



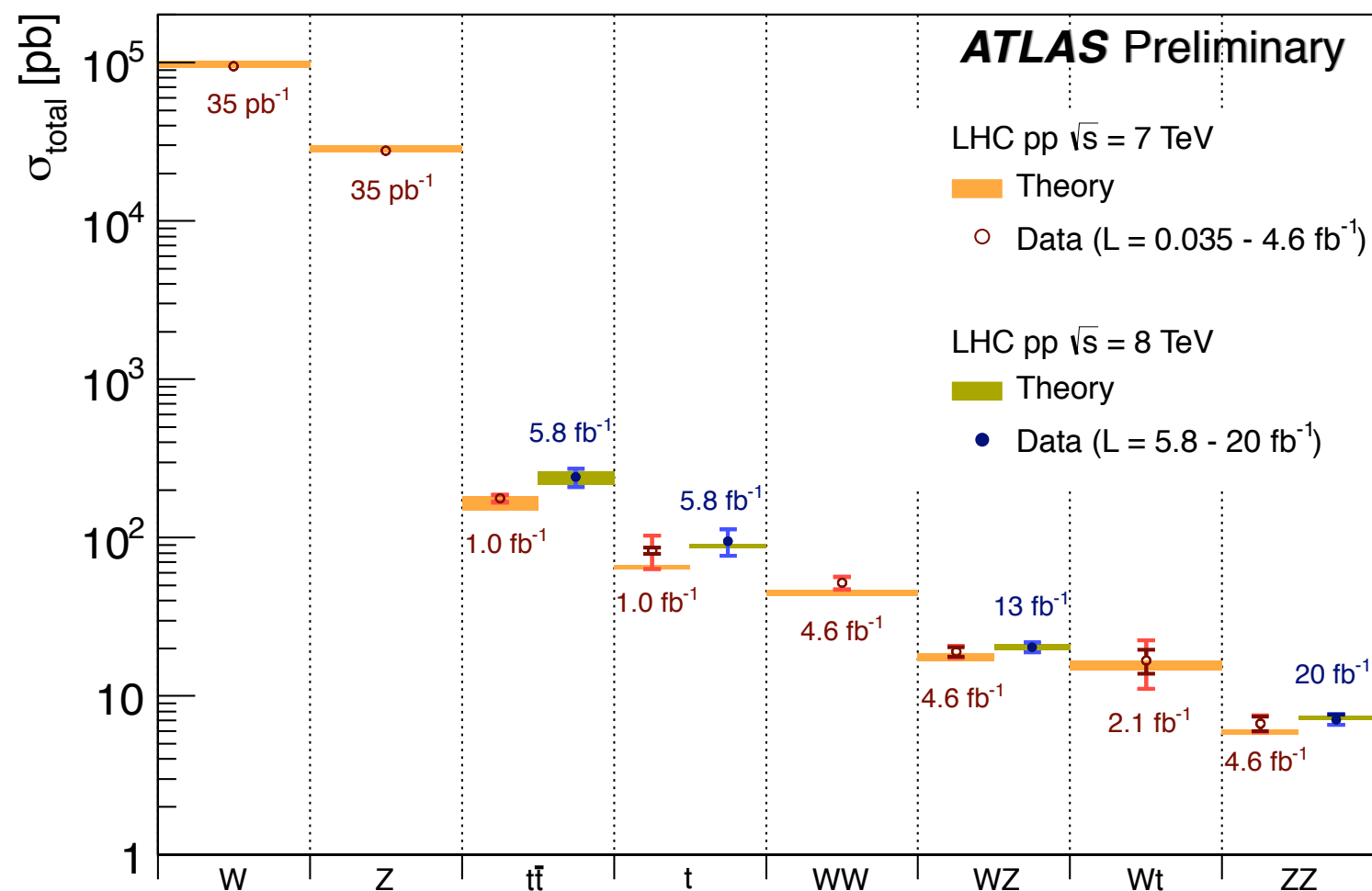
Searches for New Physics in ATLAS

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IVICFA's Fridays: EXPERIMENTAL PHYSICS
Valencia
25 Oct. 2013

Introduction

- ▶ The Standard Model of elementary particles is a very successful theory.
- ▶ Precise predictions, verified by experiment over many orders of magnitude.



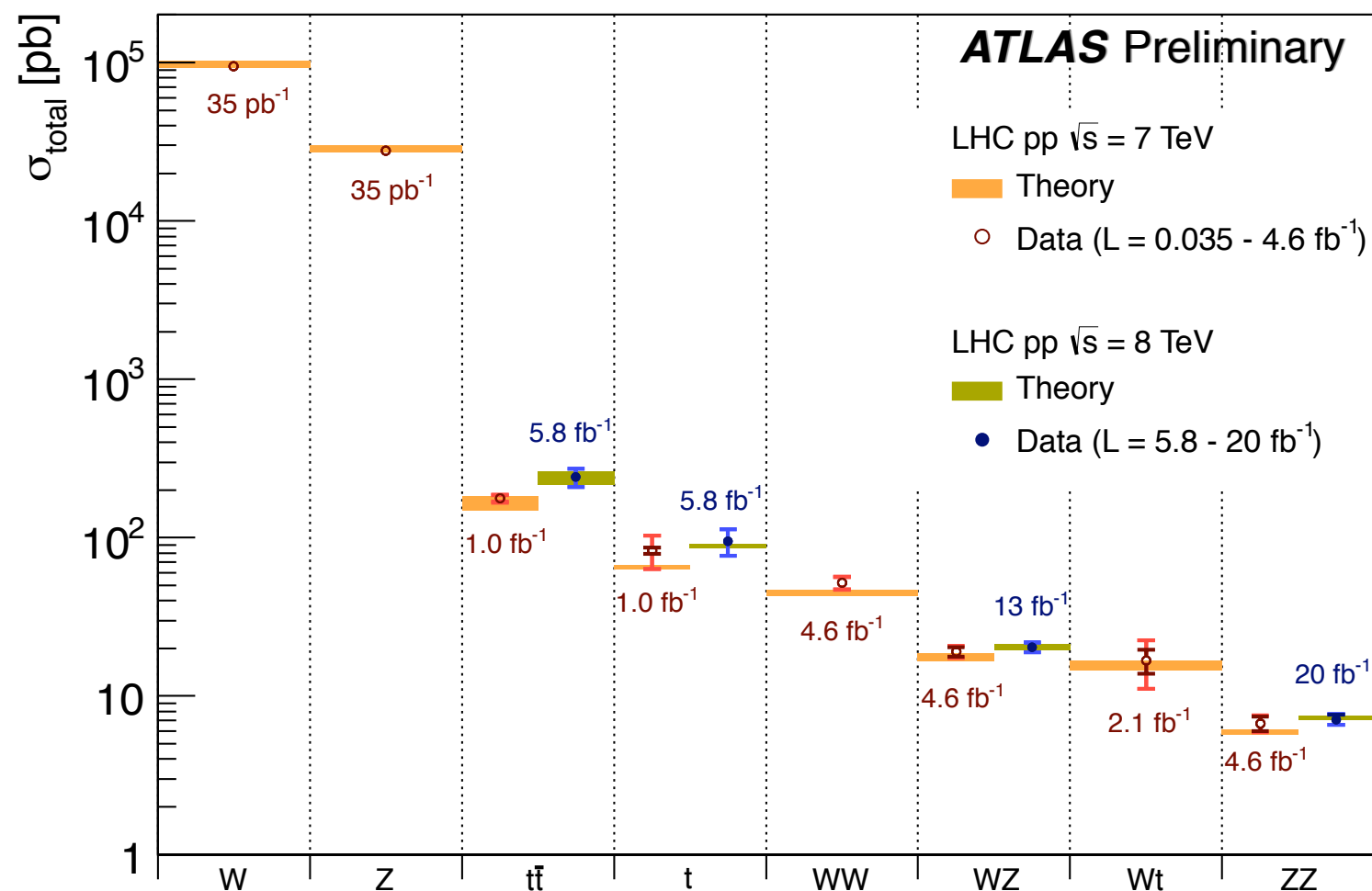
Standard Model



Introduction

► So, what's the problem?

- Needs high levels of fine tuning to avoid quadratic divergences in Higgs mass corrections at high energies
- No explanation of dark matter, dark energy
- No neutrino masses
- No matter-antimatter asymmetry
- No unification of forces
- ...



Standard Model



Introduction

- ▶ SM continues to be validated, besides finding the missing piece, the Higgs!
- ▶ Impressive agreement with theory across orders of magnitude.
- ▶ Established a stable ground for new physics searches. Still, deeper understanding is needed (PDF, NNLO QCD calculations, NLO EWK corr.)

Supersymmetry

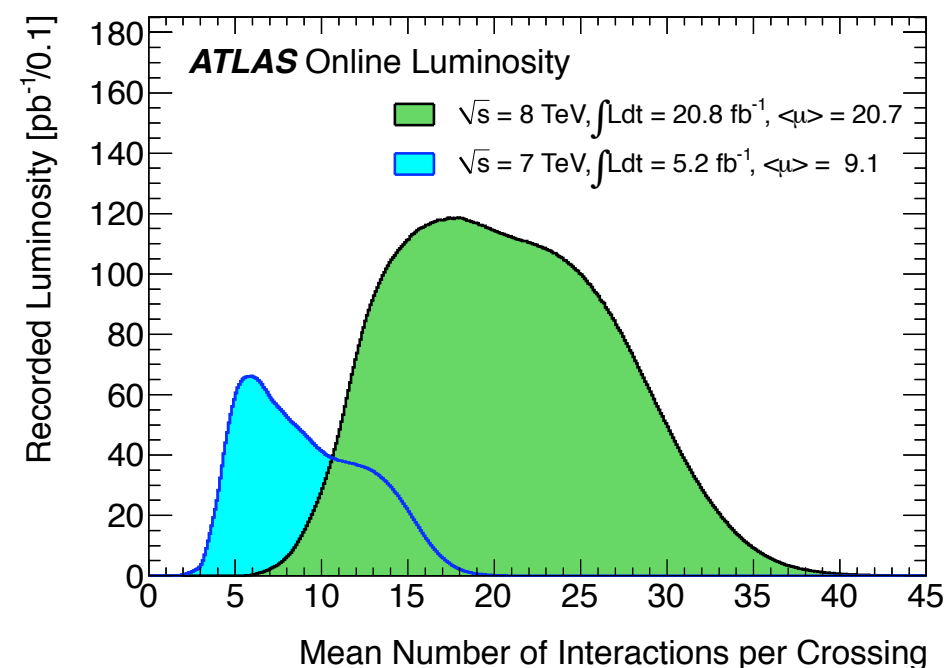
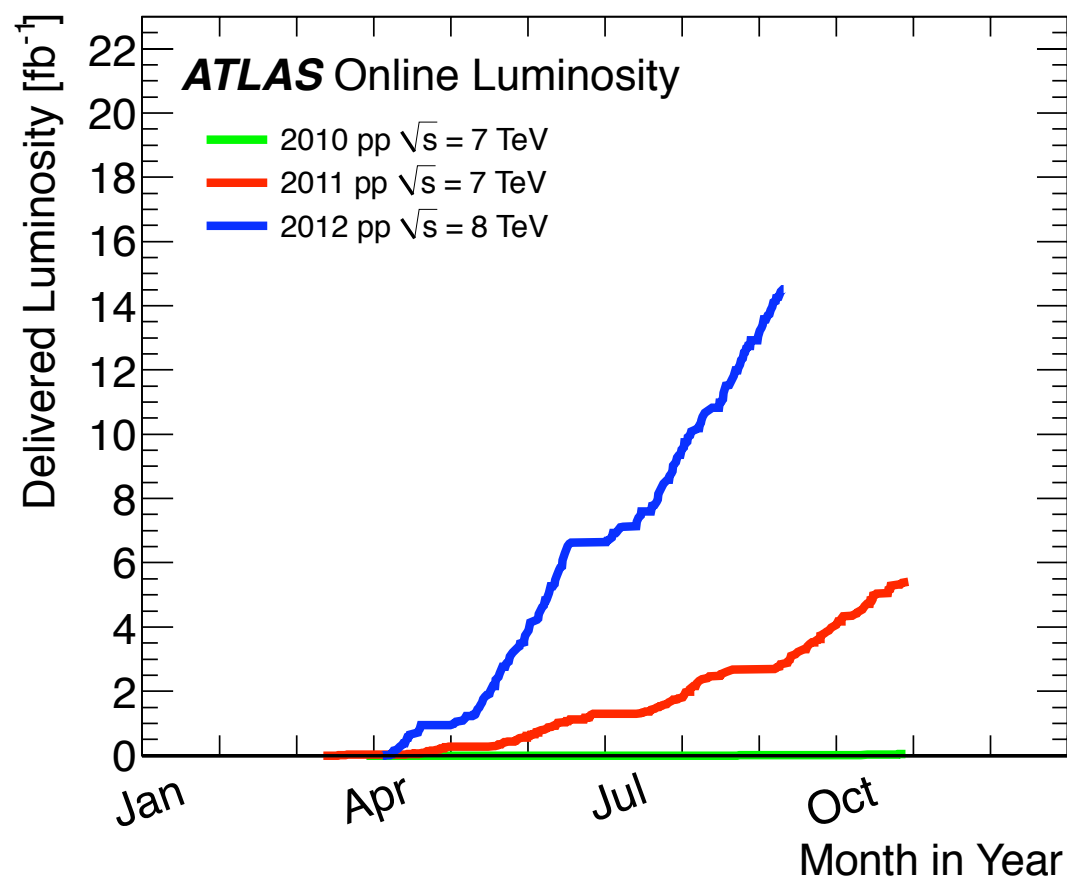
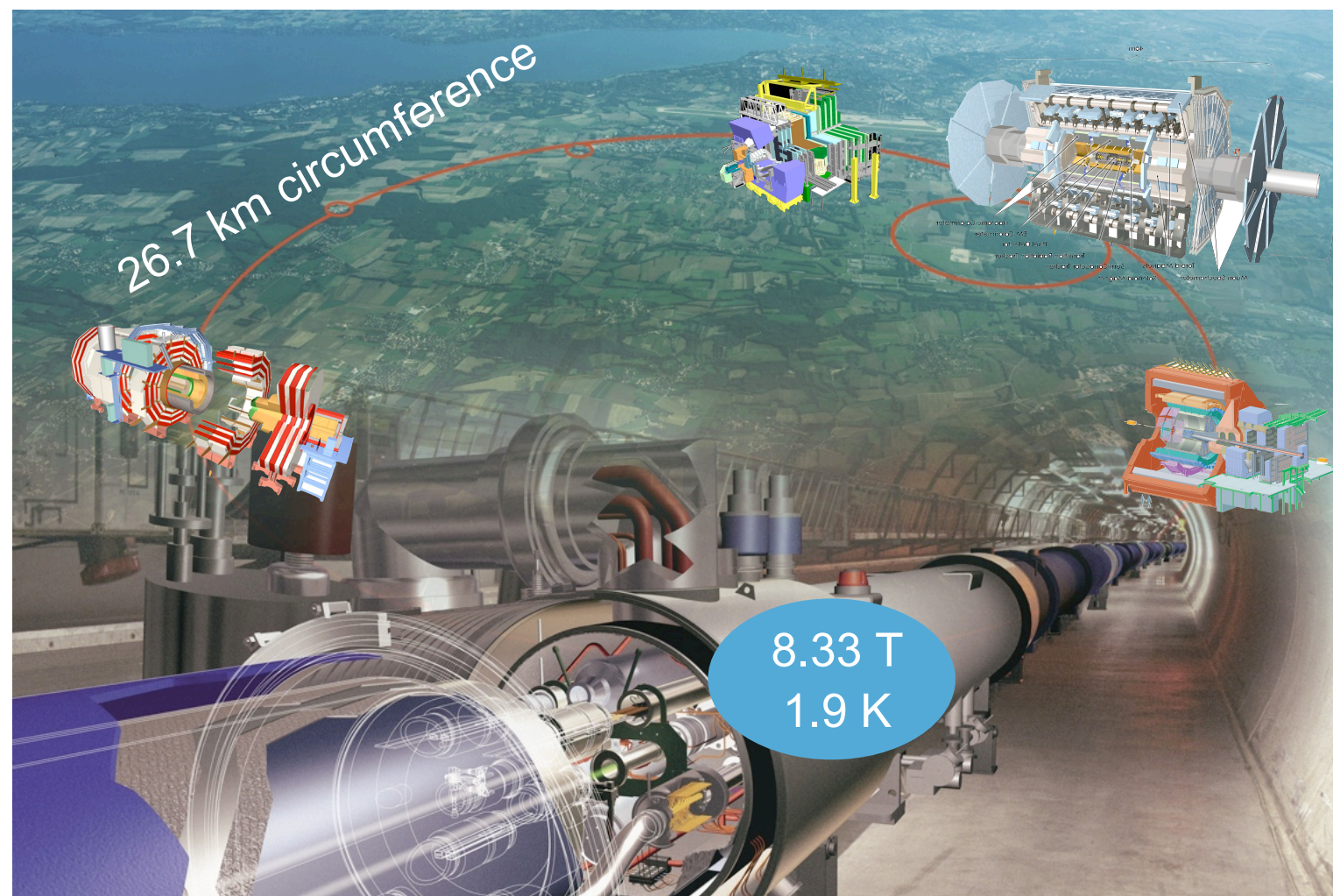
- ▶ SM limitations:
 - ✓ Needs high levels of fine tuning to avoid quadratic divergences in Higgs mass corrections at high energies
 - ✓ No explanation of dark matter, dark energy
 - ✓ No neutrino masses
 - No matter-antimatter asymmetry
 - ✓ No unification of forces
 - ...

Exotic models

- Extra dimensions
- Technicolor(s)
- Little Higgs
- Leptoquarks
- Excited vector bosons and fermions
- Contact Interactions
- Compositeness
- Heavy and Vector-like quarks
- Heavy neutrino
- Quantum black holes
- DM WIMPS
- Heavy Majorana neutrinos
- Magnetic monopoles
- ...

- ▶ Impossible to cover everything.
Put priority on the most recent results

- ▶ pp (and heavy ion) collider
- ▶ Excellent performance so far:
- ▶ **LHC delivered**
 - ~23 fb⁻¹ of pp collisions at $\sqrt{s} = 8$ TeV
 - ~5 fb⁻¹ of pp collisions at $\sqrt{s} = 7$ TeV
- ▶ **ATLAS:**
 - ~90% of recorded and good data in total delivered



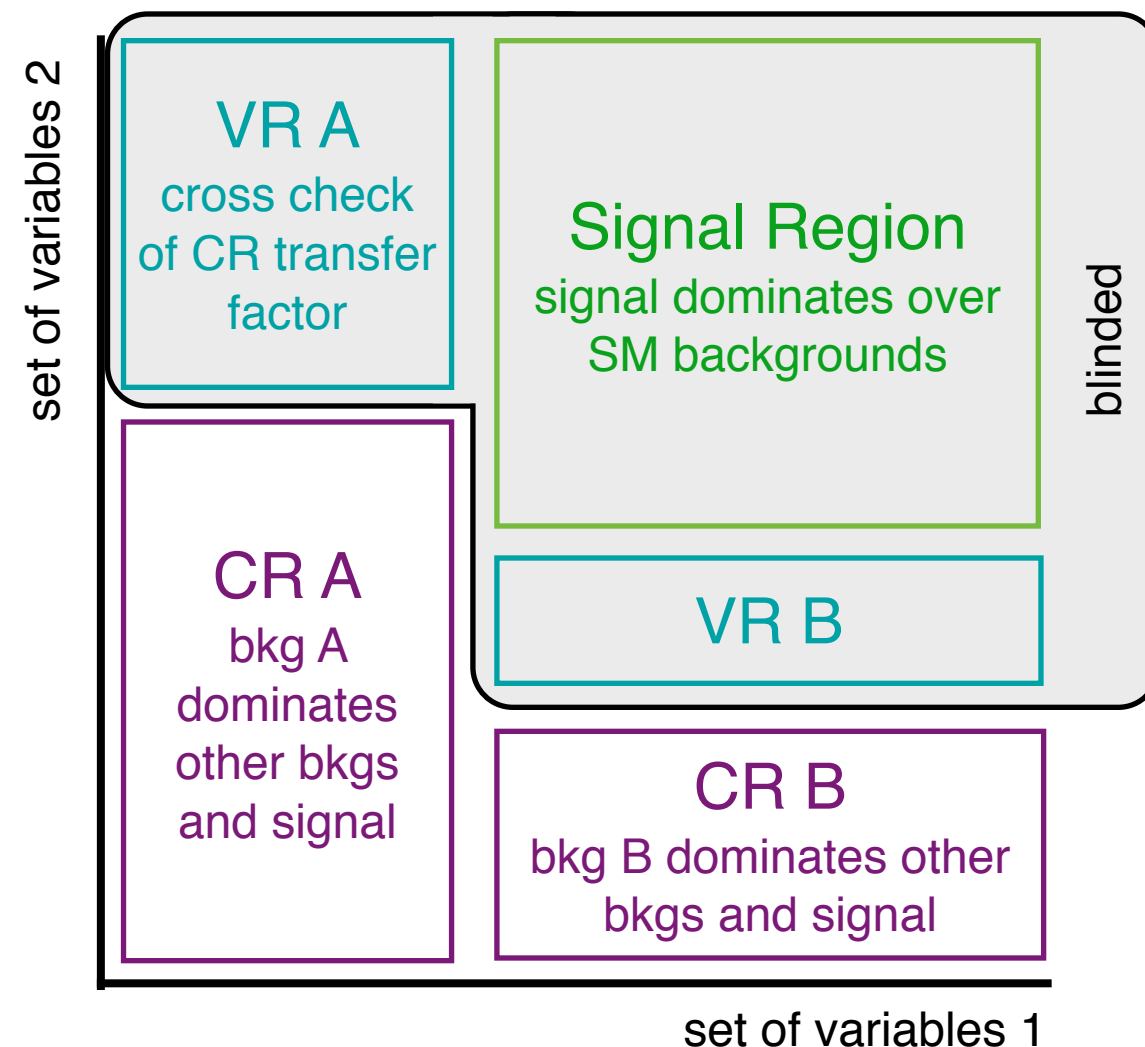
Large pileup (number of interactions per bunch crossing) suppression strategies have been carefully developed

Search method

- ▶ MC used to optimise signal selection in **Signal Regions** (SR).

