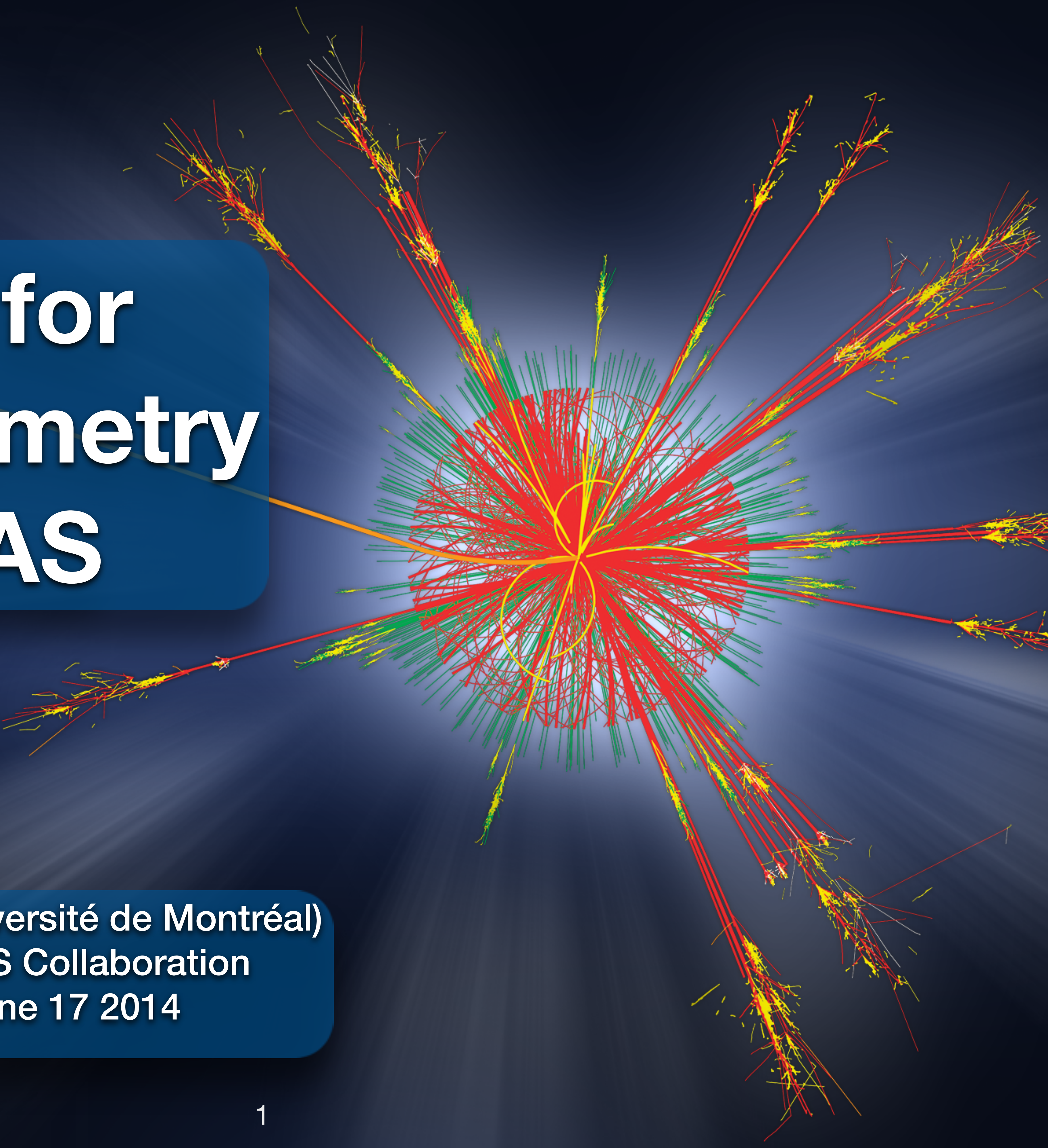
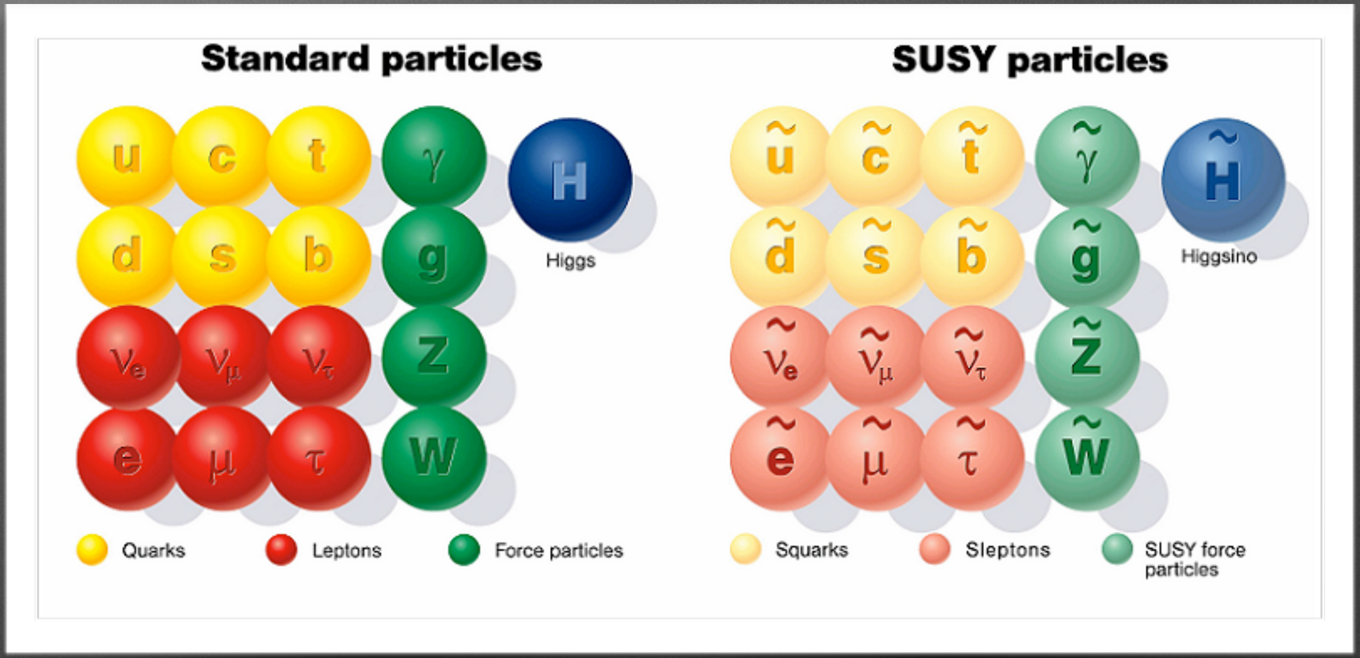
Search for Supersymmetry at ATLAS



Jean-François Arguin (Université de Montréal)
On behalf of the ATLAS Collaboration
CAP Congress, June 17 2014

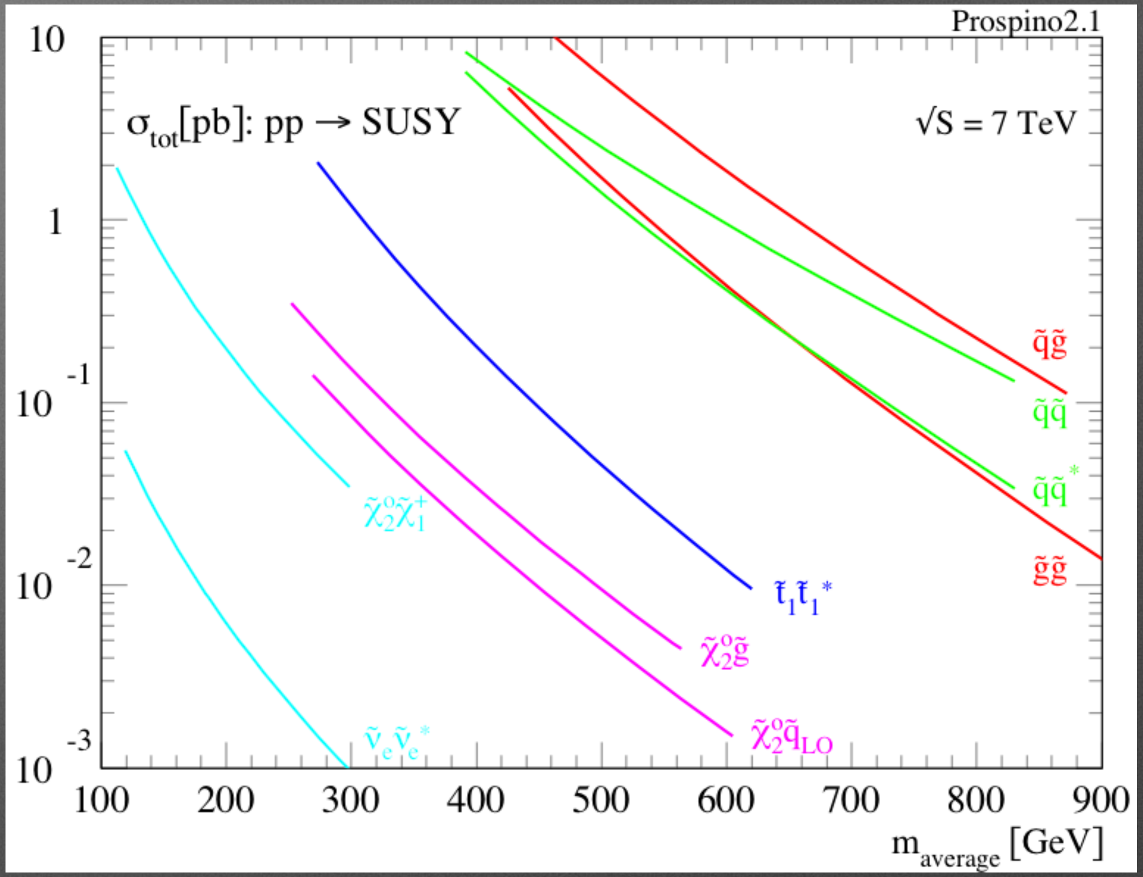
Why SUSY

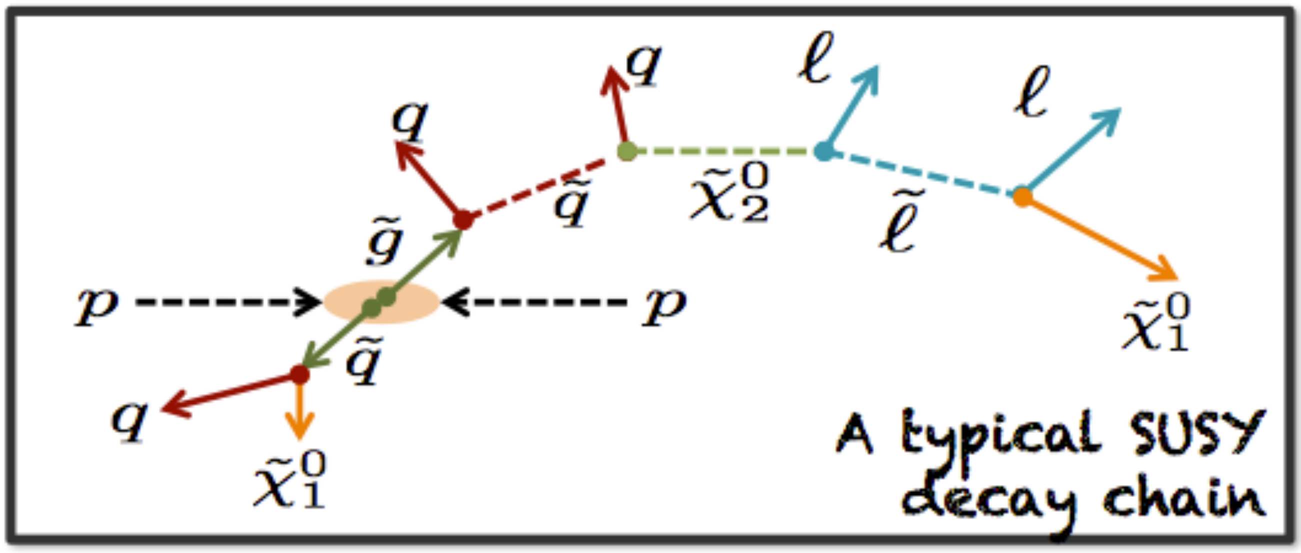
- Supersymmetry: often considered the favorite SM extension
  - Provides good dark matter candidate
  - Coupling constant unification
  - **Solution to fine-tuning problem of the Higgs → need SUSY at O(TeV) scale**
- SUSY pheno considerations
  - SUSY must be broken!
  - R-parity generally assumed to be conserved
    - Stable lightest SUSY particle (LSP) → E_T^{miss}
    - SUSY particles are pair-produced



General LHC SUSY Pheno

- Strongly produced squarks and gluinos dominate
  - But weakly-produced SUSY also very important (see later)
- R-parity conservation implies (long) decay chains containing high-p_T:
  - Jets (sometimes b-jets)
  - Missing E_T (due to LSP)
  - Possibly leptons

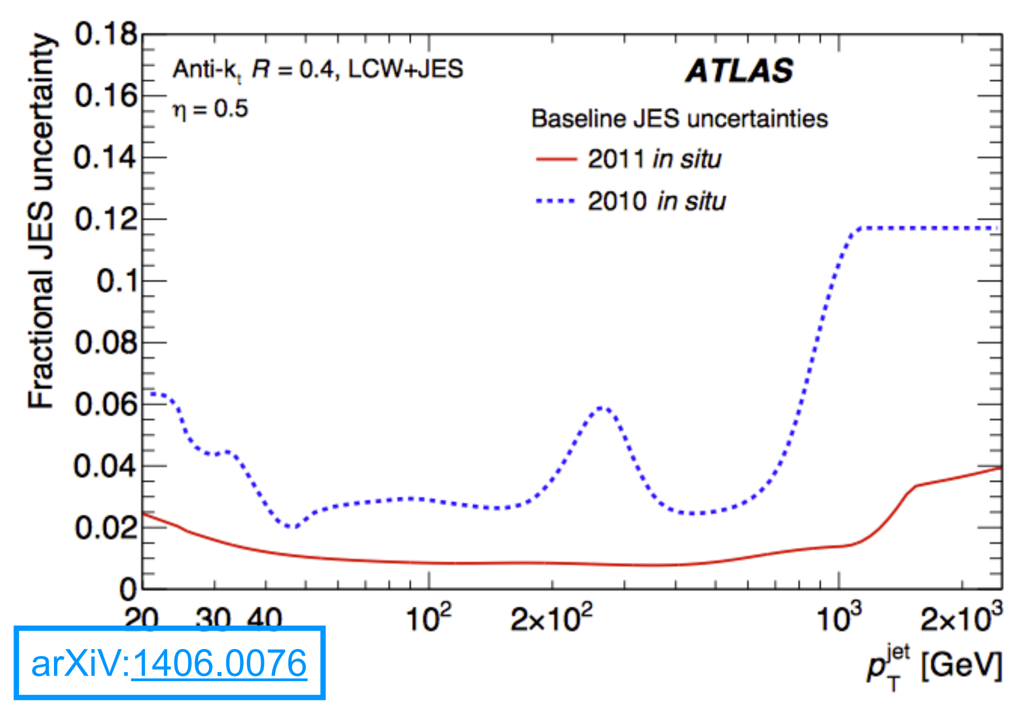




Courtesy of Anna Sfyria

SUSY searches use the full ATLAS detector

- Require well-understood detector:
  - Energy scale and resolution, trigger and reconstruction efficiencies for…
  - Electron, muon, tau, photon, jet, b-jet, missing E_T, …
  - Over a very large energy spectrum (highest to lowest p_T → compressed spectra)
- SUSY search sensitivity can be limited by systematic uncertainties!



