Searches for Supersymmetry in Resonance Production, R-Parity Violating Signatures and Events with Long-Lived Particles with the ATLAS Detector

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Current ATLAS SUSY Limits

ATLAS SUSY Searches* - 95% CL Lower Limits

Status: Moriond 2014

ATLAS Preliminary

$\int \mathcal{L}\, dt = (4.6 - 22.9)\ \mathrm{fb}^{-1}$ $\sqrt{s} = 7,\ 8$ 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	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 $m(\tilde{q})$	1308.1841
	$\tilde{q}\tilde{q}, \tilde{q}\to q\tilde{\chi}^0_1$	0	2-6 jets	Yes	20.3	$\tilde{q}$ 740 GeV	$m(\tilde{\chi}^0_1)$=0 GeV	ATLAS-CONF-2013-047
	$\tilde{g}\tilde{g}, \tilde{g}\to q\bar{q}\tilde{\chi}^0_1$	0	2-6 jets	Yes	20.3	$\tilde{g}$ 1.3 TeV	$m(\tilde{\chi}^0_1)$=0 GeV	ATLAS-CONF-2013-047
	$\tilde{g}\tilde{g}, \tilde{g}\to qq\tilde{\chi}^{\pm}_1\to qqW^{\pm}\tilde{\chi}^0_1$	1 e, μ	3-6 jets	Yes	20.3	$\tilde{g}$ 1.18 TeV	$m(\tilde{\chi}^0_1)$<200 GeV, $m(\tilde{\chi}^{\pm})=0.5(m(\tilde{\chi}^0_1)+m(\tilde{g}))$	ATLAS-CONF-2013-062
	$\tilde{g}\tilde{g}, \tilde{g}\to qq(\ell\ell/\ell\nu/\nu\nu)\tilde{\chi}^0_1$	2 e, μ	0-3 jets	-	20.3	$\tilde{g}$ 1.12 TeV	$m(\tilde{\chi}^0_1)$=0 GeV	ATLAS-CONF-2013-089
	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	-	Yes	20.3	$\tilde{g}$ 1.28 TeV	$m(\tilde{\chi}^0_1)$>50 GeV	ATLAS-CONF-2014-001
	GGM (wino NLSP)	1 $e, \mu + \gamma$	-	Yes	4.8	$\tilde{g}$ 619 GeV	$m(\tilde{\chi}^0_1)$>50 GeV	ATLAS-CONF-2012-144
	GGM (higgsino-bino NLSP)	γ	1 b	Yes	4.8	$\tilde{g}$ 900 GeV	$m(\tilde{\chi}^0_1)$>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
3^{rd} gen. $\tilde{g}$ med.	$\tilde{g}\to b\bar{b}\tilde{\chi}^0_1$	0	3 b	Yes	20.1	$\tilde{g}$ 1.2 TeV	$m(\tilde{\chi}^0_1)$<600 GeV	ATLAS-CONF-2013-061
	$\tilde{g}\to t\bar{t}\tilde{\chi}^0_1$	0	7-10 jets	Yes	20.3	$\tilde{g}$ 1.1 TeV	$m(\tilde{\chi}^0_1)$ <350 GeV	1308.1841
	$\tilde{g}\to t\bar{t}\tilde{\chi}^0_1$	0-1 e, μ	3 b	Yes	20.1	$\tilde{g}$ 1.34 TeV	$m(\tilde{\chi}^0_1)$<400 GeV	ATLAS-CONF-2013-061
	$\tilde{g}\to b\bar{t}\tilde{\chi}^+_1$	0-1 e, μ	3 b	Yes	20.1	$\tilde{g}$ 1.3 TeV	$m(\tilde{\chi}^0_1)$<300 GeV	ATLAS-CONF-2013-061
3^{rd} gen. squarks direct production	$\tilde{b}_1\tilde{b}_1, \tilde{b}_1\to b\tilde{\chi}^0_1$	0	2 b	Yes	20.1	$\tilde{b}_1$ 100-620 GeV	$m(\tilde{\chi}^0_1)$<90 GeV	1308.2631
	$\tilde{b}_1\tilde{b}_1, \tilde{b}_1\to t\tilde{\chi}^{\pm}_1$	2 e, μ (SS)	0-3 b	Yes	20.7	$\tilde{b}_1$ 275-430 GeV	$m(\tilde{\chi}^{\pm}_1)=2\, m(\tilde{\chi}^0_1)$	ATLAS-CONF-2013-007
	$\tilde{t}_1\tilde{t}_1$(light), $\tilde{t}_1\to b\tilde{\chi}^{\pm}_1$	1-2 e, μ	1-2 b	Yes	4.7	$\tilde{t}_1$ 110-167 GeV	$m(\tilde{\chi}^0_1)$=55 GeV	1208.4305, 1209.2102
	$\tilde{t}_1\tilde{t}_1$(light), $\tilde{t}_1\to Wb\tilde{\chi}^0_1$	2 e, μ	0-2 jets	Yes	20.3	$\tilde{t}_1$ 130-210 GeV	$m(\tilde{\chi}^0_1)=m(\tilde{t}_1)-m(W)$-50 GeV, $m(\tilde{t}_1)<<m(\tilde{\chi}^{\pm}_1)$	1403.4853
	$\tilde{t}_1\tilde{t}_1$(medium), $\tilde{t}_1\to t\tilde{\chi}^0_1$	2 e, μ	2 jets	Yes	20.3	$\tilde{t}_1$ 215-530 GeV	$m(\tilde{\chi}^0_1)$=1 GeV	1403.4853
	$\tilde{t}_1\tilde{t}_1$(medium), $\tilde{t}_1\to b\tilde{\chi}^{\pm}_1$	0	2 b	Yes	20.1	$\tilde{t}_1$ 150-580 GeV	$m(\tilde{\chi}^0_1)$<200 GeV, $m(\tilde{\chi}^{\pm}_1)-m(\tilde{\chi}^0_1)$=5 GeV	1308.2631
	$\tilde{t}_1\tilde{t}_1$(heavy), $\tilde{t}_1\to t\tilde{\chi}^0_1$	1 e, μ	1 b	Yes	20.7	$\tilde{t}_1$ 200-610 GeV	$m(\tilde{\chi}^0_1)$=0 GeV	ATLAS-CONF-2013-037
	$\tilde{t}_1\tilde{t}_1$(heavy), $\tilde{t}_1\to t\tilde{\chi}^0_1$	0	2 b	Yes	20.5	$\tilde{t}_1$ 320-660 GeV	$m(\tilde{\chi}^0_1)$=0 GeV	ATLAS-CONF-2013-024
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to c\tilde{\chi}^0_1$	0	mono-jet/c-tag	Yes	20.3	$\tilde{t}_1$ 90-200 GeV	$m(\tilde{t}_1)-m(\tilde{\chi}^0_1)$<85 GeV	ATLAS-CONF-2013-068
	$\tilde{t}_1\tilde{t}_1$(natural GMSB)	2 e, μ (Z)	1 b	Yes	20.3	$\tilde{t}_1$ 150-580 GeV	$m(\tilde{\chi}^0_1)$>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	20.3	$\tilde{t}_2$ 290-600 GeV	$m(\tilde{\chi}^0_1)$<200 GeV	1403.5222
EW direct	$\tilde{\ell}_{L,R}\tilde{\ell}_{L,R}, \tilde{\ell}\to\ell\tilde{\chi}^0_1$	2 e, μ	0	Yes	20.3	$\tilde{\ell}$ 90-325 GeV	$m(\tilde{\chi}^0_1)$=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	$\tilde{\chi}^{\pm}_1$ 140-465 GeV	$m(\tilde{\chi}^0_1)$=0 GeV, $m(\tilde{\ell},\tilde{\nu})=0.5(m(\tilde{\chi}^{\pm}_1)+m(\tilde{\chi}^0_1))$	1403.5294
	$\tilde{\chi}^+_1\tilde{\chi}^-_1, \tilde{\chi}^+_1\to\tilde{\tau}\nu(\tau\tilde{\nu})$	2 τ	-	Yes	20.7	$\tilde{\chi}^{\pm}_1$ 180-330 GeV	$m(\tilde{\chi}^0_1)$=0 GeV, $m(\tilde{\tau},\tilde{\nu})=0.5(m(\tilde{\chi}^{\pm}_1)+m(\tilde{\chi}^0_1))$	ATLAS-CONF-2013-028
	$\tilde{\chi}^{\pm}_1\tilde{\chi}^0_2\to\tilde{\ell}_L\nu\tilde{\ell}_L\ell(\tilde{\nu}\nu), \ell\tilde{\nu}\tilde{\ell}_L\ell(\tilde{\nu}\nu)$	3 e, μ	0	Yes	20.3	$\tilde{\chi}^{\pm}_1, \tilde{\chi}^0_2$ 700 GeV	$m(\tilde{\chi}^{\pm}_1)=m(\tilde{\chi}^0_2)$, $m(\tilde{\chi}^0_1)$=0, $m(\tilde{\ell},\tilde{\nu})=0.5(m(\tilde{\chi}^{\pm}_1)+m(\tilde{\chi}^0_1))$	1402.7029
	$\tilde{\chi}^{\pm}_1\tilde{\chi}^0_2\to W\tilde{\chi}^0_1 Z\tilde{\chi}^0_1$	2-3 e, μ	0	Yes	20.3	$\tilde{\chi}^{\pm}_1, \tilde{\chi}^0_2$ 420 GeV	$m(\tilde{\chi}^{\pm}_1)=m(\tilde{\chi}^0_2)$, $m(\tilde{\chi}^0_1)$=0, sleptons decoupled	1403.5294, 1402.7029
	$\tilde{\chi}^{\pm}_1\tilde{\chi}^0_2\to W\tilde{\chi}^0_1 h\tilde{\chi}^0_1$	1 e, μ	2 b	Yes	20.3	$\tilde{\chi}^{\pm}_1, \tilde{\chi}^0_2$ 285 GeV	$m(\tilde{\chi}^{\pm}_1)=m(\tilde{\chi}^0_2)$, $m(\tilde{\chi}^0_1)$=0, sleptons decoupled	ATLAS-CONF-2013-093
Long-lived particles	Direct $\tilde{\chi}^+_1\tilde{\chi}^-_1$ prod., long-lived $\tilde{\chi}^{\pm}_1$	Disapp. trk	1 jet	Yes	20.3	$\tilde{\chi}^{\pm}_1$ 270 GeV	$m(\tilde{\chi}^{\pm}_1)-m(\tilde{\chi}^0_1)$=160 MeV, $\tau(\tilde{\chi}^{\pm}_1)$=0.2 ns	ATLAS-CONF-2013-069
	Stable, stopped $\tilde{g}$ R-hadron	0	1-5 jets	Yes	22.9	$\tilde{g}$ 832 GeV	$m(\tilde{\chi}^0_1)$=100 GeV, 10 μs<$\tau(\tilde{g})$<1000 s	ATLAS-CONF-2013-057
	GMSB, stable $\tilde{\tau}$, $\tilde{\chi}^0_1\to\tilde{\tau}(\tilde{e},\tilde{\mu})+\tau(e,\mu)$	1-2 μ	-	-	15.9	$\tilde{\chi}^0_1$ 475 GeV	10<$\tan\beta$<50	ATLAS-CONF-2013-058
	GMSB, $\tilde{\chi}^0_1\to\gamma\tilde{G}$, long-lived $\tilde{\chi}^0_1$	2 γ	-	Yes	4.7	$\tilde{\chi}^0_1$ 230 GeV	0.4<$\tau(\tilde{\chi}^0_1)$<2 ns	1304.6310
	$\tilde{q}\tilde{q}, \tilde{\chi}^0_1\to qq\mu$ (RPV)	1 μ, displ. vtx	-	-	20.3	$\tilde{q}$ 1.0 TeV	1.5 <$c\tau$<156 mm, BR(μ)=1, $m(\tilde{\chi}^0_1)$=108 GeV	ATLAS-CONF-2013-092
RPV	LFV $pp\to\tilde{\nu}_\tau + X, \tilde{\nu}_\tau\to e + \mu$	2 e, μ	-	-	4.6	$\tilde{\nu}_\tau$ 1.61 TeV	λ'_{311}=0.10, λ_{132}=0.05	1212.1272
	LFV $pp\to\tilde{\nu}_\tau + X, \tilde{\nu}_\tau\to e(\mu) + \tau$	1 $e, \mu + \tau$	-	-	4.6	$\tilde{\nu}_\tau$ 1.1 TeV	λ'_{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
	$\tilde{\chi}^+_1\tilde{\chi}^-_1, \tilde{\chi}^+_1\to W\tilde{\chi}^0_1, \tilde{\chi}^0_1\to ee\tilde{\nu}_\mu, e\mu\tilde{\nu}_e$	4 e, μ	-	Yes	20.7	$\tilde{\chi}^{\pm}_1$ 760 GeV	$m(\tilde{\chi}^0_1)$>300 GeV, λ_{121}>0	ATLAS-CONF-2013-036
	$\tilde{\chi}^+_1\tilde{\chi}^-_1, \tilde{\chi}^+_1\to W\tilde{\chi}^0_1, \tilde{\chi}^0_1\to\tau\tau\tilde{\nu}_e, e\tau\tilde{\nu}_\tau$	3 $e, \mu + \tau$	-	Yes	20.7	$\tilde{\chi}^{\pm}_1$ 350 GeV	$m(\tilde{\chi}^0_1)$>80 GeV, λ_{133}>0	ATLAS-CONF-2013-036
	$\tilde{g}\to qqq$	0	6-7 jets	-	20.3	$\tilde{g}$ 916 GeV	BR(t)=BR(b)=BR(c)=0%	ATLAS-CONF-2013-091
	$\tilde{g}\to\tilde{t}_1 t, \tilde{t}_1\to bs$	2 e, μ (SS)	0-3 b	Yes	20.7	$\tilde{g}$ 880 GeV		ATLAS-CONF-2013-007
Other	Scalar gluon pair, sgluon$\to q\bar{q}$	0	4 jets	-	4.6	sgluon 100-287 GeV	incl. limit from 1110.2693	1210.4826
	Scalar gluon pair, sgluon$\to t\bar{t}$	2 e, μ (SS)	2 b	Yes	14.3	sgluon 350-800 GeV		ATLAS-CONF-2013-051
	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

