Searches for Supersymmetry with the ATLAS Detector

- R-Parity Violating Decays
- Resonance SUSY-Production: RPV and scalar gluons
- Metastable Particles: AMSB

Wolfgang Ehrenfeld (Bonn)
On behalf of the ATLAS Collaboration

EPS2013, Stockholm, 19.7.2013

Content

- R-parity violation in
  - leptonic decays
  - hadronic decays
  - production and decay
- resonant production in extended supersymmetric models
  - scalar gluons
- compressed supersymmetric scenarios
  - meta-stable particles in AMSB models
- see also talk by Masssimo Corradi on long-lived particle searches (12:00, 19.7.2013)

R-Parity Violating Supersymmetry

- standard searches for SUSY assume R-parity conservation (RPC)

$$R = (-1)^{3(B-L)+2s}$$

  and rely on
  - pair production of SUSY particles
  - stable lightest SUSY particle (LSP) → missing transverse energy
- R-parity violation (RPV) can be allowed as long as either lepton or baryon number conservation is applied

$$L_{RPV} = \lambda_{ijk} L_i L_j \overline{E}_k + \lambda'_{ijk} L_i Q_j \overline{D}_k + \kappa_i L_i H_2 + \lambda''_{ijk} U_i \overline{U}_j \overline{D}_k$$

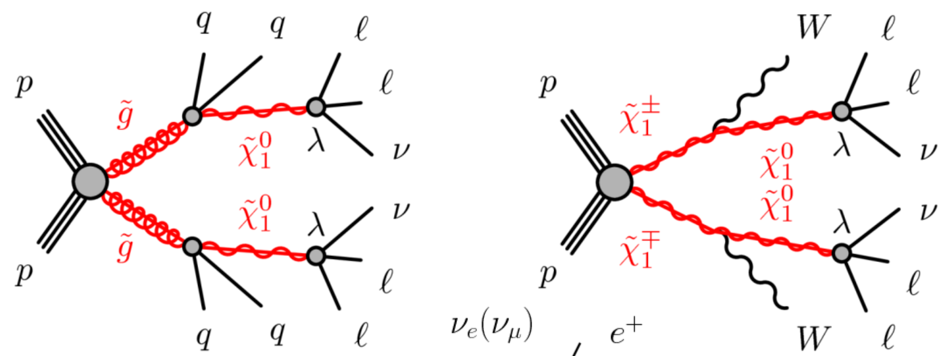
lepton number violating **baryon number violating**

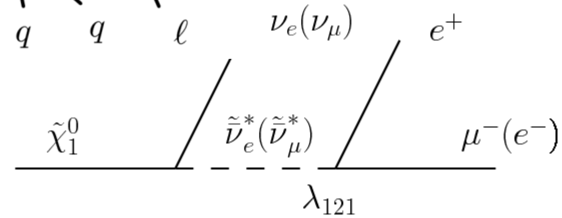
- search strategies need to be adjusted to considered scenario
  - final states with low Standard Model background
  - missing E_T from neutrinos
  - single particle/resonance production

SUSY Searches with 4 or more Leptons

ATL-CONF-2013-36

- high lepton multiplicity can be realised in SUSY with lepton number violation
- assume SUSY pair-production (RPC)
  - gluino or chargino pairs
- and prompt decay of neutralino LSP (RPV)
  - light leptons (e/μ) and hadronic taus (τ_{had})



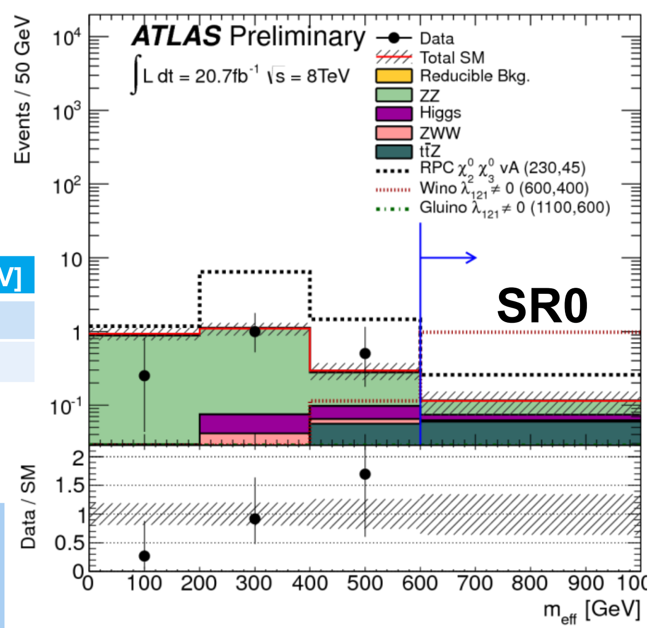


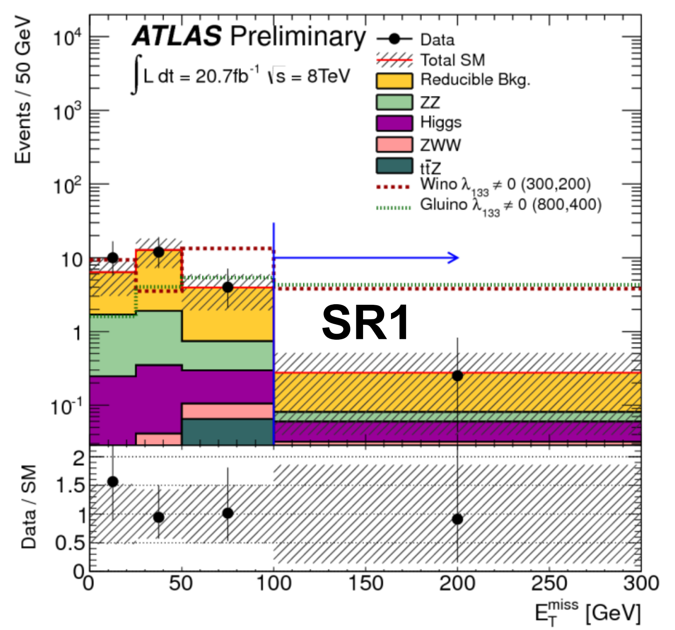
- search for final states with four or more leptons with missing E_T from neutrinos
  - 5 signal regions
    2 dedicated for RPV
  - see also Sam King (18.15, 19.7.)

SR	N(e+μ)	N(τ)	mis E_T[GeV]	M_{eff}[GeV]
SR0	≥4	≥0	>75 or	>600
SR1	=3	≥1	>100 or	>400

  - Z veto

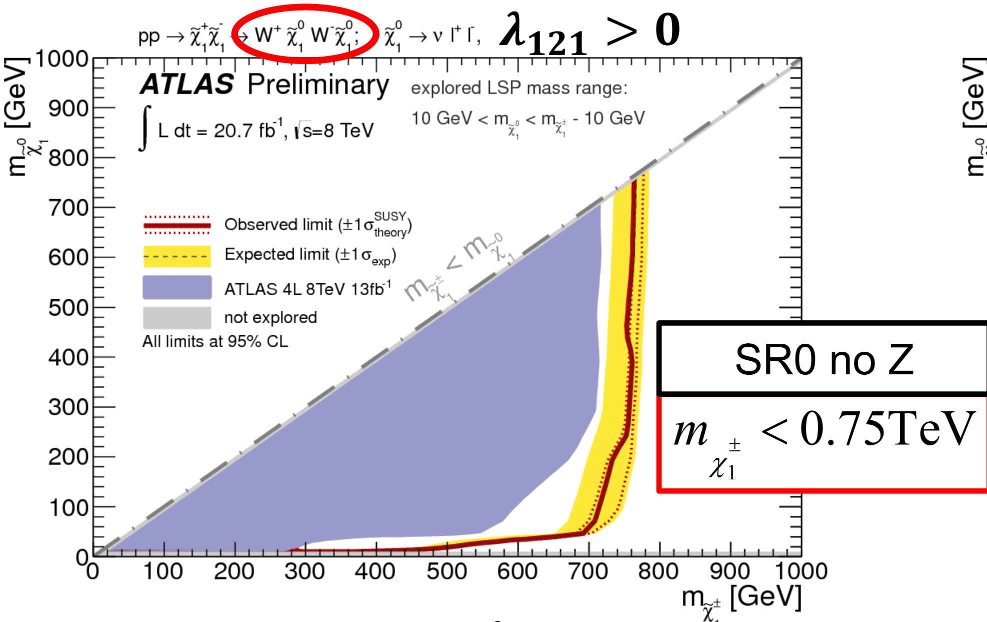
H_T = scalar sum of p_T
m_{eff} = H_T + missing E_T