- ▶ Searches rely on the understanding of the SM backgrounds:

- Irreducible bkg:
 - Dominant sources: Normalise MC to data in **Control Regions** → **transfer factor**.
 - **Validation regions**: transfer factors cross check.
 - Minor sources → **MC estimation**.
- Reducible bkg:
 - Fake EtMiss → **data-driven**
 - Charge mismeasurement → **data-driven**
 - Fake leptons → **data-driven**



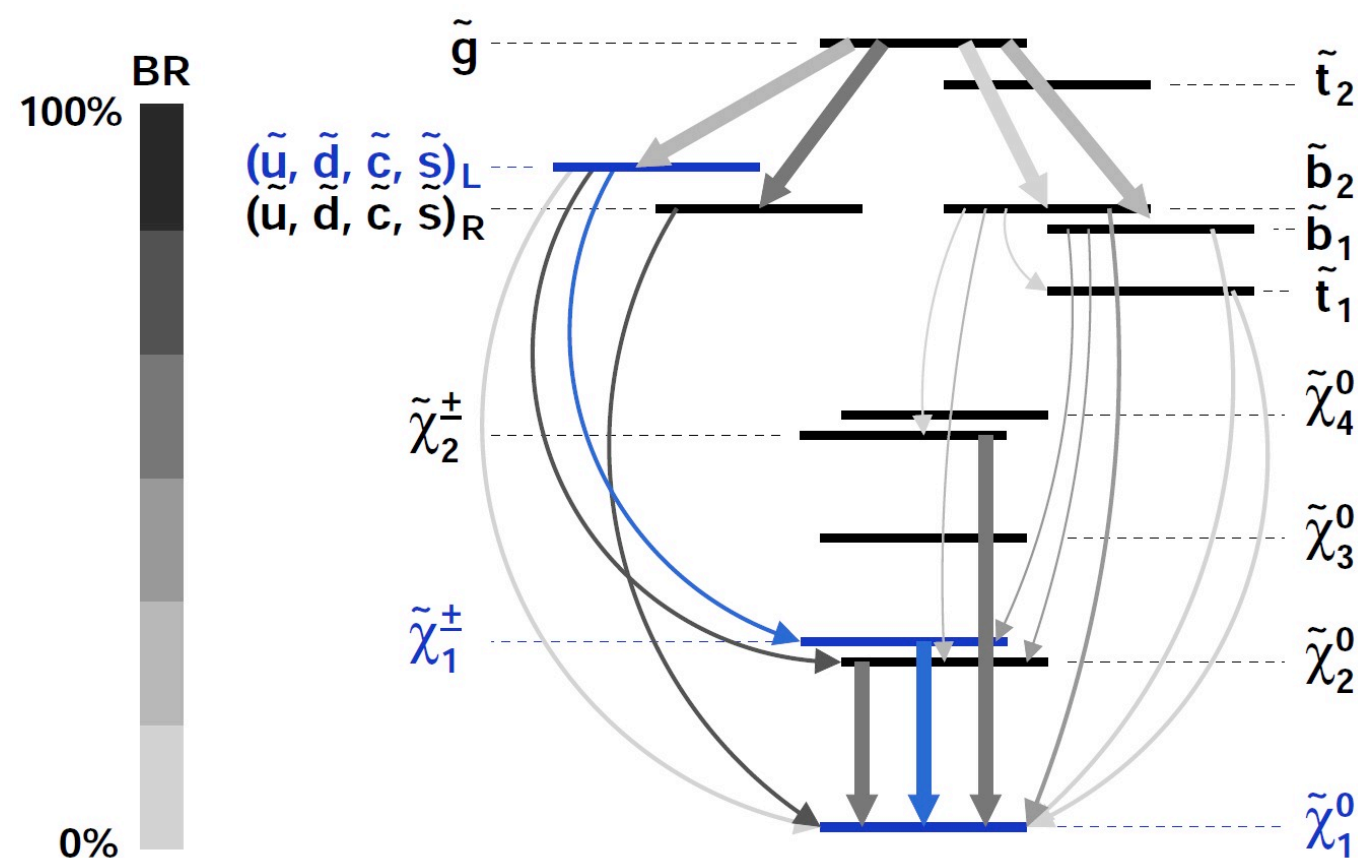
- ▶ Interpretation of results using CLs prescriptions.

- Discovery fit (look for an excess of data wrt SM estimation; no signal considered)
- Exclusion fit (limit setting; particular model considered)

SUSY

- ▶ SUSY breaking mechanism not known.
- ▶ SUSY is not a single model but a large theoretical framework. Where should we look?
 - Searches using full-model simulations
 - Searches using simplified models

Physics model e.g. MSUGRA/CMSSM



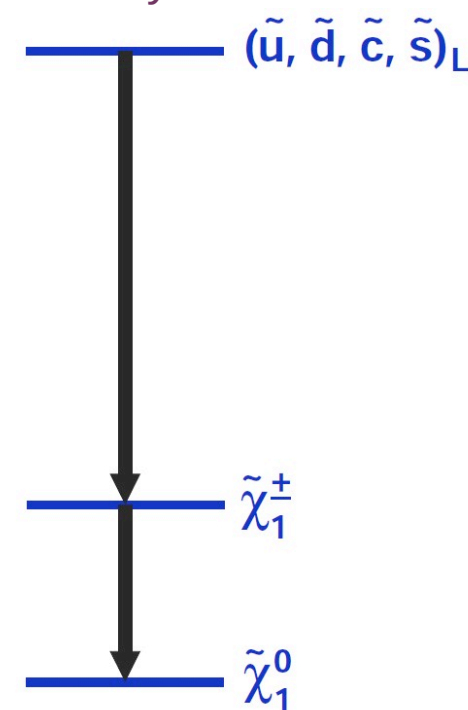
A typical SUSY spectrum involves

- + many sparticles with different masses
- + many different possible ways for each to decay

Focus on process of interest

Simplified model

Study a specific decay chain



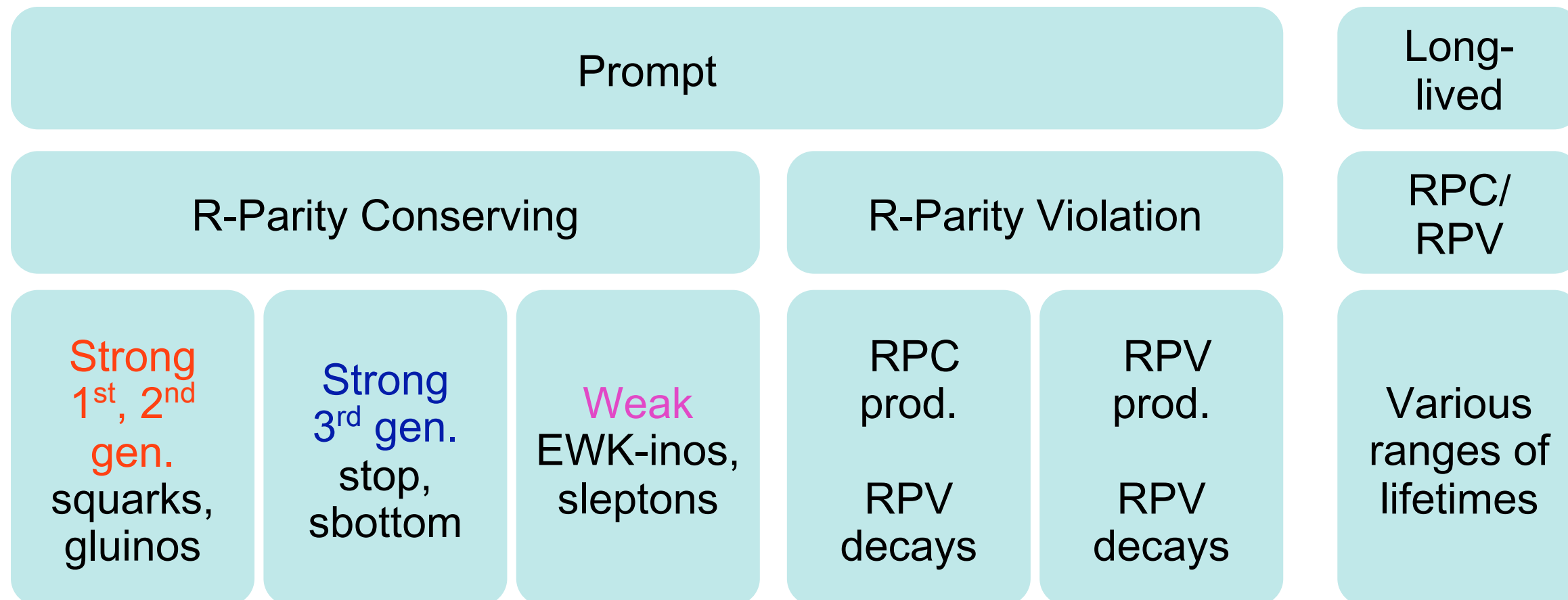
- + Small number of sparticles, assumed BR – usually 100%.
- + Described by masses and cross-sections.
- + Simple and broad approach for designing SUSY searches.

From Tina Potter
LHC Seminar 15 Oct 2013

SUSY search strategy

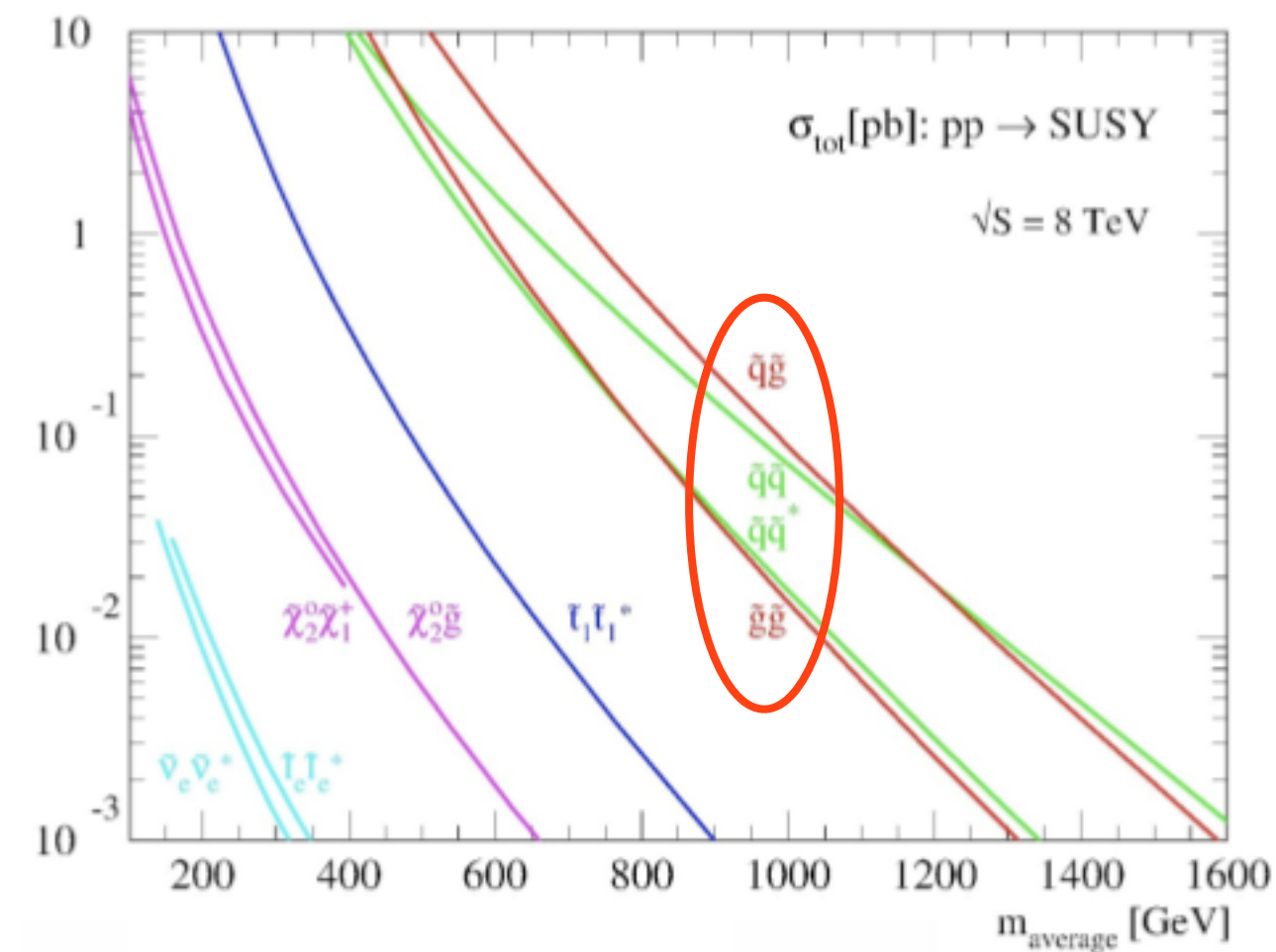
- Search strategy designed to provide coverage for a broad class of models.

$$\mathcal{R} = (-1)^{3B + L + 2S} = \begin{cases} +1 & \text{for SM particles} \\ -1 & \text{for SUSY particles} \end{cases}$$



- For each search, a number of signal regions is optimised based on a variety of models: full physics models, generalised models, simplified models.
- Defines topology and identifies possible background

squark/gluino searches

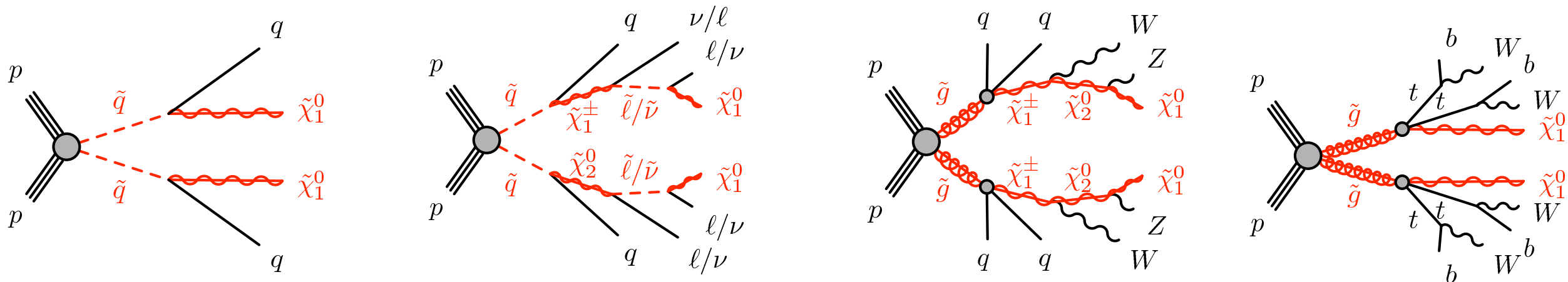


- Strongly produced SUSY particles at the LHC dominate total SUSY cross-section in many SUSY models (eg. mSUGRA/cMSSM)

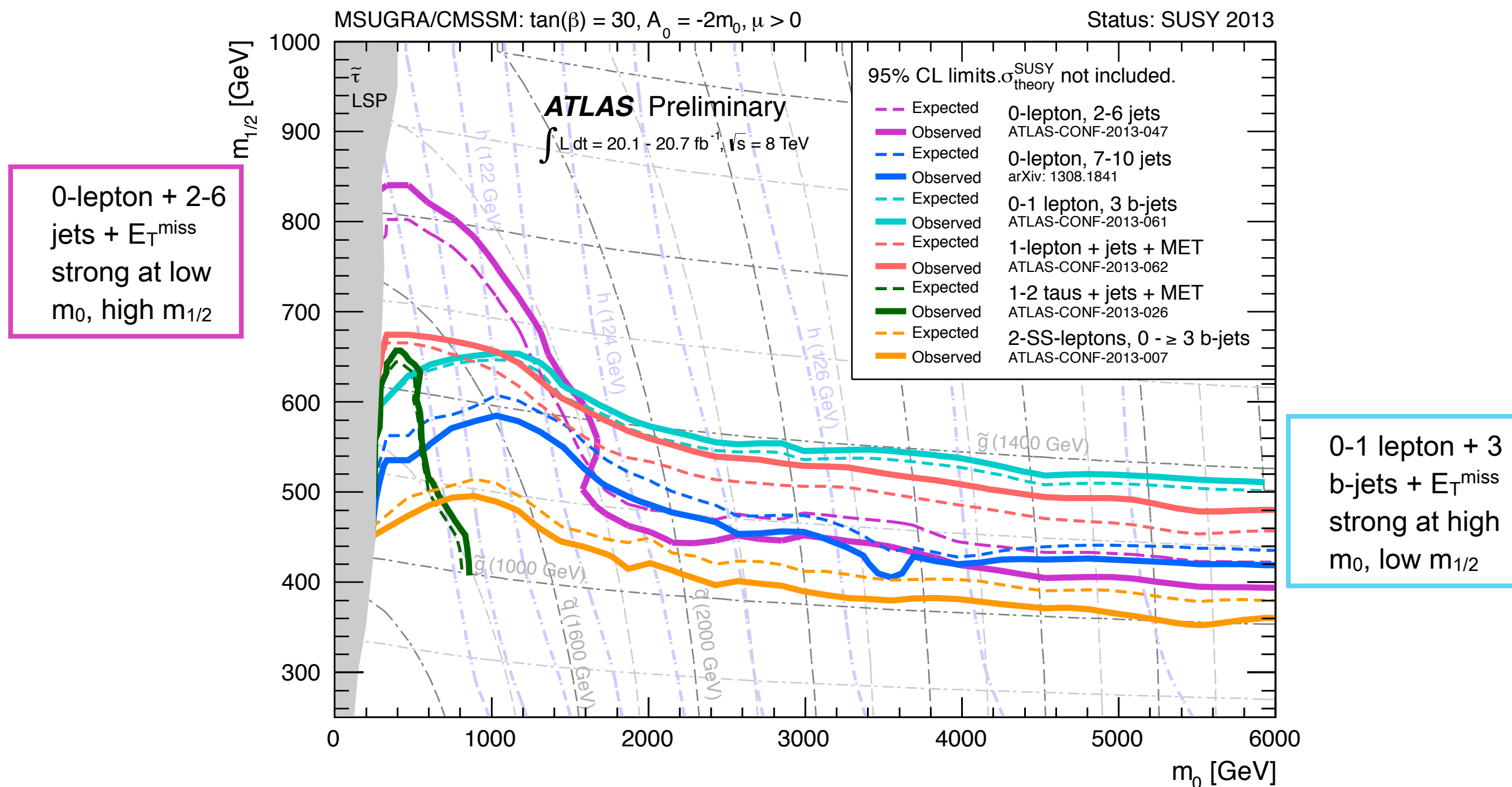
Analyses:

0-lepton + 2-6 jets + E_T^{miss}
 0-lepton + 7-10 jets + E_T^{miss}
 1-2 lepton + jets + E_T^{miss}
 2-lepton + 2-6 jets + E_T^{miss}
 1-2 taus + jets + E_T^{miss}
 Z(l) + E_T^{miss}
 photon + lepton + E_T^{miss}