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

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

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

Long-lived particles and RPV Analyses

- This talk will only cover analyses with updated results since Pheno2013 (*)

Long-lived particles	Direct $\tilde{\chi}_1^+\tilde{\chi}_1^-$ prod., long-lived $\tilde{\chi}_1^\pm$	ATLAS-CONF-2013-069	★
	Stable, stopped $\tilde{g}$ R-hadron	ATLAS-CONF-2013-057	★
	GMSB, stable $\tilde{\tau}$, $\tilde{\chi}_1^0 \to \tilde{\tau}(\tilde{e},\tilde{\mu})+\tau(e,\mu)$	ATLAS-CONF-2013-058	★
	GMSB, $\tilde{\chi}_1^0 \to \gamma\tilde{G}$, long-lived $\tilde{\chi}_1^0$	1304.6310	
	$\tilde{q}\tilde{q}$, $\tilde{\chi}_1^0 \to qq\mu$ (RPV)	ATLAS-CONF-2013-092	★
RPV	LFV $pp \to \tilde{\nu}_\tau + X, \tilde{\nu}_\tau \to e + \mu$	1212.1272	
	LFV $pp \to \tilde{\nu}_\tau + X, \tilde{\nu}_\tau \to e(\mu) + \tau$	1212.1272	
	Bilinear RPV CMSSM	ATLAS-CONF-2012-140	
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+ \to W\tilde{\chi}_1^0, \tilde{\chi}_1^0 \to ee\tilde{\nu}_\mu, e\mu\tilde{\nu}_e$	ATLAS-CONF-2013-036	
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+ \to W\tilde{\chi}_1^0, \tilde{\chi}_1^0 \to \tau\tau\tilde{\nu}_e, e\tau\tilde{\nu}_\tau$	ATLAS-CONF-2013-036	
	$\tilde{g} \to qqq$	ATLAS-CONF-2013-091	★
	$\tilde{g} \to \tilde{t}_1 t$, $\tilde{t}_1 \to bs$	ATLAS-CONF-2013-007	

