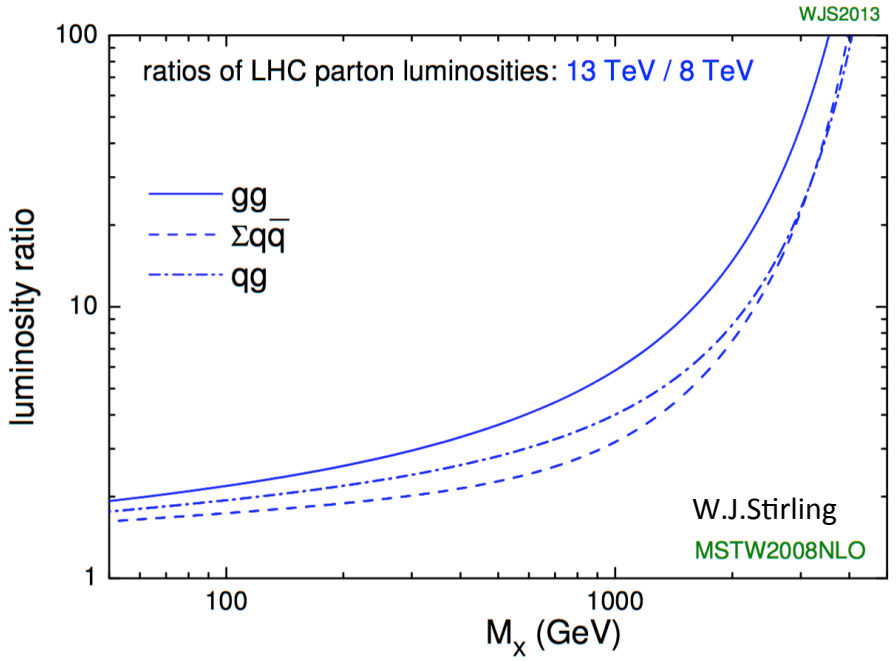
Conclusions and Outlook

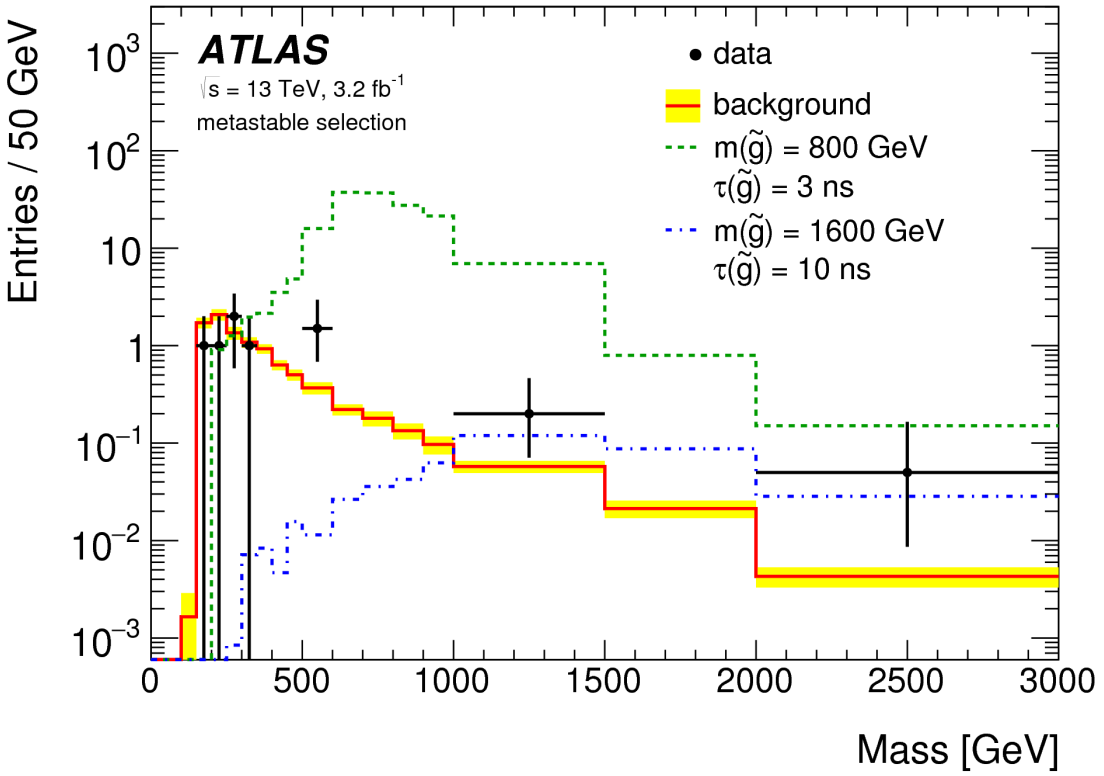
- The LHC Run 2 is in full swing
- A wide range of 13 TeV analyses based on 3.3 fb^{-1} from 2015 published
  - Higher centre of mass energy
  - New Pixel layer installed
  - Improved analysis
- Limits improved on squarks, gluinos, stop, sbottoms under a wide variety of assumptions. More talks this week
- Looking forward to the 2016 dataset!