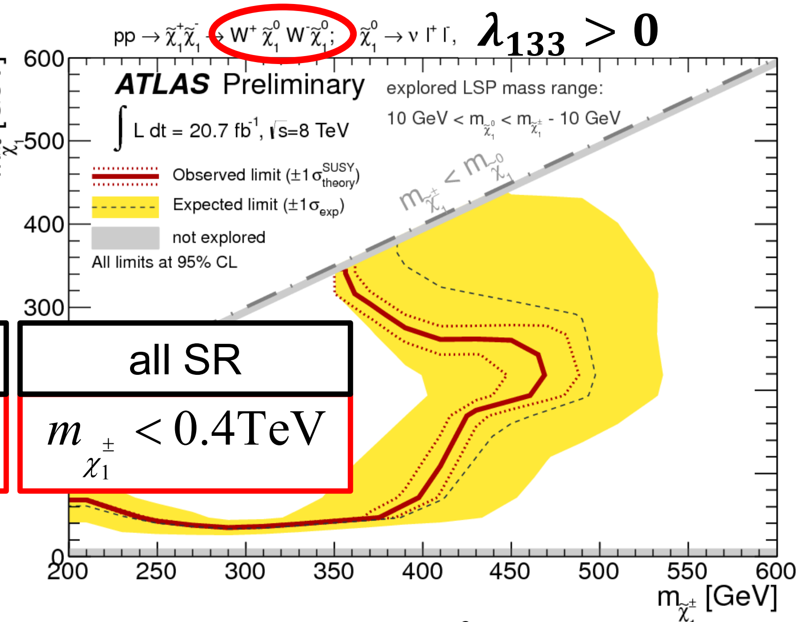


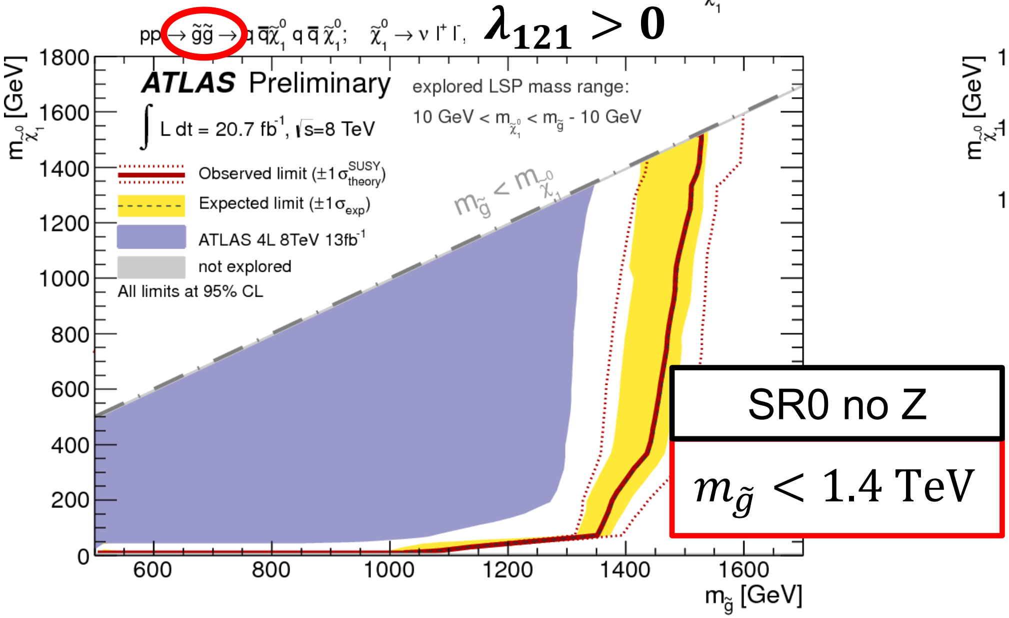


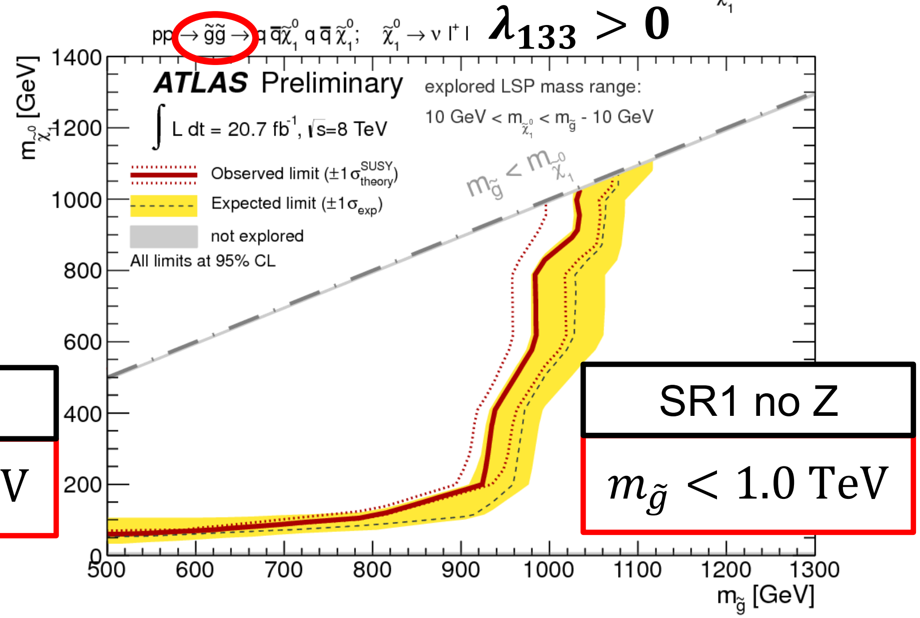
SUSY Searches with 4 or more Leptons

ATL-CONF-2013-36





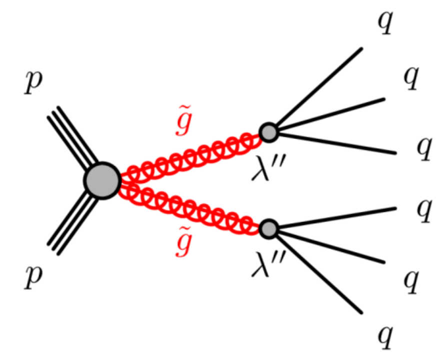




Massive Resonance decaying to 2 x 3 Jets

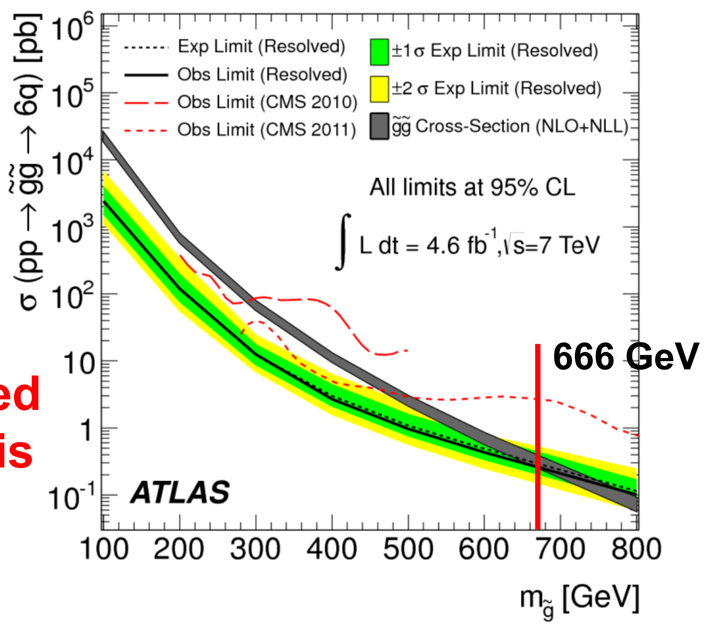
JHEP 12 (2012) 086

- pair production of massive particles decaying into three jets each
- interpretation in terms of RPV prompt gluino decays into three light quark jets
- two orthogonal search strategies:
  - high $\tilde{g}$ mass: resolved analysis
    reconstruct all 6 jets (R=0.4) using multi-jet triggers
  - low $\tilde{g}$ mass: boosted analysis
    reconstruct 2 large jets (R=1) with substructure using single-jet triggers