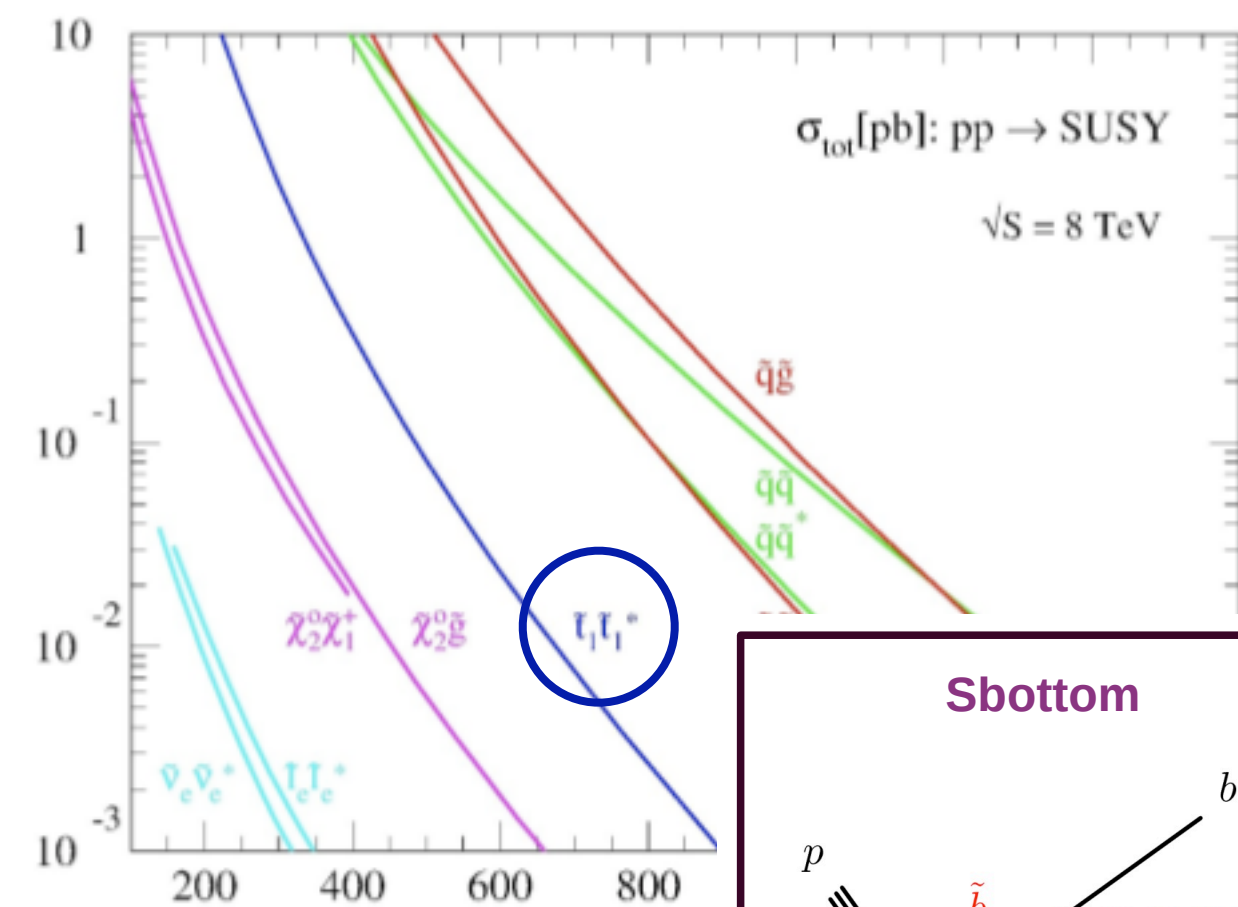
- Final state depends on decay of squark/gluino



- ▶ A specific SUSY framework like mSUGRA can be used to compare the performance of search channels

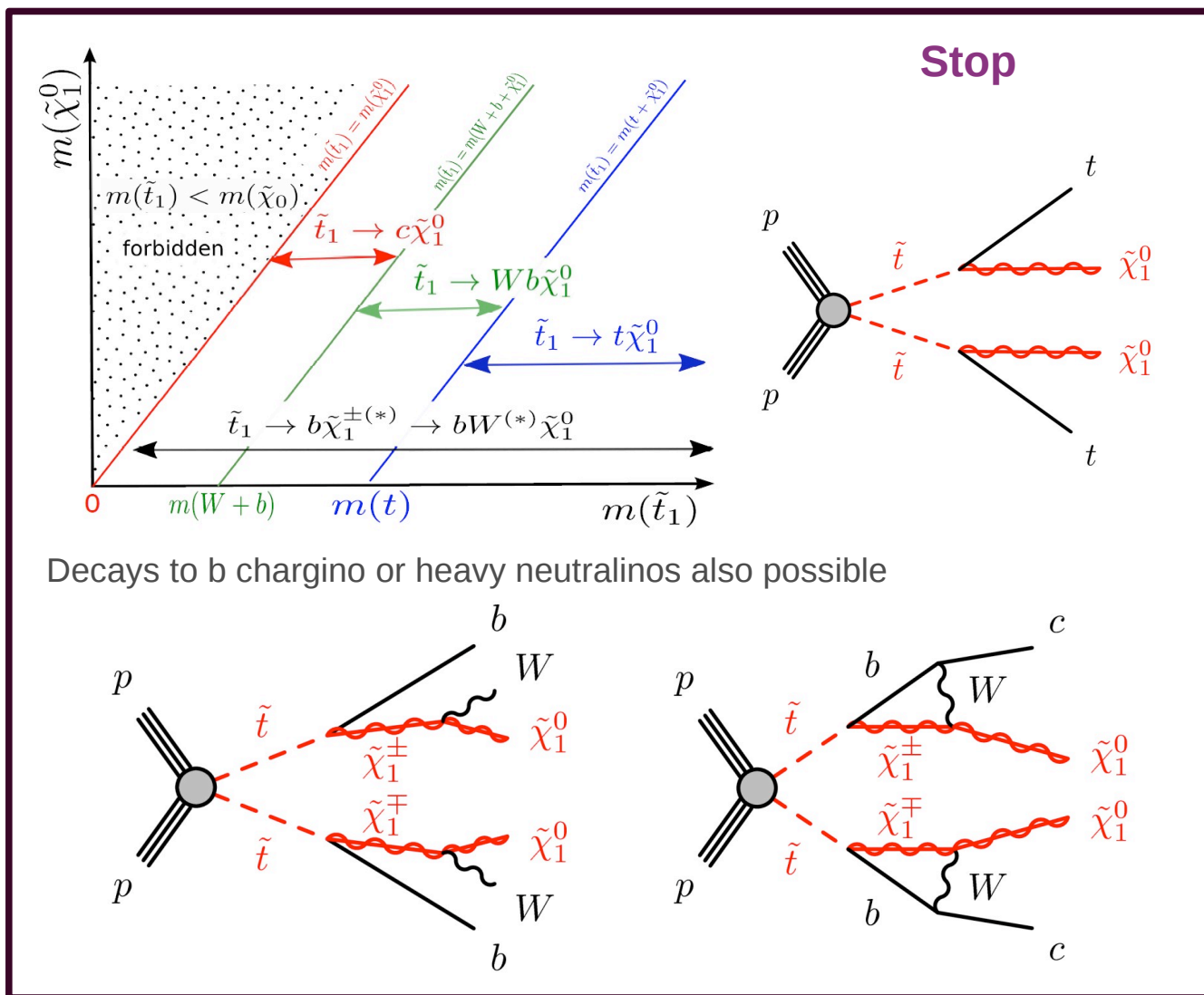
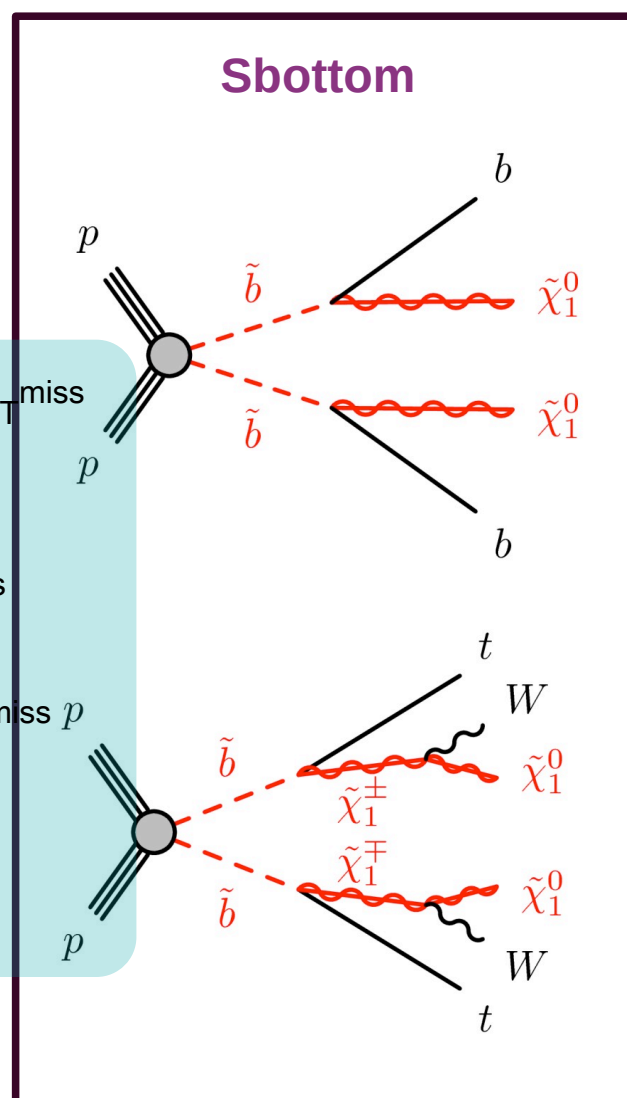


- ▶ Exclusion limit at 95% CL for 8 TeV analyses in the $(m_0, m_{1/2})$ plane for a "Higgs-aware" MSUGRA/CMSSM model with: $\tan\beta = 30; A_0 = -2m_0, \mu > 0$
- ▶ model excluded for $m_q < 1.8 \text{ TeV}; m_g < 1.4 \text{ TeV}$

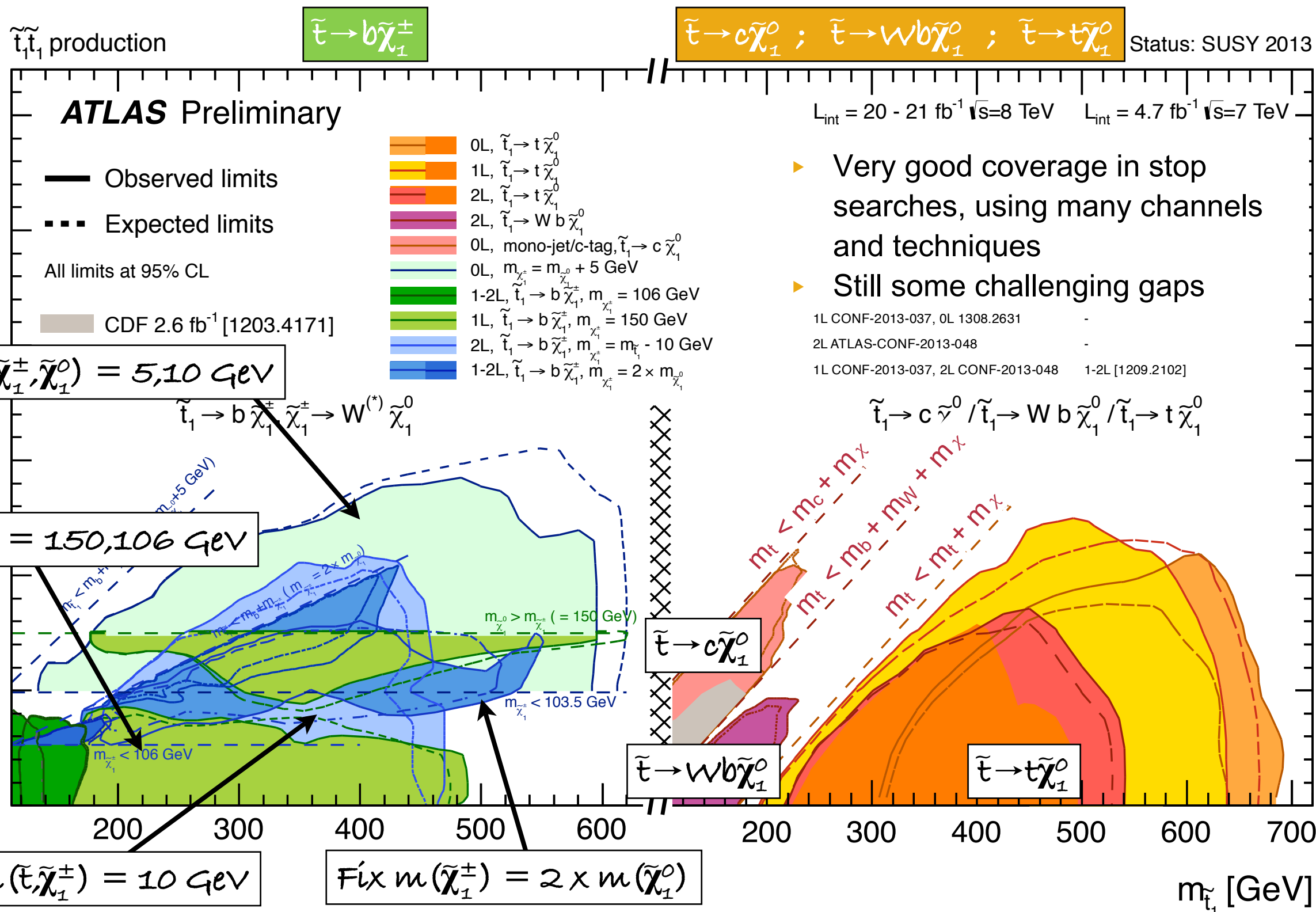


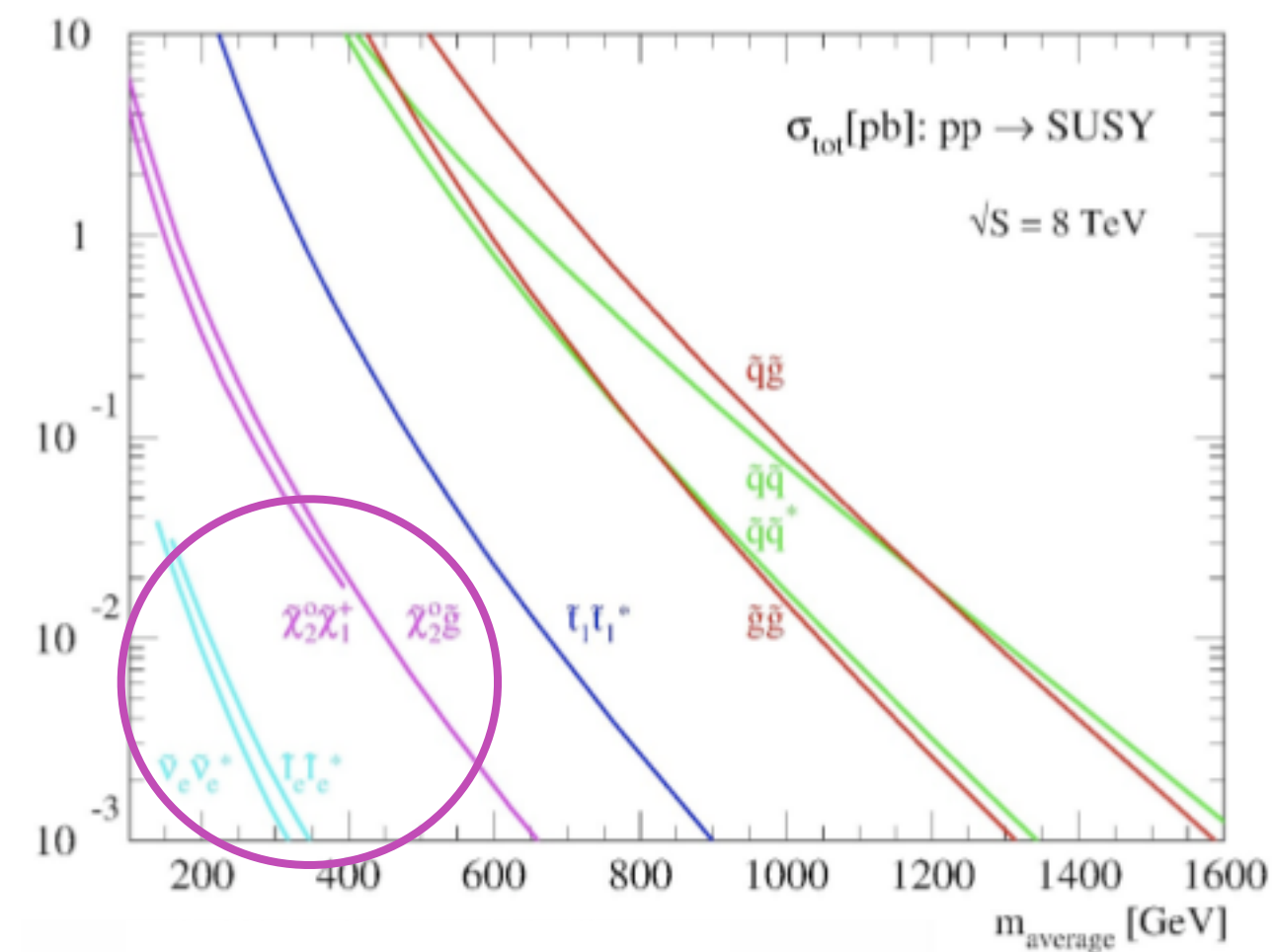
- ▶ Smaller cross section than 1st, 2nd gen. squarks
- ▶ Light stop preferred by naturalness
- ▶ Final state depends on decay of stop/sbottom

0-lepton + 6 jets + 2 b-jets + E_T^{miss}
 0-lepton + 2 b-jets + E_T^{miss}
 0-1 lepton + ≥ 3 b-jets + E_T^{miss}
 2 SS leptons (+ b-jets) + E_T^{miss}
 3 leptons + jets + E_T^{miss}
 1-lepton + 4 jets (1 b-jet) + E_T^{miss}
 2-lepton (+ 2 b-jets) + E_T^{miss}
 Charm/mono-jet + E_T^{miss}
 Z(ll) + 2 b-jets + E_T^{miss}



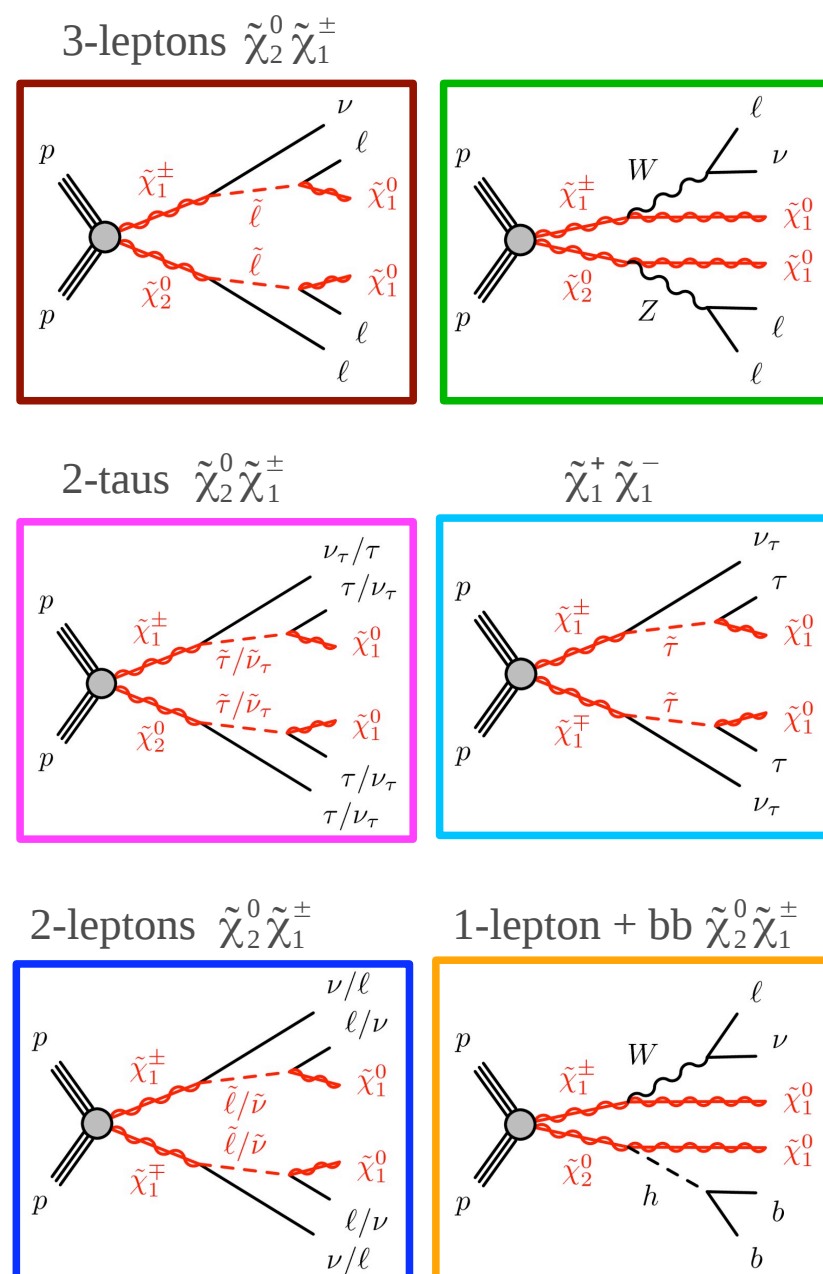
- Global picture of multitude of complementary direct stop searches
- Caution: simplified decay models take different assumptions!