R-Parity Violating Supersymmetry & Long Lived Particles

- R-parity: $R= (-1)^{3(B-L)+2s}$ -> R = +1 for SM particle, R=-1 for superpartners

- Many SUSY models assume R-Parity Conservation (RPC)

  -> Hinted at by proton stability

  -> Lightest Supersymmetric Particle (LSP) is stable -> Good dark matter candidate

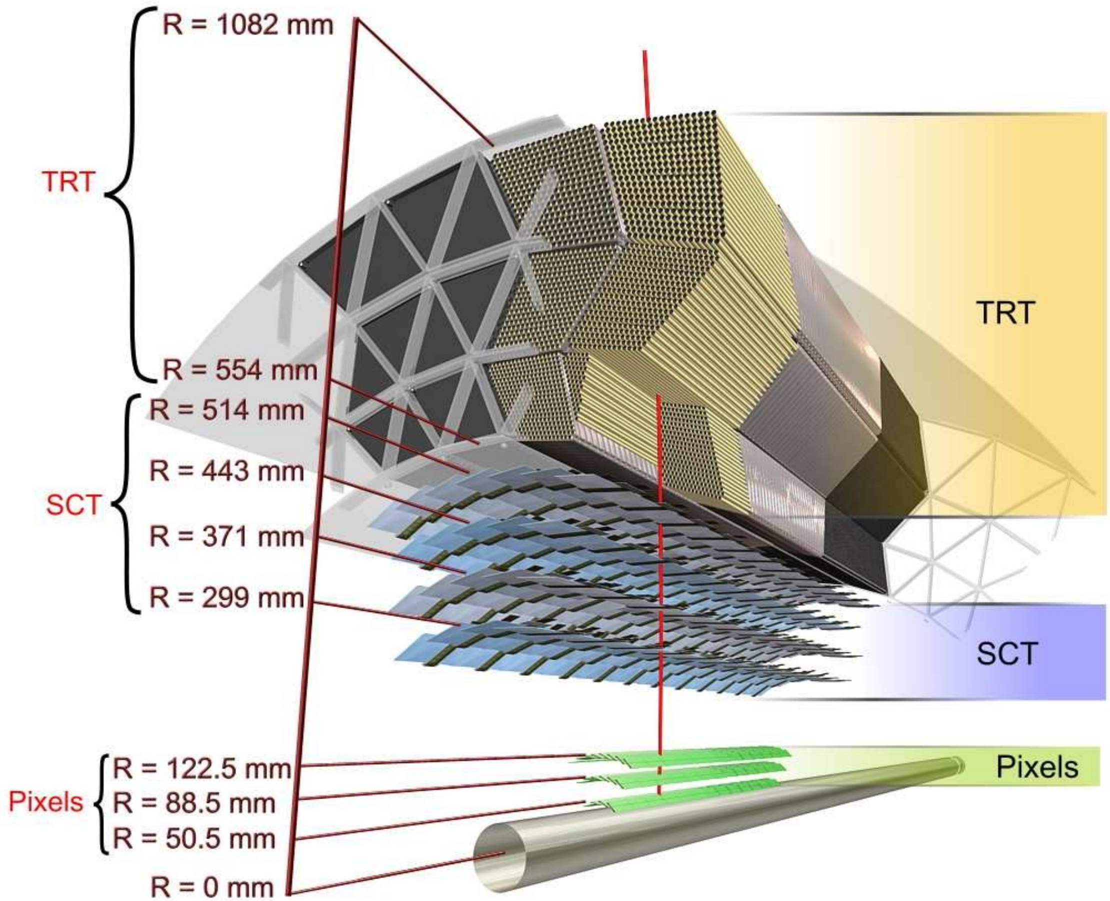
- However, R-Parity Violating (RPV) terms can be added into superpotential:

$$W_{RPV}= \lambda_{ijk}L_iL_jE_k + \lambda'_{ijk}L_iQ_jD_k + \kappa_iL_iH_2 + \lambda''_{ijk}D_iD_jD_k$$

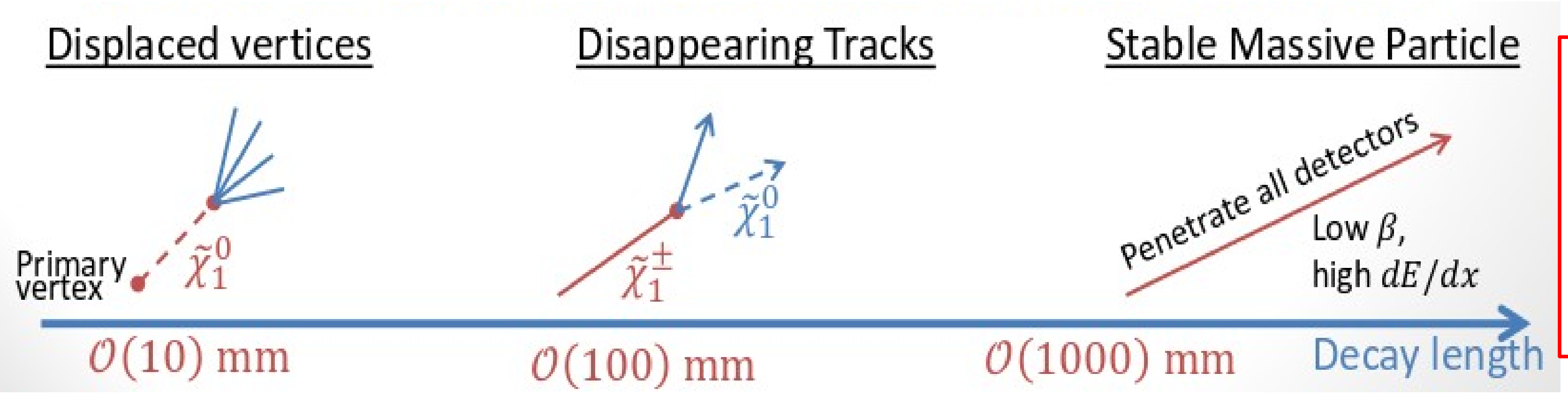
  -> So long as lepton & baryon number violation is not simultaneous

- Long Lived Particles can exist if there are weak couplings (e.g. RPV & GMSB), small mass splittings (e.g. AMSB) or heavy mediator particles (e.g. split-SUSY)

Long Lived Particles in ATLAS



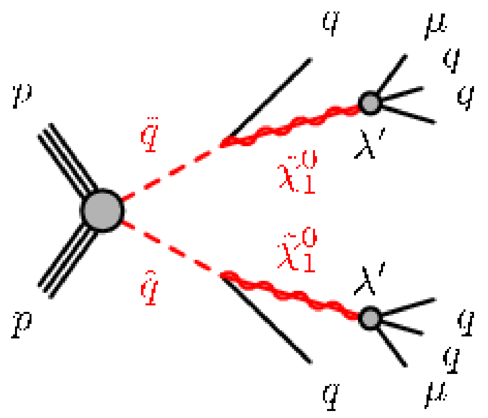
- Lifetime of LLP will determine which part of the detector the decay occurs in
- Different analysis techniques required for different regions



Definitions:

- TRT – Transition Radiation Tracker
- SCT – Semiconductor Tracker

Search for Final States with a Muon and a Multi-Track Displaced Vertex



- In RPV models lightest neutralino can decay to a muon and two SM quarks
- RPV λ' coupling allows neutralino to be long lived