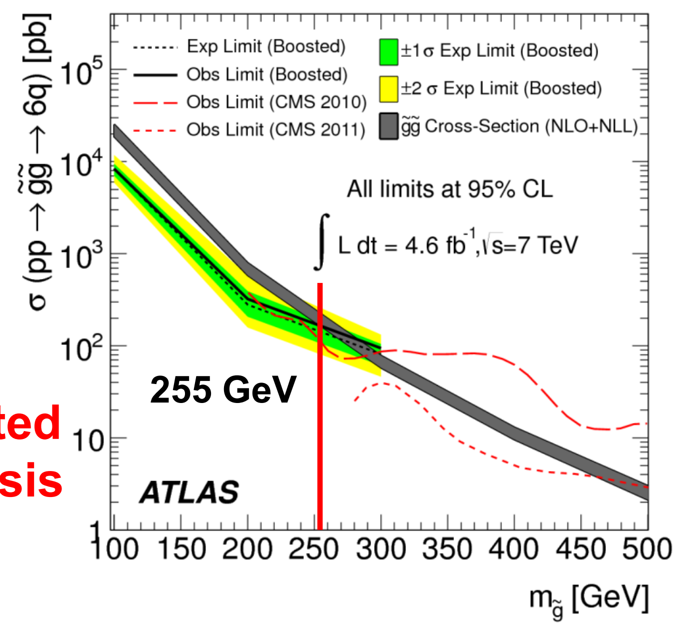


$$\tilde{g} \rightarrow q\tilde{q} \rightarrow qqq\ (m_{\tilde{q}} \gg m_{\tilde{g}})$$

resolved analysis



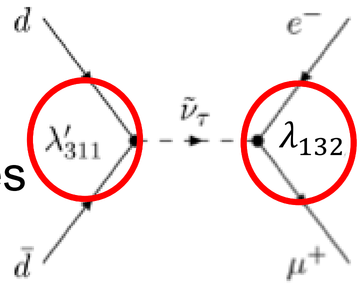
boosted analysis

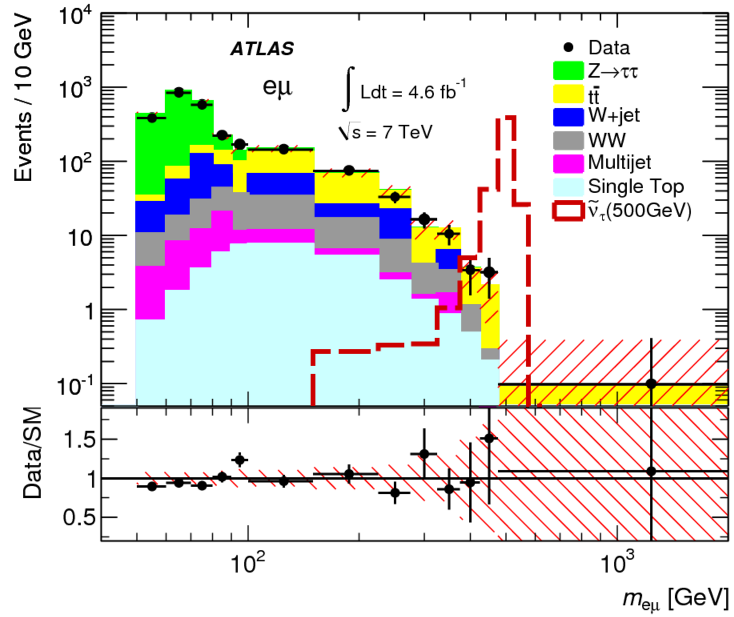


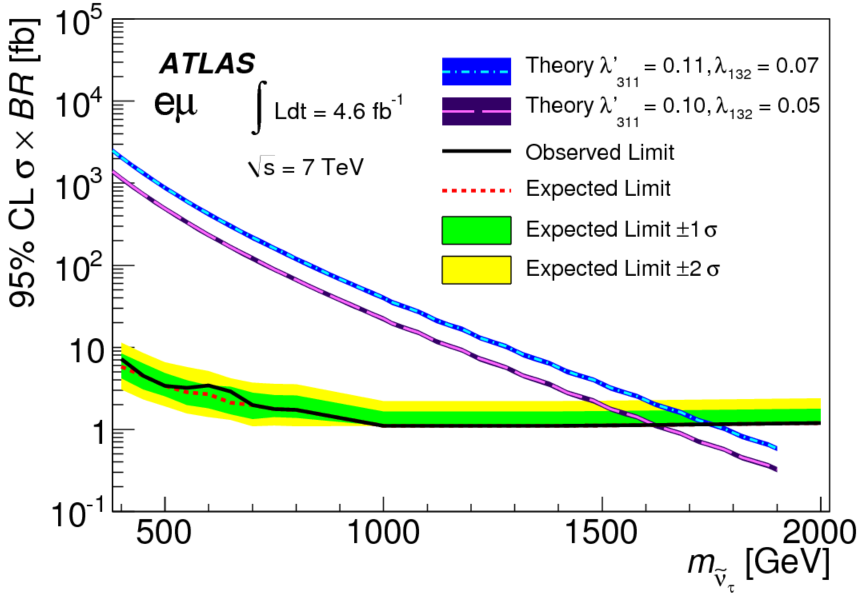
Heavy Narrow Resonances decaying to eμ, eτ, μτ

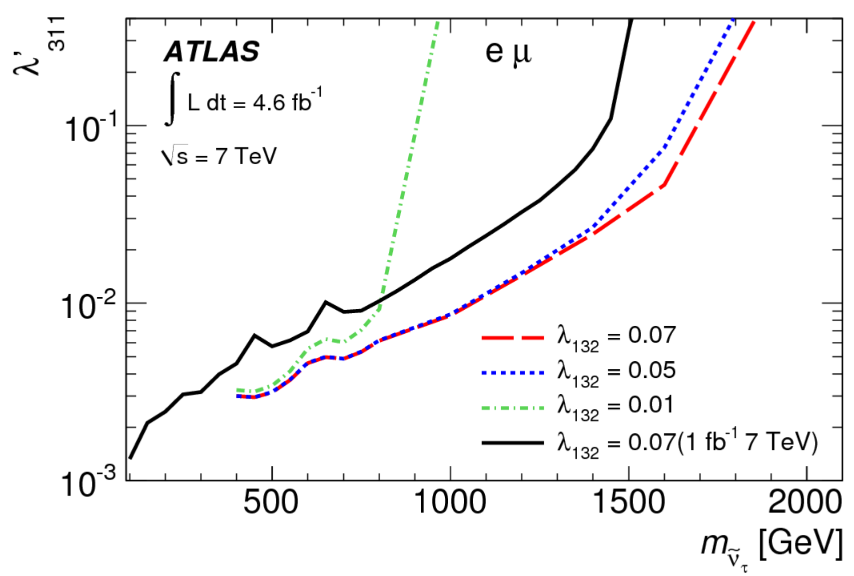
PLB 723 (2013) 15

- lepton number violation can lead to decays of heavy particles into pairs of different generation leptons
- search for resonance in eμ, $e\tau_{had}$, $\mu\tau_{had}$ final states
- interpretation in terms of sneutrino resonance (Z' also possible)
- limit on visible cross section: 3.2/42/40 fb







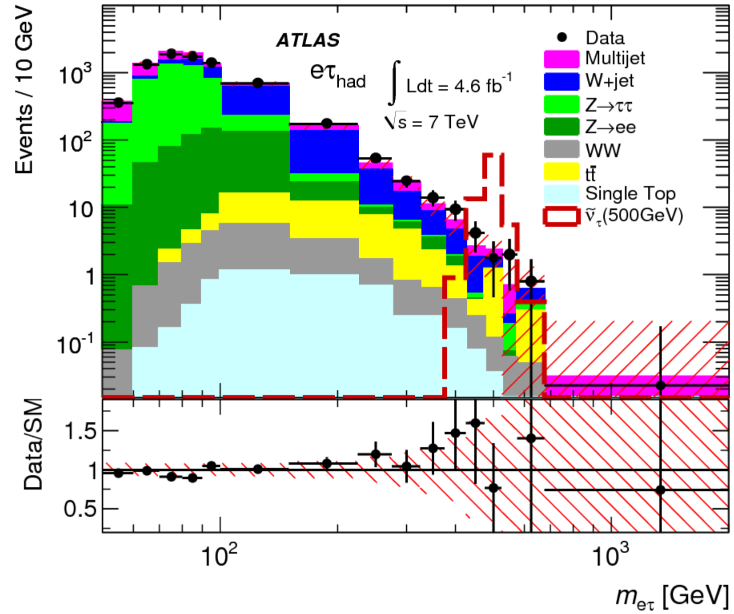


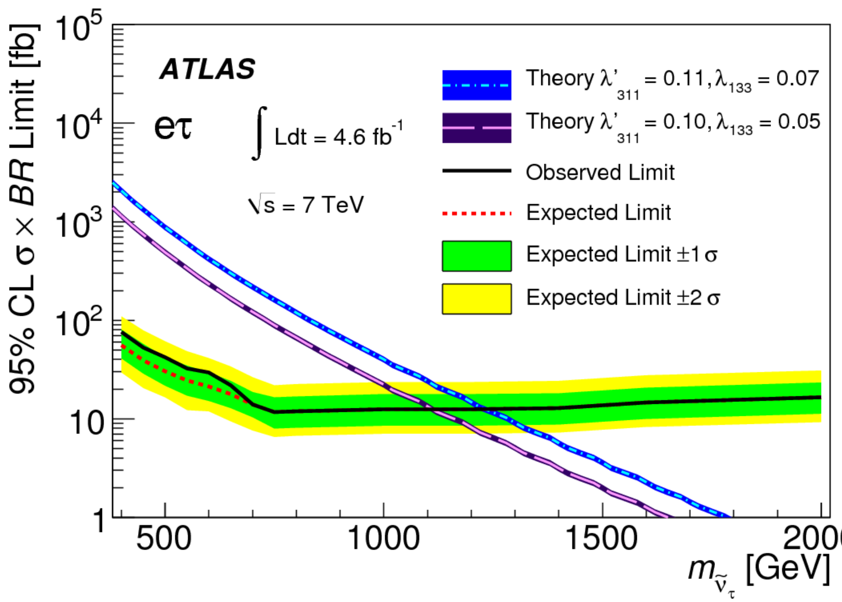
Heavy Narrow Resonances decaying to eμ, eτ, μτ