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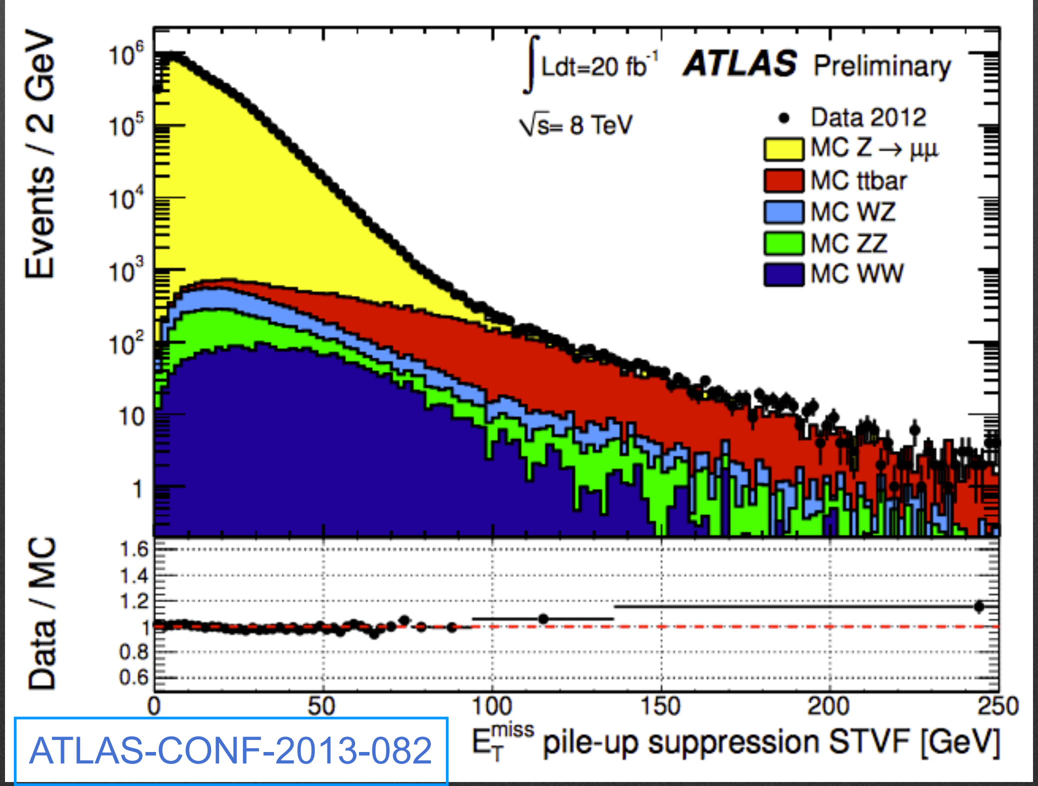
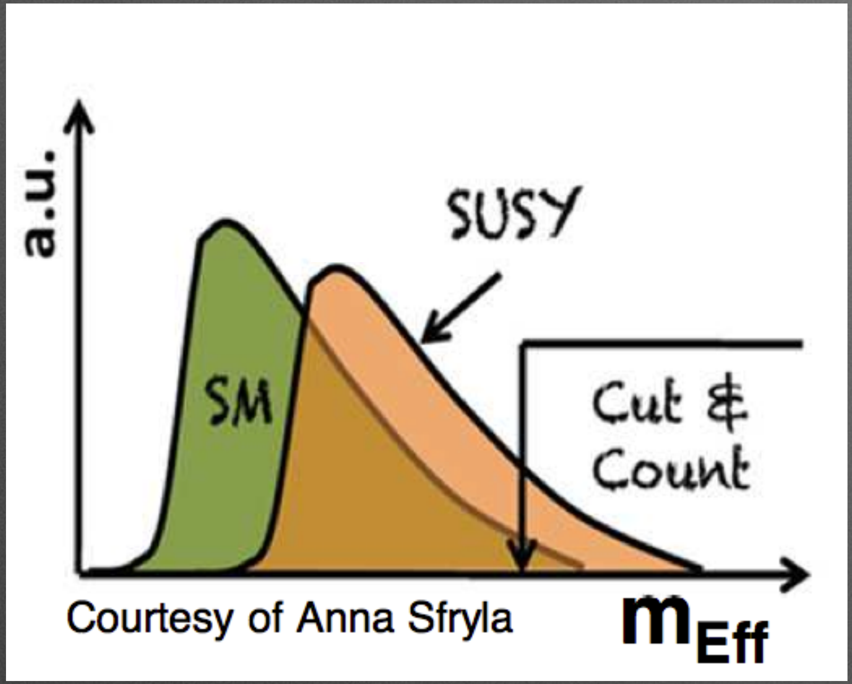


ATLAS-CONF-2013-082

Analysis strategy



Courtesy of Anna Sfryla

SUSY will generally be harder than SM in relevant kinematic variables

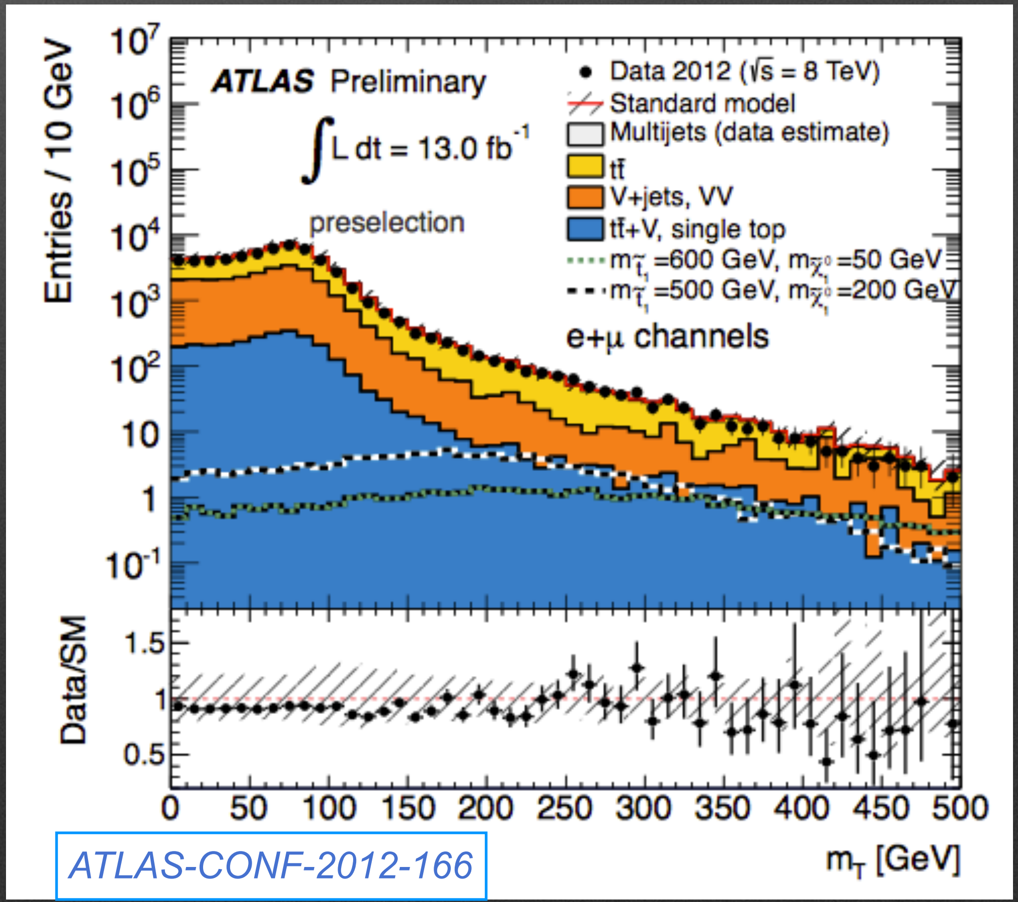
- m_{eff}, E_T^{miss}, transverse mass, etc

Effective mass:

$$m_{\rm eff} = E_{\rm T}^{\rm miss} + \sum p_{\rm T}^{\ell} + \sum p_{\rm T}^{\rm jet}$$

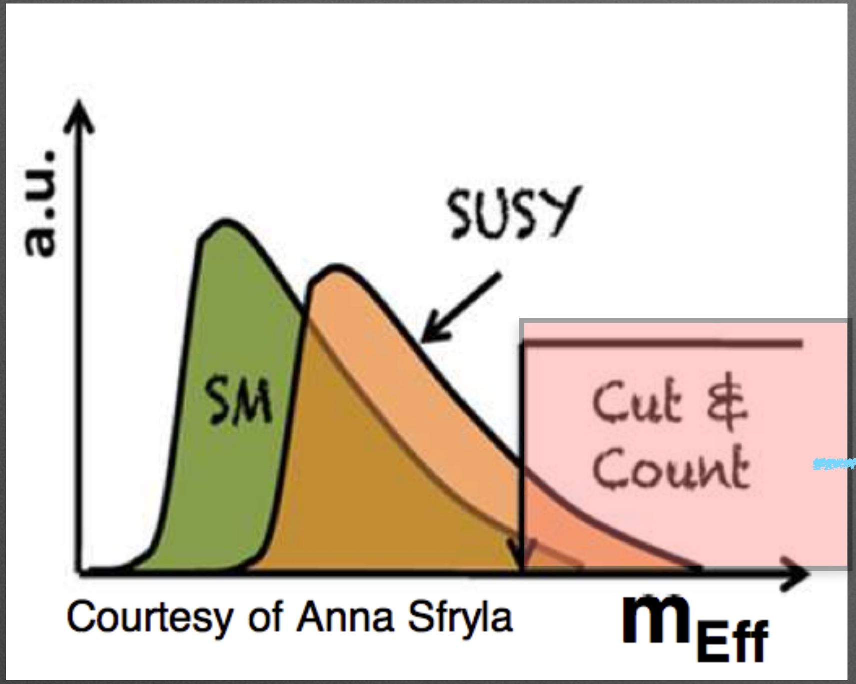
Transverse mass:

$$m_{\rm T} = \sqrt{2 p_{\rm T} E_{\rm T}^{\rm miss}(1 - \cos\Delta\phi(\ell, E_{\rm T}^{\rm miss}))},$$



ATLAS-CONF-2012-166

Analysis strategy

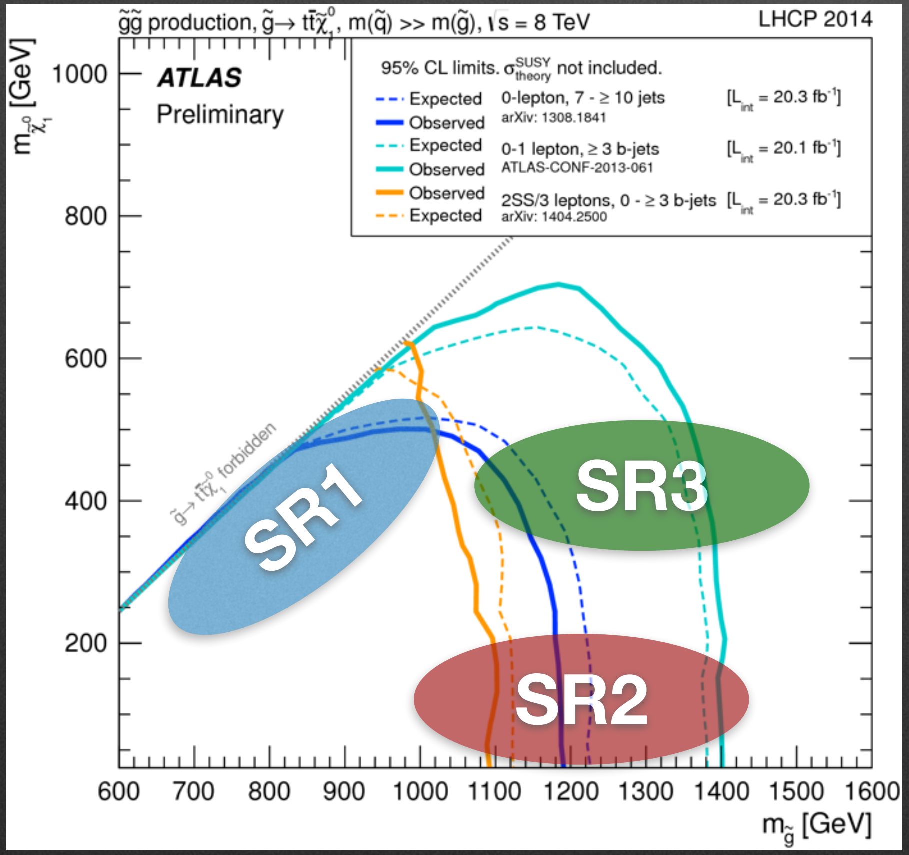


Courtesy of Anna Sfryla

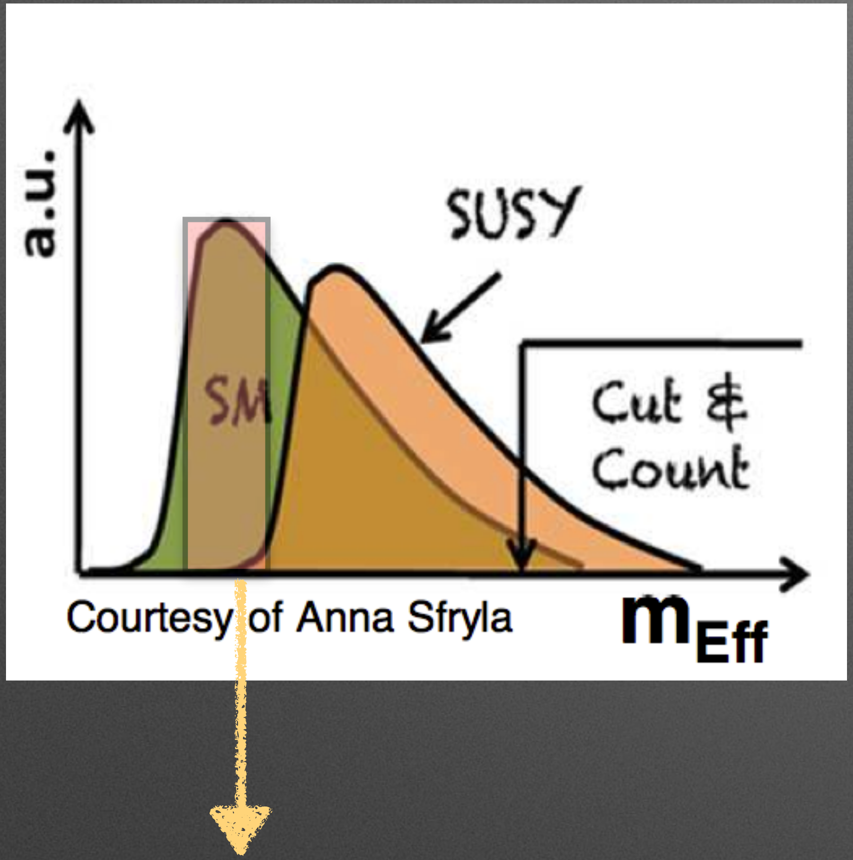
SUSY will generally be harder than SM in relevant kinematic variables

- m_{eff}, E_T^{miss}, transverse mass, etc

Signal regions: optimize several signal regions to cover as much SUSY phase space as possible



Analysis strategy



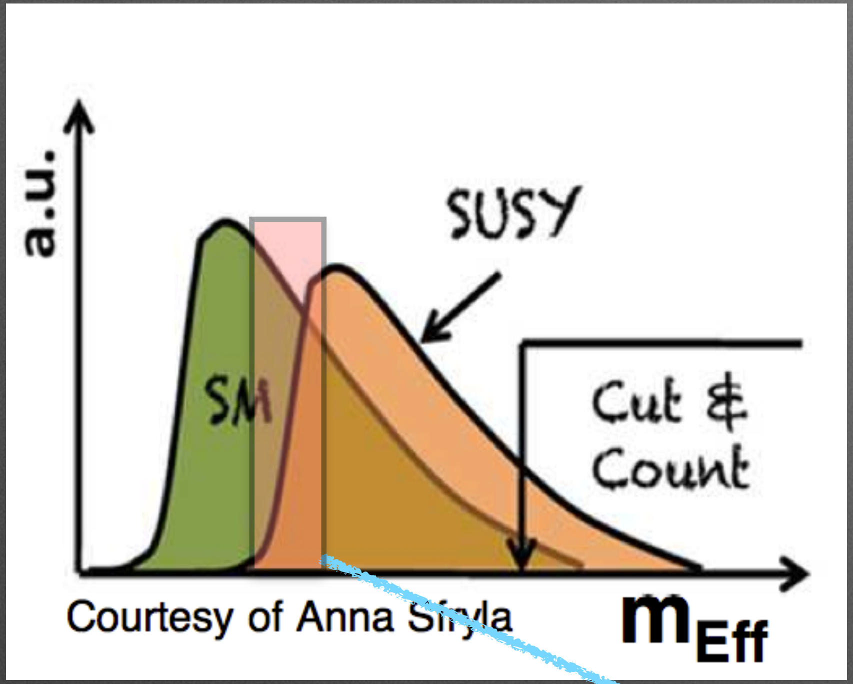
SUSY will generally be harder than SM in relevant kinematic variables