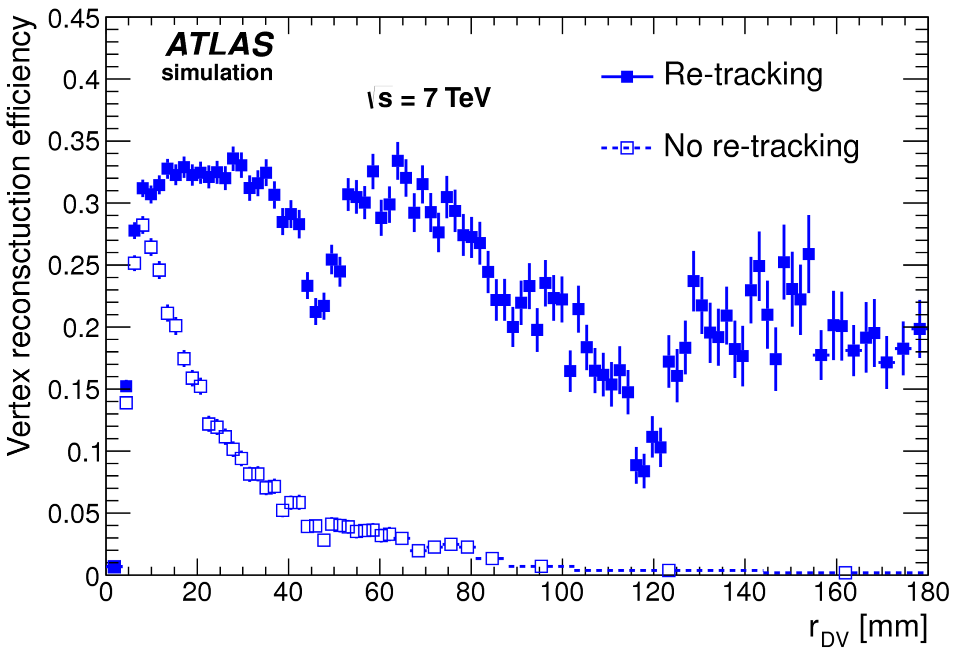
  -> Displaced vertex O(10mm) from primary vertex
- High energy muon used for triggering
- Background rejection makes use of high track multiplicity
- Also require displaced vertex to be in region with no material

  -> expect 0.02 +/- 0.02 background events

- Standard ATLAS tracking assumes tracks come from primary vertex

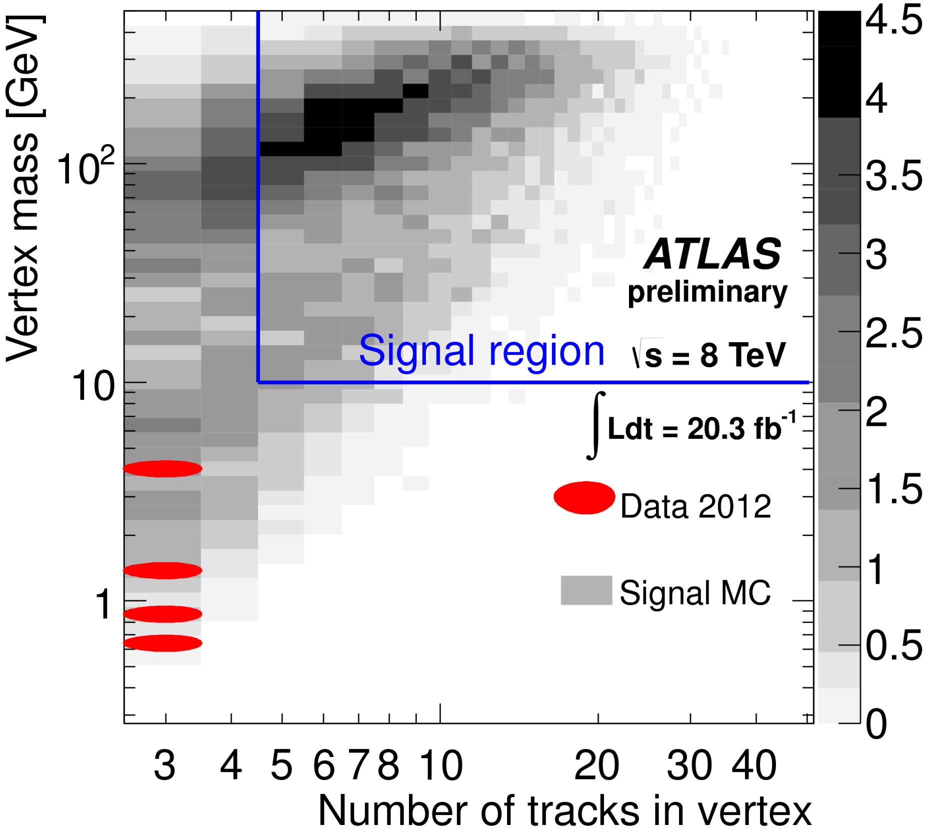
  -> Many tracks from displaced vertex missed

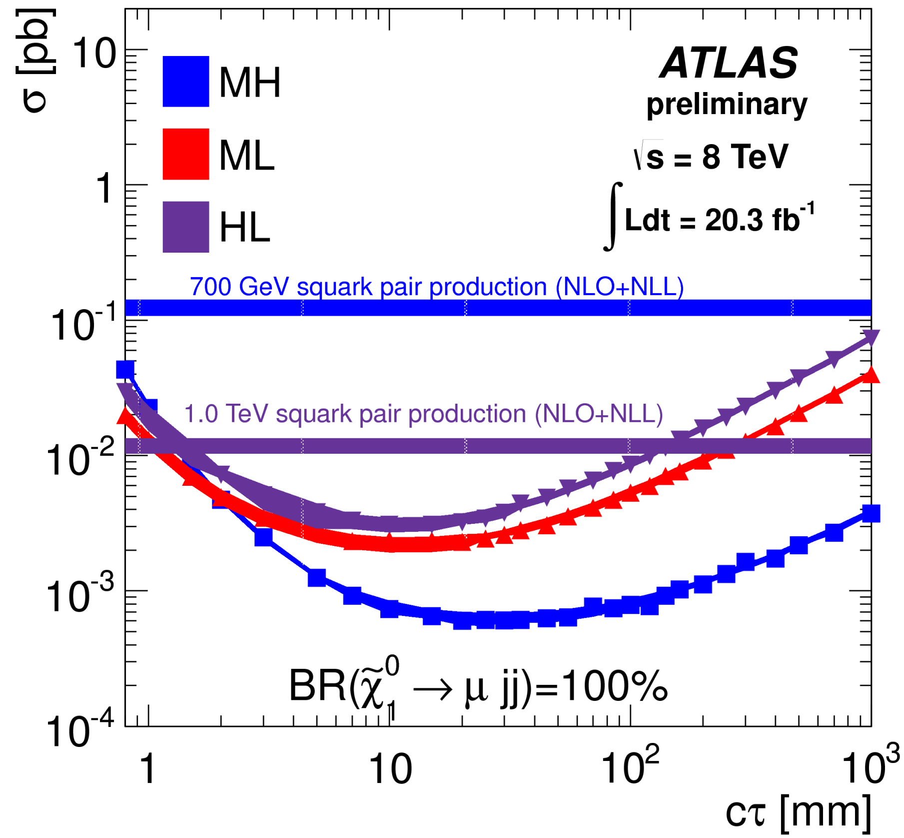
- Rerun tracking algorithms with looser requirements to increase identification efficiency



ATLAS-CONF-2013-092

Search for Final States with a Muon and a Multi-Track Displaced Vertex





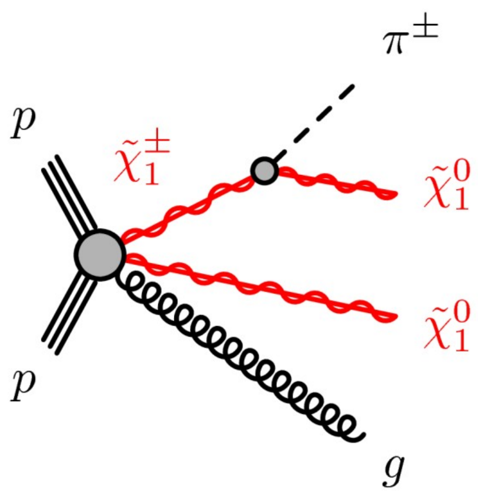
No events observed in signal region

Interpret results using three different combinations of squark and neutralino mass as a function of lifetime