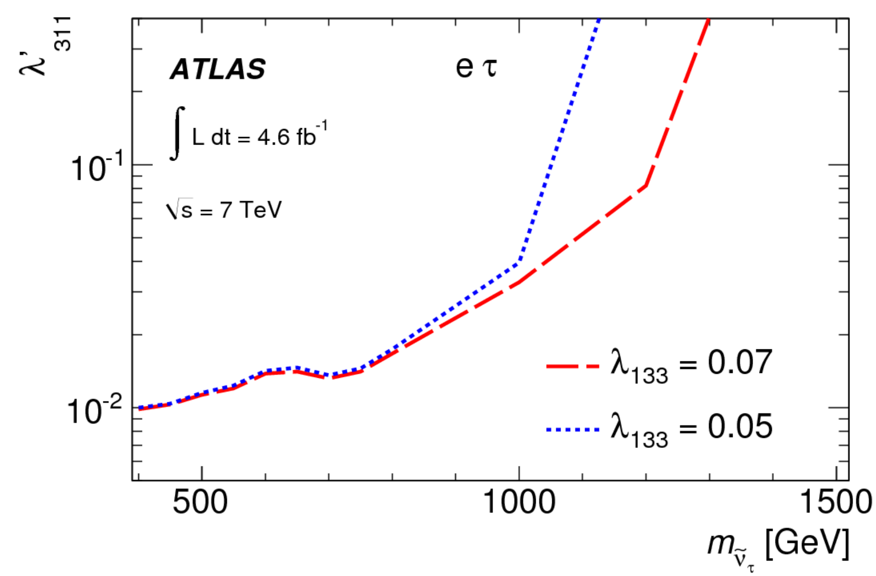
PLB 723 (2013) 15

- lepton number violation can lead to decays of heavy particles into pairs of different generation leptons
- search for resonance in eμ, eτ, μτ final states
- exclusion

at $m_{\tilde{\nu}_\tau} = 500$ GeV	eμ:	$\lambda'_{311} > 0.003$
$\lambda_{i3k} = 0.07$	eτ:	$\lambda'_{311} > 0.01$
	μτ:	$\lambda'_{311} > 0.01$



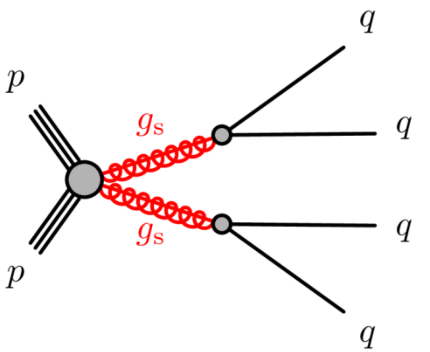


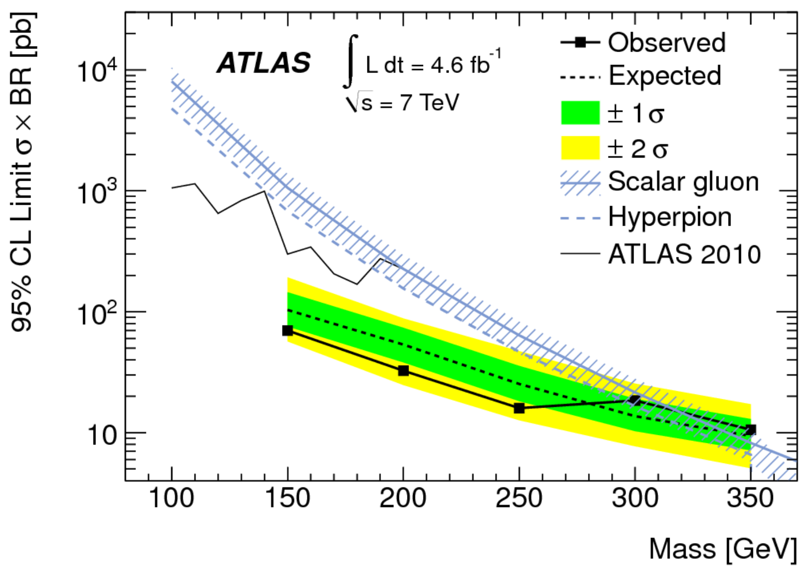


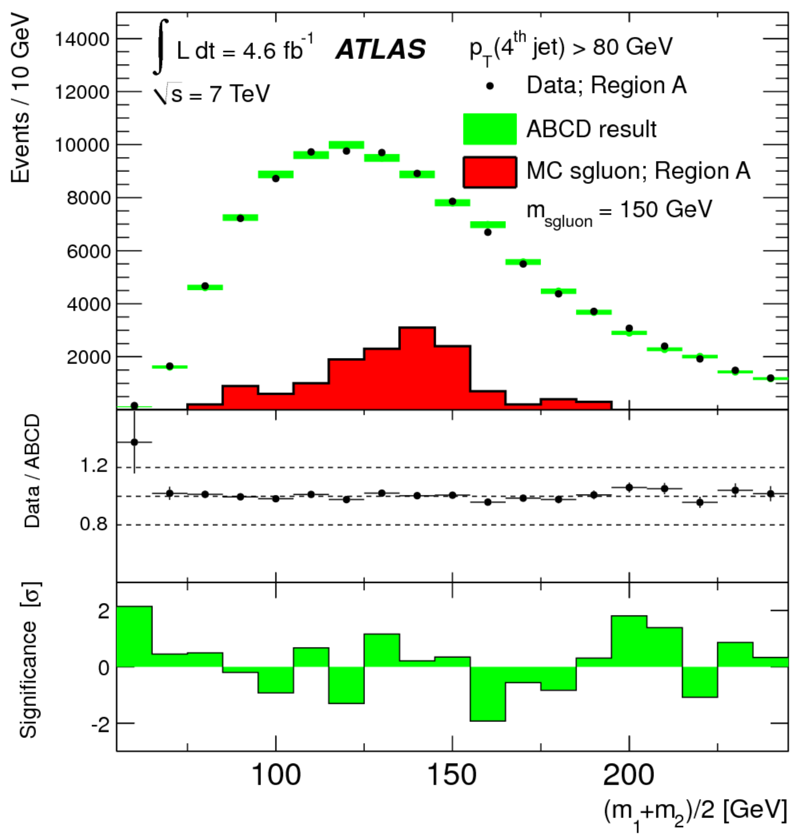
Massive Colored Resonance decaying to 2 x 2 Jets

EPJC 73 (2013) 2263

- pair production of massive scalar particles decaying into two jets each
- interpretation in terms of scalar gluons (sgluon) in extended SUSY or hyperpions in compositeness models
- jets paired into sgluon candidates based on $\Delta R \sim 1$ and similar masses
- define signal (and background) regions on $\frac{|m_1-m_2|}{m_1+m_2} < 0.15$ and $|\cos\theta^*| < 0.5$







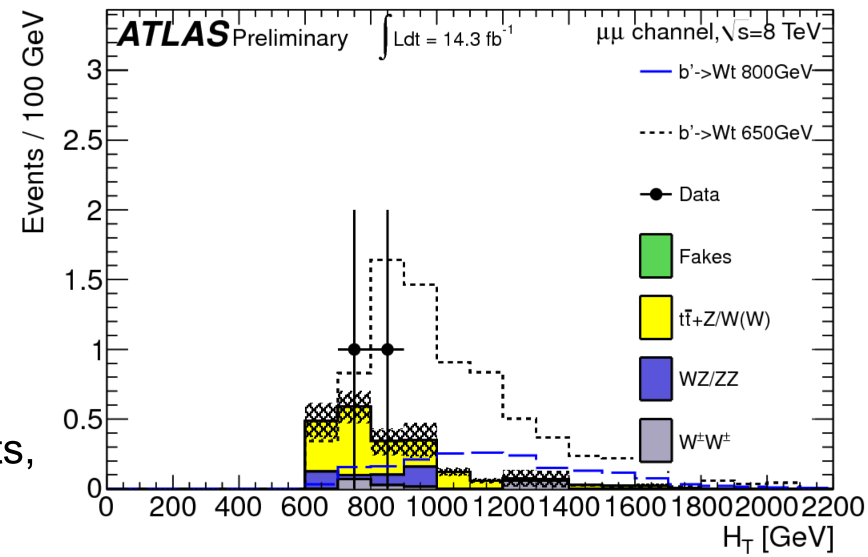
Particles decaying to Same-Sign Dileptons and *b* Jets