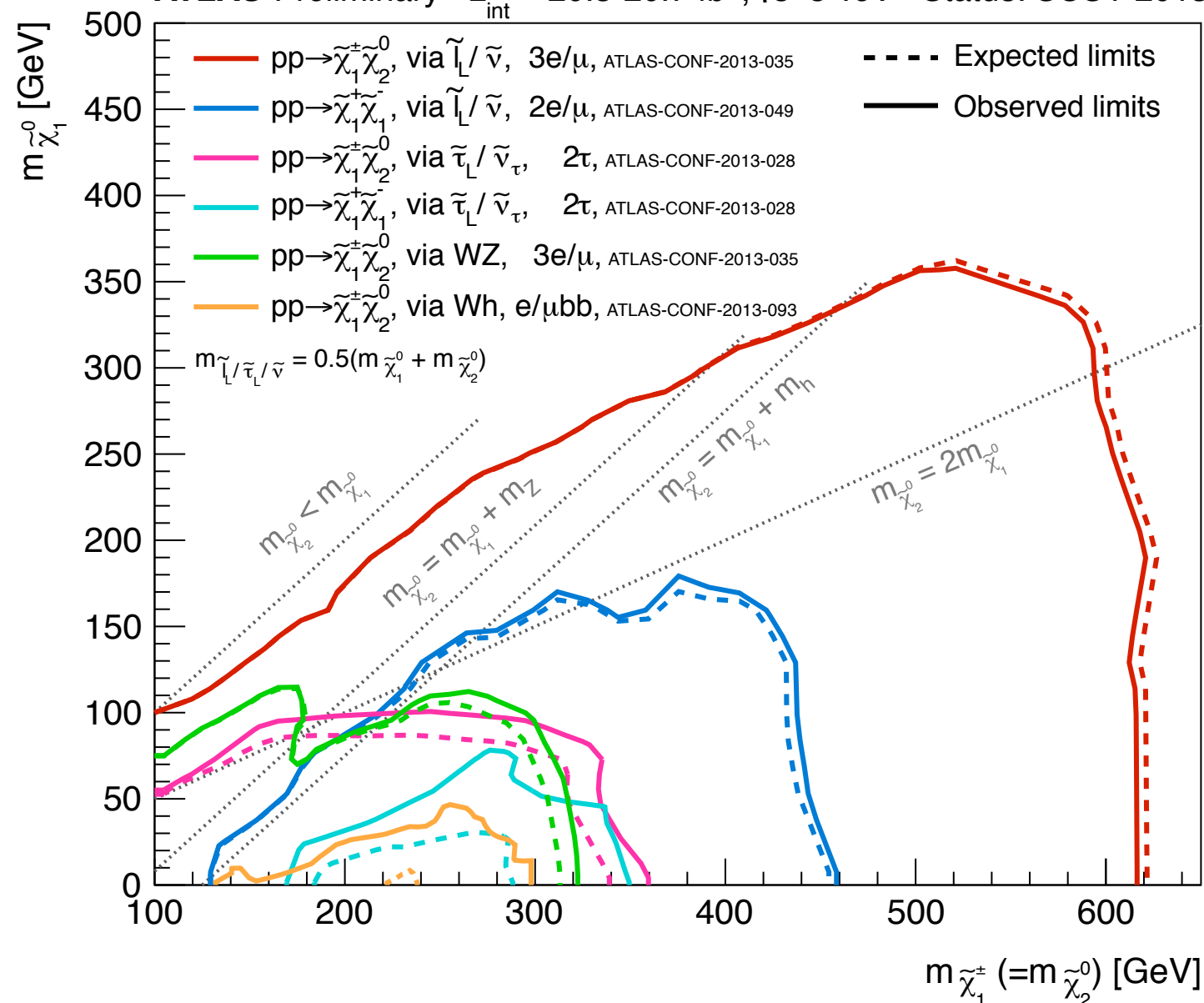


2-lepton + E_T^{miss}
 3-lepton + E_T^{miss}
 4-lepton + E_T^{miss}
 2-taus + E_T^{miss}
 1-lepton + 2 b-jets + E_T^{miss}

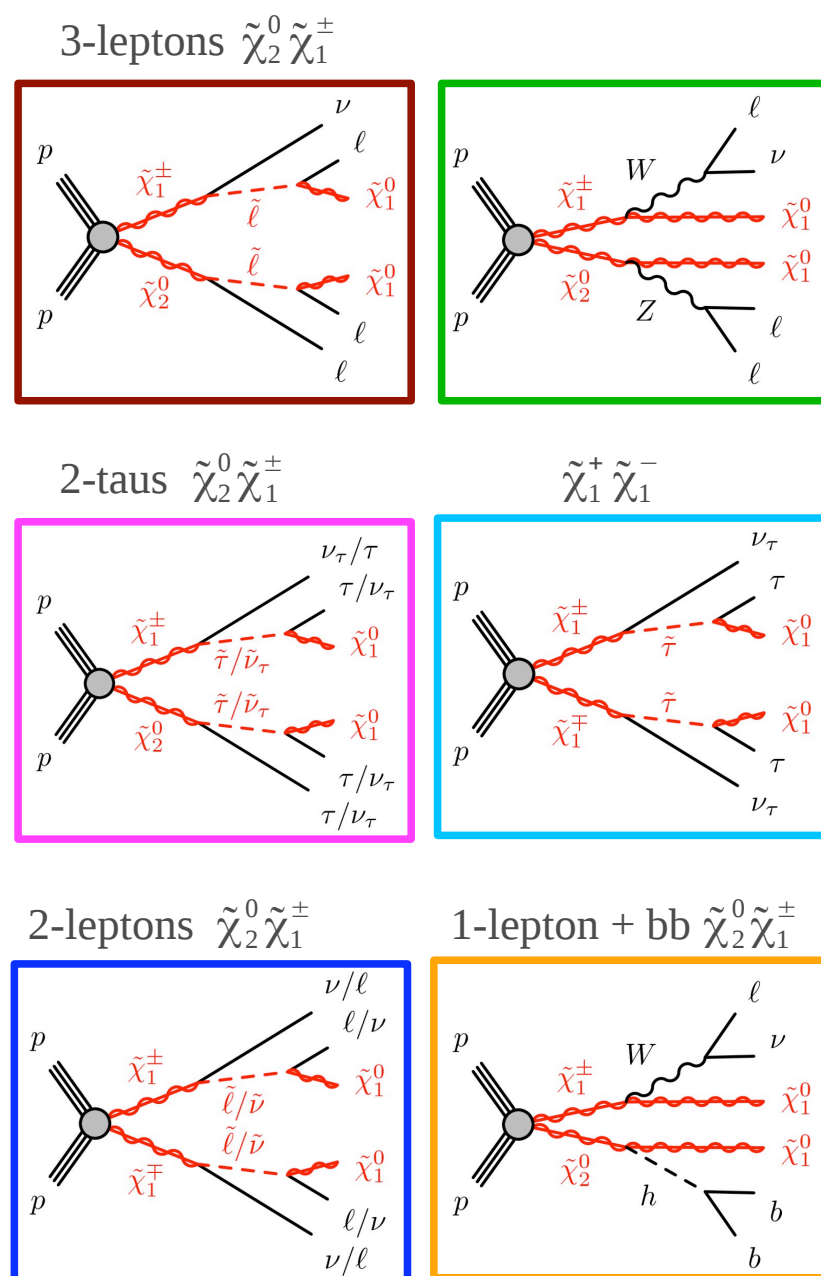
- ▶ Electroweak SUSY processes have small cross sections
- ▶ Light higgsinos preferred by naturalness



ATLAS Preliminary L_{int} = 20.3-20.7 fb⁻¹, √s=8 TeV Status: SUSY 2013



- ▶ Electroweak SUSY processes have small cross sections
- ▶ Light higgsinos preferred by naturalness



RPV searches

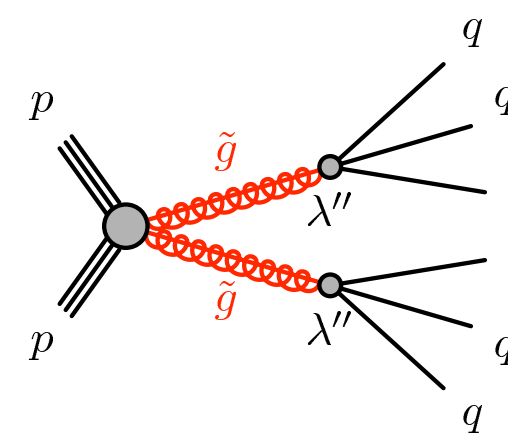
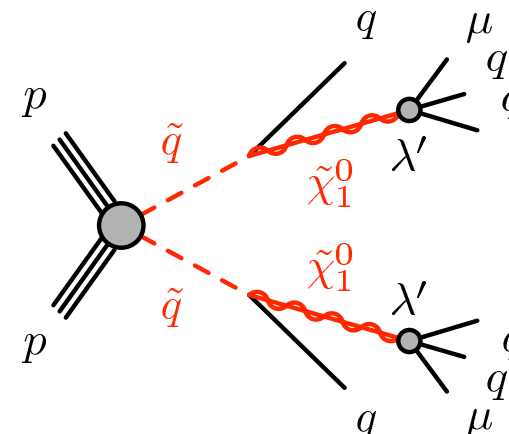
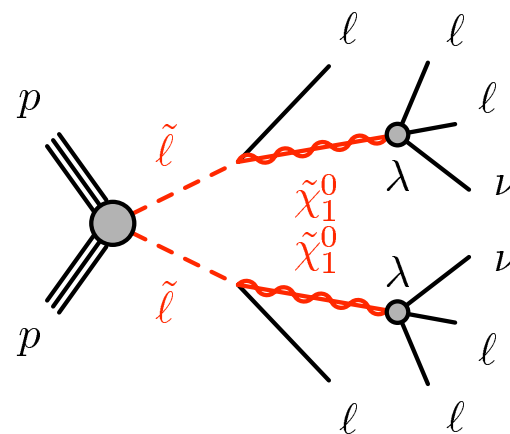
- ▶ Conserving lepton (L) and baryon (B) numbers ensures proton lifetime BUT soft violation of B OR L still keeps proton lifetime safe.

$$\mathcal{R} = (-1)^{3B + L + 2s} = \begin{cases} +1 & \text{for SM particles} \\ -1 & \text{for SUSY particles} \end{cases}$$

L-number violating terms

$$W_{RP}^{MSSM} = \sum_i \epsilon_i \hat{L}_i \hat{H}_u + \sum_{i,j,k} \lambda_{ijk} \hat{L}_i \hat{L}_j \hat{E}_k + \sum_{i,j,k} \lambda'_{ijk} \hat{L}_i \hat{Q}_j \hat{D}_k + \underbrace{\sum_{i,j,k} \lambda''_{ijk} \hat{U}_i^c \hat{D}_j^c \hat{D}_k^c}_{\text{B-number violating terms}}$$

$$\begin{array}{ll} \tilde{\chi}_1^0 \rightarrow e^\pm W^\mp & \tilde{\chi}_1^0 \rightarrow \nu b \bar{b} \\ \tilde{\chi}_1^0 \rightarrow \mu^\pm W^\mp & \tilde{\chi}_1^0 \rightarrow \nu \tau \tau \\ \tilde{\chi}_1^0 \rightarrow \tau^\pm W^\mp & \tilde{\chi}_1^0 \rightarrow \nu \tau \mu \\ \tilde{\chi}_1^0 \rightarrow \nu Z & \tilde{\chi}_1^0 \rightarrow \nu \tau e \end{array}$$

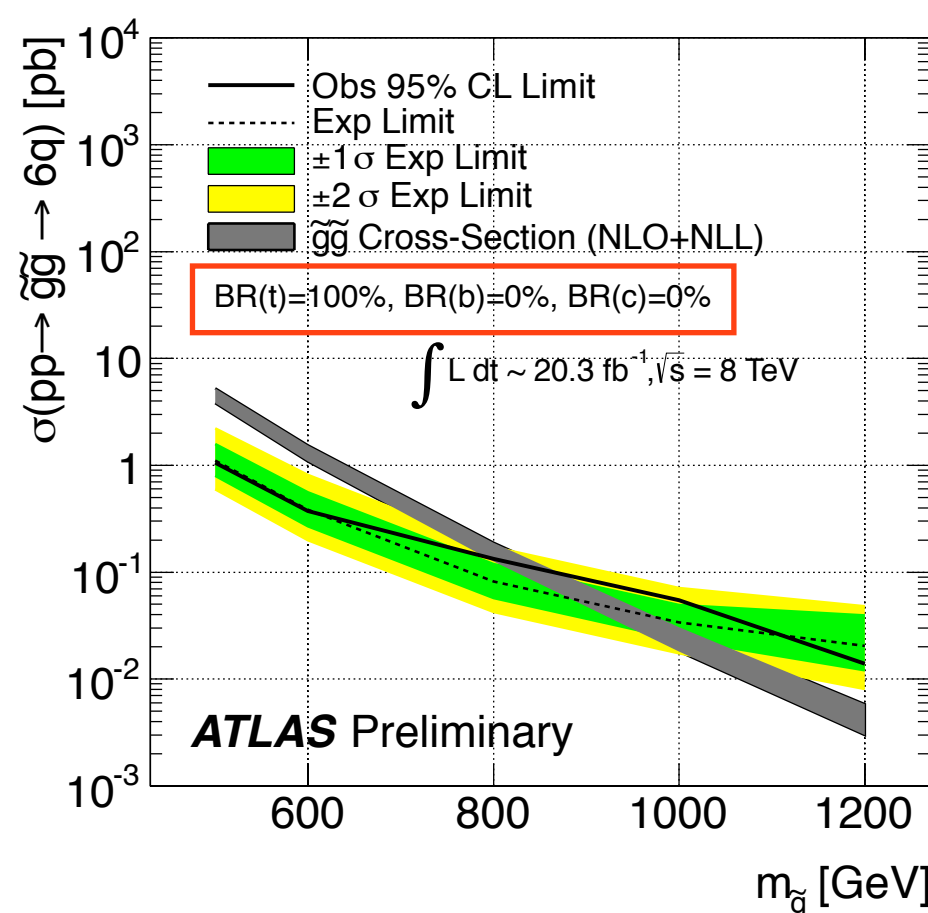
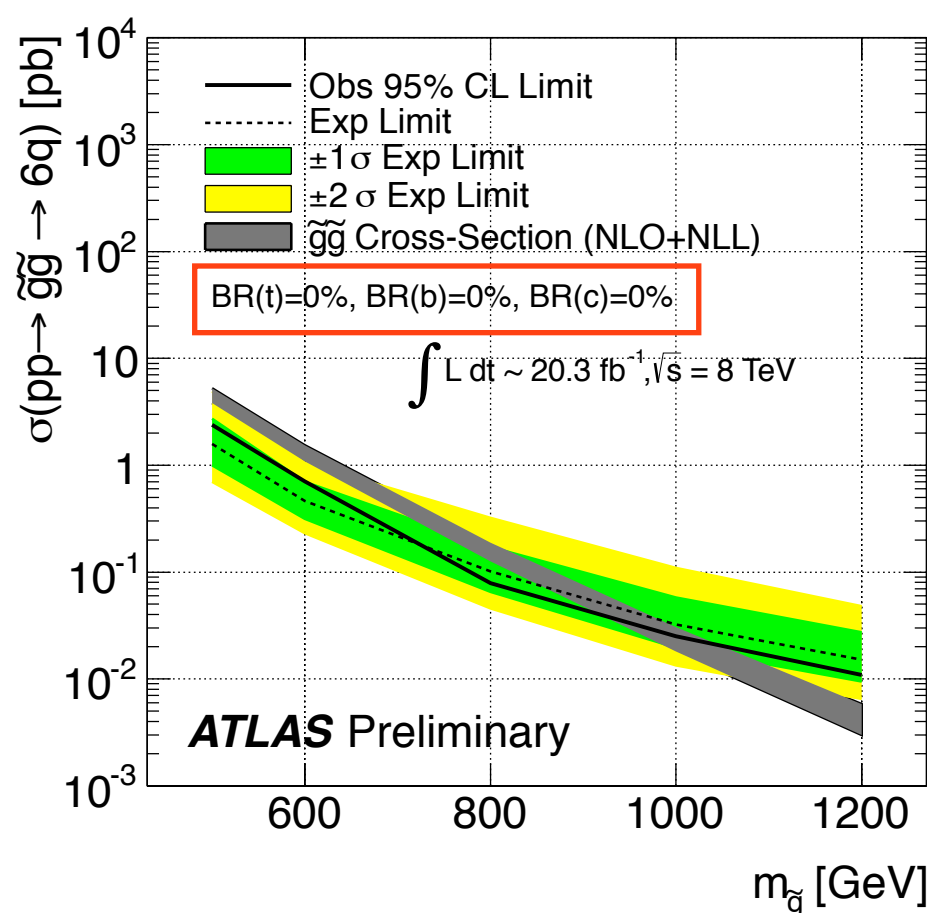


- ▶ L and/or B violation constrained by previous experiments but not forbidden.
- ▶ RPV can happen at production level and/or decay vertex

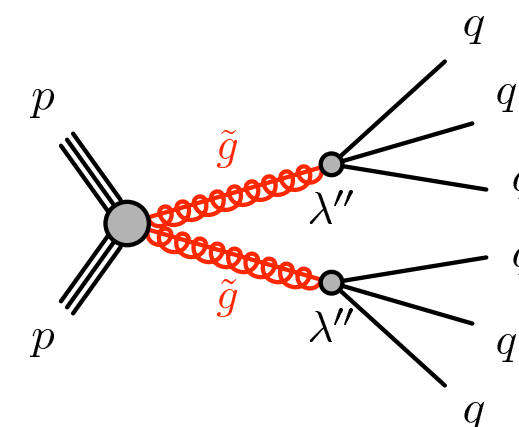
Multijets (2x3 jets)

Heavy resonances to $e\mu$, $e\tau$, $\mu\tau$
4-leptons
1-lepton + jets + E_T^{miss}

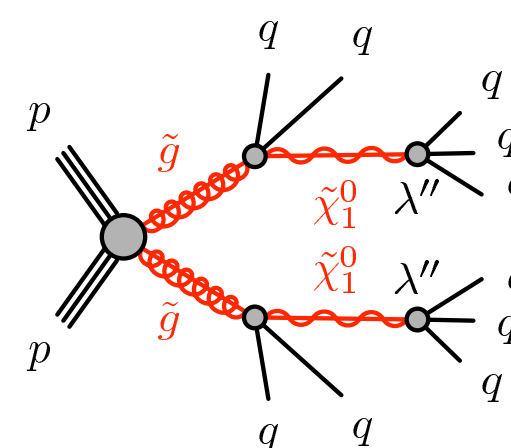
- Consider gluino or neutralino LSP decaying to jets
- Searching for resonances is difficult due to combinatorics
- Search for events with > 6 high pt jets with 0-2 b-tagged jets to estimate BR to heavy flavour quarks



6-quark model



10-quark model

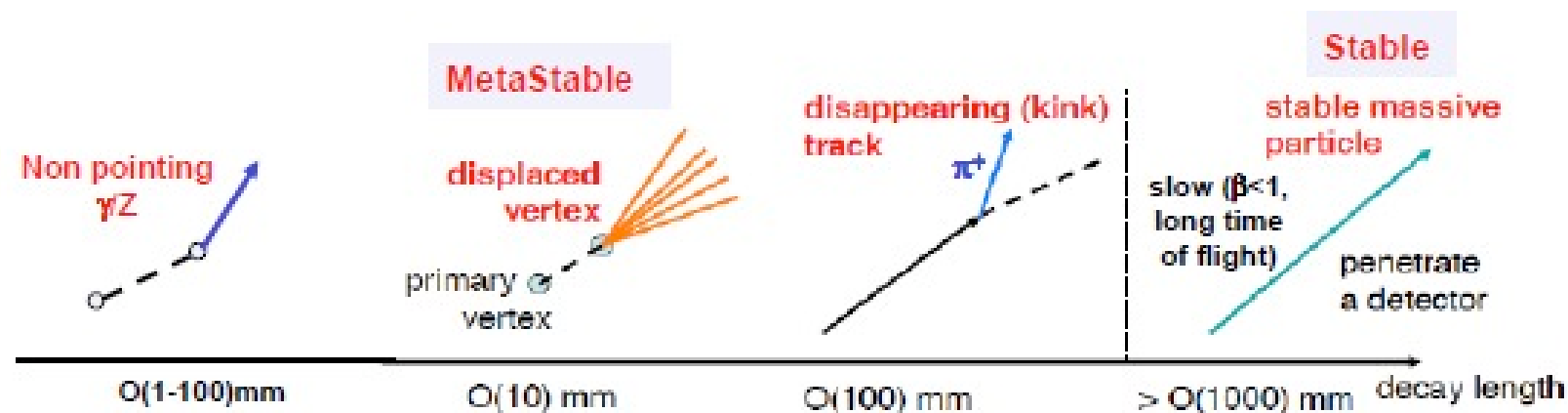


- Gluinos excluded up to ~ 900 GeV for $BR(\text{heavy quarks}) = 0\%$; up to ~ 800 GeV for $BR(\text{top}) = 100\%$

Long-lived particles

- ▶ Long-lived particles can arise from:
 - Heavy mediator sparticles e.g. split SUSY
 - mass degeneracy
 - weak couplings, eg RPV
- ▶ Wide lifetime coverage

Disappearing track
stopped gluino
long-lived slepton
displaced vertex
non-pointing photon



Exotic models

- ▶ Many extensions of the SM other than SUSY have been developed
- ▶ Signature based searches: cover as much of the theory space as we can with a set of searches based on more general experimental signatures
 - ▶ Then interpret them in specific models to obtain limits on masses, scales, etc.