Sample	M_q	m_X
MH	700	494
ML	700	108
HL	1000	108

ATLAS-CONF-2013-092

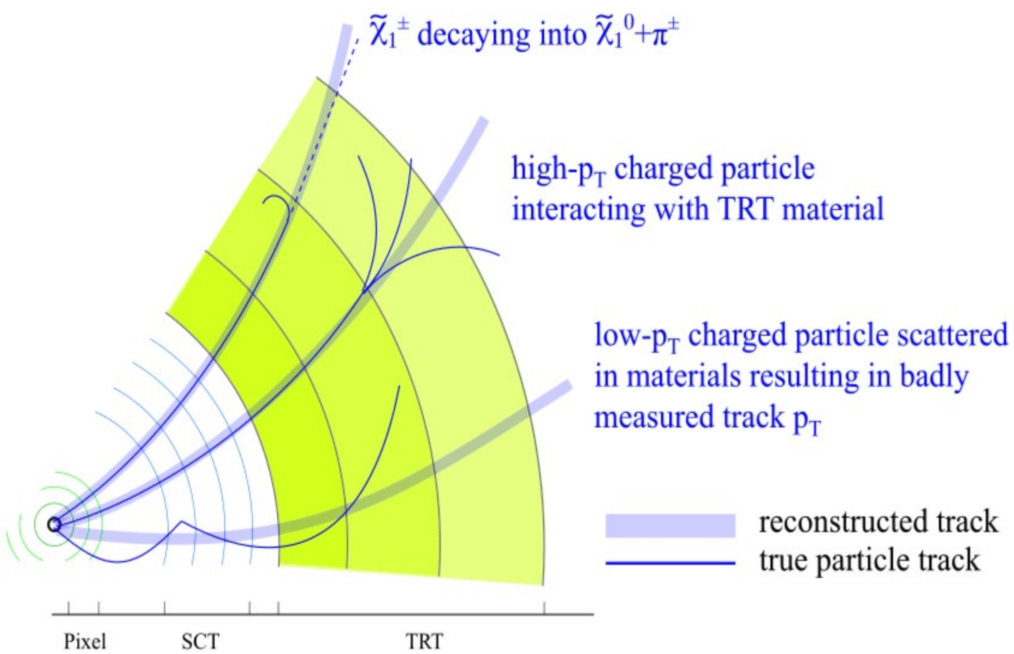
Search for Direct Chargino Production in Events with Disappearing Tracks



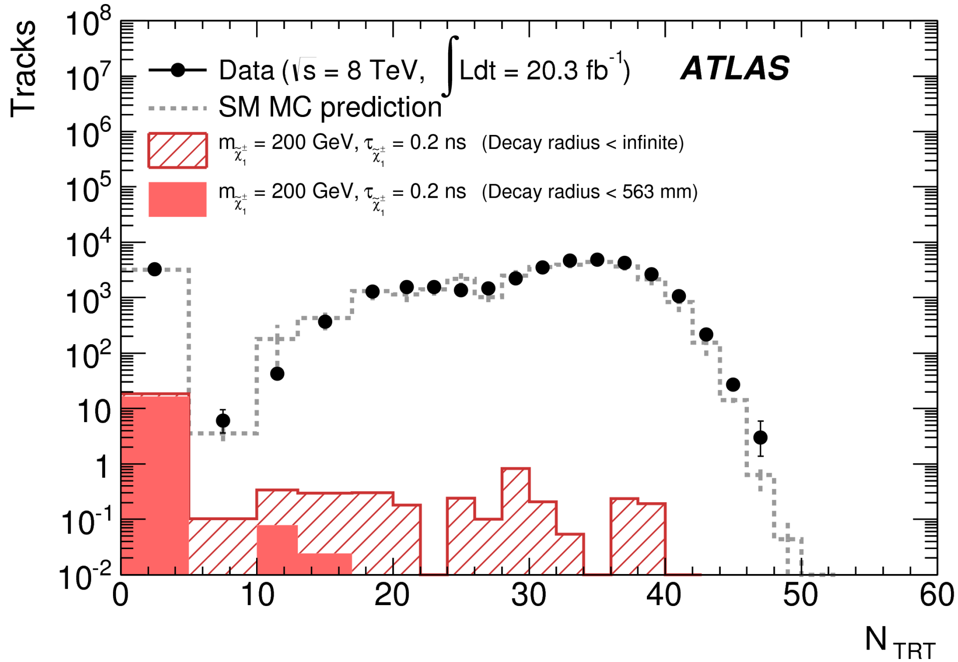
- In AMSB if lightest gauginos are approximately mass-degenerate $\chi^{\pm}_1$ can be long lived