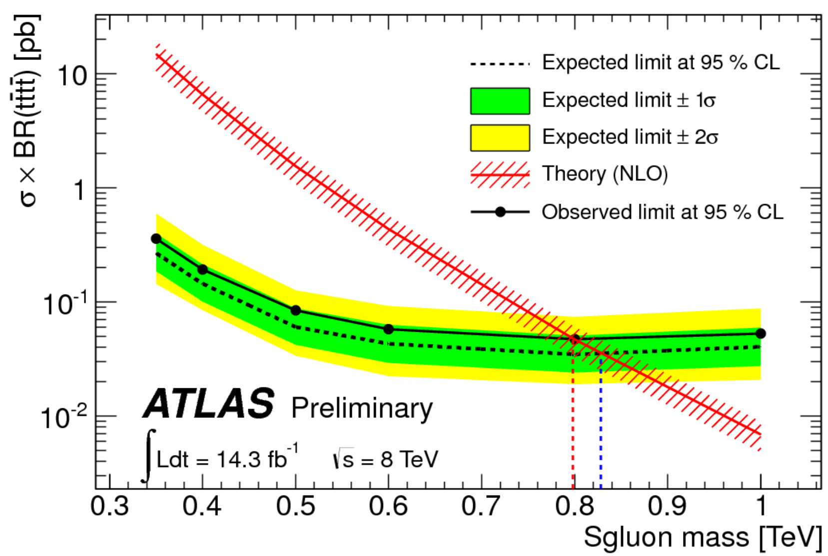
ATL-CONF-2013-51

- scalar gluons can decay into $t\bar{t}$ pairs if mass is above threshold
- final state with four top quarks
  → search for same sign dilepton pairs and b-jets
- b' signal region:
  - two same sign light leptons (e/μ), ≥1 b-jets, mis E_T > 40 GeV and H_T > 650 GeV
- scalar gluon signal region:
  - b' SR and ≥2 b-jets

Selection step	Channel					
	ee		*eμ*		*μμ*	
	Data	Backgr.	Data	Backgr.	Data	Backgr.
$N_{jets} \geq 2$	371	317 ± 53	344	363 ± 60	127	128 ± 24
$N_{b-jets} \geq 1$	90	87 ± 16	139	154 ± 28	47	57 ± 14
$E_T^{miss} > 40$ GeV	55	46 ± 8	100	100 ± 17	37	40 ± 10
$H_T > 650$ GeV	3	2.7 ± 0.6	10	4.4 ± 1.0	2	2.3 ± 1.2
$N_{b-jets} \geq 2$	1	0.75 ± 0.25	6	2.0 ± 0.5	1	0.8 ± 1.2

- see also talk by Antonella Succurro (15:15, 18.7.)

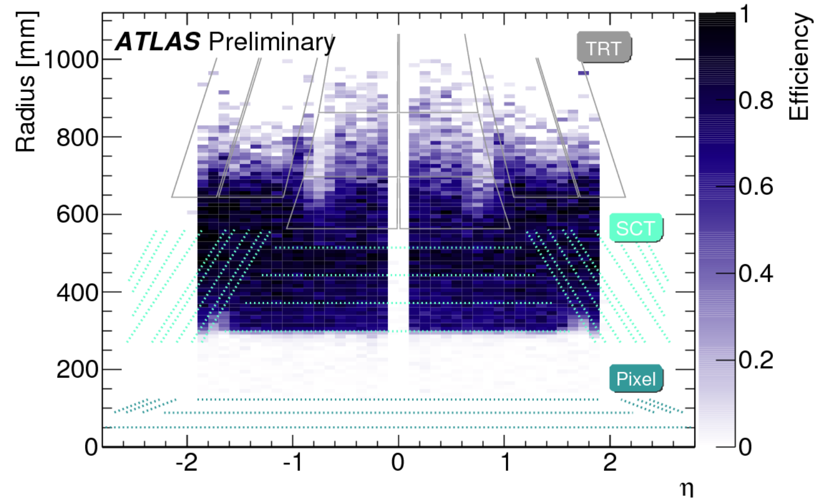


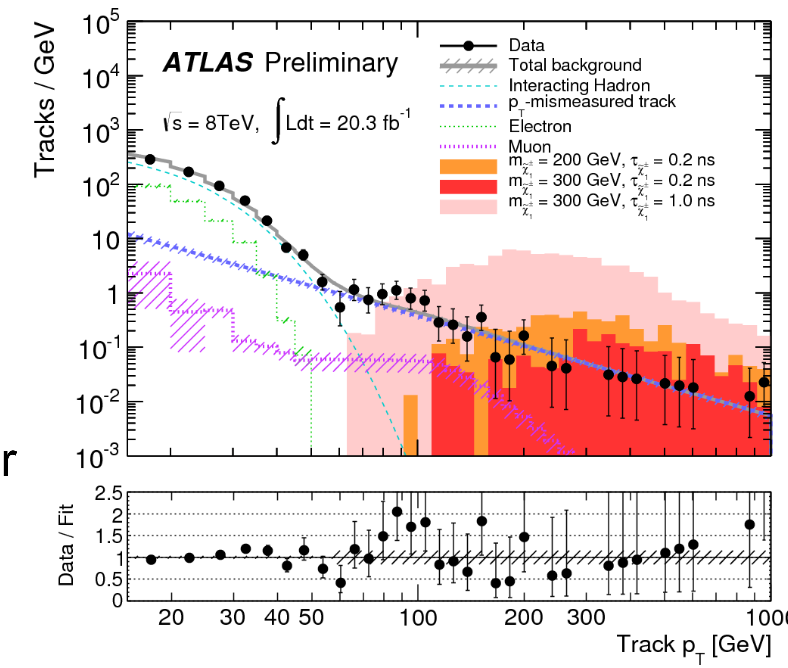


Direct Chargino Production based on Disappearing Tracks

ATL-CONF-2013-69

- charginos and neutralinos are almost degenerated in mass in Anomaly Mediated SUSY Breaking (AMSB)
  - $\Delta m_{\tilde{\chi}_1} = m_{\tilde{\chi}_1^\pm} - m_{\tilde{\chi}_1^0} \sim$ 160 MeV
  - chargino is metastable with significant lifetime τ = 0.2 ns/6cm
    → disappearing tracks in inner detector
- veto events with leptons and select events with at least one jet and missing E_T
- dedicated track selection:
  - isolated high p_T track from interaction point
  - hits in PIXEL(≥3) and SCT(≥2)
  - track pointing to TRT and number of TRT hits less than five (out of 32)
- high efficiency for charginos decaying after the PIXEL and before the TRT detector