▶ Pursue signature based searches

Heavy resonances: dileptons, dijets, top-antitop, dibosons, diphotons, ditau, lepton + jets, photon + jets, Z + b-jet, Z+lepton, tau+b-jet, Z+photon, W+photon

Mono-X: mono-jet, mono-photon, mono-W, mono-Z, ...

Same sign dileptons
multileptons

non-resonant excess in ll mass

Long-lived particles

slow-moving particles

...

Extra dimensions

Technicolor(s)

Little Higgs

Leptoquarks

Excited vector bosons and fermions

Contact Interactions

Compositeness

Heavy and Vector-like quarks

Heavy neutrino

TeV Gravity

Quantum black holes

DM WIMPS

Heavy Majorana neutrinos

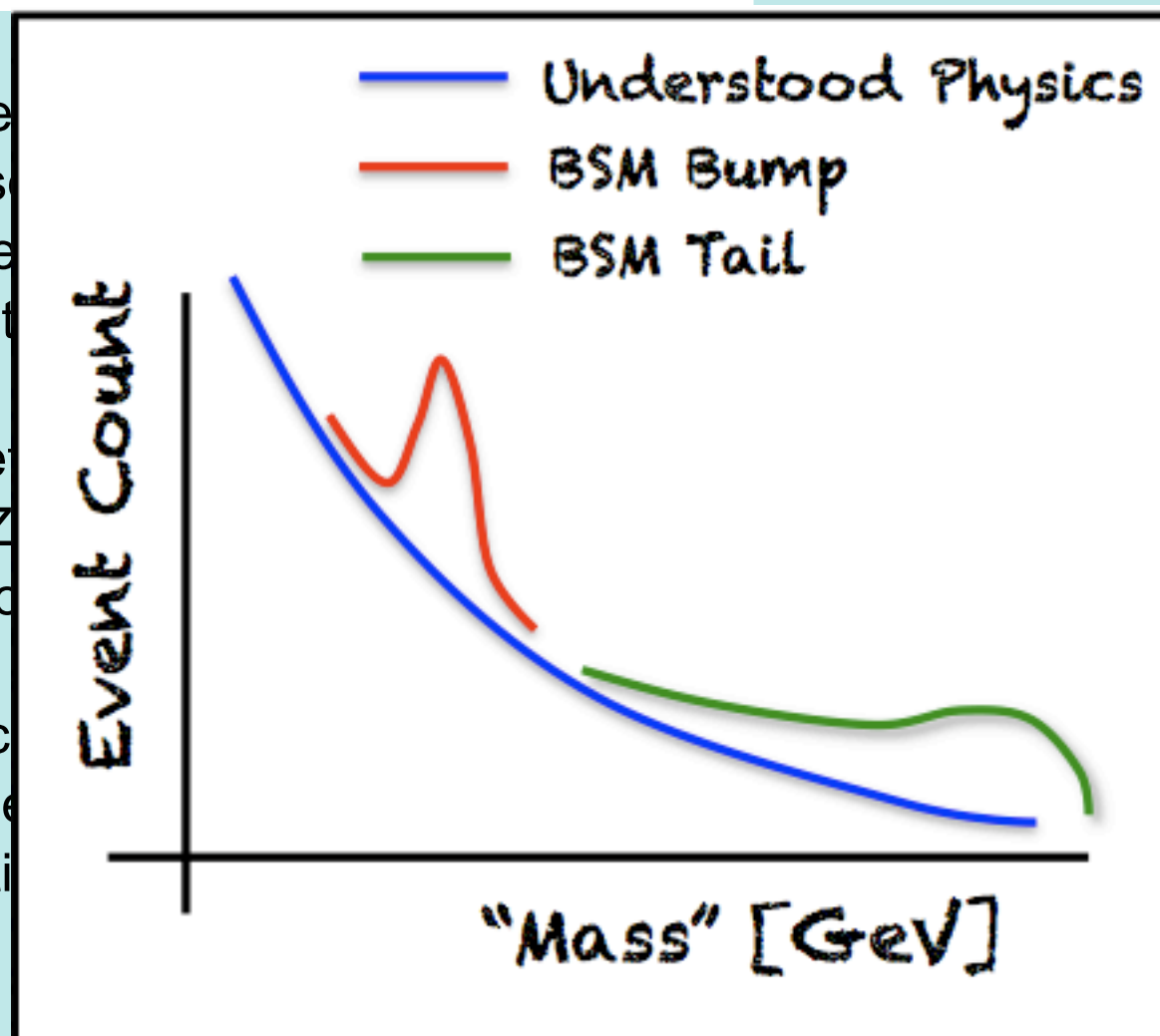
Magnetic monopoles

...

Exotic models

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- ▶ Pursue signature based searches

Heavy resonance
top-antitop, diboson
ditaus, lepton + jet
+b-jet, Z+lepton, t
W+photon
Mono-X: mono-jet
mono-W, mono-Z
Same sign dilepton
multileptons
non-resonant exc
Long-lived particle
slow-moving parti
...



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interactions

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Vector-like quarks

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black holes

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brana neutrinos

monopoles

- ▶ inspect mass spectrums and look for excess not explained by well understood phenomena



VLQ's
4th gen b' quarks
4-top final state

Same sign dileptons

21

14.3 fb⁻¹ @ 8 TeV

ATLAS-CONF-2013-051

► General search for anomalies in SS dileptons

► Low SM bkg

► Selection:

Same-sign dilepton (e/μ)

≥ 2 jets (≥1 b-tagged)

$E_T^{\text{miss}} > 40$ GeV

H_T (jets+leptons) > 550 or 650 GeV

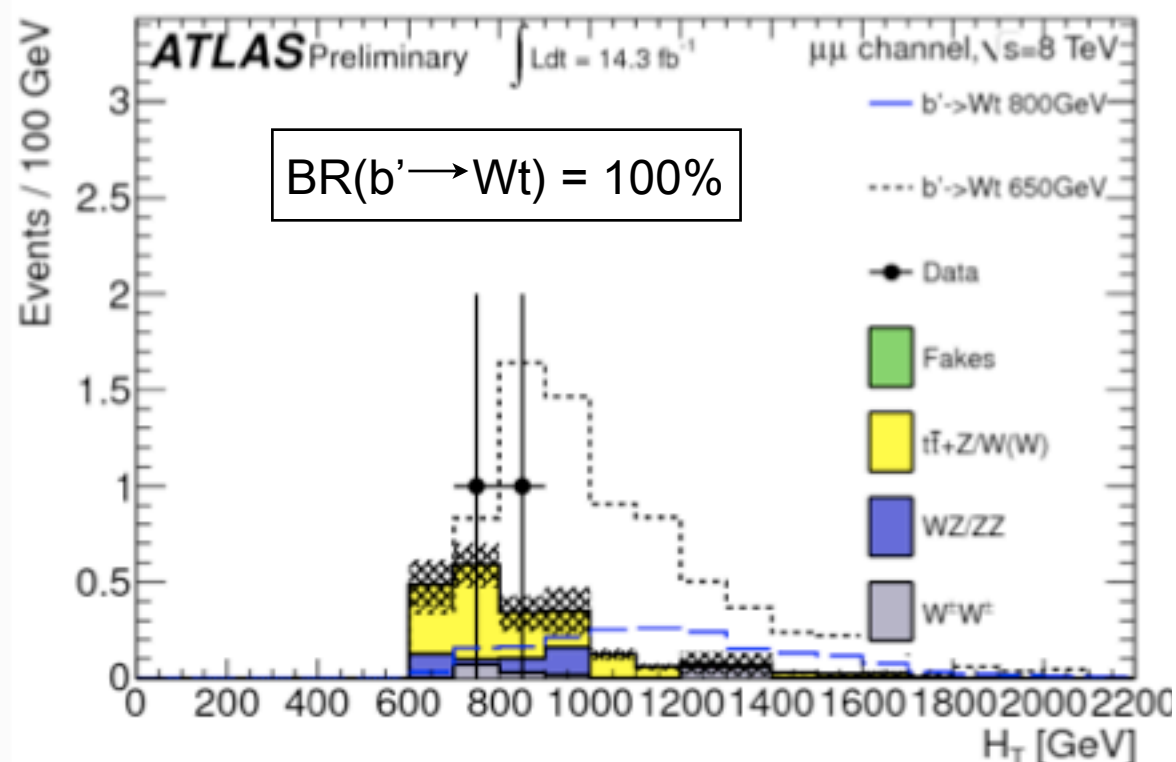
► 4th gen quarks excluded: b' pair production results in 4 W results

► Bkg estimation:

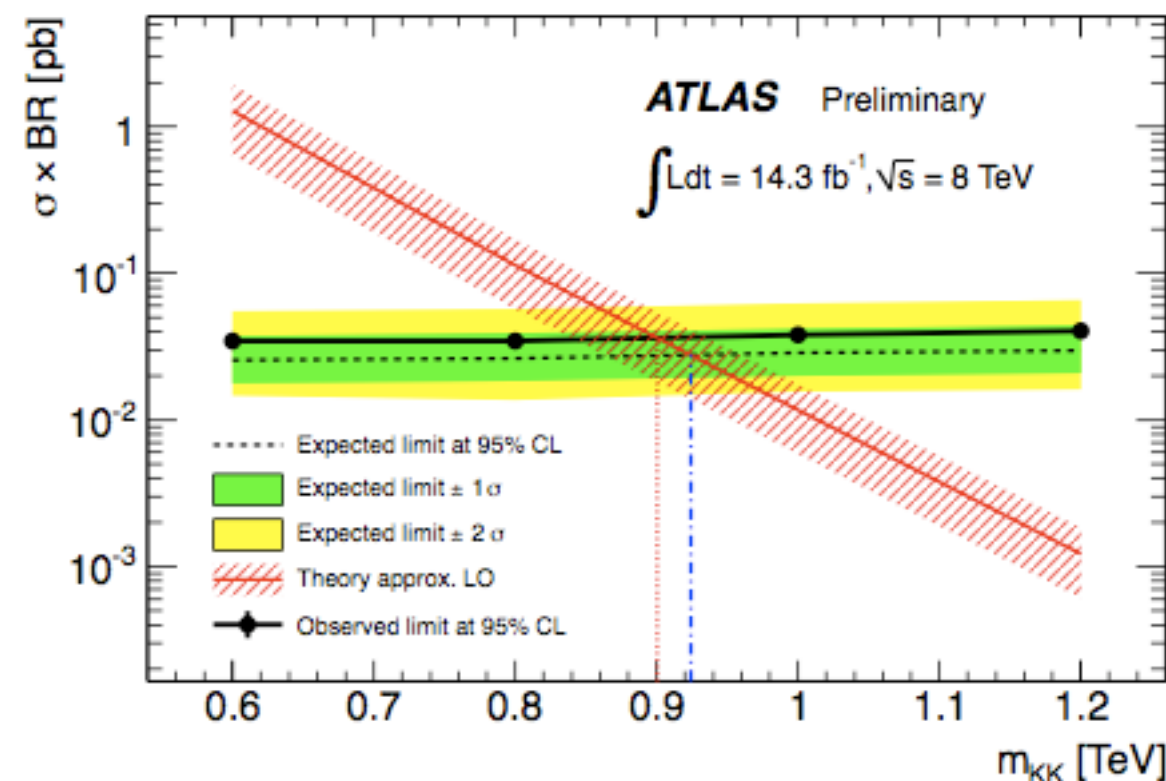
Bkg from fakes, charge-flip: estimated from data

Other bkg from MC

► 2 UED under real projective plane predicts pair production of KK excitations, each of them decaying to ttbar



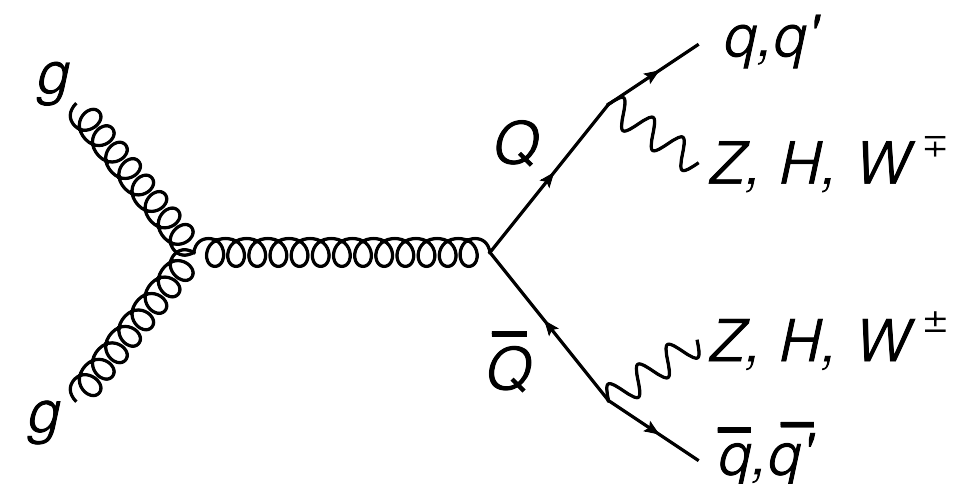
► excluded $m(b') < 0.72$ GeV



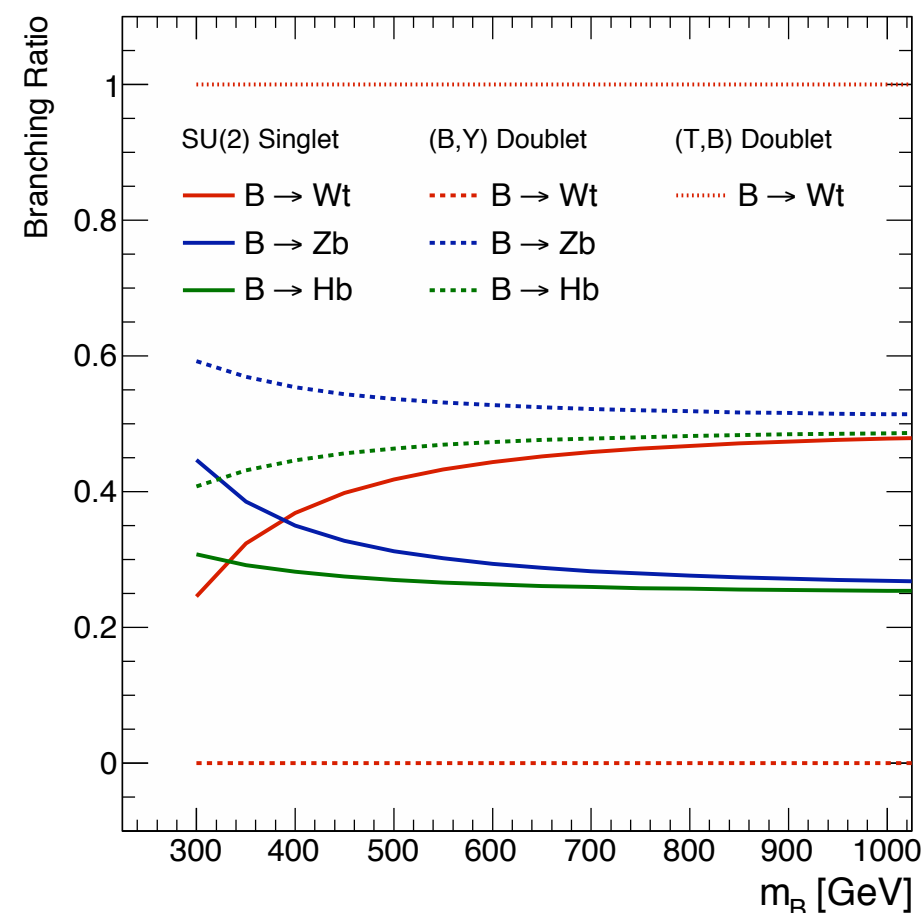
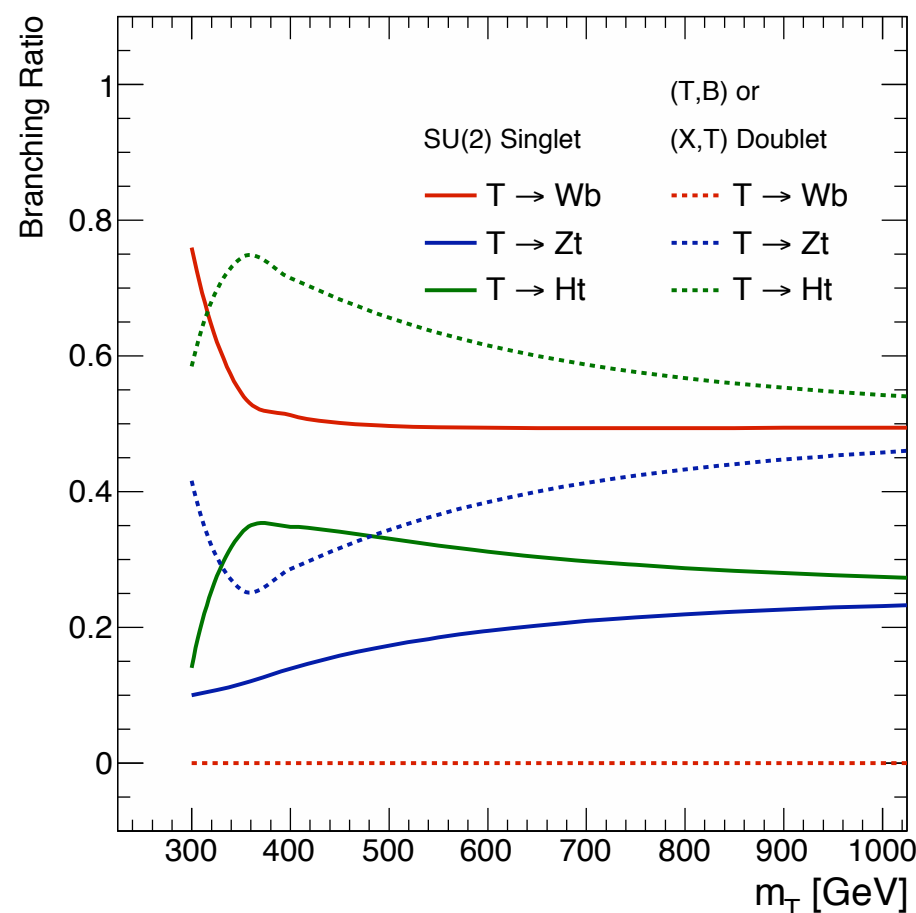
► excluded $m_{KK} < 0.90$ TeV

Vector-like quarks

- ▶ Vector-like quark (VLQ): left-handed and right-handed components transform identically under isospin sym.
- ▶ Top partner quark (T) cancels the Higgs divergences
- ▶ Appears in **Little Higgs, Extra dimensions** models