- Lifetime O(0.1ns) -> Decay late in tracker

  -> Few hits in outer layer of tracker

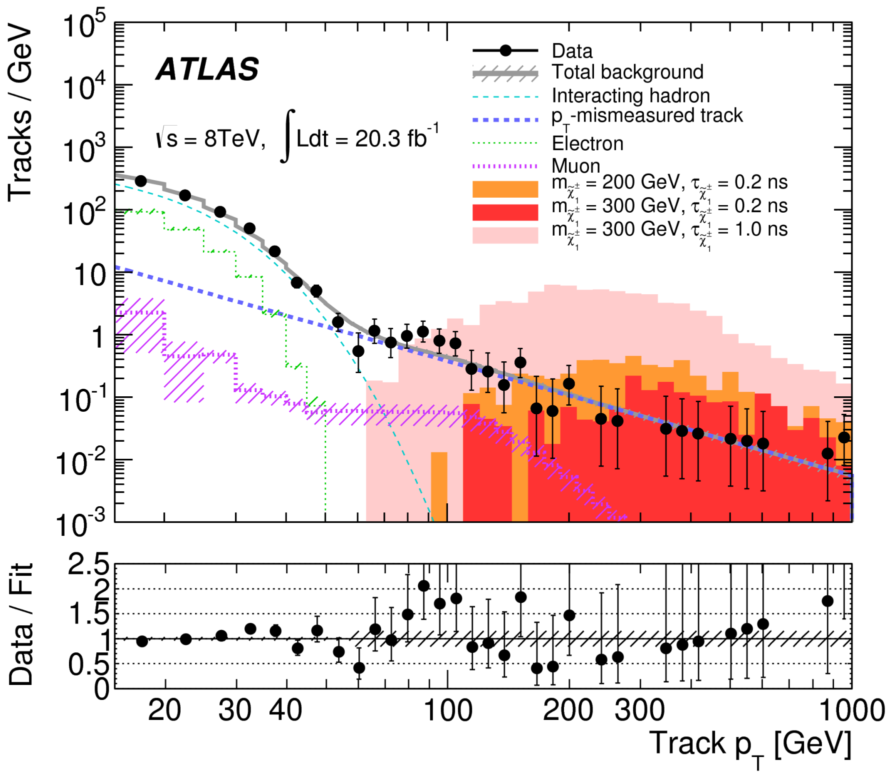


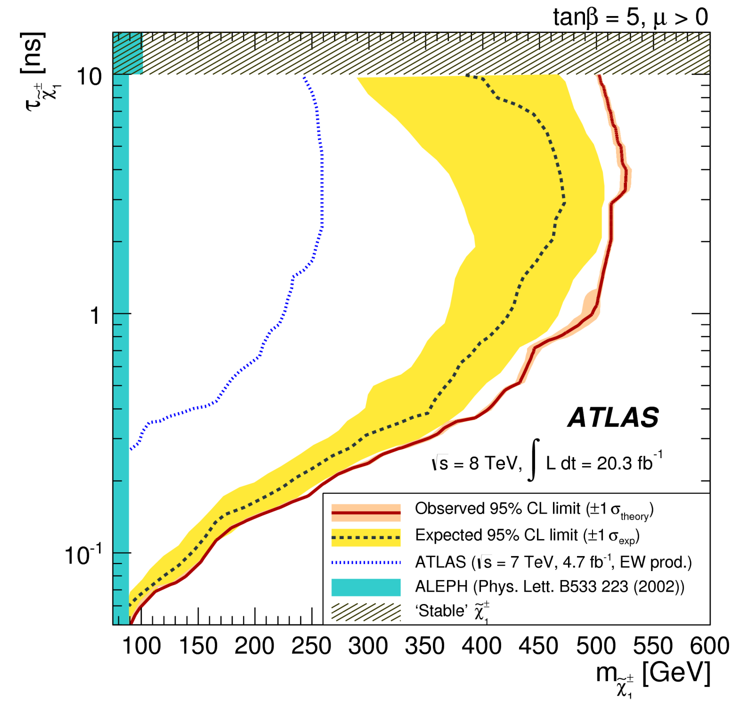
- Trigger on high p_T ISR jet

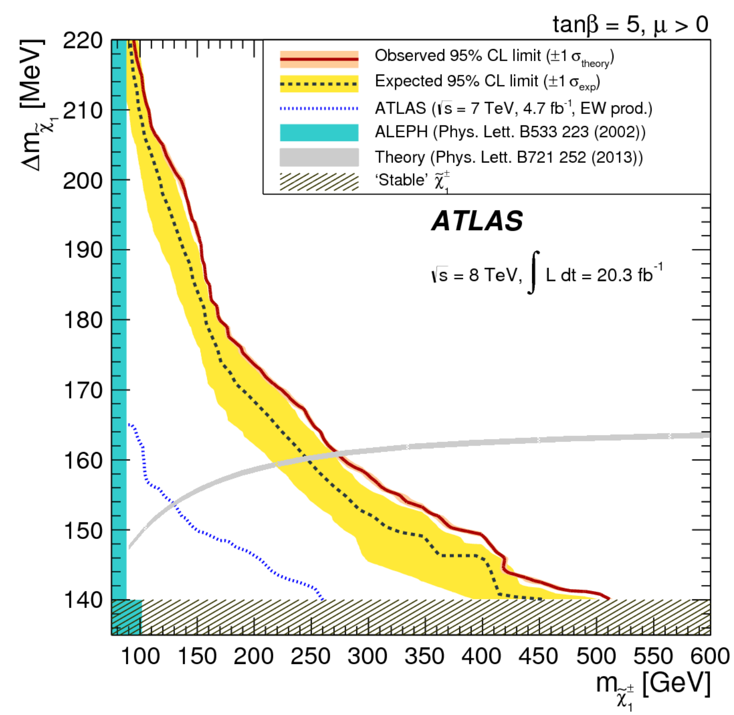


Phys. Rev. D 88, 112006 (2013)

Search for Direct Chargino Production in Events with Disappearing Tracks







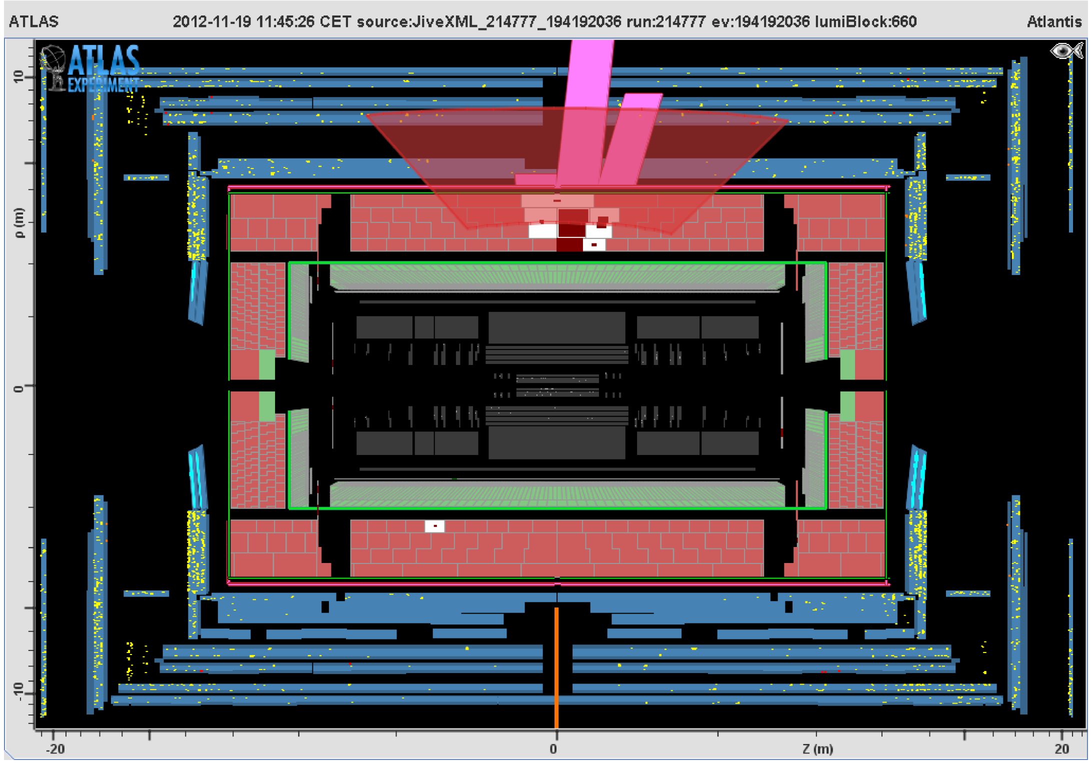
- Determine background from fit to the candidate track p_T spectra

No excess over background observed

exclusion limits set in AMSB model parameter space

Phys. Rev. D 88, 112006 (2013)

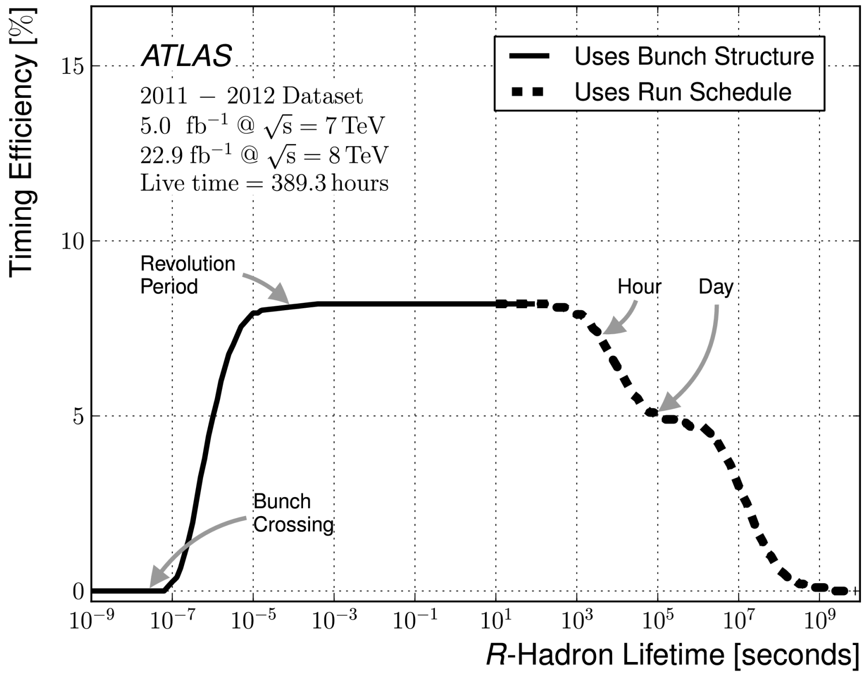
Search for Long-Lived Heavy Rhadrons



Rhadrons are composites of a gluino or squark with SM partons

- May only deposit small amounts of energy in calorimeters
- Can undergo interactions with detector material
- Rhadron can be stopped by calorimeter