- m_{eff}, E_T^{miss}, transverse mass, etc

Signal regions: optimize several signal regions to cover as much SUSY phase space as possible

Control regions: design background-rich regions, as close as possible to the SR, where the dominant background can be normalized

Analysis strategy



Courtesy of Anna Sfyla

SUSY will generally be harder than SM in relevant kinematic variables

- m_{eff}, E_T^{miss}, transverse mass, etc

Signal regions (SR): optimize several signal regions to cover as much SUSY phase space as possible

Control regions (CR): design background-rich regions, as close as possible to the SR, where the dominant background can be normalized (next slide)

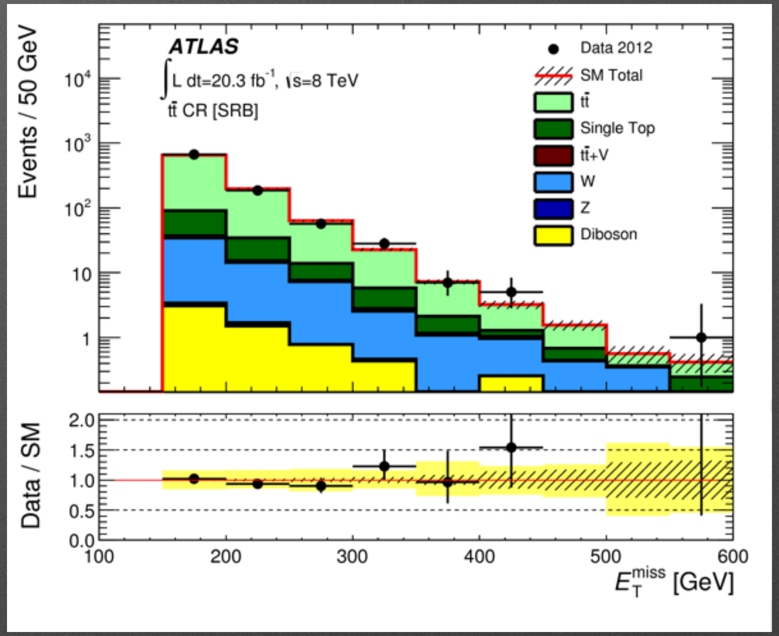
Validation regions (VR): regions closer to SR, but still background-enriched, to cross-check the background estimates

Background estimates

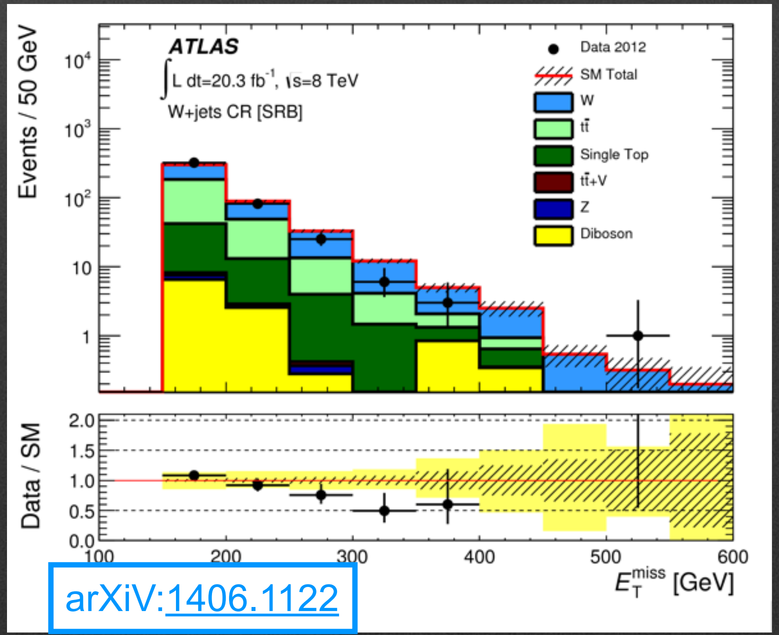
Example: 0-lepton stop search (ttbar + E_T^{miss} signature)

- Control regions are defined for the dominant backgrounds
    - Typically: ttbar, W/Z+jets, diboson
    - Background normalization in the SR adjusted to the one of the CR
- Smaller backgrounds normalized using theory predictions
    - ttbar + W/Z/H, triboson, etc
- QCD multijets and fake lepton background estimate with data-driven techniques

ttbar CR:
≥ 1 b-jet

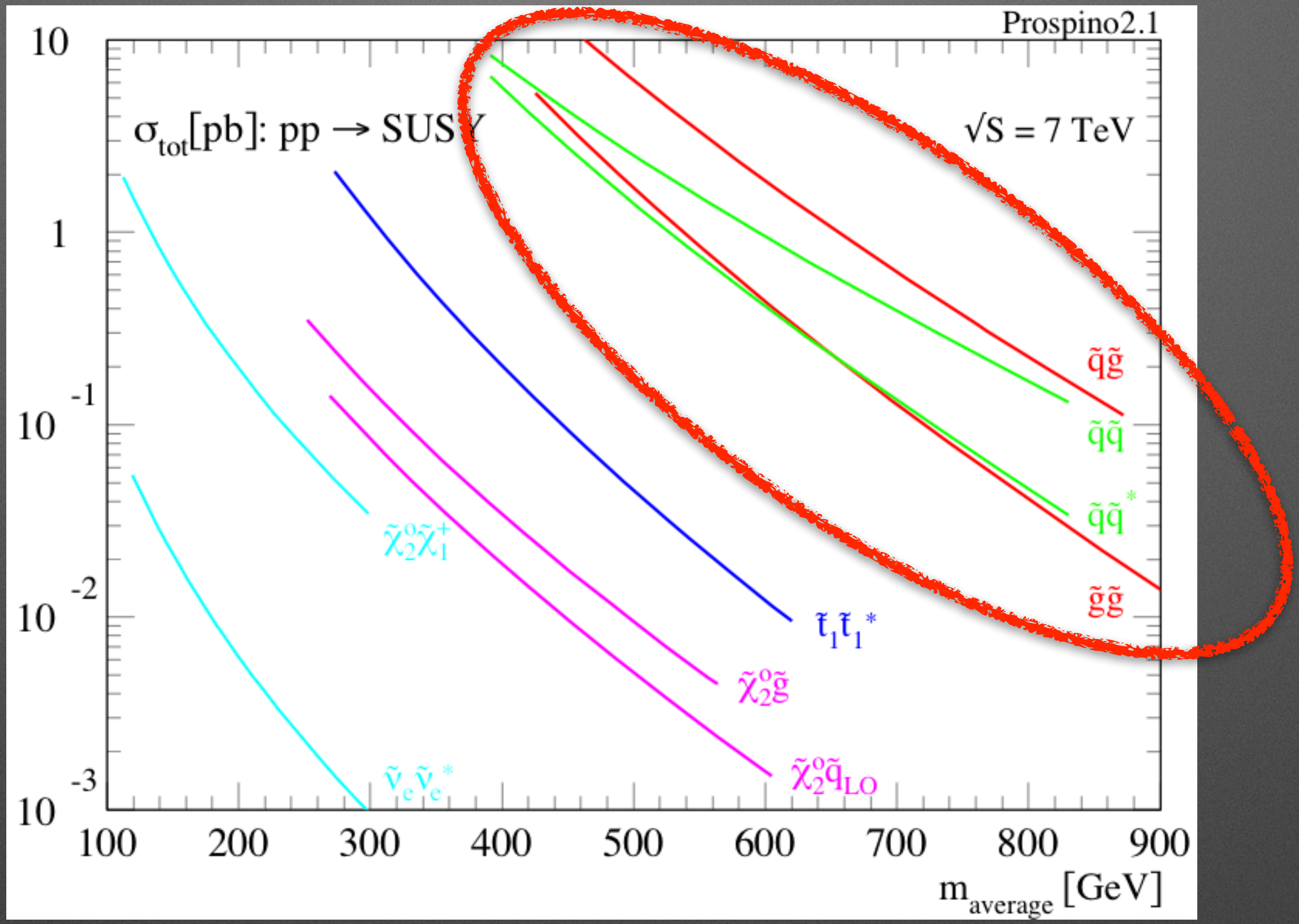


W+jets CR:
0 b-jet



arXiv:1406.1122

Approach 1: look for the most "obvious" signals



All results presented are with the full 2012 dataset ($\sqrt{s}$ = 8 TeV, $\int L\,dt$ = 20 fb^{-1})

Search with jets + E_T^{miss} search (no leptons)

arXiV:1406.1122

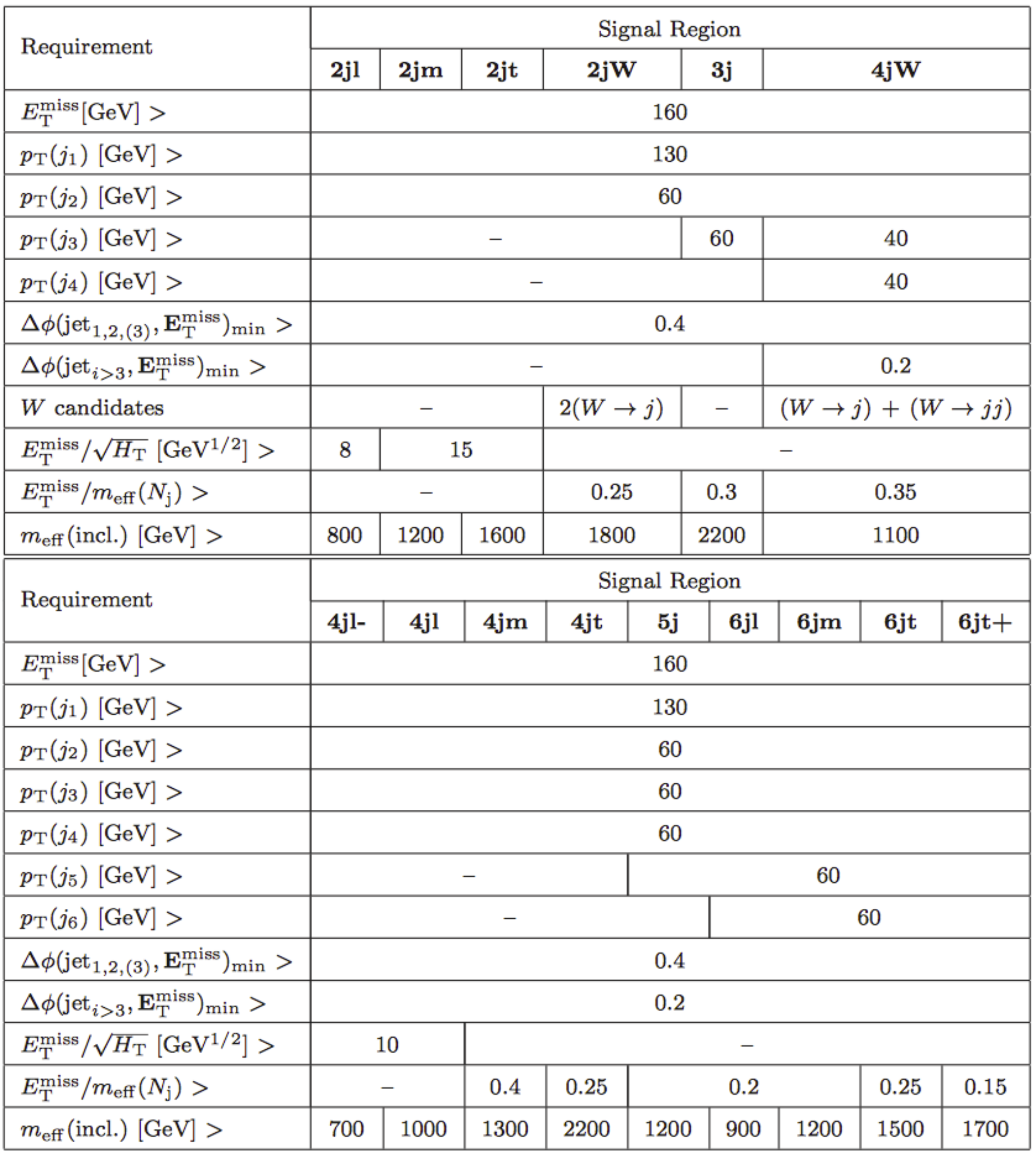
- Target signal: $(\tilde{g}\tilde{g},\ \tilde{q}\tilde{q},\ \tilde{q}\tilde{g})$
- with decays:

  $\tilde{q} \rightarrow q\tilde{\chi}_1^0$ $\tilde{g} \rightarrow q\bar{q}\tilde{\chi}_1^0$

  - or

  $\tilde{q} \rightarrow q\tilde{\chi}^{\pm}$ $\tilde{g} \rightarrow q\bar{q}\tilde{\chi}^{\pm}$

  - And subsequently: $W^{\pm}\tilde{\chi}_1^0$
- Define 15 signal regions with varying jet multiplicity (2-6 jets) and m_{eff} cuts