- ▶ BR model dependent
- ▶ Several channels can contribute significantly in many scenarios



Vector-like quarks:

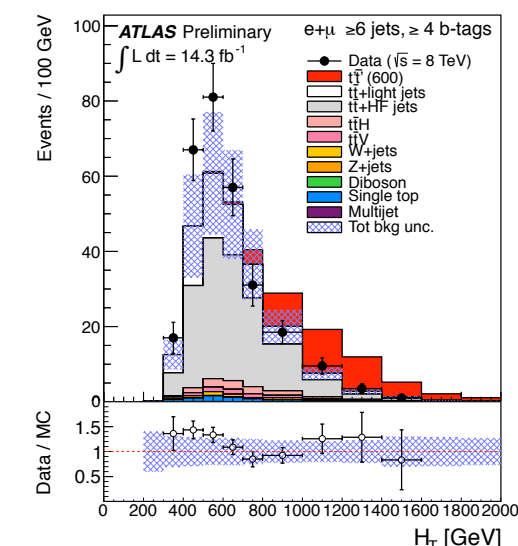
14.3 fb⁻¹ @ 8 TeV

$T \rightarrow Ht \rightarrow bbt$

- Selection: 1 lepton (e/μ) + ≥ 6 jets
- 3 signal regions, based on 2,3,≥4 b-tagged jets

- bkg estimation:
 - ttbar (main), normalized in CR
 - Multijet bkg: “matrix method”
 - W+jets: normalization from charge asymmetry
 - All other bkg from MC

ATLAS-CONF-2013-018

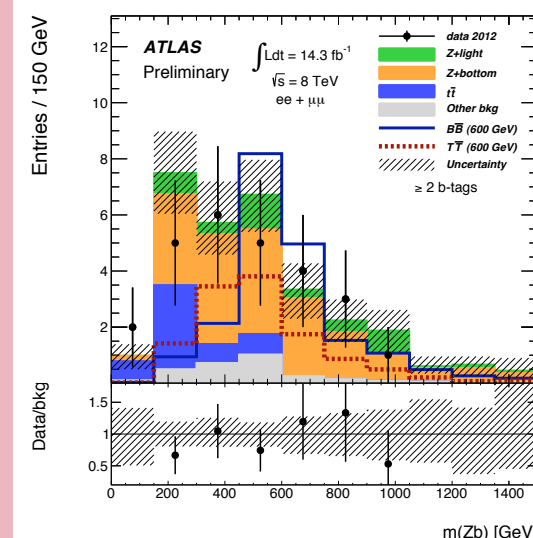


$T \rightarrow Zt$

- Selection: 2 lepton (e/μ) + 2 b-jets
- $p_T(Z) > 150$ GeV,
- $H_T(\text{jets}) > 600$ GeV
- Final discriminant is $m(Z, \text{highest } p_T b)$

- bkg estimation:
 - Z+jets (main), from
 - Multijet bkg: “matrix method”

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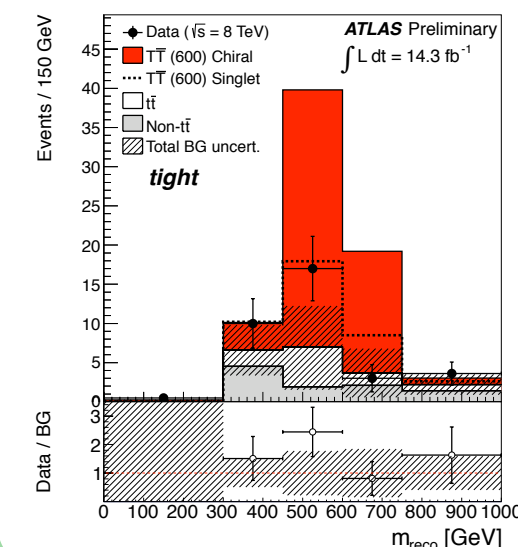


$T \rightarrow Wb$

- Selection: 1 lepton (e/μ) + ≥ 4 jets + ≥ 1 btag
- $p_T(b_1) > 160$ GeV, $p_T(b_2) > 80$ GeV
- $H_T(\text{jets+leptons+MET}) > 800$ GeV

- bkg estimation:
 - ttbar (main), from MC
 - Multijet bkg: “matrix method”
 - W+jets: normalization from charge asymmetry

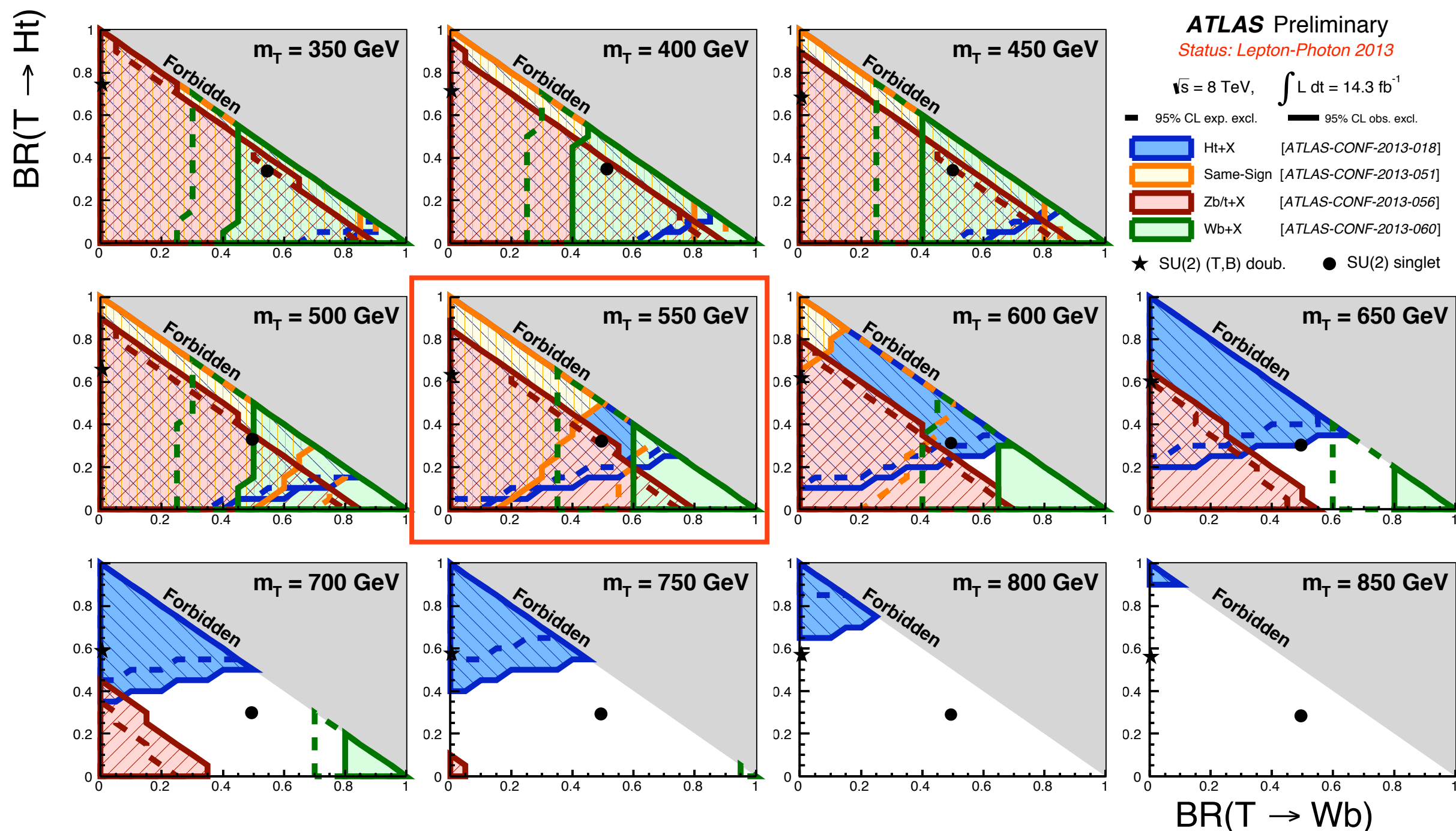
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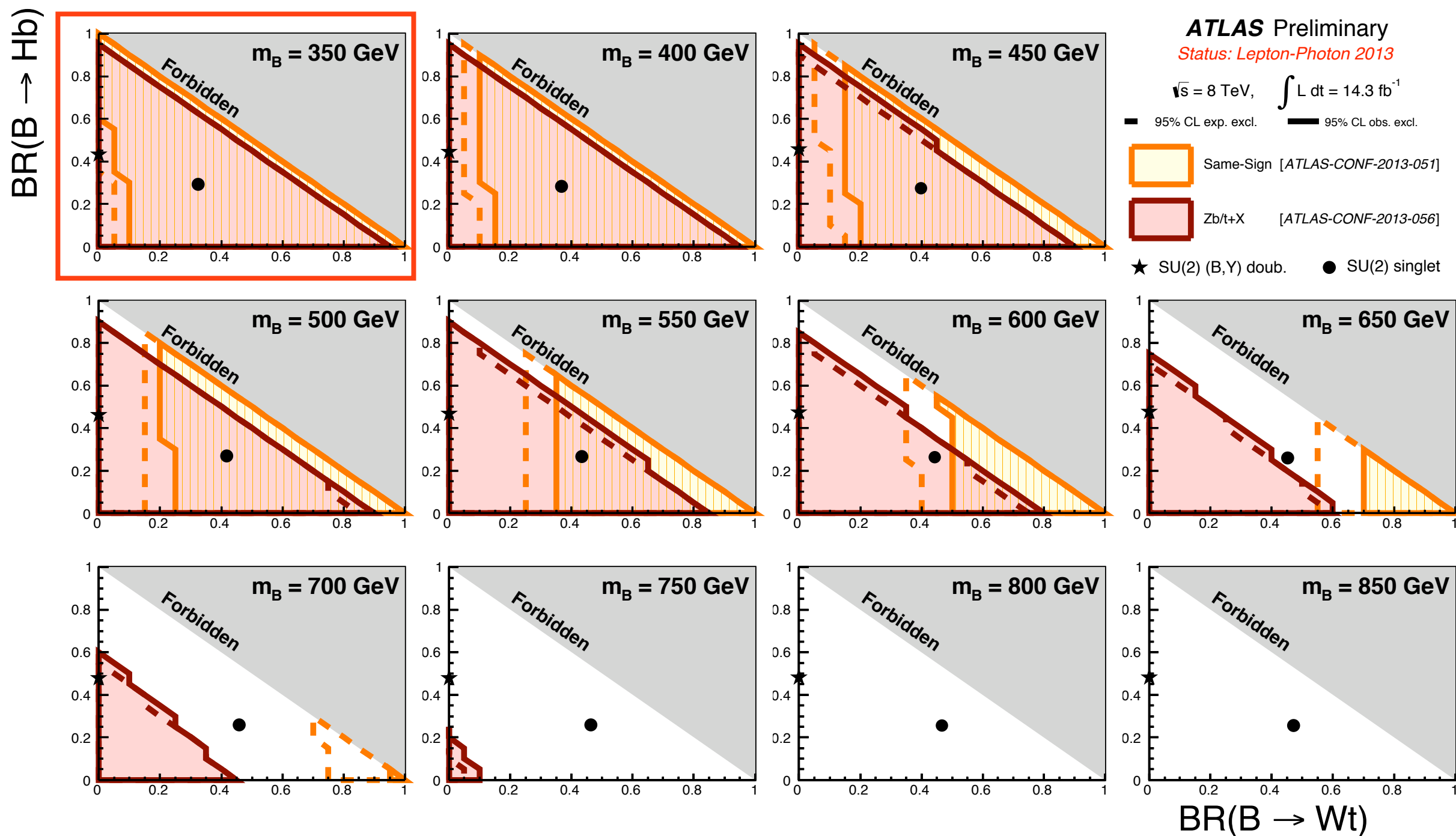
Evolution of T limits

14.3 fb⁻¹ @ 8 TeV

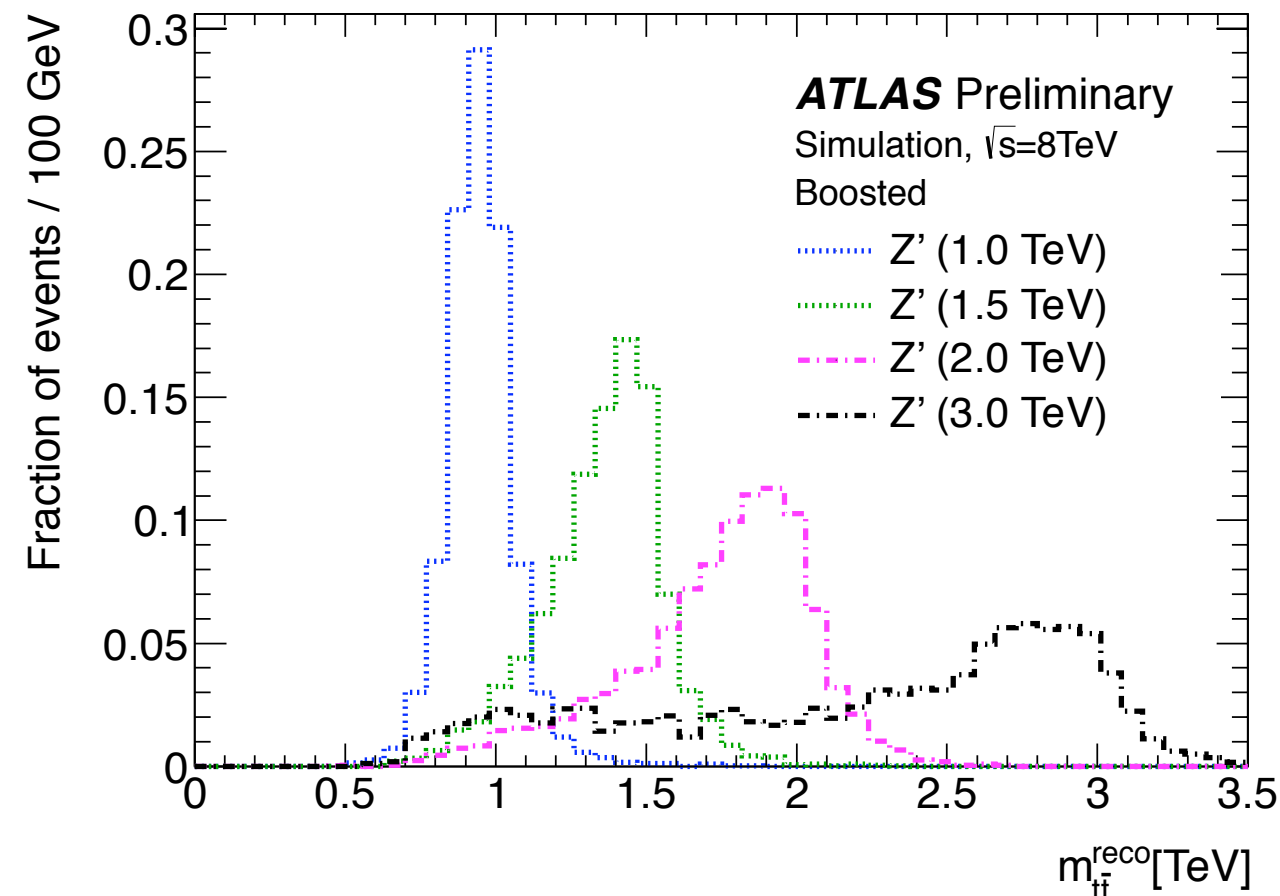
- ▶ assuming $\text{BR}(T \rightarrow Zt) = 1 - \text{BR}(T \rightarrow Ht) - \text{BR}(T \rightarrow Wb)$
- ▶ Full coverage up to 550 GeV



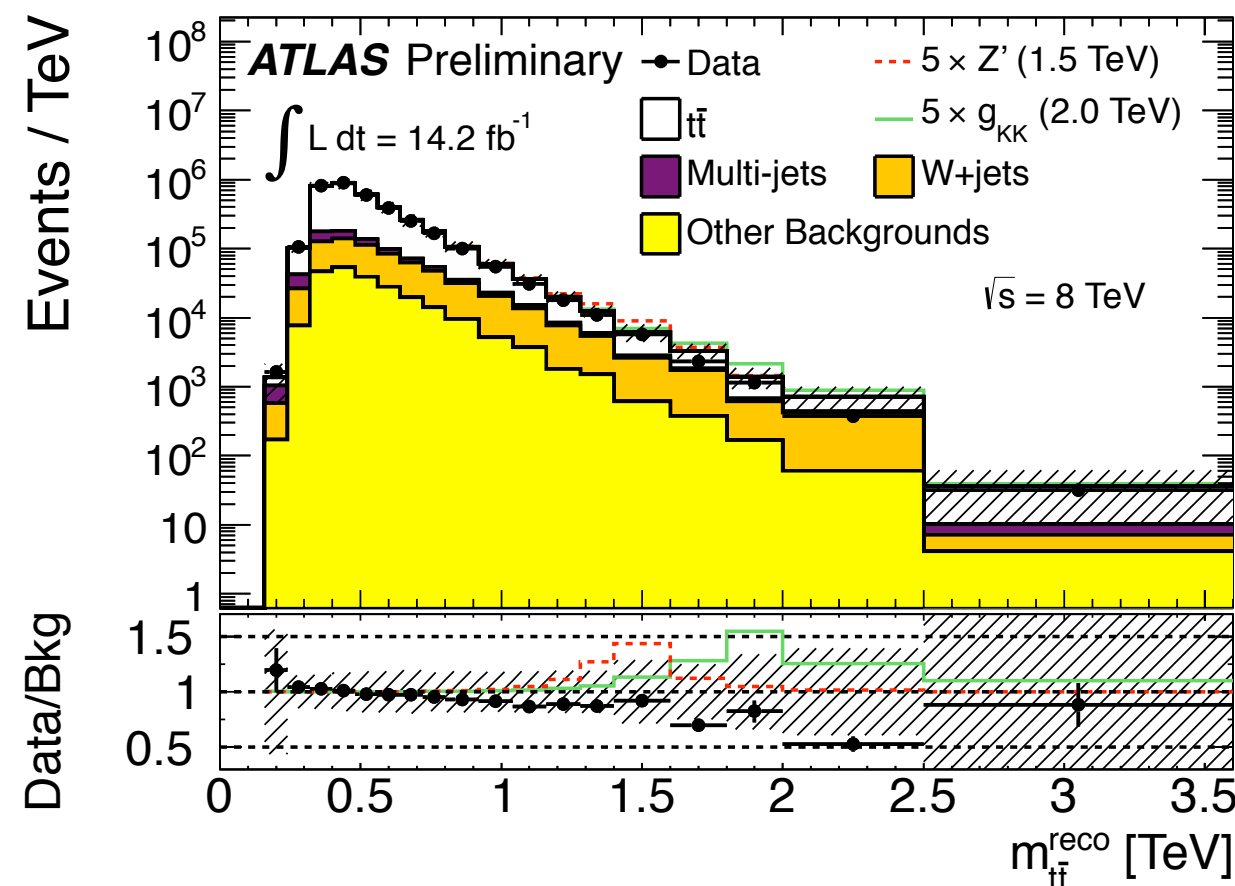
Evolution of B limits

14.3 fb⁻¹ @ 8 TeV


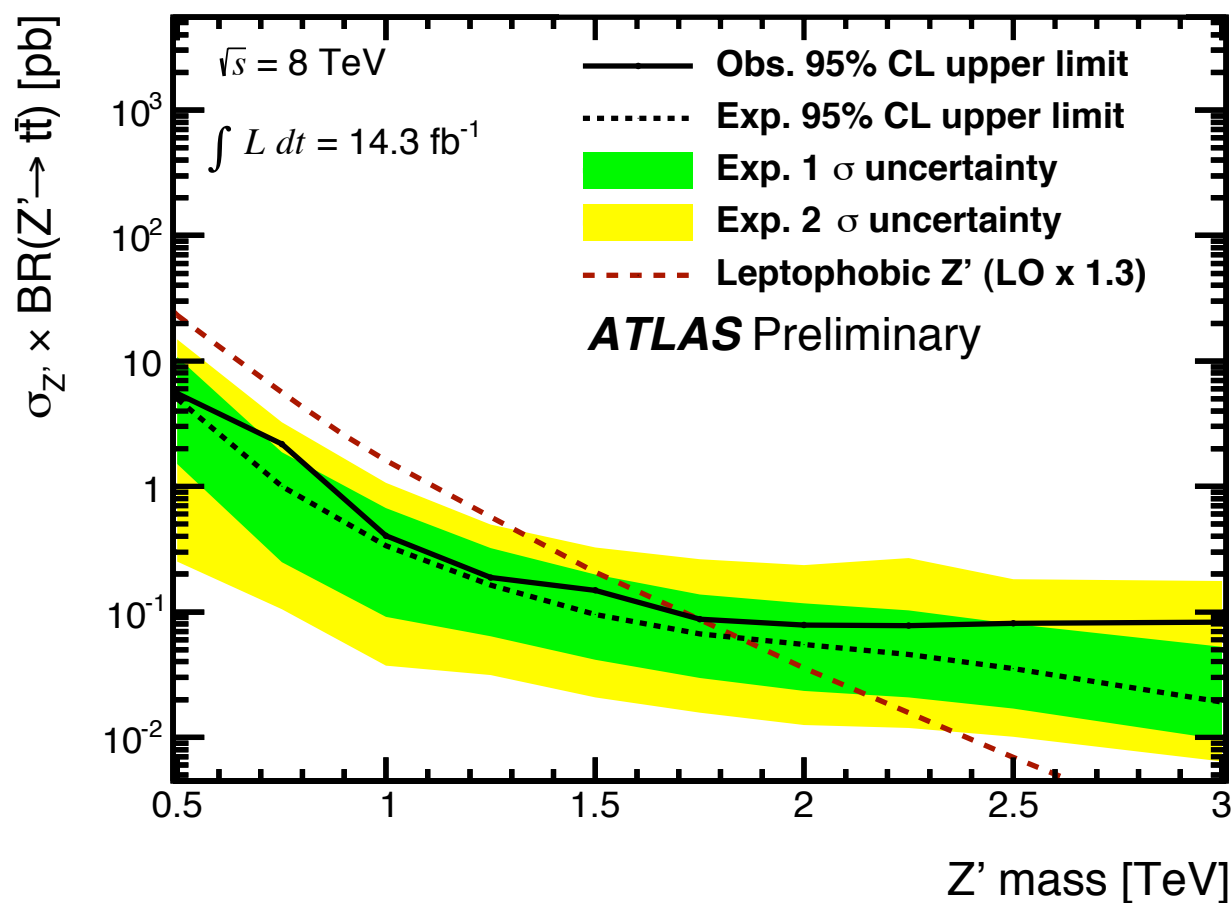
- ▶ **Bump hunt in ttbar mass**
- ▶ Use two reconstruction methods for hadronically decaying tops:
 - fully-resolved: top treated as 2-3 small (R=0.4) jets
 - boosted: top treated as one large (R=1.0) jet
- ▶ p_T > 25 GeV (small), 300 GeV (large)
- ▶ ≥ 1 btag (small radius jet)