-> decay can be very delayed and still be detected



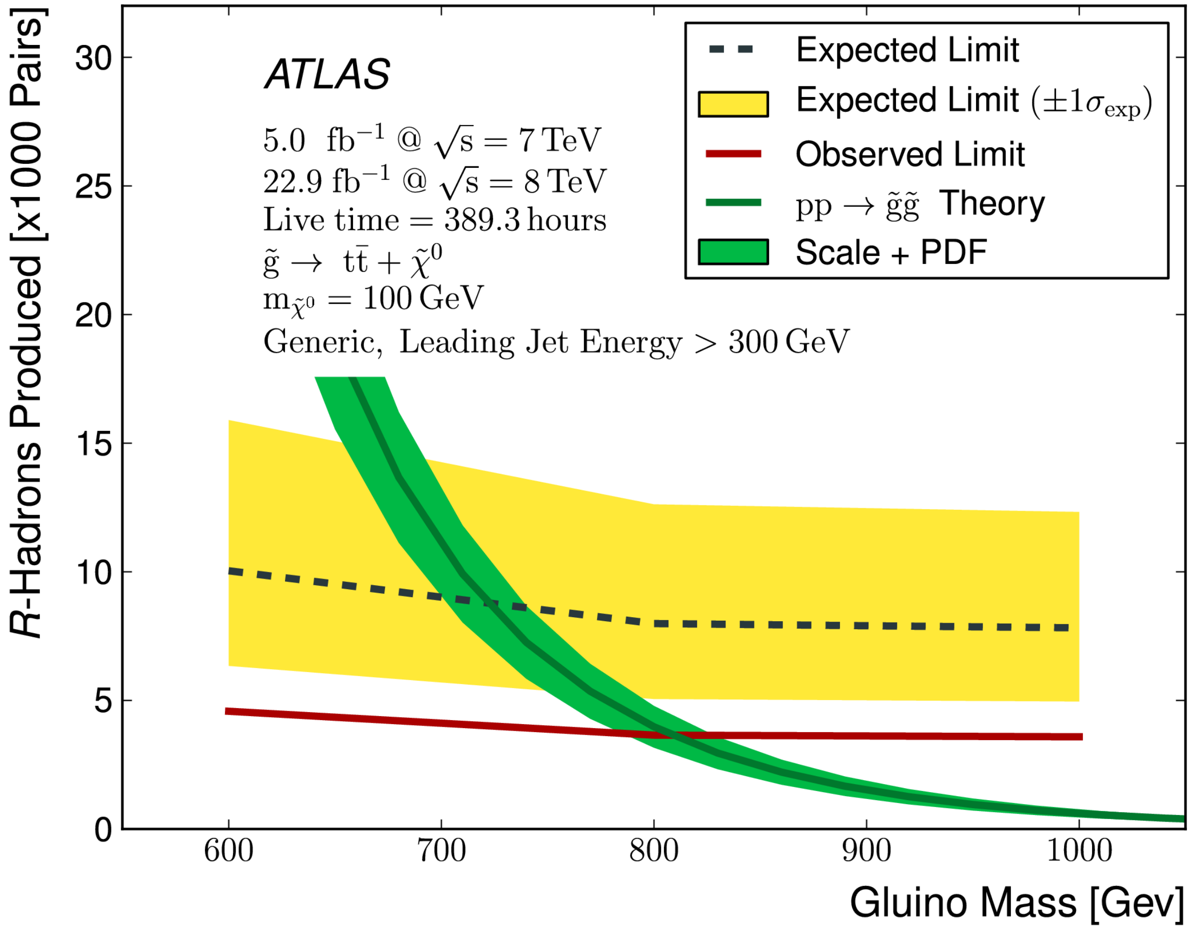
- Search for jets in empty bunch crossings
- Backgrounds from cosmic muons and beam halo muons (reject events with reconstructed muon segments)
- Analysis sensitive to Rhadrons with lifetimes between 10^{-6} – 10^{7} seconds
- Uses 2011 (7TeV) & 2012 (8TeV) data

Phys. Rev. D 88, 112003 (2013)

Search for Long-Lived Heavy Rhadrons

Leading jet energy (GeV)	Muon veto	Events	Cosmic region Beam-halo bkgd.	Scaling	Number of events in search region Cosmic	Beam-halo	Total background	Observed
50	No	1640	82 ± 40	3.1	4820 ± 570	900 ± 130	5720 ± 590	5396
50	Yes	2	1.1 ± 0.6	2.4	2.1 ± 3.6	12 ± 3	14.2 ± 4.0	10
100	Yes	1	0.8 ± 0.5	2.4	0.4 ± 2.7	6 ± 2	6.4 ± 2.9	5
300	Yes	1	$0.000^{+0.01}_{-0}$	2.4	2.4 ± 2.4	0.5 ± 0.4	2.9 ± 2.4	0

No excess over background observed



Phys. Rev. D 88, 112003 (2013)

Search for Long-Lived Sleptons

- In some models , eg GMSB, sleptons can be long lived

- Behave like heavy muons -> low β

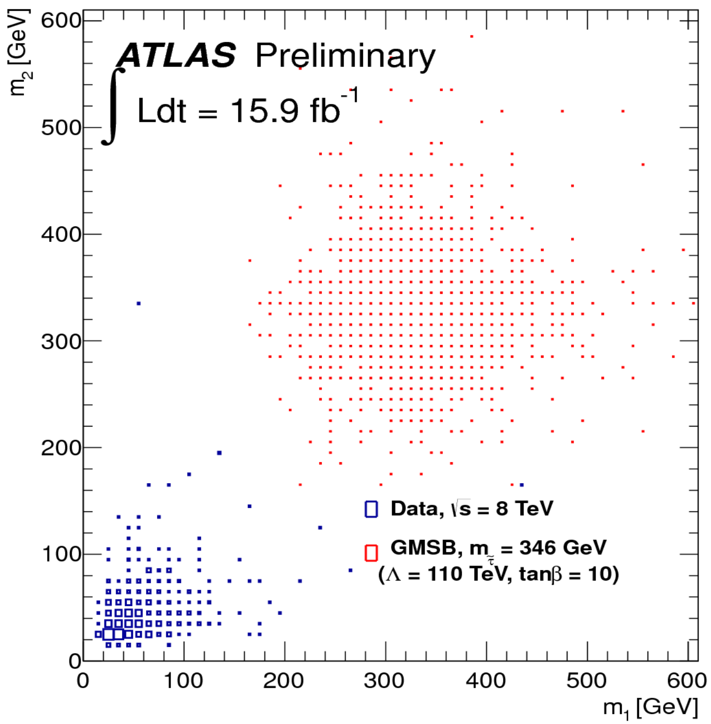
- Combine time of flight (calorimeter & muon detectors) and energy loss (pixel detector) information to calculate