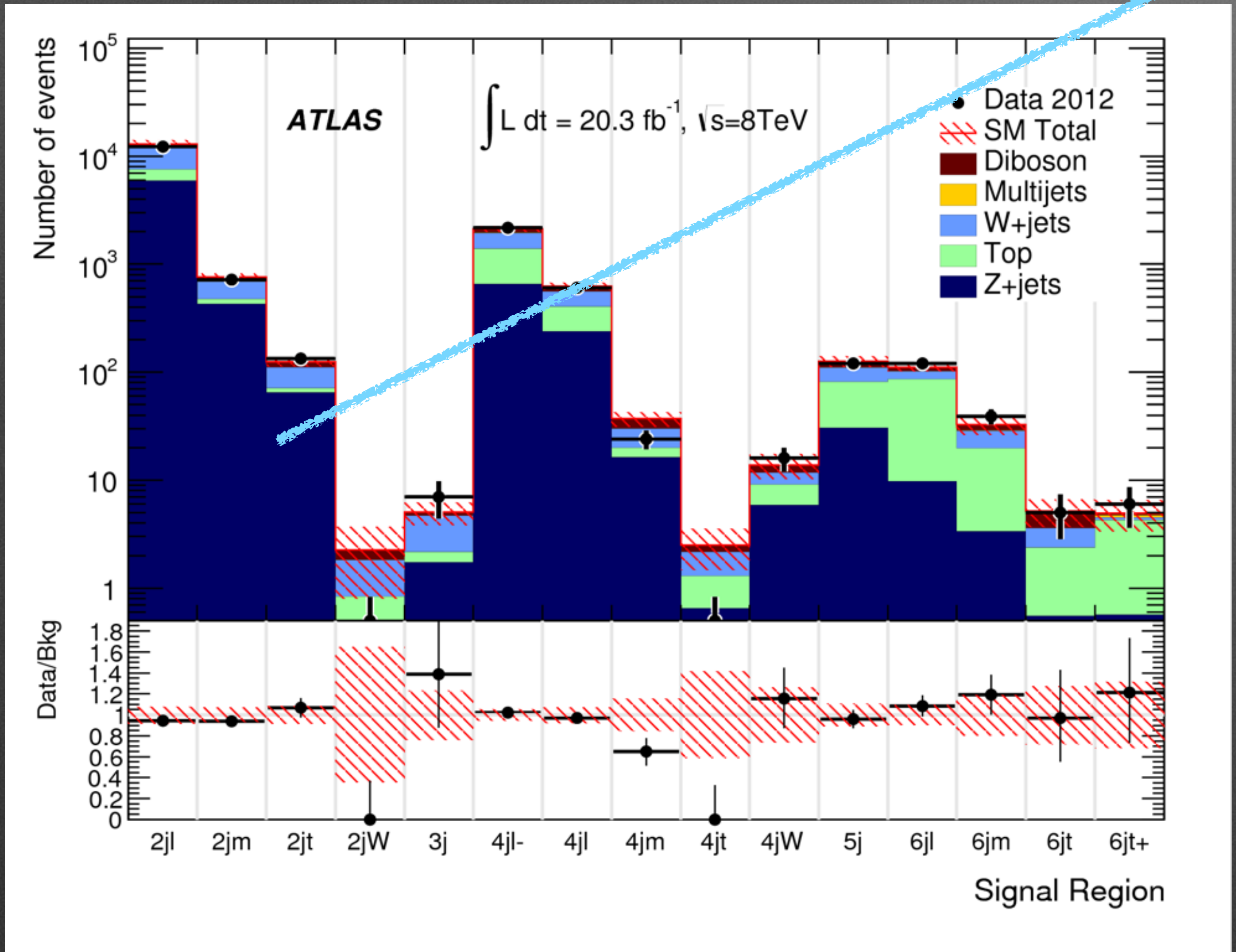


Requirement	Signal Region					
	2jl	**2jm**	**2jt**	**2jW**	**3j**	**4jW**
E_T^{miss}[GeV] >	160					
$p_T(j_1)$ [GeV] >	130					
$p_T(j_2)$ [GeV] >	60					
$p_T(j_3)$ [GeV] >	–				60	40
$p_T(j_4)$ [GeV] >	–					40
$\Delta\phi(\text{jet}_{1,2,(3)}, \mathbf{E}_T^{miss})_{min}$ >	0.4					
$\Delta\phi(\text{jet}_{i>3}, \mathbf{E}_T^{miss})_{min}$ >	–					0.2
W candidates	–			$2(W \rightarrow j)$	–	$(W \rightarrow j) + (W \rightarrow jj)$
$E_T^{miss}/\sqrt{H_T}$ [GeV$^{1/2}$] >	8	15		–		
$E_T^{miss}/m_{eff}(N_j)$ >	–			0.25	0.3	0.35
m_{eff}(incl.) [GeV] >	800	1200	1600	1800	2200	1100

Requirement	Signal Region								
	4jl-	**4jl**	**4jm**	**4jt**	**5j**	**6jl**	**6jm**	**6jt**	**6jt+**
E_T^{miss}[GeV] >	160								
$p_T(j_1)$ [GeV] >	130								
$p_T(j_2)$ [GeV] >	60								
$p_T(j_3)$ [GeV] >	60								
$p_T(j_4)$ [GeV] >	60								
$p_T(j_5)$ [GeV] >	–				60				
$p_T(j_6)$ [GeV] >	–					60			
$\Delta\phi(\text{jet}_{1,2,(3)}, \mathbf{E}_T^{miss})_{min}$ >	0.4								
$\Delta\phi(\text{jet}_{i>3}, \mathbf{E}_T^{miss})_{min}$ >	0.2								
$E_T^{miss}/\sqrt{H_T}$ [GeV$^{1/2}$] >	10		–						
$E_T^{miss}/m_{eff}(N_j)$ >	–		0.4	0.25	0.2			0.25	0.15
m_{eff}(incl.) [GeV] >	700	1000	1300	2200	1200	900	1200	1500	1700

Search with jets + E_T^{miss} search (no leptons)

arXiV:1406.1122



Z(→νν)+jets background dominates at low jet-multiplicity. Estimate in a γ+jets CR with photon p_T emulation E_T^{miss}

Search with jets + E_T^{miss} search (no leptons)

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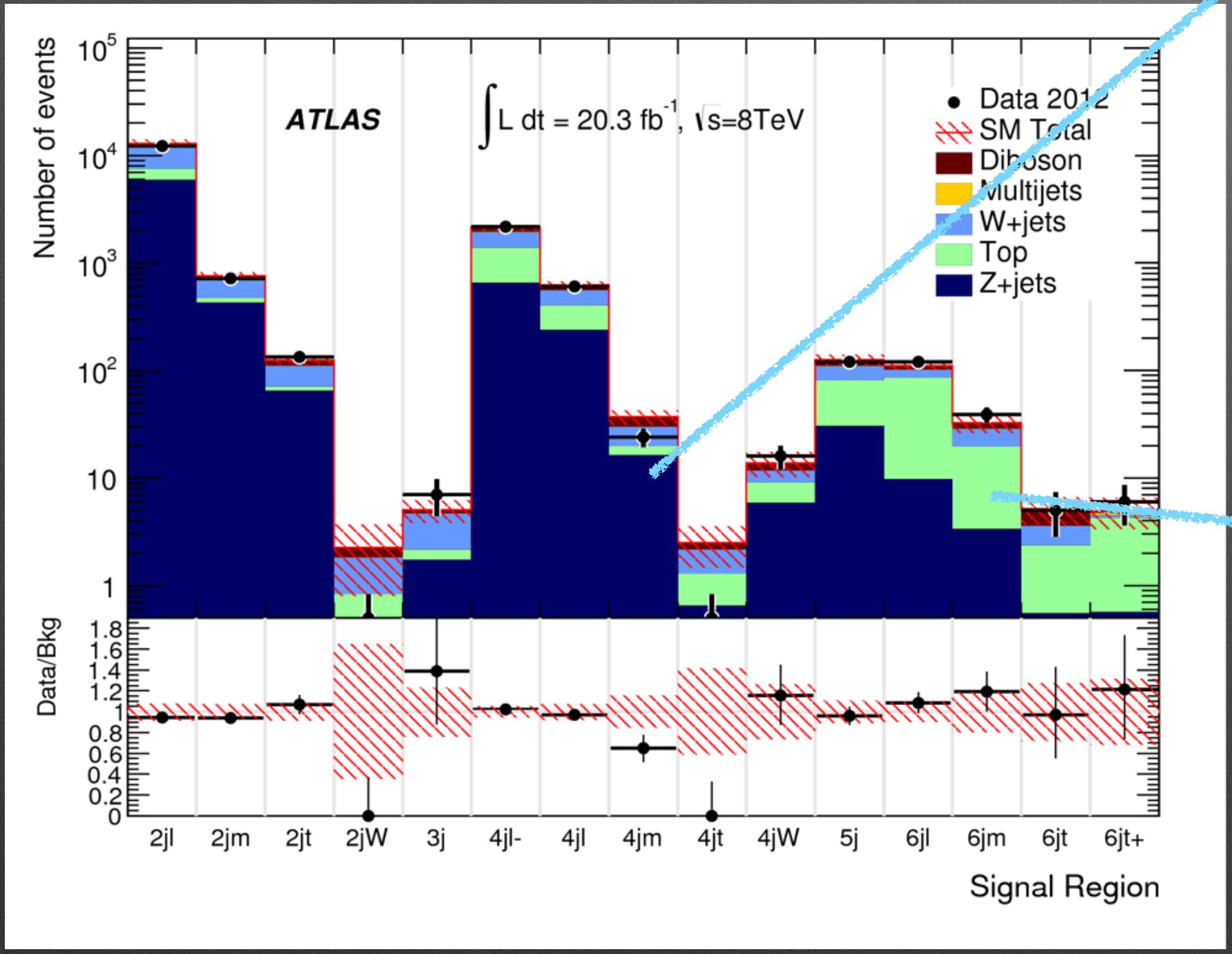


Z(→νν)+jets background dominates at low jet-multiplicity. Estimated in a γ+jets CR with photon p_T emulation E_T^{miss}

ttbar background dominates at high jet-multiplicity. Estimated in a CR with a b-tag and low transverse mass of lepton and E_T^{miss}

Search with jets + E_T^{miss} search (no leptons)

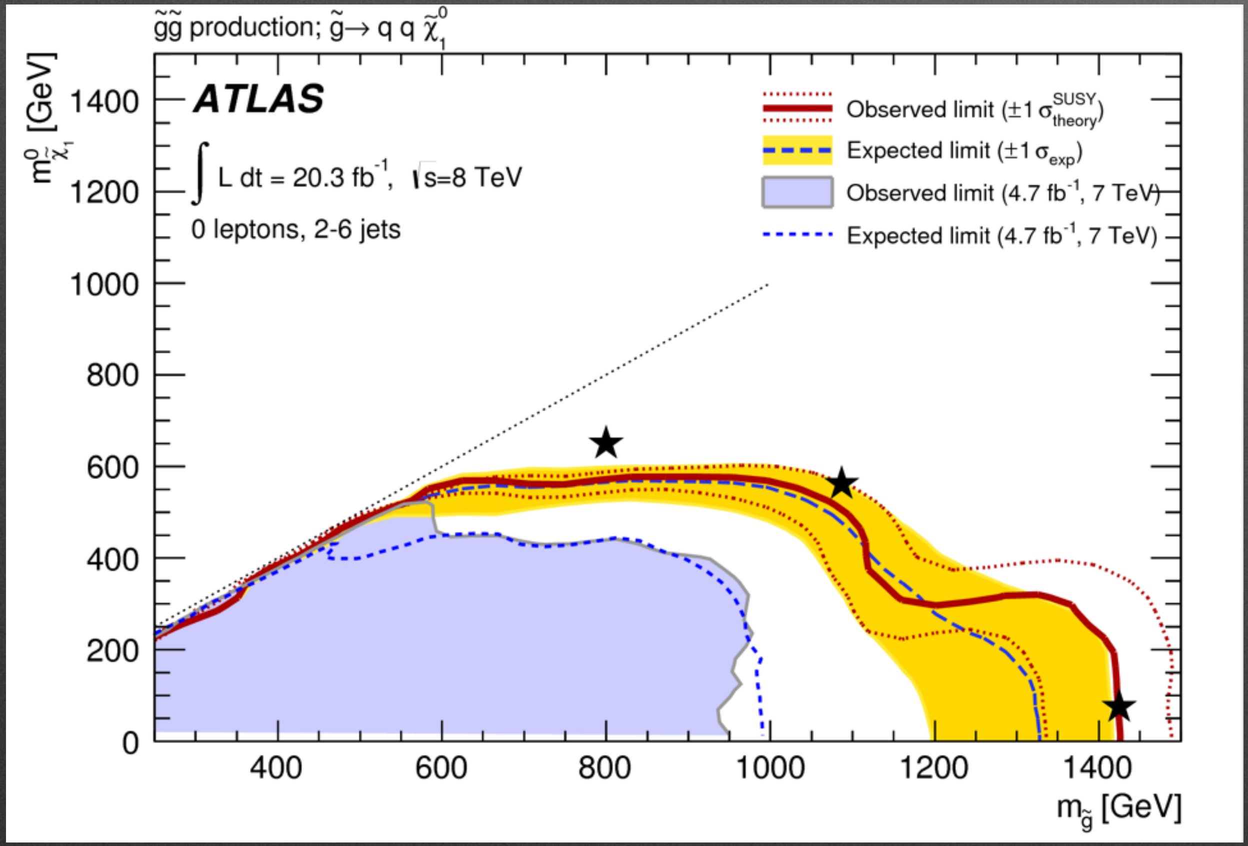
arXiV:1406.1122

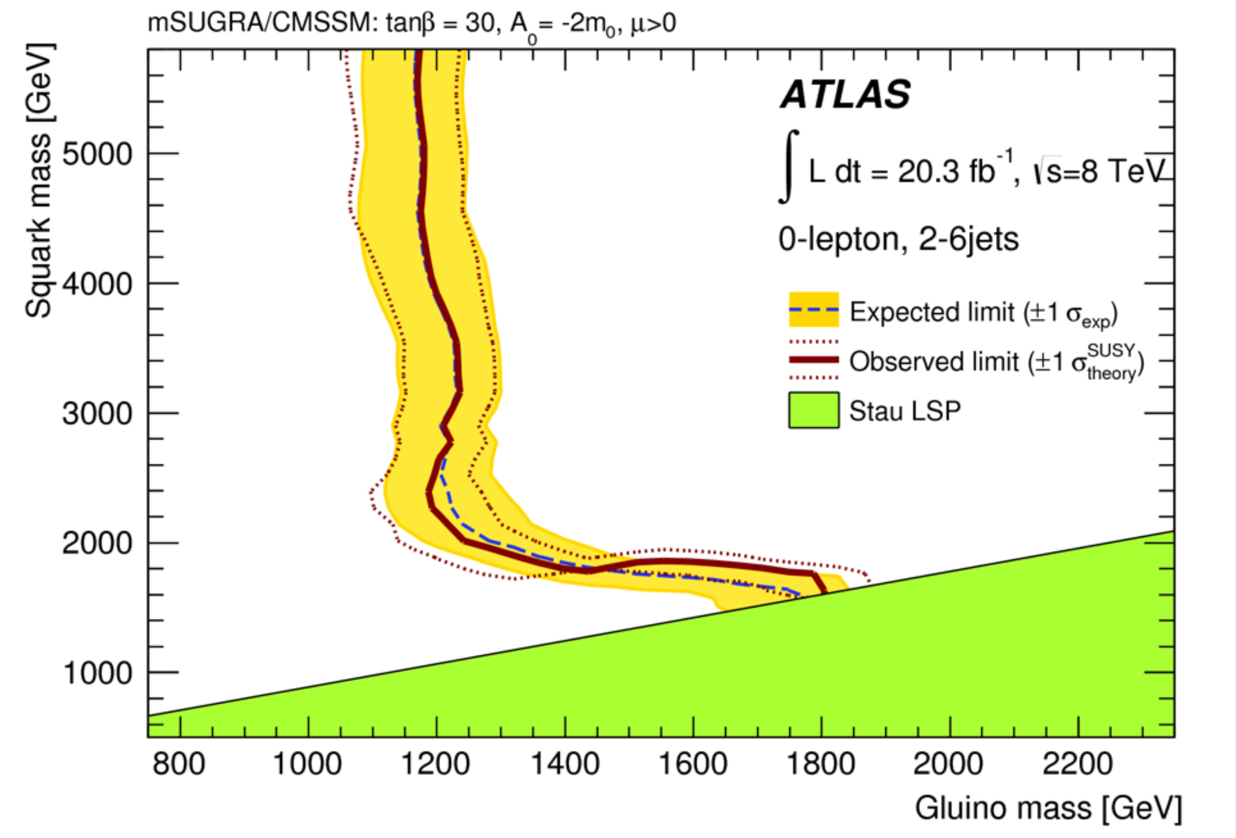
Simplified models: $\tilde{g} \to q\bar{q}\tilde{\chi}_1^0$

m(gluino) > 1330 GeV for massless LSP (95% CL)

Realistic (CMSSM) model:

m(gluino)=m(squark) > 1700 GeV (95% CL)