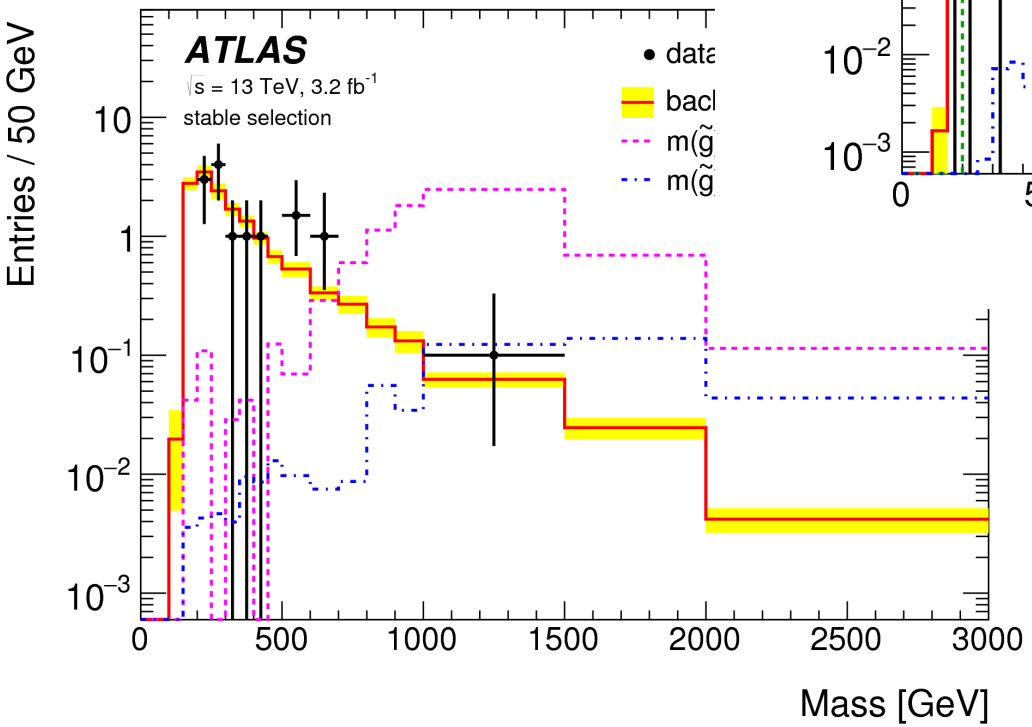




Backup


WJS2013
ratios of LHC parton luminosities: 13 TeV / 8 TeV
gg
Σqq̄
qg
W.J.Stirling
MSTW2008NLO
luminosity ratio
100
10
1
100
1000
M_X (GeV)


ATLAS
√s = 13 TeV, 3.2 fb-1
metastable selection
data
background
m(g̃) = 800 GeV
τ(g̃) = 3 ns
m(g̃) = 1600 GeV
τ(g̃) = 10 ns
Entries / 50 GeV
Mass [GeV]


ATLAS
√s = 13 TeV, 3.2 fb-1
stable selection
Entries / 50 GeV
Mass [GeV]

One Lepton, b-jets and Etmiss (cont.)