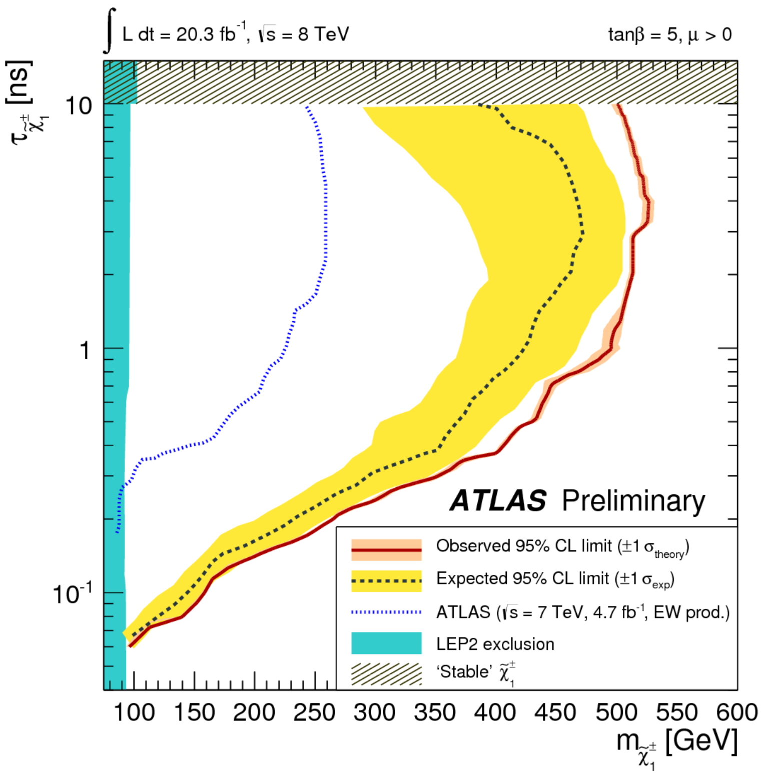


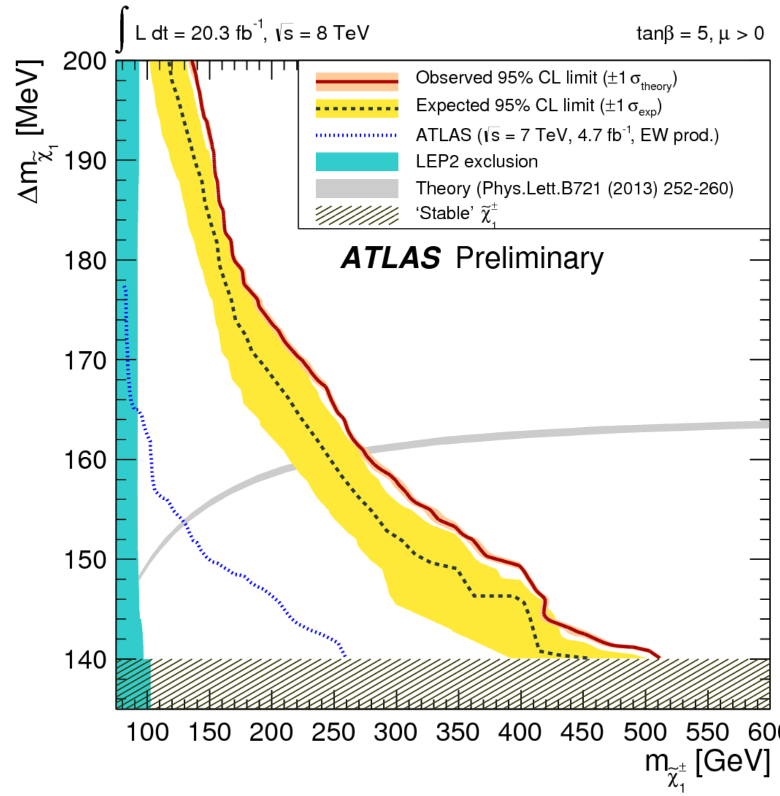


Direct Chargino Production based on Disappearing Tracks

ATL-CONF-2013-69

- interpret as limits on the chargino mass and either chargino lifetime τ or mass difference $\Delta m_{\tilde{\chi}_1}$





- $m_{\tilde{\chi}_1^\pm}$ < 270 GeV for AMSB (τ = 0.2ns /$\Delta m_{\tilde{\chi}_1}$ = 160 MeV)

Conclusion and Outlook

- certain SUSY models predict interesting signatures
  - R-parity violation: multi-lepton final states, resonances
  - compressed mass spectra: long lifetime and disappearing tracks
  - and many more
- these analyses need different searches strategies compared to standard missing E_T based R-parity conserving searches
- no evidence for SUSY found so far
- limits on SUSY model parameters competitive with corresponding R-parity conserving searches
- 20 fb^{-1} of 8 TeV data allows significant increase in exclusion limits over previous searches
  - more searches in preparation