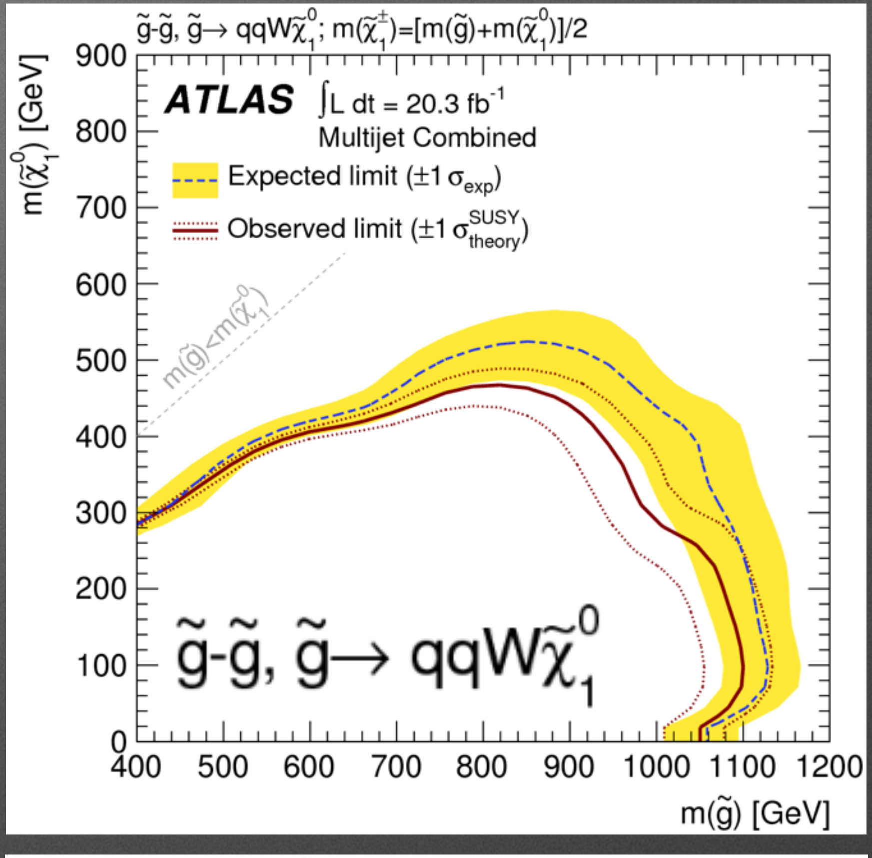


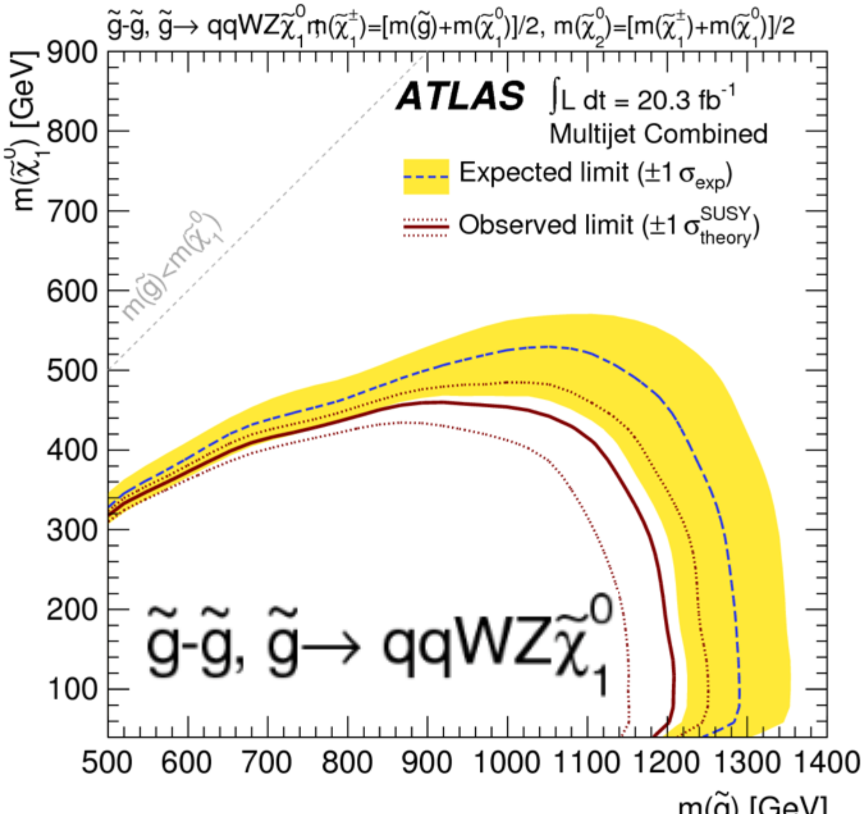


Search with multijets + E_T^{miss} search

arXiV:1308.1841

- Extend multijets search for multiplicities ≥7, ≥8, ≥9, ≥10 jets!
- Sensitive to final states with several W/Z→jj in the event
- Dominated by multijets background
- Also include SR with b-jets (see later)

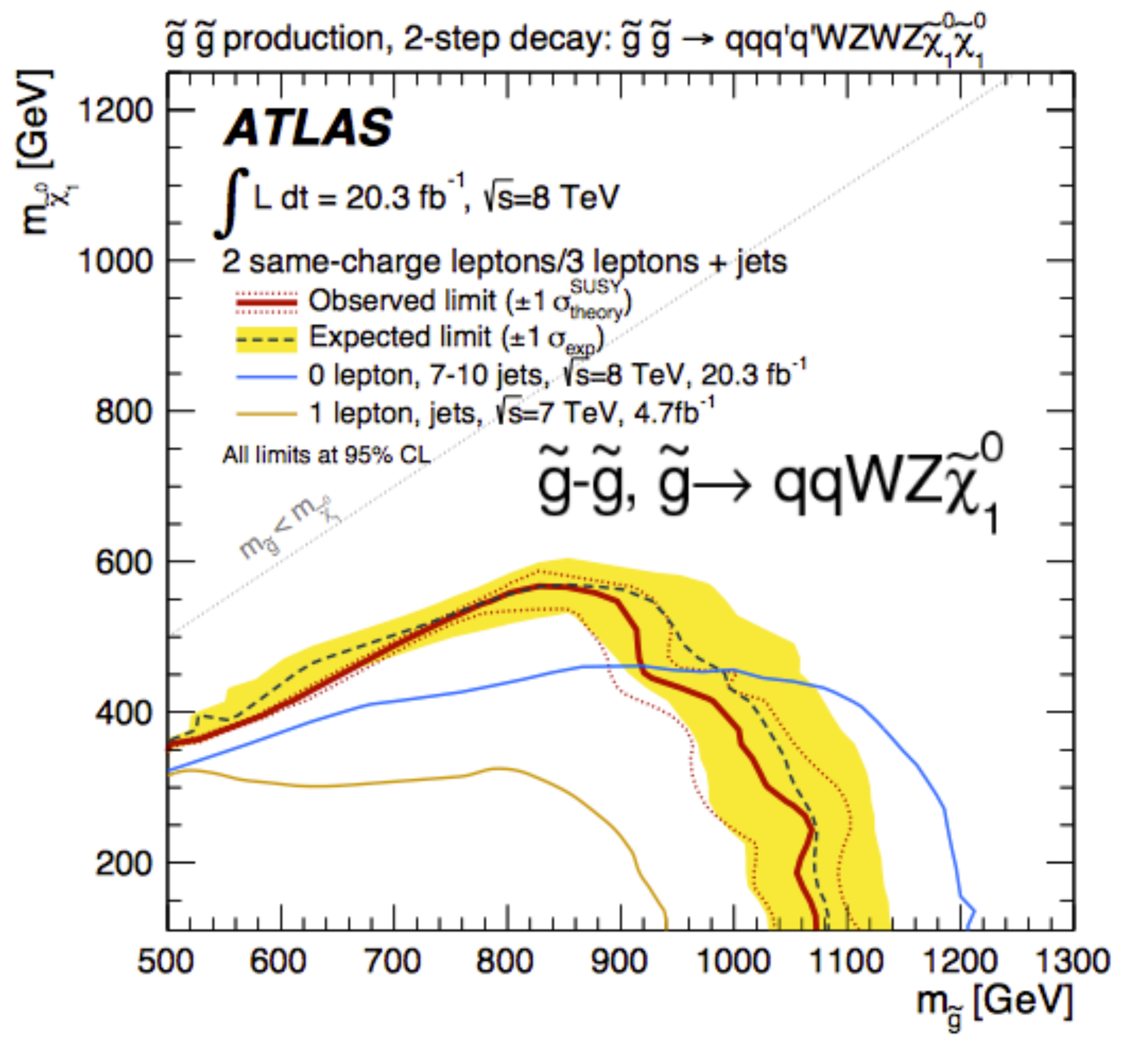




Search with multijets + same-sign (SS) lepton pairs and 3 leptons

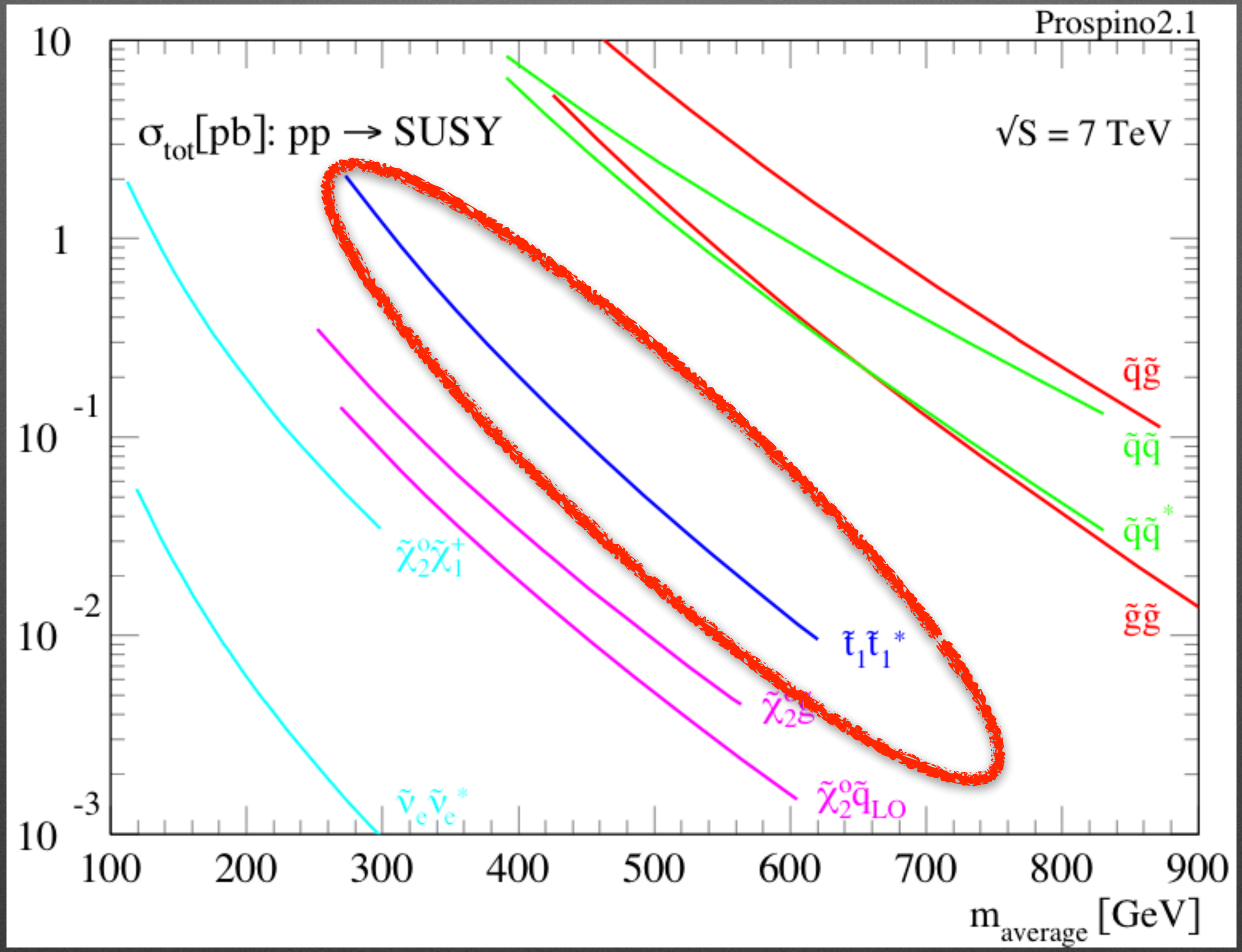
arXiV:1404.2500

- Same motivation as multijets analysis, but for $W \to l\nu$ and $Z \to ll$
  - Pros: smaller background, looser cuts on e.g. E_T^{miss}
  - Cons: smaller branching fractions
- Dominant backgrounds: WZ+jets, ttbarW/Z, fake leptons, charge-flip
- Also include SR with b-jets (see later)



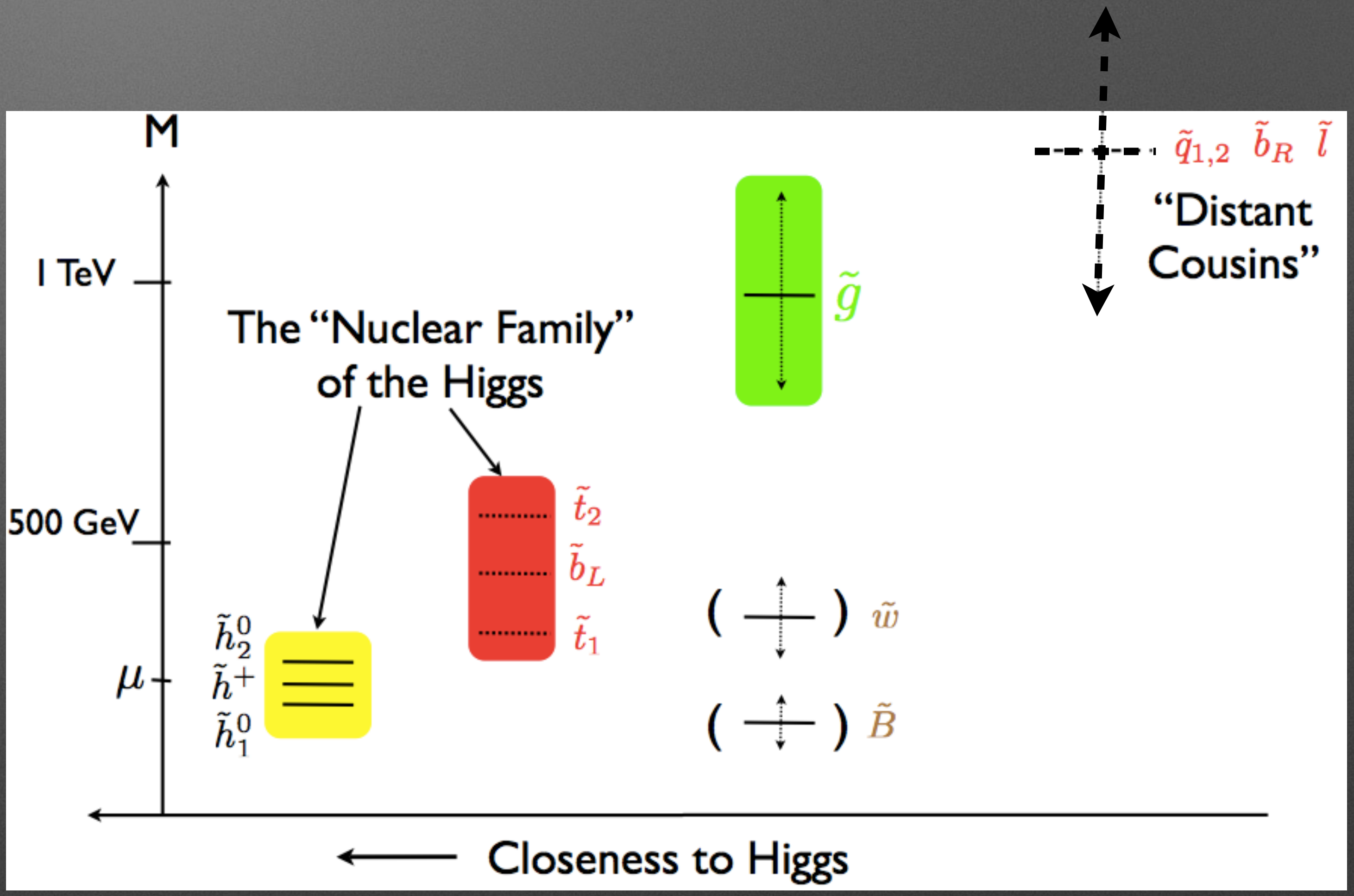
Complementarity of SUSY searches: SS/3L analysis better coverage when mass spectrum more compressed