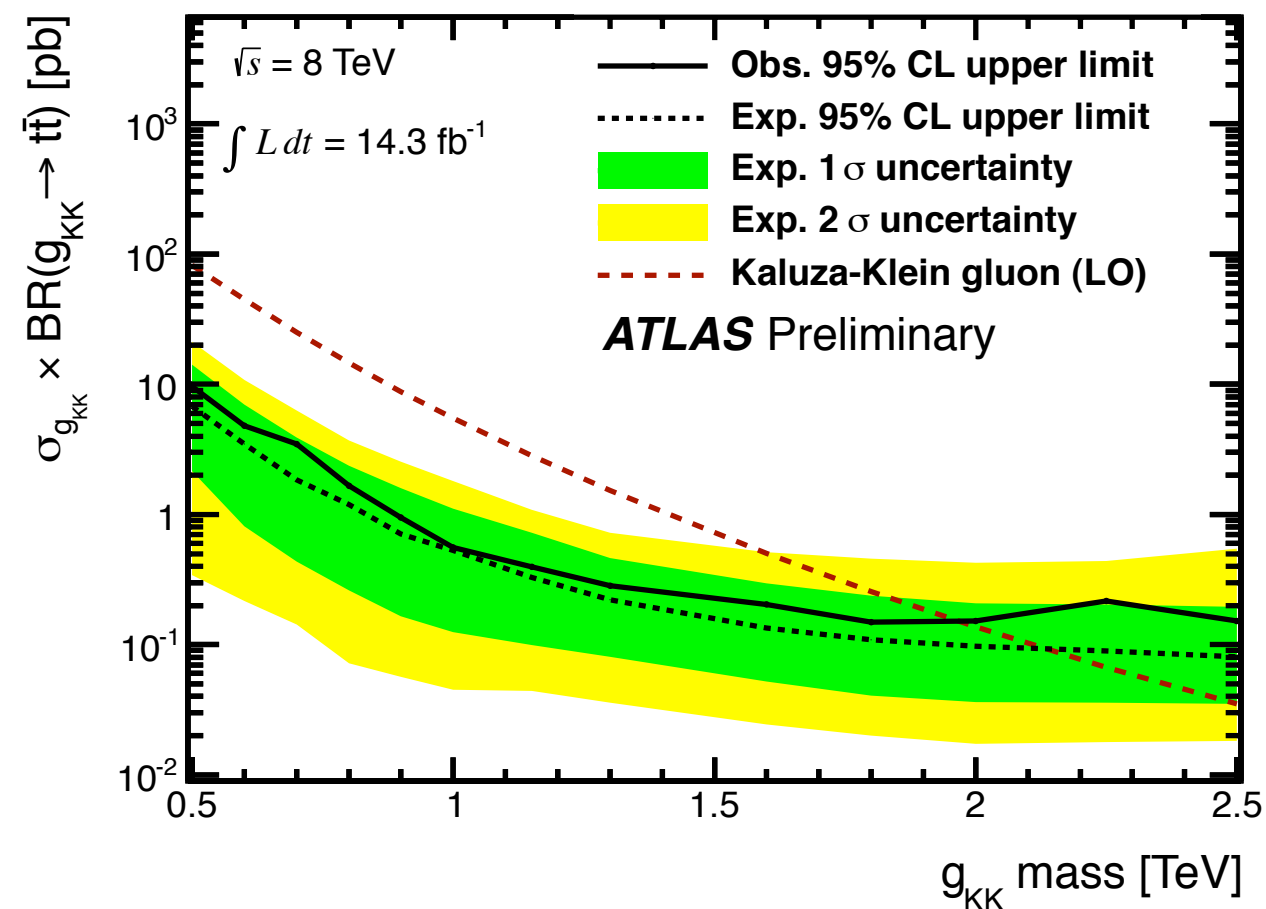
- ▶ Large-radius R=1.0 jet with b-tagging
- ▶ Sharp mass peak due to unambiguous top decay product association in l+jets



- **Bump hunt in ttbar mass**
- Use two reconstruction methods for hadronically decaying tops:
 - fully-resolved: top treated as 2-3 small (R=0.4) jets
 - boosted: top treated as one large (R=1.0) jet)
- p_T > 25 GeV (small), 300 GeV (large)
- ≥ 1 btag (small radius jet)



- Exclude Z' between 0.5 and 1.8 TeV

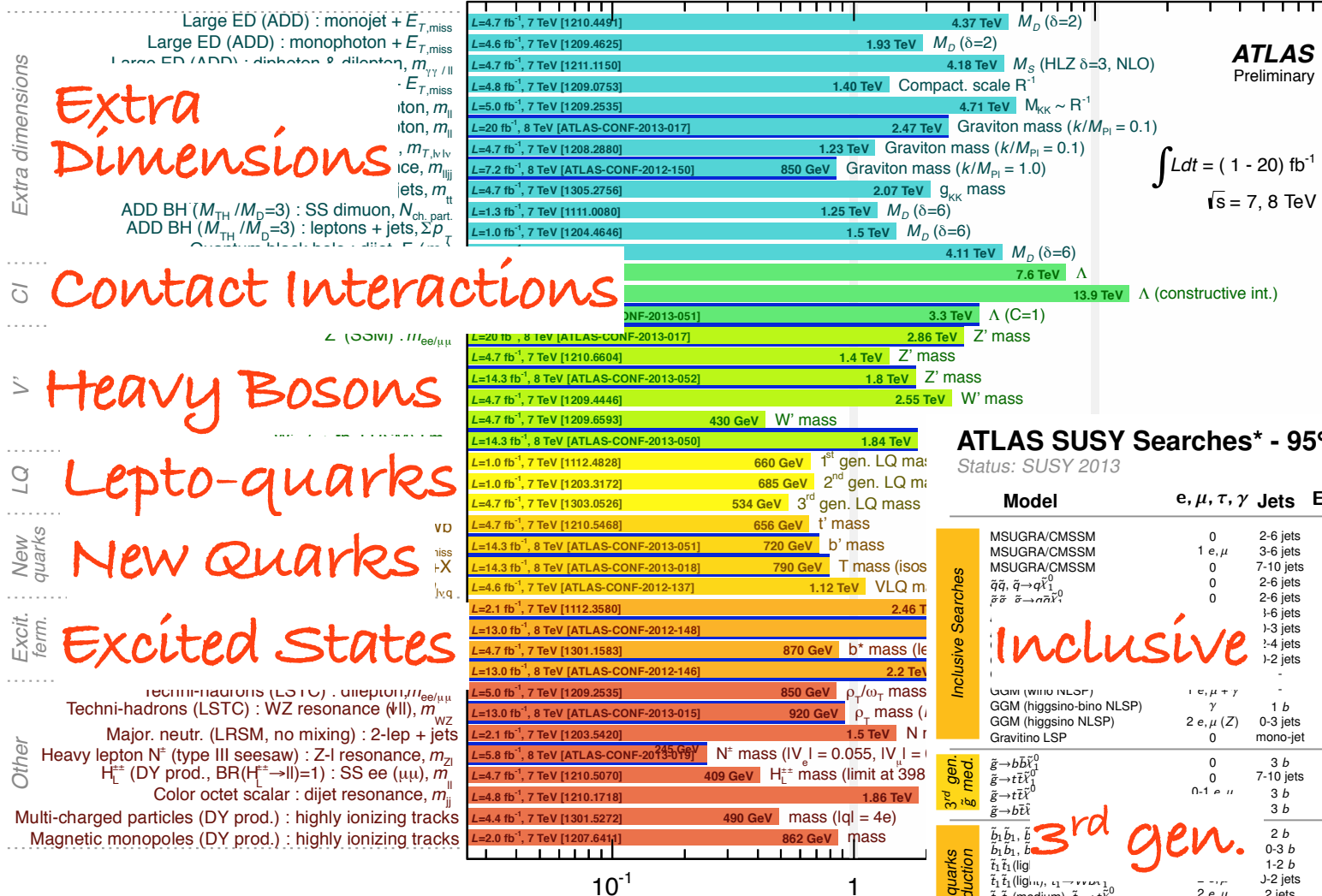


- Exclude KK gluon between 0.5 and 2 TeV

Summary

- Huge number of signatures analysed

No sign of new physics

ATLAS Exotics Searches* - 95% CL Lower Limits (Status: May 2013)

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

ATLAS SUSY Searches* - 95% CL Lower Limits

Status: SUSY 2013

	Model	e, μ, τ, γ	Jets	$E_{\text{T}}^{\text{miss}}$	$\int \mathcal{L} dt [\text{fb}^{-1}]$	Mass limit	Reference
Inclusive Searches	MSUGRA/CMSSM	0	2-6 jets	Yes	20.3	$\tilde{q}, \tilde{g}$	1.7 TeV
	MSUGRA/CMSSM	1 e, μ	3-6 jets	Yes	20.3	any $m(\tilde{q})$	1.2 TeV
	MSUGRA/CMSSM	0	7-10 jets	Yes	20.3	any $m(\tilde{q})$	1.1 TeV
	$\tilde{q}\tilde{q} \rightarrow q\tilde{\chi}_1^0$	0	2-6 jets	Yes	20.3	$\tilde{q}$	740 GeV
	$\tilde{\tau}\tilde{\tau} \rightarrow \tau\tilde{\chi}_1^0$	0	2-6 jets	Yes	20.3	$\tilde{\tau}$	1.3 TeV
		0	1-6 jets	Yes	20.3	$\tilde{\tau}$	1.18 TeV
		0	1-3 jets	-	20.3	$\tilde{\tau}$	1.12 TeV
		0	1-4 jets	Yes	4.7	$\tilde{\tau}$	1.24 TeV
		0	1-2 jets	Yes	20.7	$\tilde{\tau}$	1.4 TeV
		-	-	Yes	4.8	$\tilde{\tau}$	1.07 TeV
	GGM (WILU NLSP)	1 $e, \mu + \gamma$	-	Yes	4.8	$\tilde{g}$	619 GeV
	GGM (higgsino-bino NLSP)	γ	1 b	Yes	4.8	$\tilde{g}$	900 GeV
GGM (higgsino NLSP)	2 e, μ (Z)	0-3 jets	Yes	5.8	$\tilde{g}$	690 GeV	
Gravitino LSP	0	mono-jet	Yes	10.5	$\tilde{g}$	645 GeV	
3 rd gen. $\tilde{g}$ med.	$\tilde{g} \rightarrow b\tilde{\chi}_1^0$	0	3 b	Yes	20.1	$\tilde{g}$	1.2 TeV
	$\tilde{g} \rightarrow t\tilde{\chi}_1^0$	0	7-10 jets	Yes	20.3	$\tilde{g}$	1.1 TeV
	$\tilde{g} \rightarrow t\tilde{\chi}_1^0$	0-1 e, μ	3 b	Yes	20.1	$\tilde{g}$	1.34 TeV
	$\tilde{g} \rightarrow b\tilde{\chi}_1^0$	0	3 b	Yes	20.1	$\tilde{g}$	1.3 TeV
		0	3 b	Yes	20.1	$\tilde{g}$	1.3 TeV
3 rd gen. squarks direct production	$\tilde{b}_1\tilde{b}_1, \tilde{b}_1\tilde{b}_1$	0	2 b	Yes	20.1	$\tilde{b}_1$	100-620 GeV
	$\tilde{b}_1\tilde{b}_1, \tilde{b}_1\tilde{b}_1$	0	0-3 b	Yes	20.7	$\tilde{b}_1$	275-430 GeV
	$\tilde{t}_1\tilde{t}_1$ (lig)	0	1-2 b	Yes	4.7	$\tilde{t}_1$	110-167 GeV
	$\tilde{t}_1\tilde{t}_1$ (lig)	-	J-2 jets	Yes	20.3	$\tilde{t}_1$	130-220 GeV
	$\tilde{t}_1\tilde{t}_1$ (medium), $\tilde{t}_1 \rightarrow t\tilde{\chi}_1^0$	2 e, μ	2 jets	Yes	20.3	$\tilde{t}_1$	225-525 GeV
	$\tilde{t}_1\tilde{t}_1$ (medium), $\tilde{t}_1 \rightarrow b\tilde{\chi}_1^0$	0	2 b	Yes	20.1	$\tilde{t}_1$	150-580 GeV
	$\tilde{t}_1\tilde{t}_1$ (heavy), $\tilde{t}_1 \rightarrow t\tilde{\chi}_1^0$	1 e, μ	1 b	Yes	20.7	$\tilde{t}_1$	200-610 GeV
	$\tilde{t}_1\tilde{t}_1$ (heavy), $\tilde{t}_1 \rightarrow t\tilde{\chi}_1^0$	0	2 b	Yes	20.5	$\tilde{t}_1$	320-660 GeV
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow c\tilde{\chi}_1^0$	0	mono-jet/c-tag	Yes	20.3	$\tilde{t}_1$	90-200 GeV
	$\tilde{t}_1\tilde{t}_1$ (natural GMSB)	2 e, μ (Z)	1 b	Yes	20.7	$\tilde{t}_1$	500 GeV
	$\tilde{b}_2\tilde{b}_2, \tilde{b}_2 \rightarrow \tilde{t}_1 + Z$	3 e, μ (Z)	1 b	Yes	20.7	$\tilde{b}_2$	271-520 GeV
	EW direct	$\tilde{\chi}_{1,2}^0, \tilde{\chi}_{1,2}^\pm$	0	-	Yes	20.3	$\tilde{\chi}$
$\tilde{\chi}_{1,2}^0, \tilde{\chi}_{1,2}^\pm$		0	-	Yes	20.3	$\tilde{\chi}$	125-450 GeV
$\tilde{\chi}_{1,2}^0, \tilde{\chi}_{1,2}^\pm$		0	-	Yes	20.7	$\tilde{\chi}$	180-330 GeV
$\tilde{\chi}_{1,2}^0, \tilde{\chi}_{1,2}^\pm$		0	-	Yes	20.7	$\tilde{\chi}$	600 GeV
$\tilde{\chi}_{1,2}^0, \tilde{\chi}_{1,2}^\pm$		0	-	Yes	20.7	$\tilde{\chi}$	315 GeV
$\tilde{\chi}_{1,2}^0, \tilde{\chi}_{1,2}^\pm$		0	-	Yes	20.3	$\tilde{\chi}$	285 GeV
Long-lived particles	$\tilde{\chi}_{1,2}^0, \tilde{\chi}_{1,2}^\pm$	0	-	Yes	3	$\tilde{\chi}$	270 GeV
	$\tilde{\chi}_{1,2}^0, \tilde{\chi}_{1,2}^\pm$	0	-	Yes	9	$\tilde{\chi}$	832 GeV
	$\tilde{\chi}_{1,2}^0, \tilde{\chi}_{1,2}^\pm$	0	-	Yes	9	$\tilde{\chi}$	475 GeV
	$\tilde{\chi}_{1,2}^0, \tilde{\chi}_{1,2}^\pm$	0	-	Yes	7	$\tilde{\chi}$	230 GeV
	$\tilde{\chi}_{1,2}^0, \tilde{\chi}_{1,2}^\pm$	0	-	Yes	3	$\tilde{\chi}$	1.0 TeV
RPV	LFV $\tilde{p} \rightarrow \tilde{\nu}_\tau + X, \tilde{\nu}_\tau \rightarrow e + \mu$	2 e, μ	-	-	4.6	$\tilde{\nu}_\tau$	1.61 TeV
		1 $e, \mu + \tau$	-	-	4.6	$\tilde{\nu}_\tau$	1.1 TeV
		1 e, μ	7 jets	Yes	4.7	$\tilde{q}, \tilde{g}$	1.2 TeV
		4 e, μ	-	Yes	20.7	$\tilde{\chi}^\pm$	760 GeV
		3 $e, \mu + \tau$	-	Yes	20.7	$\tilde{\chi}^\pm$	350 GeV
		0	6-7 jets	-	20.3	$\tilde{g}$	916 GeV
	$\tilde{g} \rightarrow \tilde{t}_1 \tilde{t}, \tilde{t}_1 \rightarrow \nu S$	2 e, μ (SS)	0-3 b	Yes	20.7	$\tilde{g}$	880 GeV
Other	Scalar gluon pair, $\text{sgluon} \rightarrow q\bar{q}$	0	4 jets	-	4.6	sgluon	100-287 GeV
	Scalar gluon pair, $\text{sgluon} \rightarrow t\bar{t}$	2 e, μ (SS)	1 b	Yes	14.3	sgluon	800 GeV
	WIMP interaction (D5, Dirac χ)	0	mono-jet	Yes	10.5	M^* scale	704 GeV
						$\sqrt{s} = 7 \text{ TeV}$ full data	
						$\sqrt{s} = 8 \text{ TeV}$ partial data	
						$\sqrt{s} = 8 \text{ TeV}$ 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.

Conclusions and Perspectives

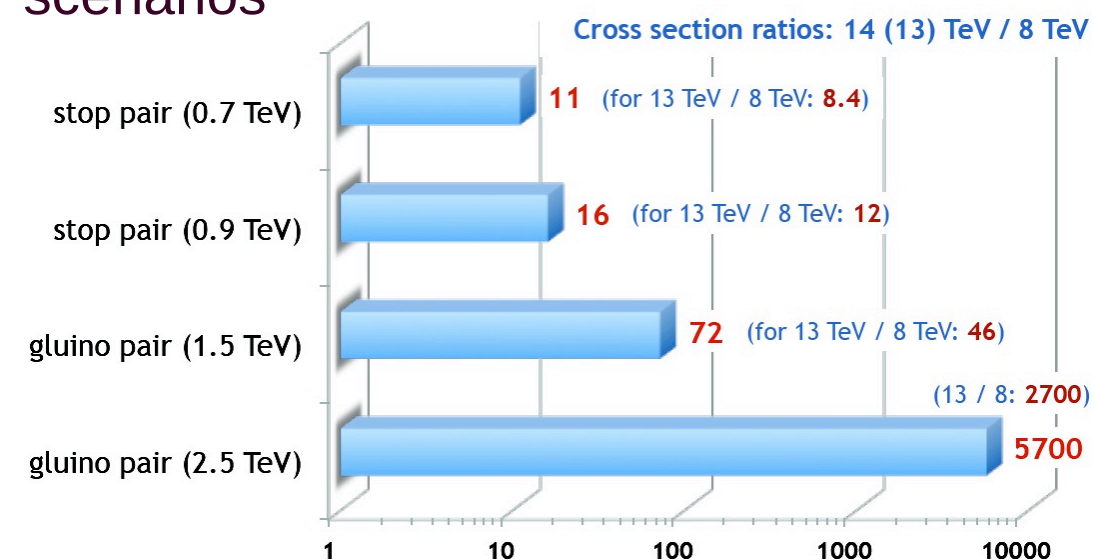
► LHC run-1 dataset

- ATLAS experiment and LHC worked beautifully. High efficiency of data taking, computing, physics analyses
- Discovery on the new boson is the gateway to a full exploration of symmetry breaking in ew sector
- Broad signature-based search programme developed
- Effort to probe maximum number of models, parameter spaces possible
- Detailed and thorough searches, wide range of signatures covered
- Up to now, all results consistent with SM: No sign of new physics yet

► What is next?