ATLAS SUSY Searches* - 95% CL Lower Limits

Status: EPS 2013

ATLAS Preliminary

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

	Model	e, μ, τ, γ	Jets	E_T^{miss}	$\int \mathcal{L} dt [fb^{-1}]$	Mass limit		Reference
Inclusive Searches	MSUGRA/CMSSM	0	2-6 jets	Yes	20.3	$\tilde{q}, \tilde{g}$ 1.7 TeV	$m(\tilde{q})=m(\tilde{g})$	ATLAS-CONF-2013-047
	MSUGRA/CMSSM	1 e, μ	3-6 jets	Yes	20.3	$\tilde{g}$ 1.2 TeV	any $m(\tilde{q})$	ATLAS-CONF-2013-062
	MSUGRA/CMSSM	0	7-10 jets	Yes	20.3	$\tilde{g}$ 1.1 TeV	any $m(\tilde{q})$	ATLAS-CONF-2013-054
	$\tilde{q}\tilde{q}, \tilde{q}\rightarrow q\tilde{\chi}_1^0$	0	2-6 jets	Yes	20.3	$\tilde{q}$ 740 GeV	$m(\tilde{\chi}_1^0)=0$ GeV	ATLAS-CONF-2013-047
	$\tilde{g}\tilde{g}, \tilde{g}\rightarrow q\bar{q}\tilde{\chi}_1^0$	0	2-6 jets	Yes	20.3	$\tilde{g}$ 1.3 TeV	$m(\tilde{\chi}_1^0)=0$ GeV	ATLAS-CONF-2013-047
	$\tilde{g}\tilde{g}, \tilde{g}\rightarrow qq\tilde{\chi}_1^{\pm}\rightarrow qqW^{\pm}\tilde{\chi}_1^0$	1 e, μ	3-6 jets	Yes	20.3	$\tilde{g}$ 1.18 TeV	$m(\tilde{\chi}_1^0)<200$ GeV, $m(\tilde{\chi}^{\pm})=0.5(m(\tilde{\chi}_1^0)+m(\tilde{g}))$	ATLAS-CONF-2013-062
	$\tilde{g}\tilde{g}\rightarrow qqqq\ell\ell(\ell\ell)\tilde{\chi}_1^0\tilde{\chi}_1^0$	2 e, μ (SS)	3 jets	Yes	20.7	$\tilde{g}$ 1.1 TeV	$m(\tilde{\chi}_1^0)<650$ GeV	ATLAS-CONF-2013-007
	GMSB ($\tilde{\ell}$ NLSP)	2 e, μ	2-4 jets	Yes	4.7	$\tilde{g}$ 1.24 TeV	$\tan\beta<15$	1208.4688
	GMSB ($\tilde{\ell}$ NLSP)	1-2 τ	0-2 jets	Yes	20.7	$\tilde{g}$ 1.4 TeV	$\tan\beta>18$	ATLAS-CONF-2013-026
	GGM (bino NLSP)	2 γ	0	Yes	4.8	$\tilde{g}$ 1.07 TeV	$m(\tilde{\chi}_1^0)>50$ GeV	1209.0753
	GGM (wino NLSP)	1 $e, \mu + \gamma$	0	Yes	4.8	$\tilde{g}$ 619 GeV	$m(\tilde{\chi}_1^0)>50$ GeV	ATLAS-CONF-2012-144
	GGM (higgsino-bino NLSP)	γ	1 b	Yes	4.8	$\tilde{g}$ 900 GeV	$m(\tilde{\chi}_1^0)>220$ GeV	1211.1167
	GGM (higgsino NLSP)	2 e, μ (Z)	0-3 jets	Yes	5.8	$\tilde{g}$ 690 GeV	$m(\tilde{H})>200$ GeV	ATLAS-CONF-2012-152
	Gravitino LSP	0	mono-jet	Yes	10.5	$F^{1/2}$ scale 645 GeV	$m(\tilde{g})>10^{-4}$ eV	ATLAS-CONF-2012-147
3rd gen. $\tilde{g}$ med.	$\tilde{g}\rightarrow b\bar{b}\tilde{\chi}_1^0$	0	3 b	Yes	20.1	$\tilde{g}$ 1.2 TeV	$m(\tilde{\chi}_1^0)<600$ GeV	ATLAS-CONF-2013-061
	$\tilde{g}\rightarrow t\bar{t}\tilde{\chi}_1^0$	0	7-10 jets	Yes	20.3	$\tilde{g}$ 1.14 TeV	$m(\tilde{\chi}_1^0)<200$ GeV	ATLAS-CONF-2013-054
	$\tilde{g}\rightarrow t\bar{t}\tilde{\chi}_1^0$	0-1 e, μ	3 b	Yes	20.1	$\tilde{g}$ 1.34 TeV	$m(\tilde{\chi}_1^0)<400$ GeV	ATLAS-CONF-2013-061
	$\tilde{g}\rightarrow b\bar{t}\tilde{\chi}_1^+$	0-1 e, μ	3 b	Yes	20.1	$\tilde{g}$ 1.3 TeV	$m(\tilde{\chi}_1^0)<300$ GeV	ATLAS-CONF-2013-061
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	$\tilde{b}_1$ 100-630 GeV	$m(\tilde{\chi}_1^0)<100$ GeV	ATLAS-CONF-2013-053
	$\tilde{b}_1\tilde{b}_1, \tilde{b}_1\rightarrow t\tilde{\chi}_1^{\pm}$	2 e, μ (SS)	0-3 b	Yes	20.7	$\tilde{b}_1$ 430 GeV	$m(\tilde{\chi}_1^{\pm})=2\ m(\tilde{\chi}_1^0)$	ATLAS-CONF-2013-007
	$\tilde{t}_1\tilde{t}_1$(light), $\tilde{t}_1\rightarrow b\tilde{\chi}_1^{\pm}$	1-2 e, μ	1-2 b	Yes	4.7	$\tilde{t}_1$ 167 GeV	$m(\tilde{\chi}_1^0)=55$ GeV	1208.4305, 1209.2102
	$\tilde{t}_1\tilde{t}_1$(light), $\tilde{t}_1\rightarrow Wb\tilde{\chi}_1^0$	2 e, μ	0-2 jets	Yes	20.3	$\tilde{t}_1$ 220 GeV	$m(\tilde{\chi}_1^0)=m(\tilde{t}_1)-m(W)-50$ GeV, $m(\tilde{t}_1)<<m(\tilde{\chi}_1^{\pm})$	ATLAS-CONF-2013-048
	$\tilde{t}_1\tilde{t}_1$(medium), $\tilde{t}_1\rightarrow t\tilde{\chi}_1^0$	2 e, μ	2 jets	Yes	20.3	$\tilde{t}_1$ 225-525 GeV	$m(\tilde{\chi}_1^0)=0$ GeV	ATLAS-CONF-2013-065
	$\tilde{t}_1\tilde{t}_1$(medium), $\tilde{t}_1\rightarrow b\tilde{\chi}_1^{\pm}$	0	2 b	Yes	20.1	$\tilde{t}_1$ 150-580 GeV	$m(\tilde{\chi}_1^0)<200$ GeV, $m(\tilde{\chi}_1^{\pm})-m(\tilde{\chi}_1^0)=5$ GeV	ATLAS-CONF-2013-053
	$\tilde{t}_1\tilde{t}_1$(heavy), $\tilde{t}_1\rightarrow t\tilde{\chi}_1^0$	1 e, μ	1 b	Yes	20.7	$\tilde{t}_1$ 200-610 GeV	$m(\tilde{\chi}_1^0)=0$ GeV	ATLAS-CONF-2013-037
	$\tilde{t}_1\tilde{t}_1$(heavy), $\tilde{t}_1\rightarrow t\tilde{\chi}_1^0$	0	2 b	Yes	20.5	$\tilde{t}_1$ 320-660 GeV	$m(\tilde{\chi}_1^0)=0$ GeV	ATLAS-CONF-2013-024
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\rightarrow c\tilde{\chi}_1^0$	0	mono-jet/c-tag	Yes	20.3	$\tilde{t}_1$ 200 GeV	$m(\tilde{t}_1)-m(\tilde{\chi}_1^0)<85$ GeV	ATLAS-CONF-2013-068
	$\tilde{t}_1\tilde{t}_1$(natural GMSB)	2 e, μ (Z)	1 b	Yes	20.7	$\tilde{t}_1$ 500 GeV	$m(\tilde{\chi}_1^0)>150$ GeV	ATLAS-CONF-2013-025
	$\tilde{t}_2\tilde{t}_2, \tilde{t}_2\rightarrow\tilde{t}_1 + Z$	3 e, μ (Z)	1 b	Yes	20.7	$\tilde{t}_2$ 520 GeV	$m(\tilde{t}_1)=m(\tilde{\chi}_1^0)+180$ GeV	ATLAS-CONF-2013-025
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	$\tilde{\ell}$ 85-315 GeV	$m(\tilde{\chi}_1^0)=0$ GeV	ATLAS-CONF-2013-049
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\rightarrow\tilde{\ell}\nu(\ell\tilde{\nu})$	2 e, μ	0	Yes	20.3	$\tilde{\chi}_1^{\pm}$ 125-450 GeV	$m(\tilde{\chi}_1^0)=0$ GeV, $m(\tilde{\ell}, \tilde{\nu})=0.5(m(\tilde{\chi}_1^{\pm})+m(\tilde{\chi}_1^0))$	ATLAS-CONF-2013-049
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\rightarrow\tilde{\tau}\nu(\tau\tilde{\nu})$	2 τ	0	Yes	20.7	$\tilde{\chi}_1^{\pm}$ 180-330 GeV	$m(\tilde{\chi}_1^0)=0$ GeV, $m(\tilde{\tau}, \tilde{\nu})=0.5(m(\tilde{\chi}_1^{\pm})+m(\tilde{\chi}_1^0))$	ATLAS-CONF-2013-028
	$\tilde{\chi}_1^{\pm}\tilde{\chi}_2^0\rightarrow\tilde{\ell}_L\nu\tilde{\ell}_L\ell(\tilde{\nu}\nu), \ell\tilde{\nu}\tilde{\ell}_L\ell(\tilde{\nu}\nu)$	3 e, μ	0	Yes	20.7	$\tilde{\chi}_1^{\pm}, \tilde{\chi}_2^0$ 600 GeV	$m(\tilde{\chi}_1^{\pm})=m(\tilde{\chi}_2^0)$, $m(\tilde{\chi}_1^0)=0$, $m(\tilde{\ell}, \tilde{\nu})=0.5(m(\tilde{\chi}_1^{\pm})+m(\tilde{\chi}_1^0))$	ATLAS-CONF-2013-035
	$\tilde{\chi}_1^{\pm}\tilde{\chi}_2^0\rightarrow W^*\tilde{\chi}_1^0 Z^*\tilde{\chi}_1^0$	3 e, μ	0	Yes	20.7	$\tilde{\chi}_1^{\pm}, \tilde{\chi}_2^0$ 315 GeV	$m(\tilde{\chi}_1^{\pm})=m(\tilde{\chi}_2^0)$, $m(\tilde{\chi}_1^0)=0$, sleptons decoupled	ATLAS-CONF-2013-035
Long-lived particles	Direct $\tilde{\chi}_1^+\tilde{\chi}_1^-$ prod., long-lived $\tilde{\chi}_1^{\pm}$	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, $\tau(\tilde{\chi}_1^{\pm})=0.2$ ns	ATLAS-CONF-2013-069
	Stable, stopped $\tilde{g}$ R-hadron	0	1-5 jets	Yes	22.9	$\tilde{g}$ 857 GeV	$m(\tilde{\chi}_1^0)=100$ GeV, 10 $\mu s<\tau(\tilde{g})<1000$ s	ATLAS-CONF-2013-057
	GMSB, stable $\tilde{\tau}, \tilde{\chi}_1^0\rightarrow\tilde{\tau}(\tilde{e}, \tilde{\mu})+\tau(e, \mu)$	1-2 μ	0	-	15.9	$\tilde{\chi}_1^0$ 475 GeV	$10<\tan\beta<50$	ATLAS-CONF-2013-058
	GMSB, $\tilde{\chi}_1^0\rightarrow\gamma\tilde{G}$, long-lived $\tilde{\chi}_1^0$	2 γ	0	Yes	4.7	$\tilde{\chi}_1^0$ 230 GeV	$0.4<\tau(\tilde{\chi}_1^0)<2$ ns	1304.6310
	$\tilde{\chi}_1^0\rightarrow qq\mu$ (RPV)	1 μ	0	Yes	4.4	$\tilde{q}$ 700 GeV	1 mm$<c\tau<$1 m, $\tilde{g}$ decoupled	1210.7451
RPV	LFV $pp\rightarrow\tilde{\nu}_\tau + X, \tilde{\nu}_\tau\rightarrow e + \mu$	2 e, μ	0	-	4.6	$\tilde{\nu}_\tau$ 1.61 TeV	$\lambda'_{311}=0.10$, $\lambda_{132}=0.05$	1212.1272
	LFV $pp\rightarrow\tilde{\nu}_\tau + X, \tilde{\nu}_\tau\rightarrow e(\mu) + \tau$	1 $e, \mu + \tau$	0	-	4.6	$\tilde{\nu}_\tau$ 1.1 TeV	$\lambda'_{311}=0.10$, $\lambda_{1(2)33}=0.05$	1212.1272
	Bilinear RPV CMSSM	1 e, μ	7 jets	Yes	4.7	$\tilde{q}, \tilde{g}$ 1.2 TeV	$m(\tilde{q})=m(\tilde{g})$, $c\tau_{LSP}<1$ mm	ATLAS-CONF-2012-140
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\rightarrow W\tilde{\chi}_1^0, \tilde{\chi}_1^0\rightarrow ee\tilde{\nu}_\mu, e\mu\tilde{\nu}_e$	4 e, μ	0	Yes	20.7	$\tilde{\chi}_1^{\pm}$ 760 GeV	$m(\tilde{\chi}_1^0)>300$ GeV, $\lambda_{121}>0$	ATLAS-CONF-2013-036
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\rightarrow W\tilde{\chi}_1^0, \tilde{\chi}_1^0\rightarrow\tau\tau\tilde{\nu}_e, e\tau\tilde{\nu}_\tau$	3 $e, \mu + \tau$	0	Yes	20.7	$\tilde{\chi}_1^{\pm}$ 350 GeV	$m(\tilde{\chi}_1^0)>80$ GeV, $\lambda_{133}>0$	ATLAS-CONF-2013-036
	$\tilde{g}\rightarrow qqq$	0	6 jets	-	4.6	$\tilde{g}$ 666 GeV		1210.4813
	$\tilde{g}\rightarrow\tilde{t}_1 t, \tilde{t}_1\rightarrow bs$	2 e, μ (SS)	0-3 b	Yes	20.7	$\tilde{g}$ 880 GeV		ATLAS-CONF-2013-007
Other	Scalar gluon	0	4 jets	-	4.6	sgluon 100-287 GeV	incl. limit from 1110.2693	1210.4826
	WIMP interaction (D5, Dirac χ)	0	mono-jet	Yes	10.5	M^* scale 704 GeV	$m(\chi)<80$ GeV, limit of<687 GeV for D8	ATLAS-CONF-2012-147