Approach 2: look for natural SUSY



Natural SUSY

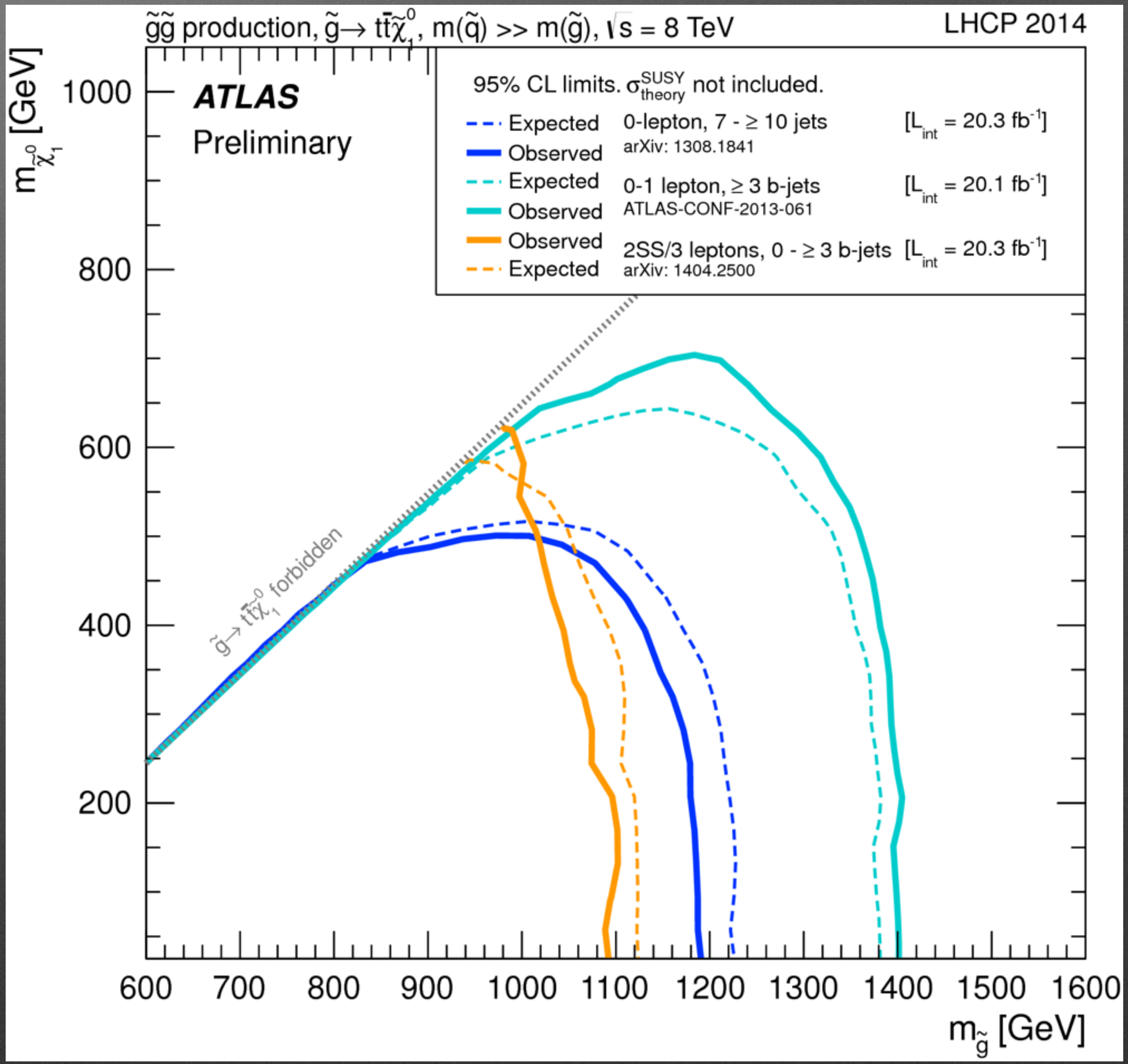
- #1 motivation for SUSY being discoverable at LHC: cancel divergent corrections to Higgs mass
- Only a few superpartners need to be light to achieve this
  - higgsinos
  - stop and sbottom
  - gluinos
- Natural SUSY can yield different signatures than “generic” SUSY → dedicated searches



Gluino-mediated stop quarks

3 b-jets search: ATLAS-CONF-2013-061

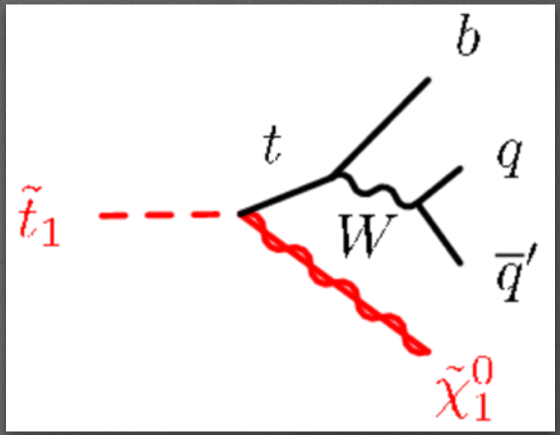
- $\tilde{g} \to t\tilde{t}_1^{(*)}$ with $\tilde{t}_1 \to t\tilde{\chi}_1^0$
- SR with b-jets of multijets and SS/3L analyses set complementary constraints
- Most powerful analysis: 3 b-jets analysis (0 lepton)
  - with ≥7 jets, large E_T^{miss} and m_{eff}
  - Background dominated by ttbar+X
- Other decays are considered in ATLAS:



$\tilde{t}_1 \to b\tilde{\chi}_1^{\pm}$ $\tilde{t}_1 \to c\tilde{\chi}_1^0$ $\tilde{t}_1 \to bs$

Direct stop searches

0-lepton stop: arXiV:1406.1122



- Most stop decays yield a W boson, a b-jet and LSP ⇒

  ttbar + E_T^{miss} signature

  - Searches performed with 0, 1 and 2 leptons

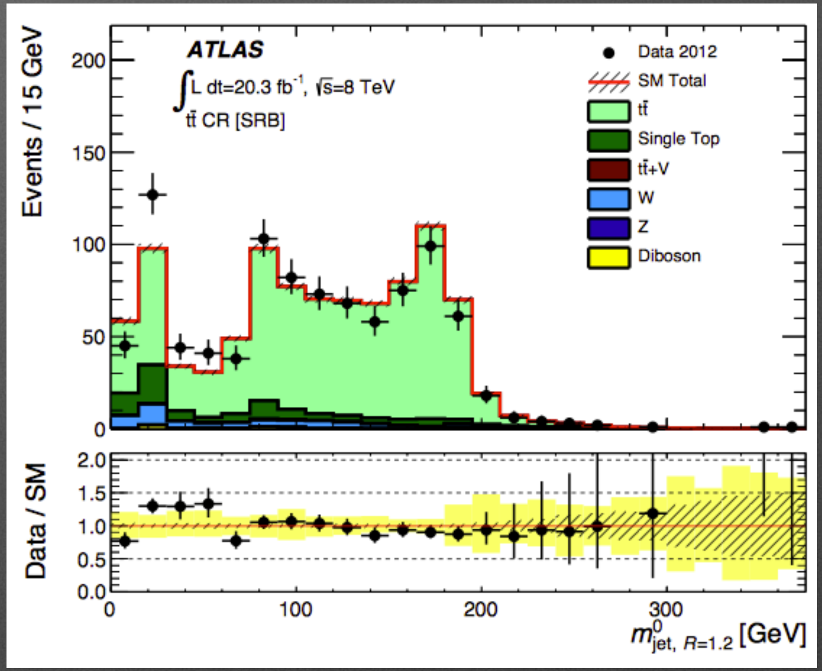
- 0-lepton analysis

  - 4-6 jet multiplicities with top-specific cuts (e.g. 3-jet mass)

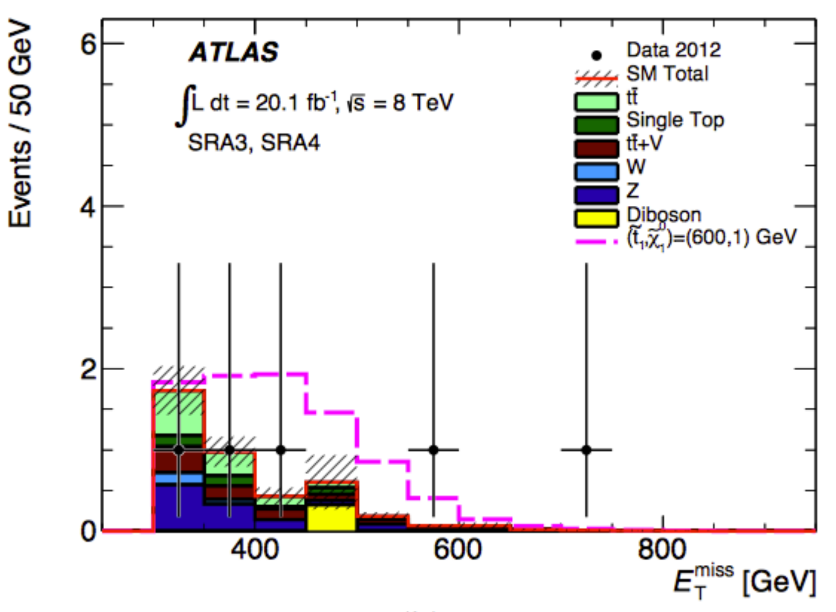
  - Boosted top and W employed for large stop mass

  - Dominant background: semileptonic ttbar with τ decay

Large-radius jet mass (ttbar CR)

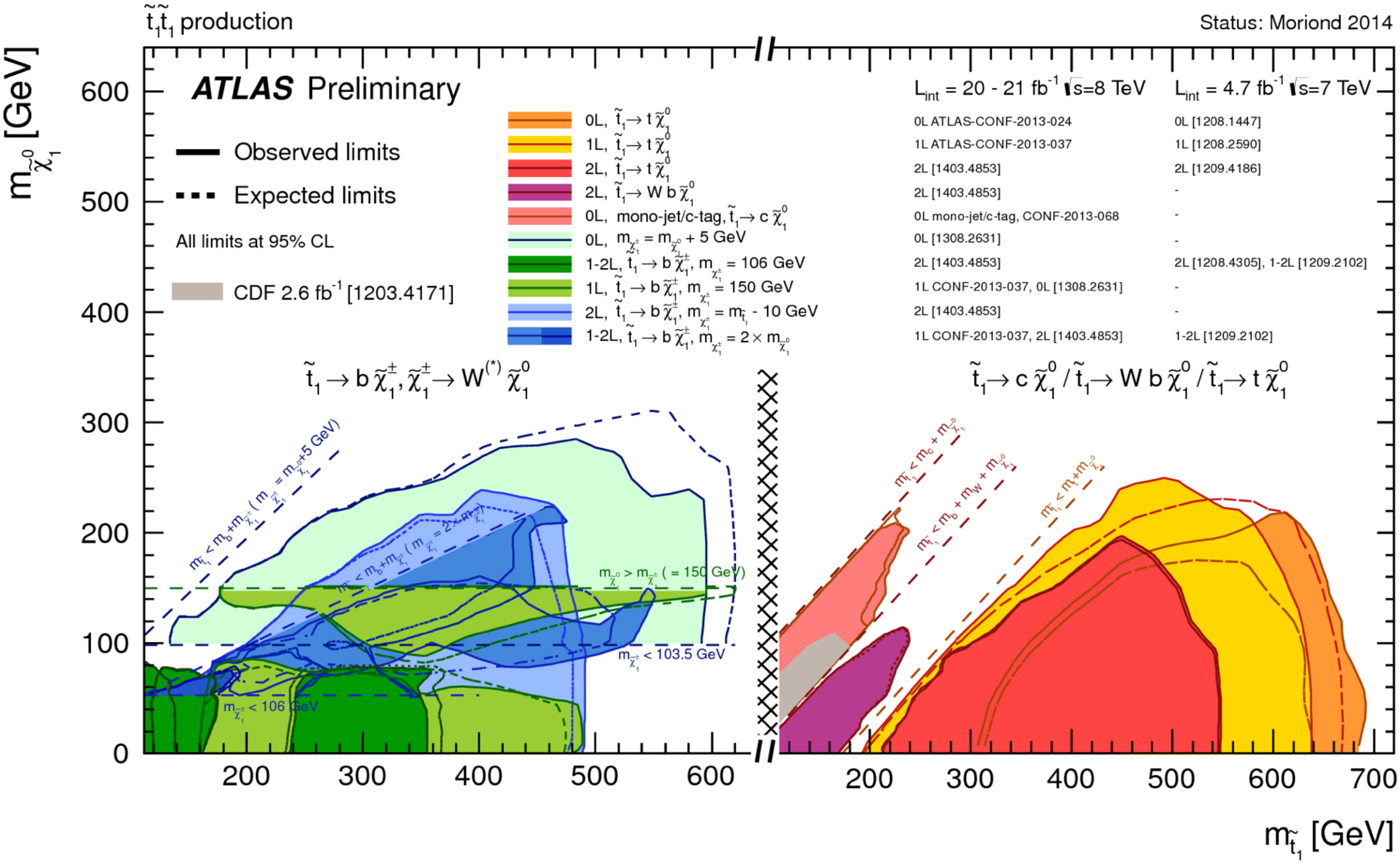


E_T^{miss} in a 6-jet SR



Summary of stop constraints

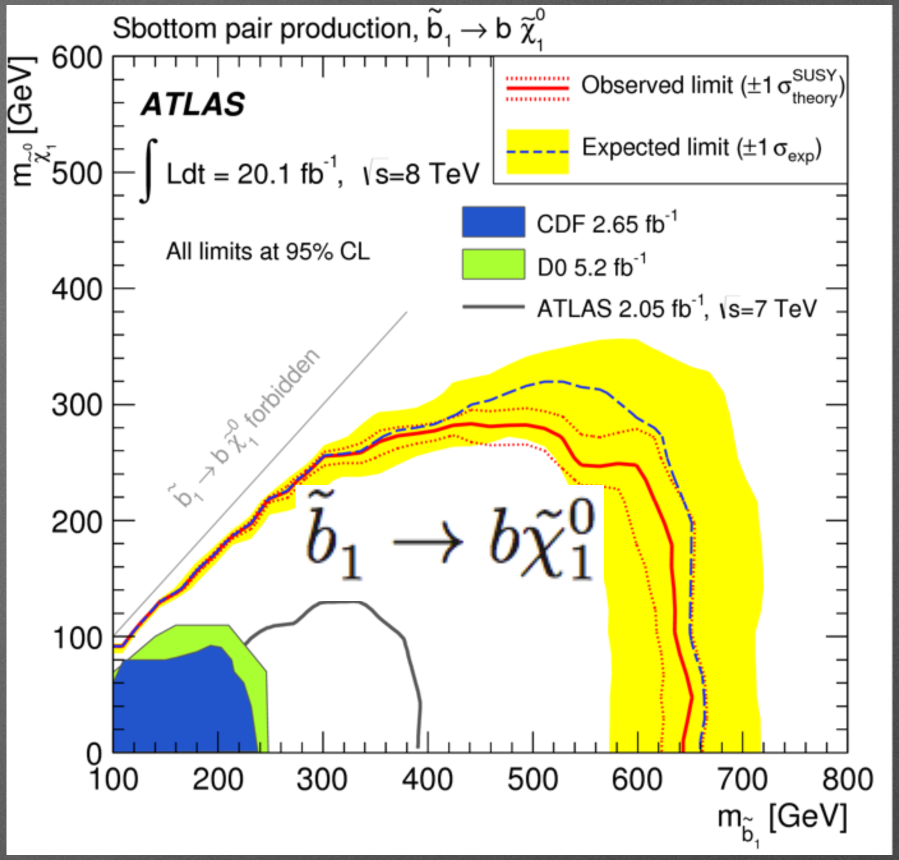
Lots of possibilities! Limits are weaker if branching fractions to a given decay ≠ 100%