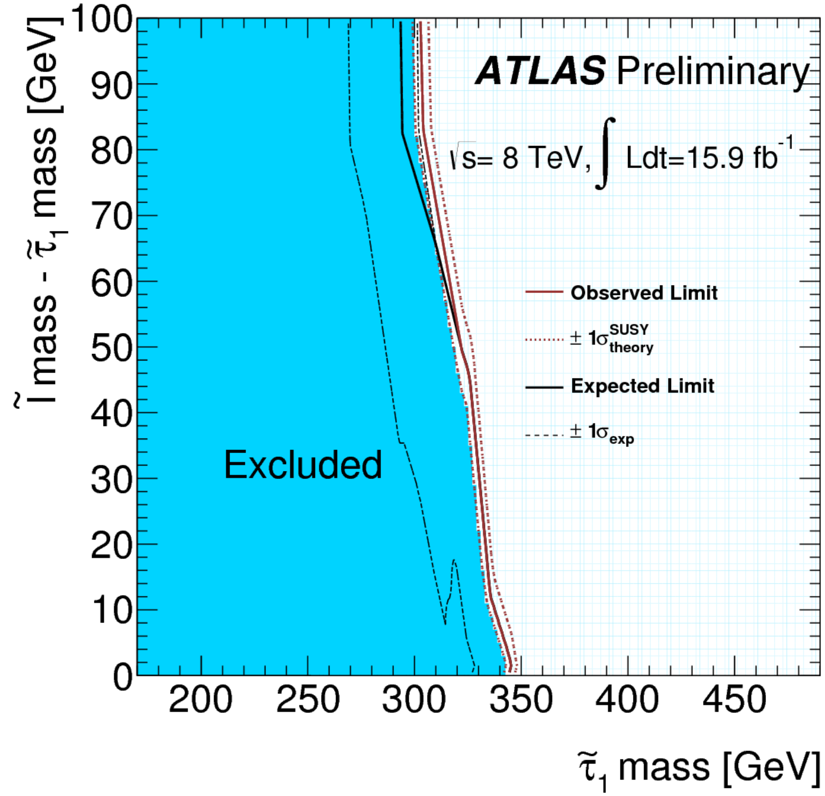
$$m_\beta = p/\gamma\beta$$

- Look for pairs of LLP with large m_β

No events observed in signal region

Interpret results using GMSB with light stau as LLP



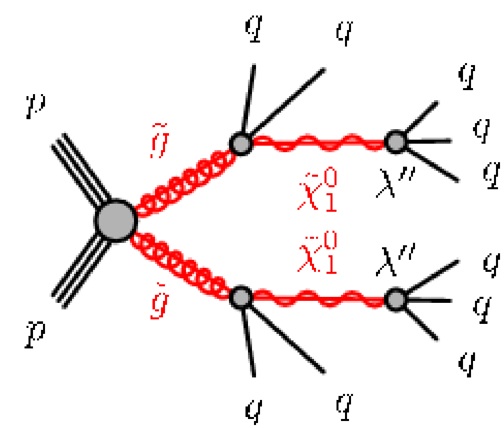


ATLAS-CONF-2013-058

Search for Massive Particles Decaying into Multiple Quarks

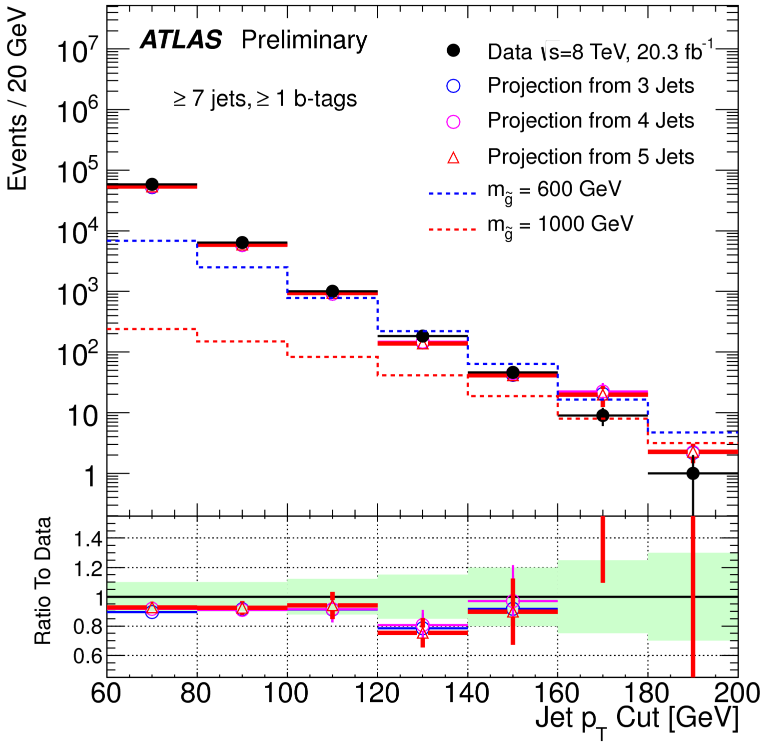
- If R-Parity can be violated decay of gluinos and neutralinos leads to final states of many quarks
- Look for events with at least 6 jets
- Perform counting experiment
- Background extrapolated from low jet multiplicity regions using MC transfer factors

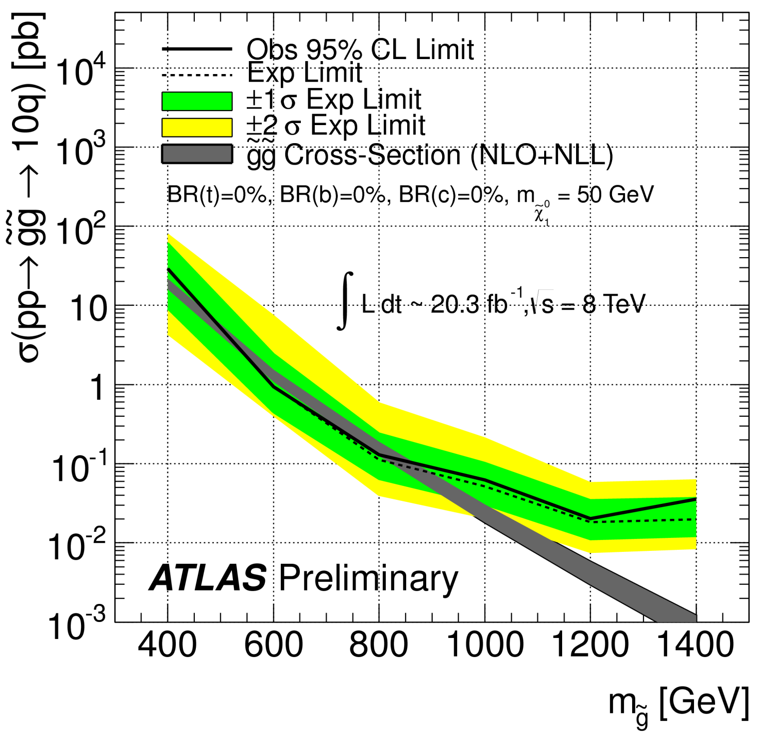
10 quark final state!



No significant deviation from SM prediction observed

Interpret results for different neutralino masses, branching ratios to SM quarks & number of quarks in final state





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Conclusion

- Models containing Resonances, RPV & long-lived particles have unique and interesting signatures
- Challenging non-standard analysis techniques are required to investigate these models
- The excellent design & performance of the ATLAS detector makes these searches possible
- No experimental evidence for BSM theories observed yet
- Many analyses now make use of the full 8TeV dataset
- Looking forward to the increased discovery reach at 13TeV in run-2!

Backup Slides

Search for Heavy Long-Lived Rhadrons – Exclusion Limits

Leading jet energy (GeV)	R-hadron model	Gluino/squark decay	Neutralino mass (GeV)	Gluino/squark mass limit (GeV) Expected	Observed
100	Generic	$\tilde{g} \rightarrow g/q\bar{q} + \tilde{\chi}^0$	$m_{\tilde{g}} - 100$	526	545
100	Generic	$\tilde{g} \rightarrow t\bar{t} + \tilde{\chi}^0$	$m_{\tilde{g}} - 380$	694	705
300	Generic	$\tilde{g} \rightarrow g/q\bar{q} + \tilde{\chi}^0$	100	731	832
300	Generic	$\tilde{g} \rightarrow t\bar{t} + \tilde{\chi}^0$	100	700	784
300	Intermediate	$\tilde{g} \rightarrow g/q\bar{q} + \tilde{\chi}^0$	100	615	699
300	Regge	$\tilde{g} \rightarrow g/q\bar{q} + \tilde{\chi}^0$	100	664	758
100	Generic	$\tilde{t} \rightarrow t + \tilde{\chi}^0$	$m_{\tilde{t}} - 200$	389	397
100	Generic	$\tilde{t} \rightarrow t + \tilde{\chi}^0$	100	384	392
100	Regge	$\tilde{t} \rightarrow t + \tilde{\chi}^0$	100	371	379
100	Regge	$\tilde{b} \rightarrow b + \tilde{\chi}^0$	100	334	344

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Search for Massive Particles Decaying into Multiple Quarks

10 quark final state results table

Sample	Jet p_T cut [GeV]	# jets	# b-tags	Signal	Background	Data
$(m_{\tilde{g}}, m_{\tilde{\chi}_1^0})$ = (400 GeV, 50 GeV)	100	7	0	1400±800	2460±350	2477
$(m_{\tilde{g}}, m_{\tilde{\chi}_1^0})$ = (400 GeV, 300 GeV)	80	7	0	9000±4000	17200±2100	15885
$(m_{\tilde{g}}, m_{\tilde{\chi}_1^0})$ = (600 GeV, 50 GeV)	100	7	1	510±140	940±140	936
$(m_{\tilde{g}}, m_{\tilde{\chi}_1^0})$ = (600 GeV, 300 GeV)	100	7	0	1700±900	2460±350	2477
$(m_{\tilde{g}}, m_{\tilde{\chi}_1^0})$ = (800 GeV, 50 GeV)	120	7	1	107±31	138±26	178
$(m_{\tilde{g}}, m_{\tilde{\chi}_1^0})$ = (800 GeV, 300 GeV)	120	7	0	380±90	370±60	444
$(m_{\tilde{g}}, m_{\tilde{\chi}_1^0})$ = (1000 GeV, 50 GeV)	180	6	0	40±6	170±40	187
$(m_{\tilde{g}}, m_{\tilde{\chi}_1^0})$ = (1000 GeV, 300 GeV)	140	7	0	50±13	105±25	107
$(m_{\tilde{g}}, m_{\tilde{\chi}_1^0})$ = (1000 GeV, 600 GeV)	180	7	0	10±5	6.1±2.2	4
$(m_{\tilde{g}}, m_{\tilde{\chi}_1^0})$ = (1200 GeV, 50 GeV)	180	7	0	1.9±1.0	6.1±2.2	4
$(m_{\tilde{g}}, m_{\tilde{\chi}_1^0})$ = (1200 GeV, 300 GeV)	180	7	0	3.2±1.4	6.1±2.2	4
$(m_{\tilde{g}}, m_{\tilde{\chi}_1^0})$ = (1200 GeV, 600 GeV)	140	7	0	28±4	105±25	107

No Significant excess over Background observed