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

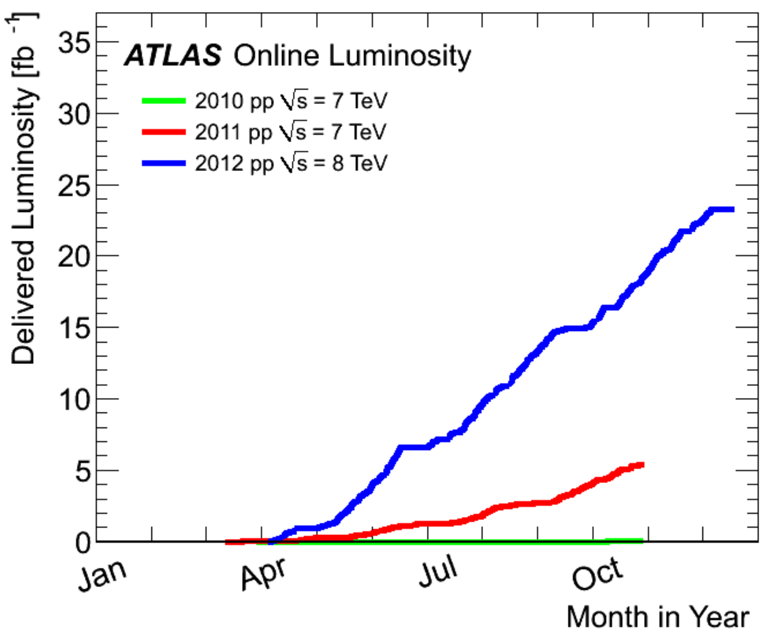
$\sqrt{s} = 7$ TeV full data | $\sqrt{s} = 8$ TeV partial data | $\sqrt{s} = 8$ TeV full data

*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.

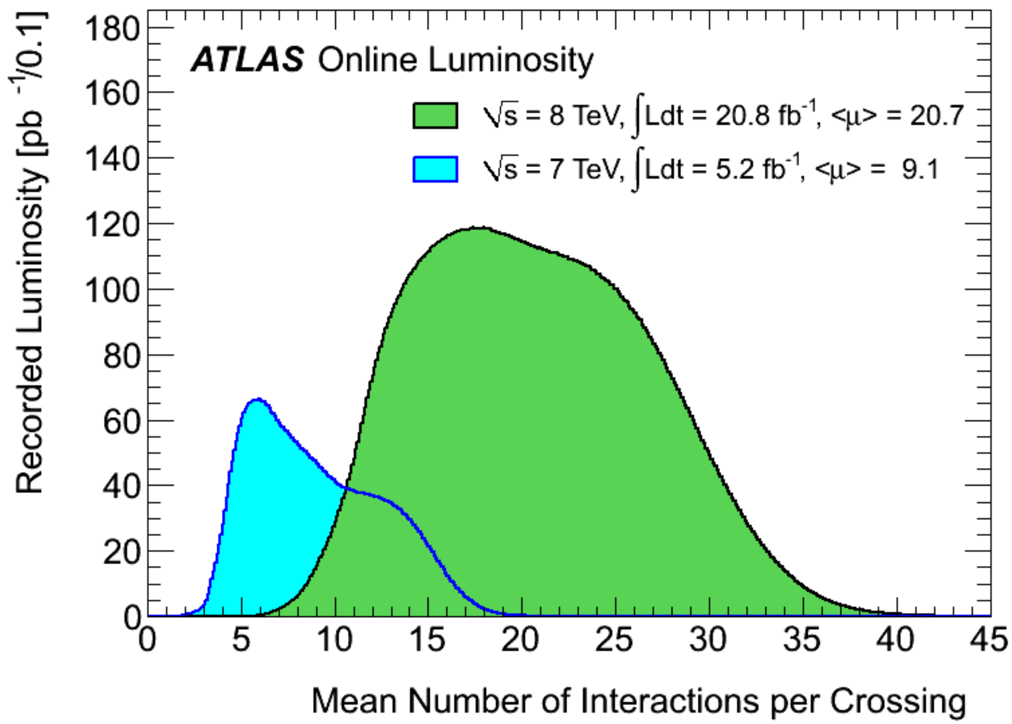
Backup

Large Hadron Collider (LHC)

- 2010/2011: $\sqrt{s}$ = 7 TeV pp
- 2012: $\sqrt{s}$ = 8 TeV pp
- Outstanding 2012 Performance
  - ~ 7.7×10^{33} $cm^{-2}s^{-1}$ peak lumi
  - ~ 23.3 fb^{-1} delivered

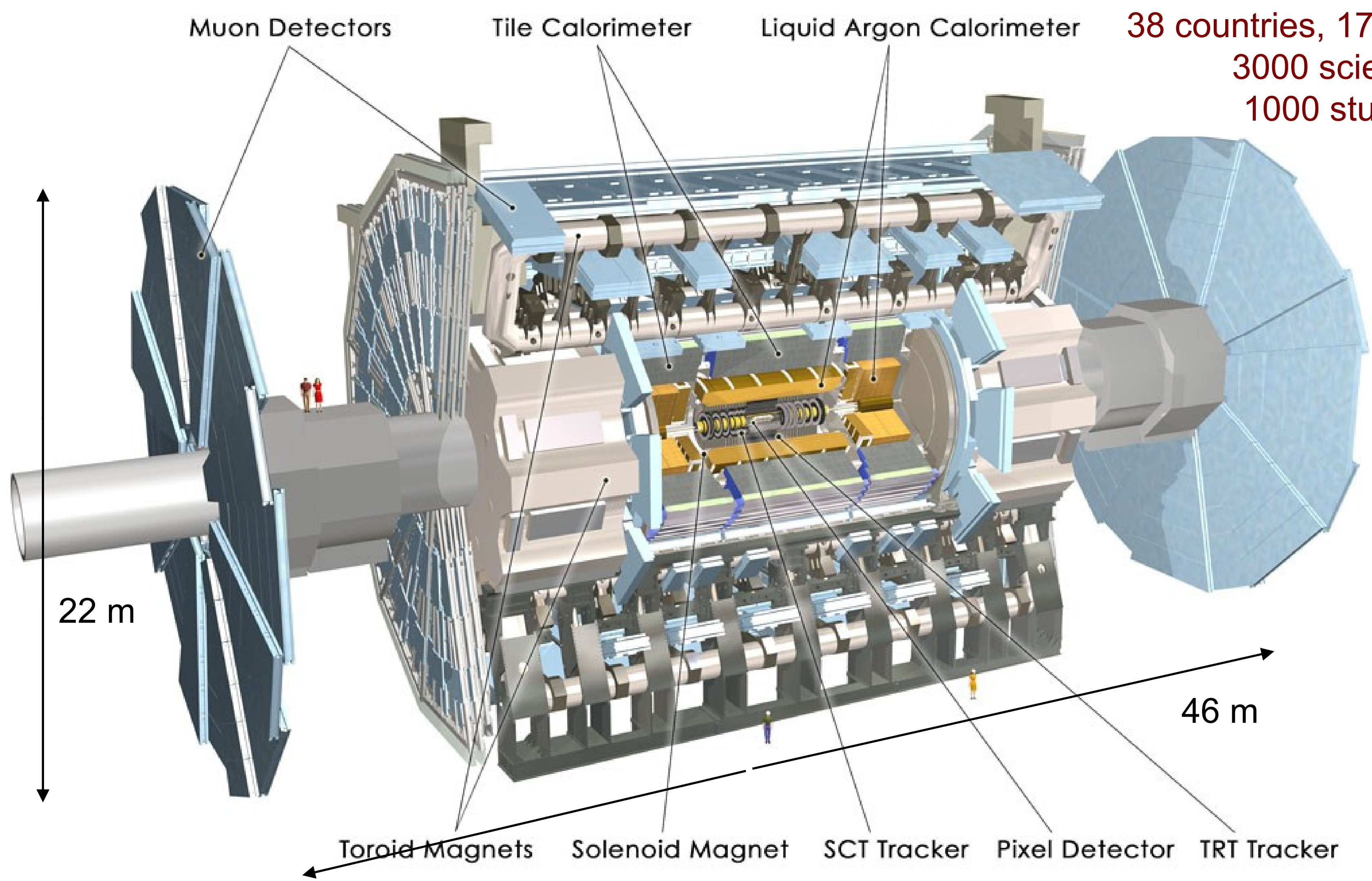


- Bunch spacing 50 ns



General-purpose Experiment: ATLAS

38 countries, 174 institutions
3000 scientists,
1000 students



Emphasis on excellent jet and missing-E_T (MET) resolution, particle identification, and standalone muon reconstruction