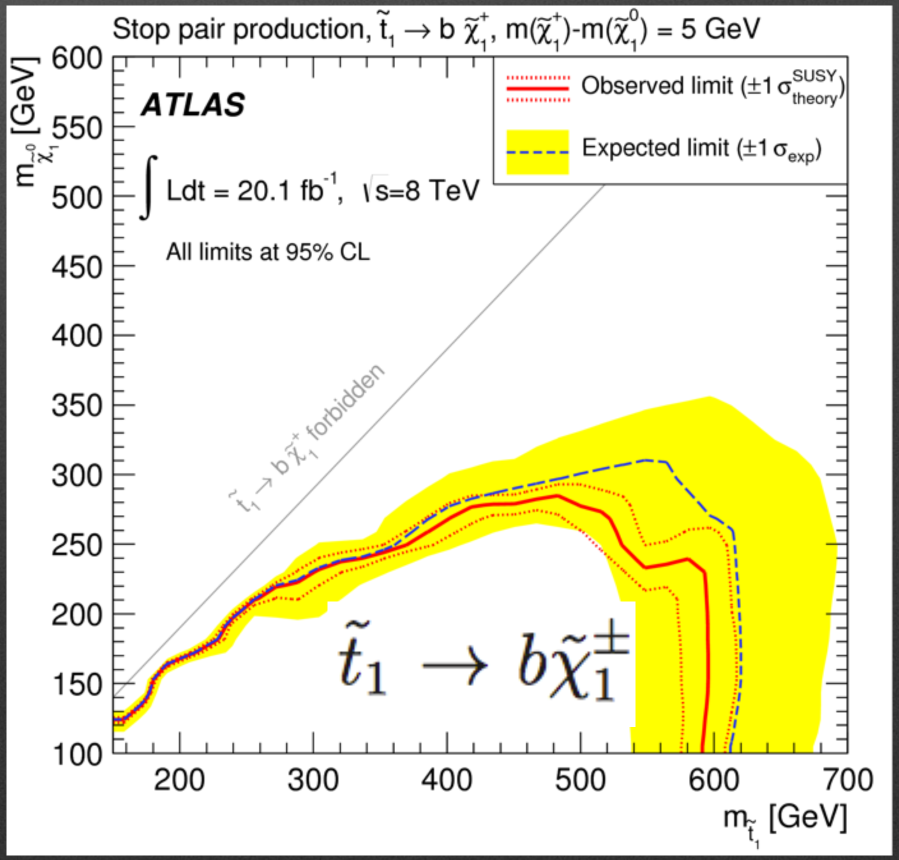


Direct sbottom

arXiV:1310.3675

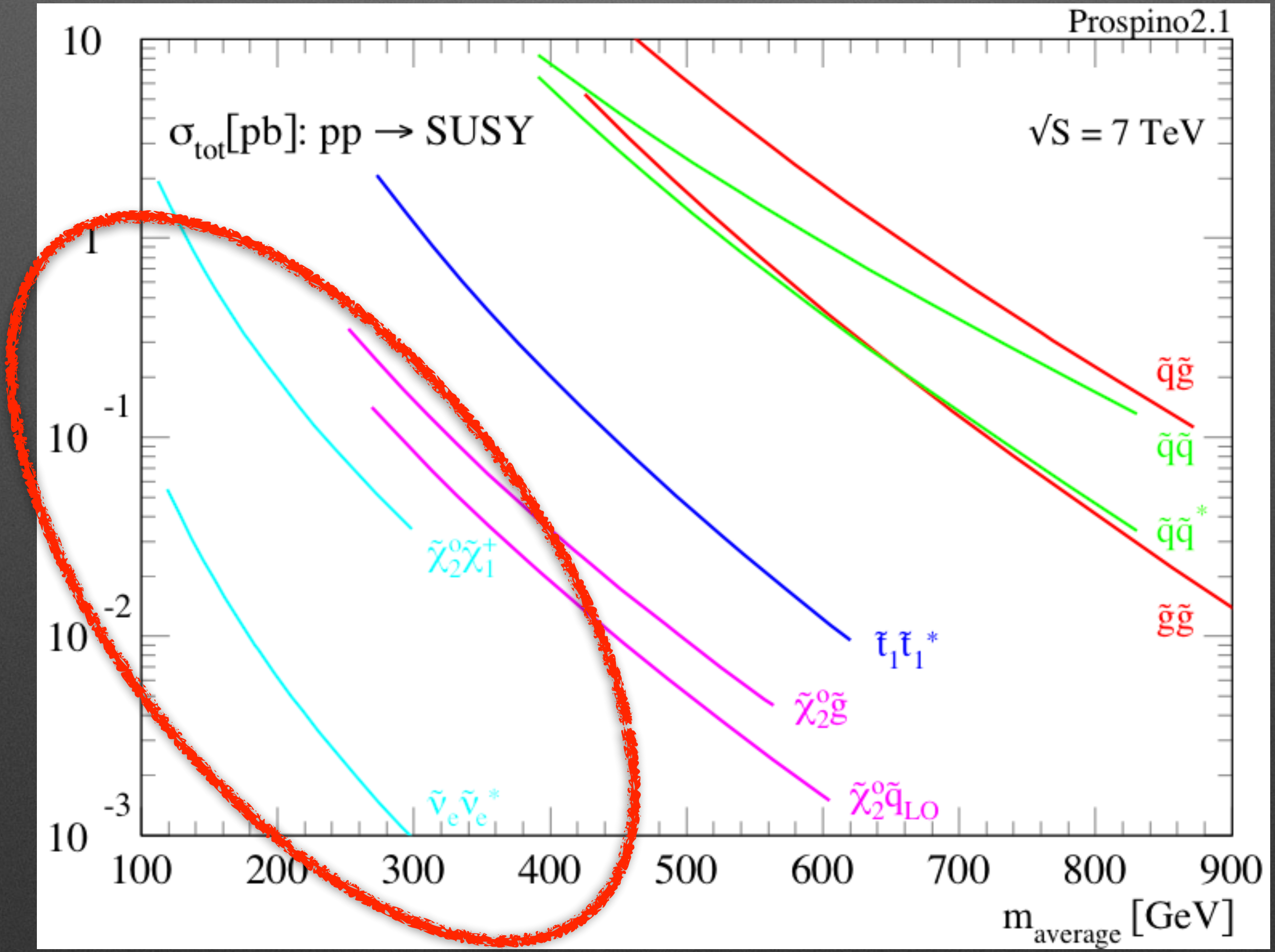
- Search for $\tilde{b}_1 \rightarrow b\tilde{\chi}_1^0$
- Selections
  - 2 high-p_T b-jets and large E_T^{miss}
  - Plus other topological cuts to remove
- Dominant backgrounds
  - ttbar and Z+bbbar
- Can also search for $\tilde{t}_1 \rightarrow b\tilde{\chi}_1^\pm$ with small $\Delta m \equiv m_{\tilde{\chi}_1^\pm} - m_{\tilde{\chi}_1^0}$
  - Natural if both gauginos are higgsino-like





Electroweak SUSY

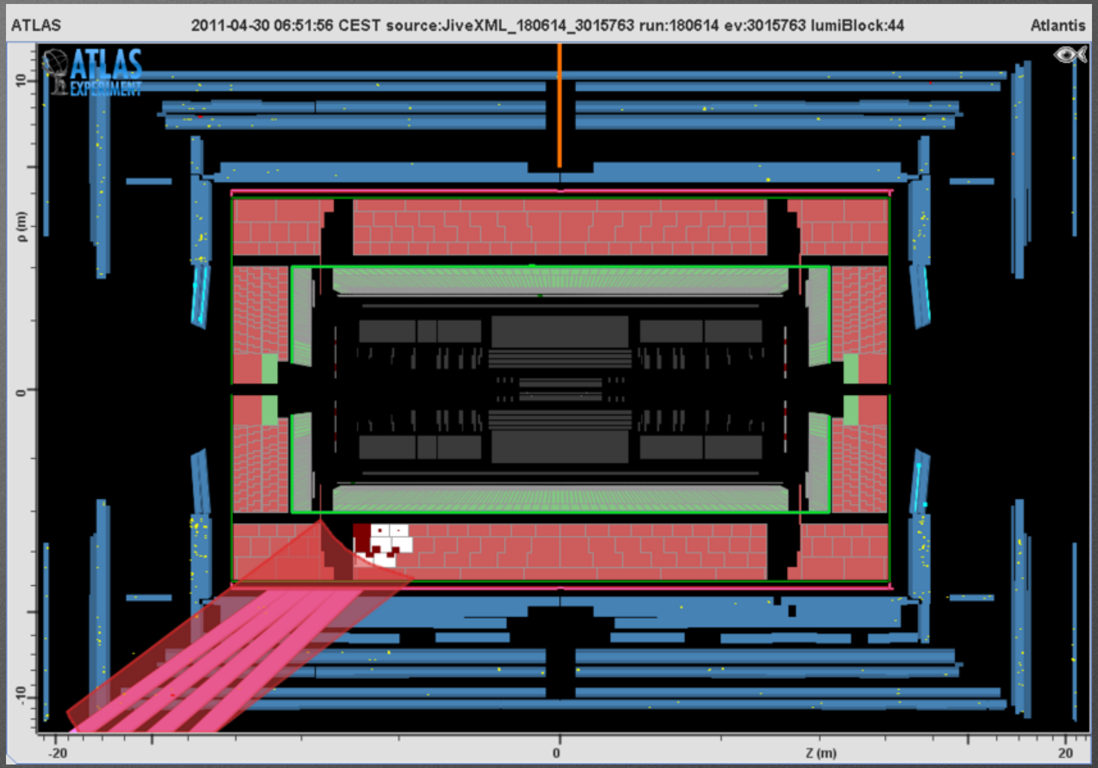
Direct gauginos production: small cross-section but generally expected to be light → maybe the only Superpartners produceable at the LHC??



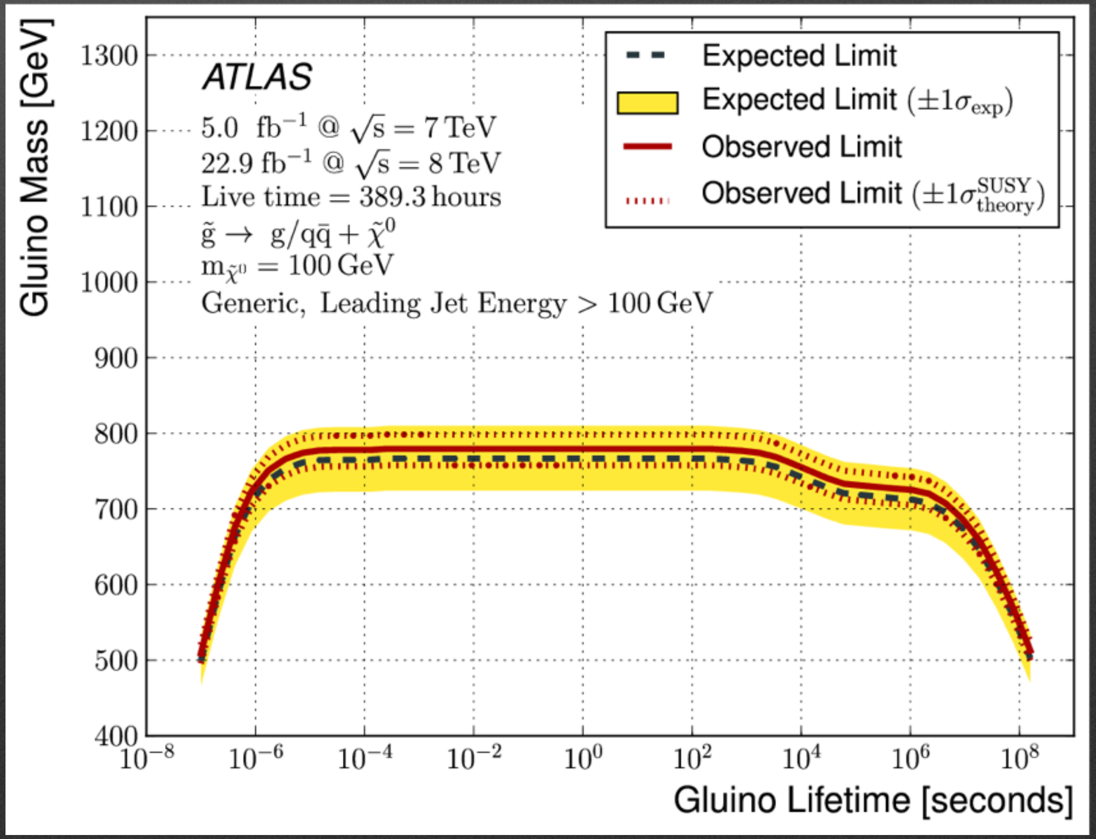
⇒ See dedicated talks by Zoltan Gecse and Matthew Gignac

“Exotic” SUSY: long-lived R-hadrons

arXiV:1310.6584

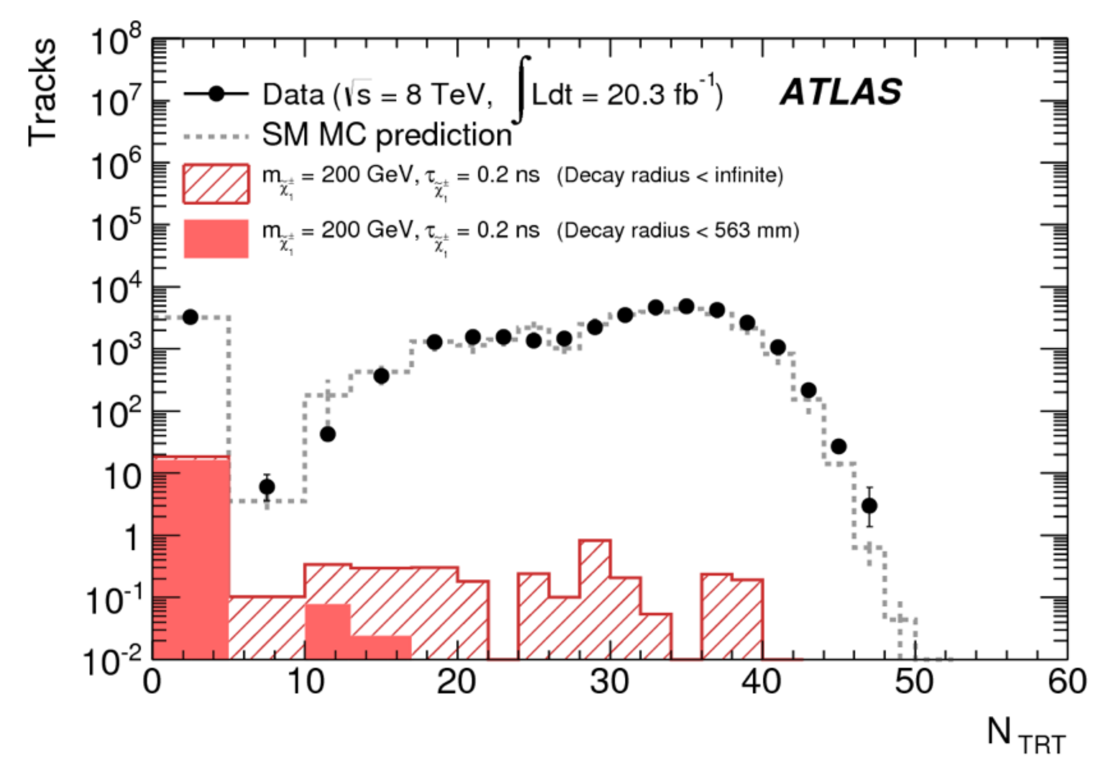


- Long-lived gluinos or squarks (e.g. split SUSY, RPV) can form R-hadrons Ex.: $\tilde{g}q\bar{q}$
  - A fraction would stop in detector
  - And decay to LSP and jets at later time
- Search performed in empty LHC bunch crossings for:
  - ≥ 1 good quality jet, large E_T^{miss}, no muon activity
- Backgrounds:
  - Beam-halo muons, cosmic muons



“Exotic SUSY”: Disappearing tracks

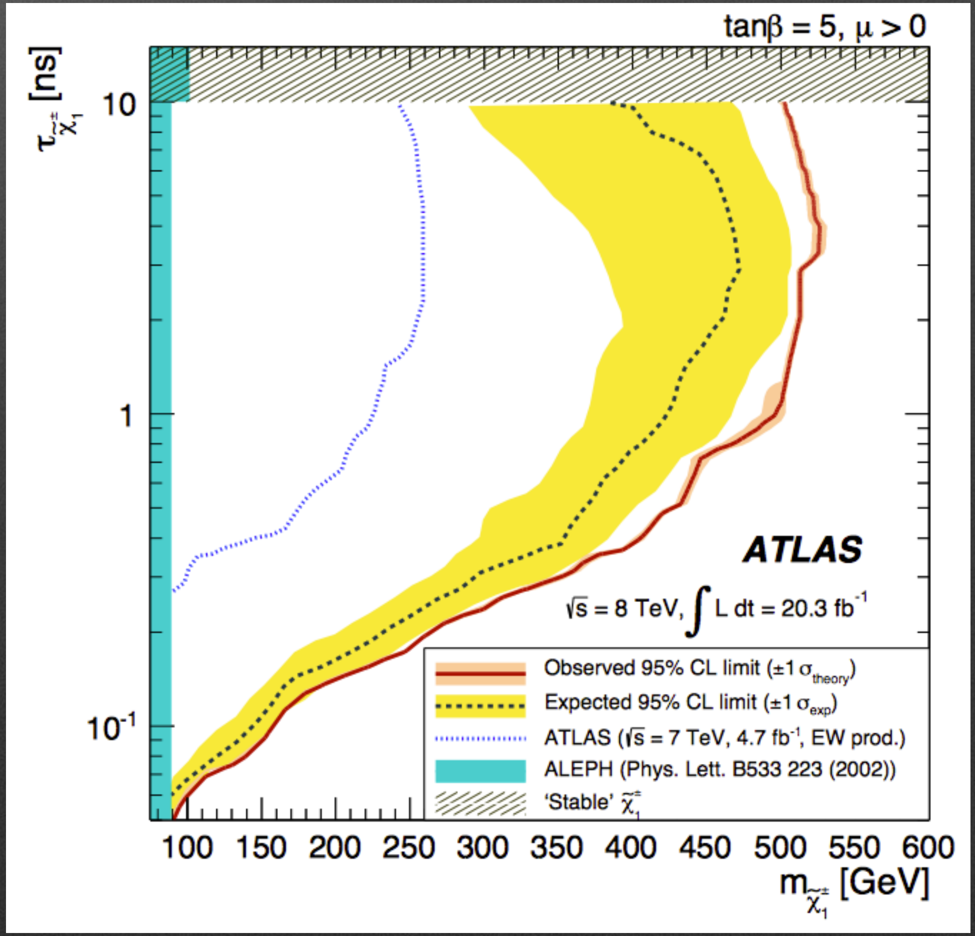
arXiV:1310.3675



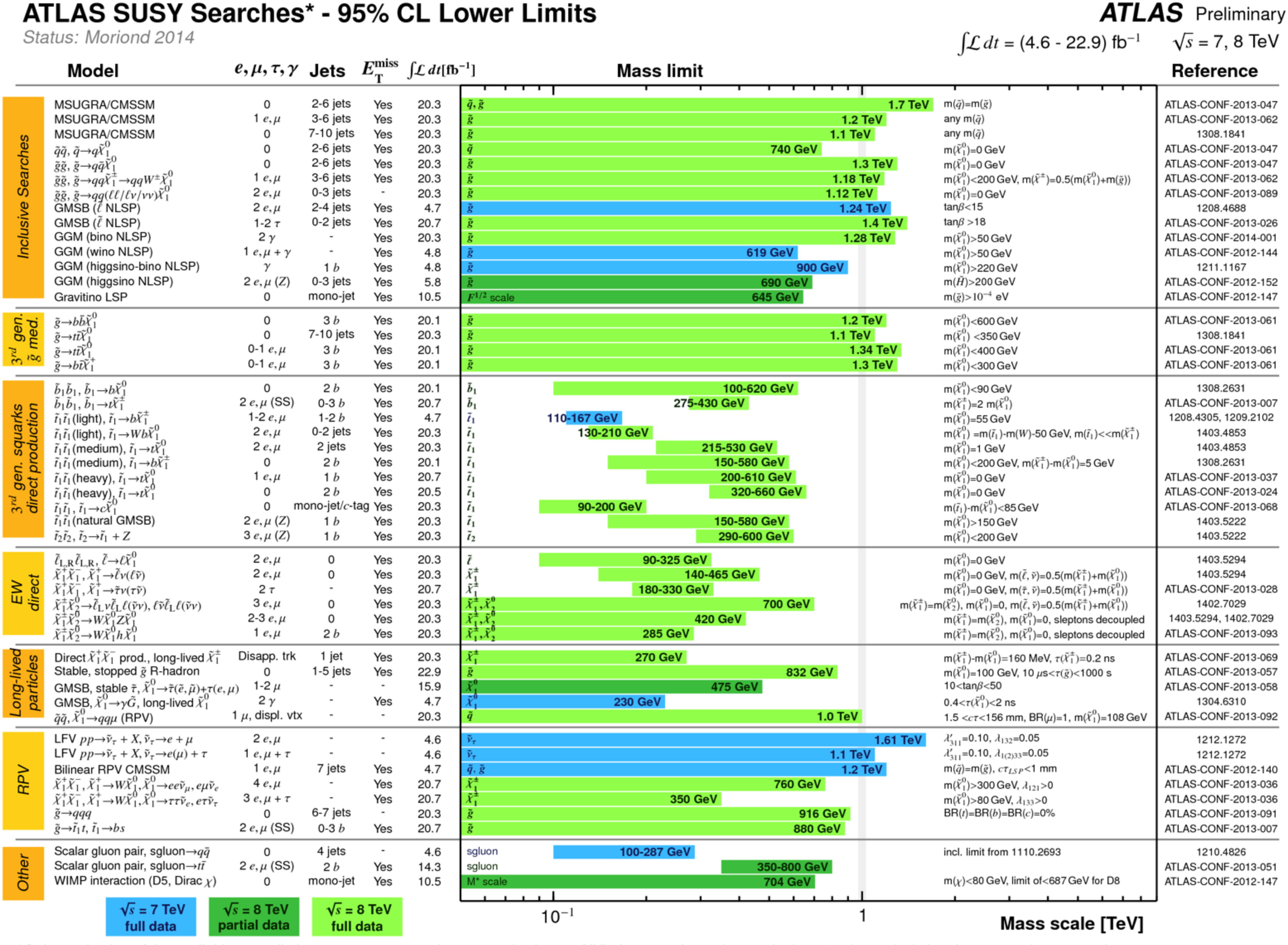
- Some SUSY models predict degenerate $\tilde\chi_1^\pm$ and $\tilde\chi_1^0$, resulting in long-lived charginos ⇒ disappearing tracks

- Selections:
  - 1 ISR jet and large E_T^{miss}
  - 1 isolated track with few numbers of TRT hits

- Backgrounds:
  - Charged-hadrons interactions, p_T mis-measured tracks



I could only cover a small fraction of existing analyses!



ATLAS SUSY Searches* - 95% CL Lower Limits

Status: Moriond 2014

ATLAS Preliminary

$\int\mathcal{L}\,dt$ = (4.6 - 22.9) 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($\tilde{q}$)	1308.1841
	$\tilde{q}\tilde{q}, \tilde{q}\to q\tilde{\chi}_1^0$	0	2-6 jets	Yes	20.3	$\tilde{q}$	740 GeV	m($\tilde{\chi}_1^0$)=0 GeV	ATLAS-CONF-2013-047
	$\tilde{g}\tilde{g}, \tilde{g}\to q\bar{q}\tilde{\chi}_1^0$	0	2-6 jets	Yes	20.3	$\tilde{g}$	1.3 TeV	m($\tilde{\chi}_1^0$)=0 GeV	ATLAS-CONF-2013-047
	$\tilde{g}\tilde{g}, \tilde{g}\to qq\tilde{\chi}_1^\pm\to qqW^\pm\tilde{\chi}_1^0$	1 e, 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
	$\tilde{g}\tilde{g}, \tilde{g}\to qq(\ell\ell/\ell\nu/\nu\nu)\tilde{\chi}_1^0$	2 e, μ	0-3 jets	-	20.3	$\tilde{g}$	1.12 TeV	m($\tilde{\chi}_1^0$)=0 GeV	ATLAS-CONF-2013-089
	GMSB ($\tilde{\ell}$ NLSP)	2 e, μ	2-4 jets	Yes	4.7	$\tilde{g}$	1.24 TeV	tanβ<15	1208.4688
	GMSB ($\tilde{\ell}$ NLSP)	1-2 τ	0-2 jets	Yes	20.7	$\tilde{g}$	1.4 TeV	tanβ >18	ATLAS-CONF-2013-026
	GGM (bino NLSP)	2 γ	-	Yes	20.3	$\tilde{g}$	1.28 TeV	m($\tilde{\chi}_1^0$)>50 GeV	ATLAS-CONF-2014-001
	GGM (wino NLSP)	1 $e, \mu + \gamma$	-	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
3^{rd} gen. $\tilde{g}$ med.	$\tilde{g}\to b\bar{b}\tilde{\chi}_1^0$	0	3 b	Yes	20.1	$\tilde{g}$	1.2 TeV	m($\tilde{\chi}_1^0$)<600 GeV	ATLAS-CONF-2013-061
	$\tilde{g}\to t\bar{t}\tilde{\chi}_1^0$	0	7-10 jets	Yes	20.3	$\tilde{g}$	1.1 TeV	m($\tilde{\chi}_1^0$) <350 GeV	1308.1841
	$\tilde{g}\to t\bar{t}\tilde{\chi}_1^0$	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
	$\tilde{g}\to b\bar{t}\tilde{\chi}_1^+$	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
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	20.1	$\tilde{b}_1$	100-620 GeV	m($\tilde{\chi}_1^0$)<90 GeV	1308.2631
	$\tilde{b}_1\tilde{b}_1, \tilde{b}_1\to t\tilde{\chi}_1^\pm$	2 e, μ (SS)	0-3 b	Yes	20.7	$\tilde{b}_1$	275-430 GeV	m($\tilde{\chi}_1^\pm$)=2 m($\tilde{\chi}_1^0$)	ATLAS-CONF-2013-007
	$\tilde{t}_1\tilde{t}_1$(light), $\tilde{t}_1\to b\tilde{\chi}_1^\pm$	1-2 e, μ	1-2 b	Yes	4.7	$\tilde{t}_1$	110-167 GeV	m($\tilde{\chi}_1^0$)=55 GeV	1208.4305, 1209.2102
	$\tilde{t}_1\tilde{t}_1$(light), $\tilde{t}_1\to Wb\tilde{\chi}_1^0$	2 e, μ	0-2 jets	Yes	20.3	$\tilde{t}_1$	130-210 GeV	m($\tilde{\chi}_1^0$) =m($\tilde{t}_1$)-m(W)-50 GeV, m($\tilde{t}_1$)<<m($\tilde{\chi}_1^\pm$)	1403.4853
	$\tilde{t}_1\tilde{t}_1$(medium), $\tilde{t}_1\to t\tilde{\chi}_1^0$	2 e, μ	2 jets	Yes	20.3	$\tilde{t}_1$	215-530 GeV	m($\tilde{\chi}_1^0$)=1 GeV	1403.4853
	$\tilde{t}_1\tilde{t}_1$(medium), $\tilde{t}_1\to b\tilde{\chi}_1^\pm$	0	2 b	Yes	20.1	$\tilde{t}_1$	150-580 GeV	m($\tilde{\chi}_1^0$)<200 GeV, m($\tilde{\chi}_1^\pm$)-m($\tilde{\chi}_1^0$)=5 GeV	1308.2631
	$\tilde{t}_1\tilde{t}_1$(heavy), $\tilde{t}_1\to t\tilde{\chi}_1^0$	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), $\tilde{t}_1\to t\tilde{\chi}_1^0$	0	2 b	Yes	20.5	$\tilde{t}_1$	320-660 GeV	m($\tilde{\chi}_1^0$)=0 GeV	ATLAS-CONF-2013-024
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to c\tilde{\chi}_1^0$	0	mono-jet/c-tag	Yes	20.3	$\tilde{t}_1$	90-200 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	20.3	$\tilde{t}_1$	150-580 GeV	m($\tilde{\chi}_1^0$)>150 GeV	1403.5222
	$\tilde{t}_2\tilde{t}_2, \tilde{t}_2\to\tilde{t}_1 + Z$	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	$\tilde{\ell}_{L,R}\tilde{\ell}_{L,R}, \tilde{\ell}\to\ell\tilde{\chi}_1^0$	2 e, μ	0	Yes	20.3	$\tilde{\ell}$	90-325 GeV	m($\tilde{\chi}_1^0$)=0 GeV	1403.5294
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to\tilde{\ell}\nu(\ell\tilde{\nu})$	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
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to\tilde{\tau}\nu(\tau\tilde{\nu})$	2 τ	-	Yes	20.7	$\tilde{\chi}_1^\pm$	180-330 GeV	m($\tilde{\chi}_1^0$)=0 GeV, m($\tilde{\tau}, \tilde{\nu}$)=0.5(m($\tilde{\chi}_1^\pm$)+m($\tilde{\chi}_1^0$))	ATLAS-CONF-2013-028
	$\tilde{\chi}_1^\pm\tilde{\chi}_2^0\to\tilde{\ell}_L\nu\tilde{\ell}_L\ell(\tilde{\nu}\nu), \ell\tilde{\nu}\tilde{\ell}_L\ell(\tilde{\nu}\nu)$	3 e, 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
	$\tilde{\chi}_1^\pm\tilde{\chi}_2^0\to W\tilde{\chi}_1^0 Z\tilde{\chi}_1^0$	2-3 e, μ	0	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
	$\tilde{\chi}_1^\pm\tilde{\chi}_2^0\to W\tilde{\chi}_1^0 h\tilde{\chi}_1^0$	1 e, μ	2 b	Yes	20.3	$\tilde{\chi}_1^\pm, \tilde{\chi}_2^0$	285 GeV	m($\tilde{\chi}_1^\pm$)=m($\tilde{\chi}_2^0$), m($\tilde{\chi}_1^0$)=0, sleptons decoupled	ATLAS-CONF-2013-093
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	ATLAS-CONF-2013-069
	Stable, stopped $\tilde{g}$ R-hadron	0	1-5 jets	Yes	22.9	$\tilde{g}$	832 GeV	m($\tilde{\chi}_1^0$)=100 GeV, 10 μs<τ($\tilde{g}$)<1000 s	ATLAS-CONF-2013-057
	GMSB, stable $\tilde{\tau}, \tilde{\chi}_1^0\to\tilde{\tau}(\tilde{e}, \tilde{\mu})+\tau(e, \mu)$	1-2 μ	-	-	15.9	$\tilde{\chi}_1^0$	475 GeV	10<tanβ<50	ATLAS-CONF-2013-058
	GMSB, $\tilde{\chi}_1^0\to\gamma\tilde{G}$, long-lived $\tilde{\chi}_1^0$	2 γ	-	Yes	4.7	$\tilde{\chi}_1^0$	230 GeV	0.4<τ($\tilde{\chi}_1^0$)<2 ns	1304.6310
	$\tilde{q}\tilde{q}, \tilde{\chi}_1^0\to qq\mu$ (RPV)	1 μ, displ. vtx	-	-	20.3	$\tilde{q}$	1.0 TeV	1.5 <$c\tau$<156 mm, BR(μ)=1, m($\tilde{\chi}_1^0$)=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
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to W\tilde{\chi}_1^0, \tilde{\chi}_1^0\to ee\tilde{\nu}_\mu, e\mu\tilde{\nu}_e$	4 e, μ	-	Yes	20.7	$\tilde{\chi}_1^\pm$	760 GeV	m($\tilde{\chi}_1^0$)>300 GeV, λ_{121}>0	ATLAS-CONF-2013-036
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to W\tilde{\chi}_1^0, \tilde{\chi}_1^0\to\tau\tau\tilde{\nu}_e, e\tau\tilde{\nu}_\tau$	3 $e, \mu + \tau$	-	Yes	20.7	$\tilde{\chi}_1^\pm$	350 GeV	m($\tilde{\chi}_1^0$)>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(χ)<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

*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.

No stones left unturned!

Summary

- Large collaborative efforts to find SUSY at the LHC
- Many different forms of SUSY are explored
- Excellent prospects for Run II!