- Better understanding of bkg
- Prepare for LHC run-2 in 2015 (13 TeV):
- new energy regime, remeasure SM, more pileup,...
- More use of boosted technologies
- Increase sensitivity to more difficult kinematic scenarios
- Explore new channels, probe more parameter space, smaller cross-sections, BRs

scenarios

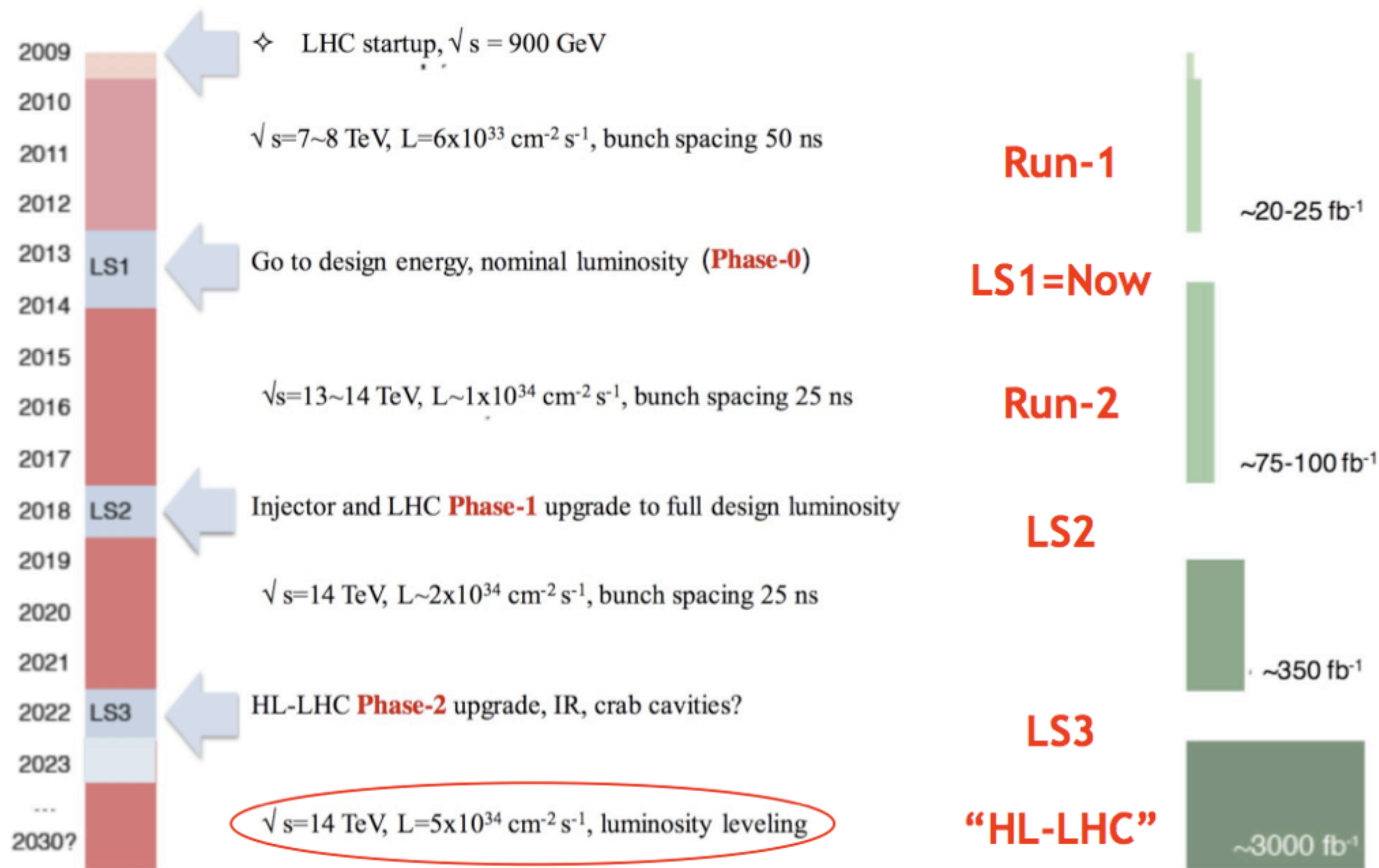


Please check out all of the ATLAS physics results at

<https://twiki.cern.ch/twiki/bin/view/AtlasPublic>

back up

The landscape in the next decade(s)

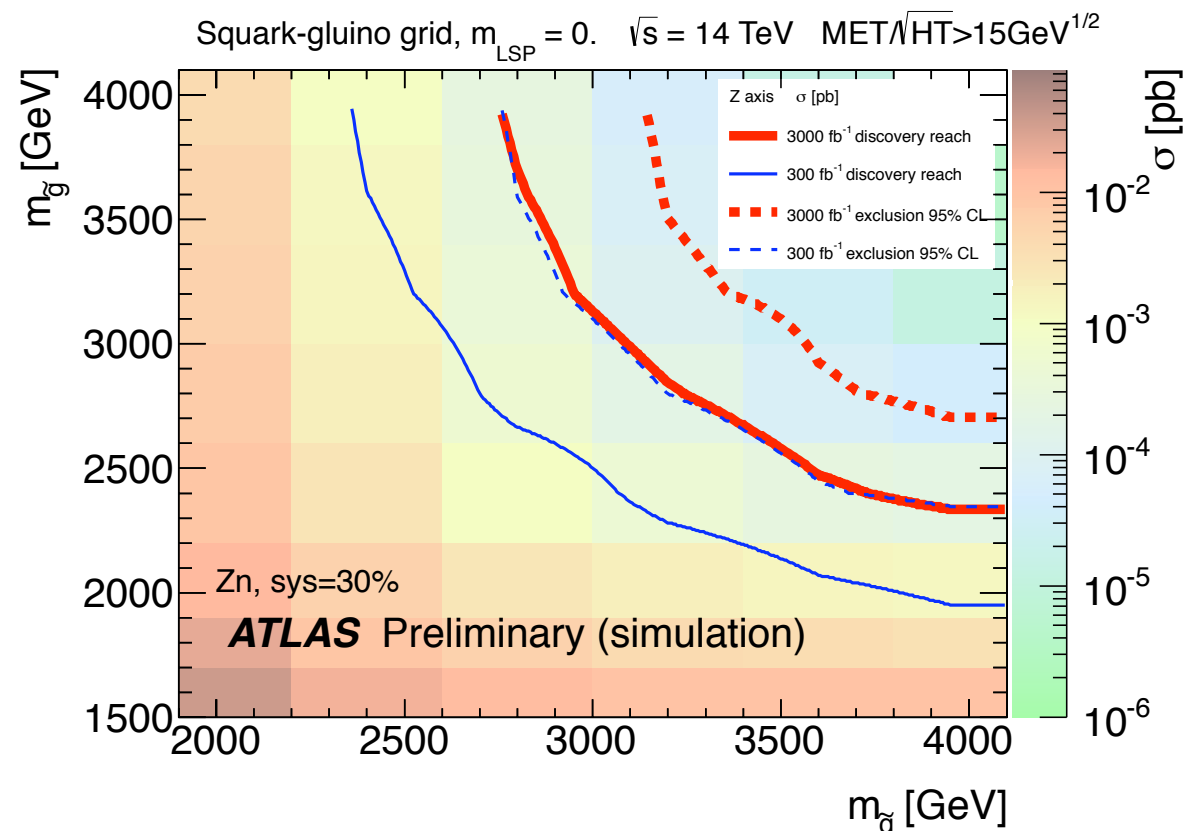


D Charlton / Birmingham - 12 August 2013, ICISE inauguration, Quy Nhon, Vietnam

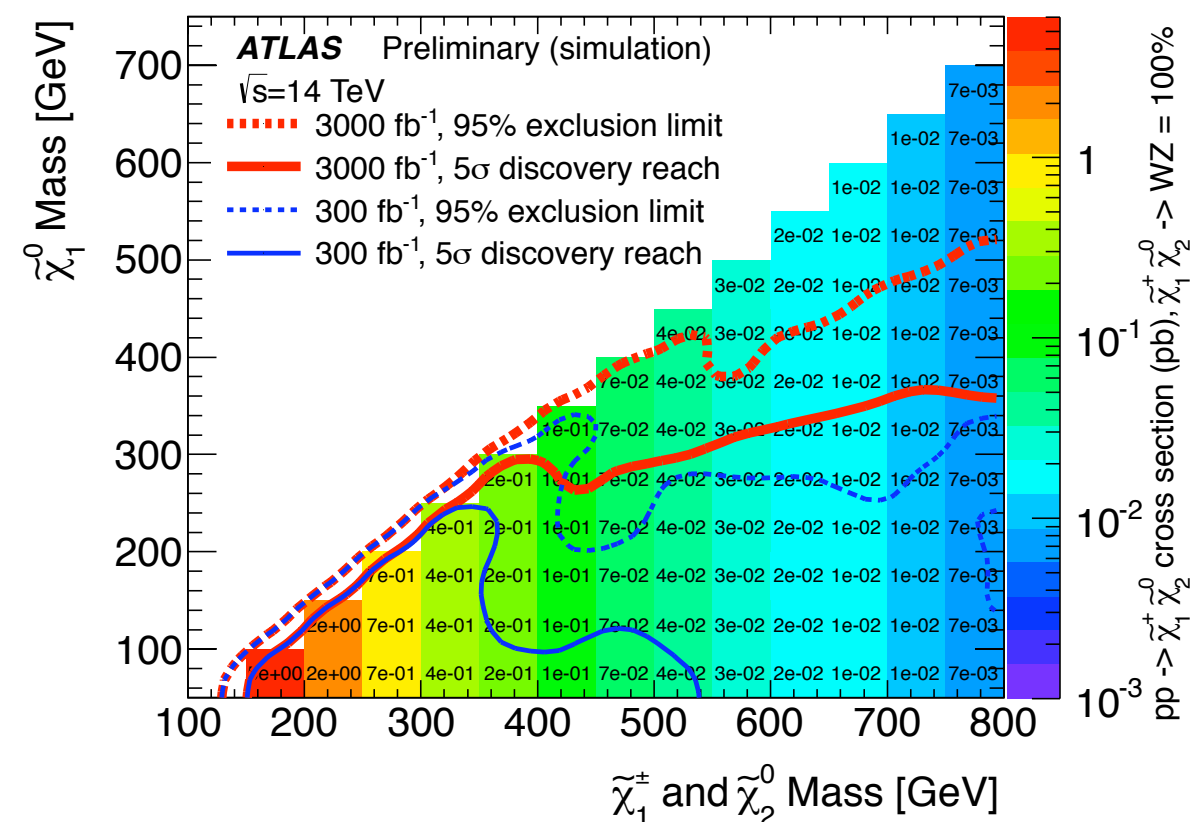
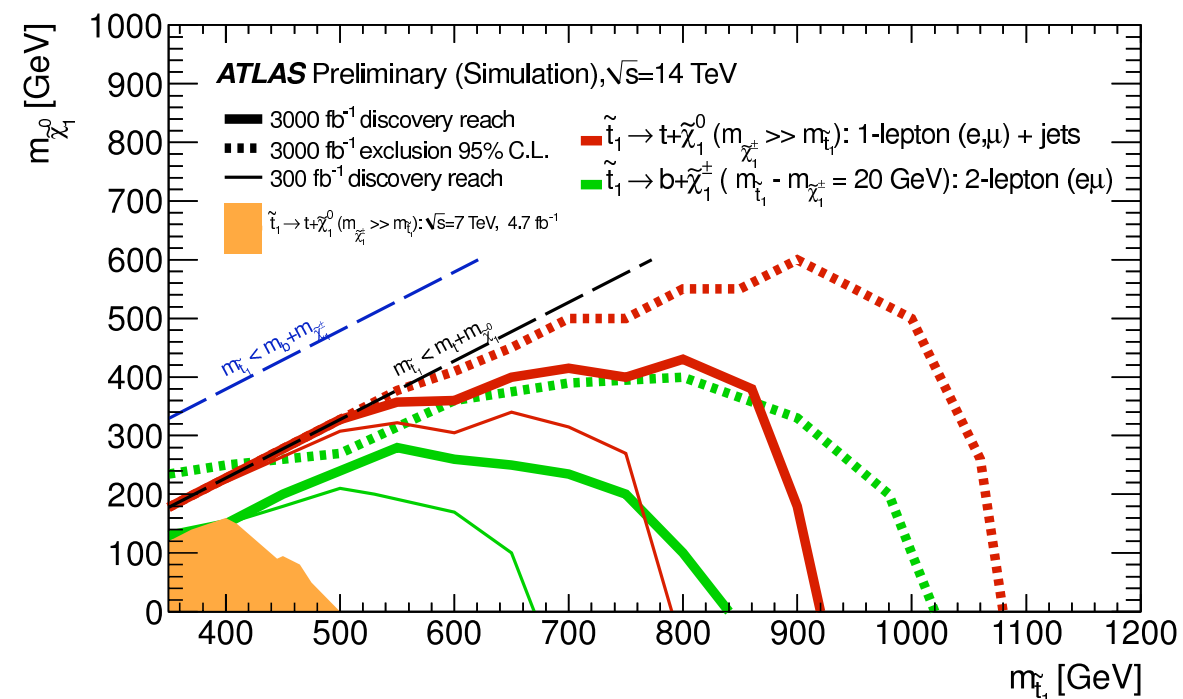
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Run 2 SUSY perspectives

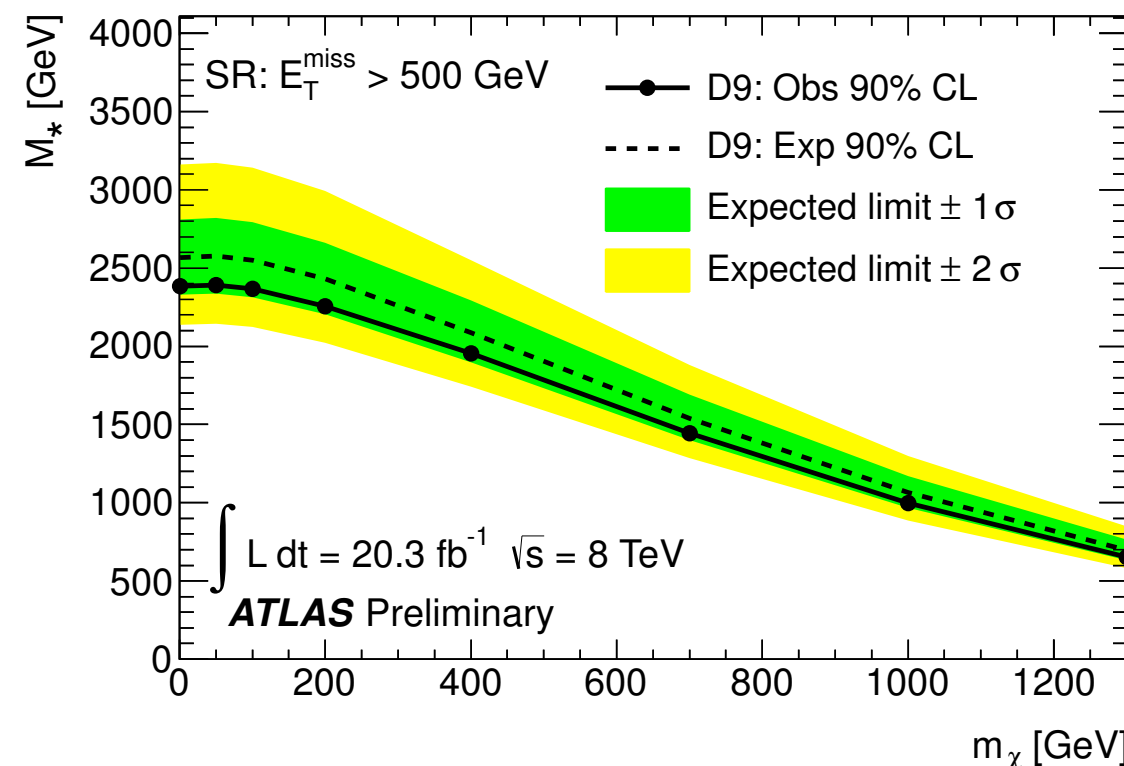
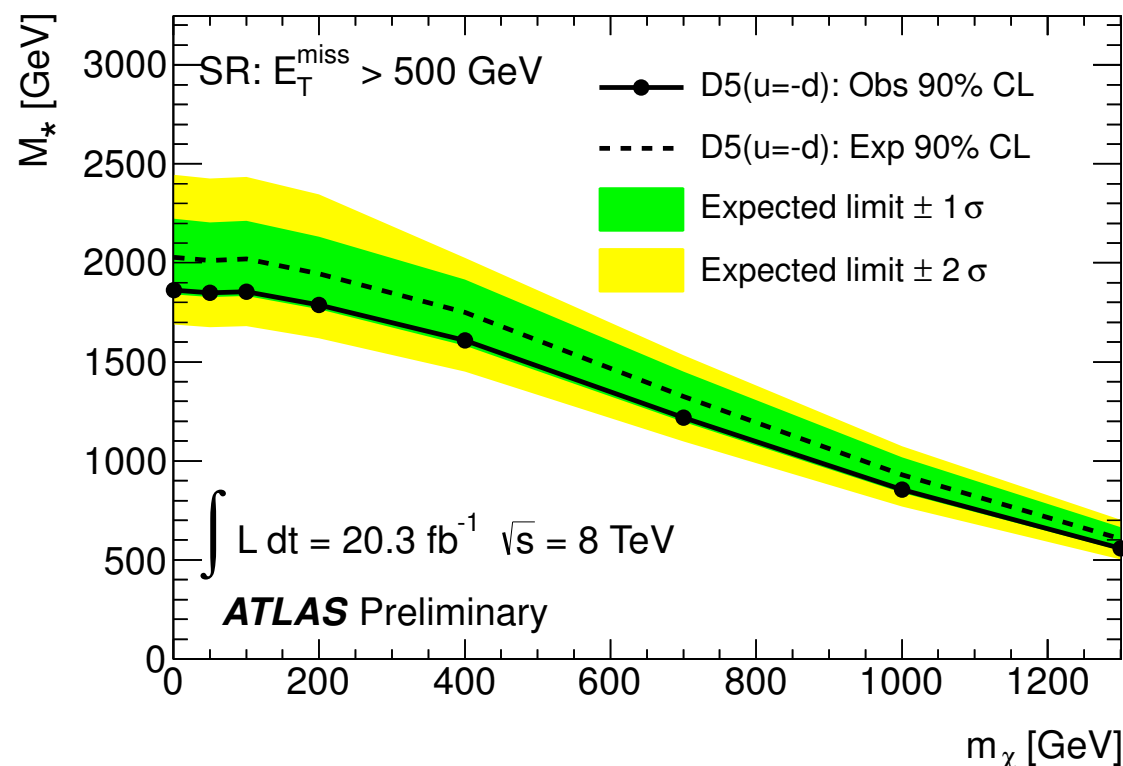
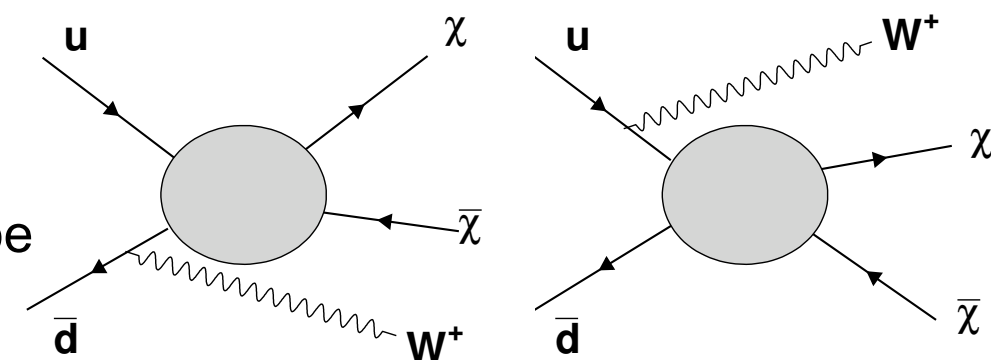
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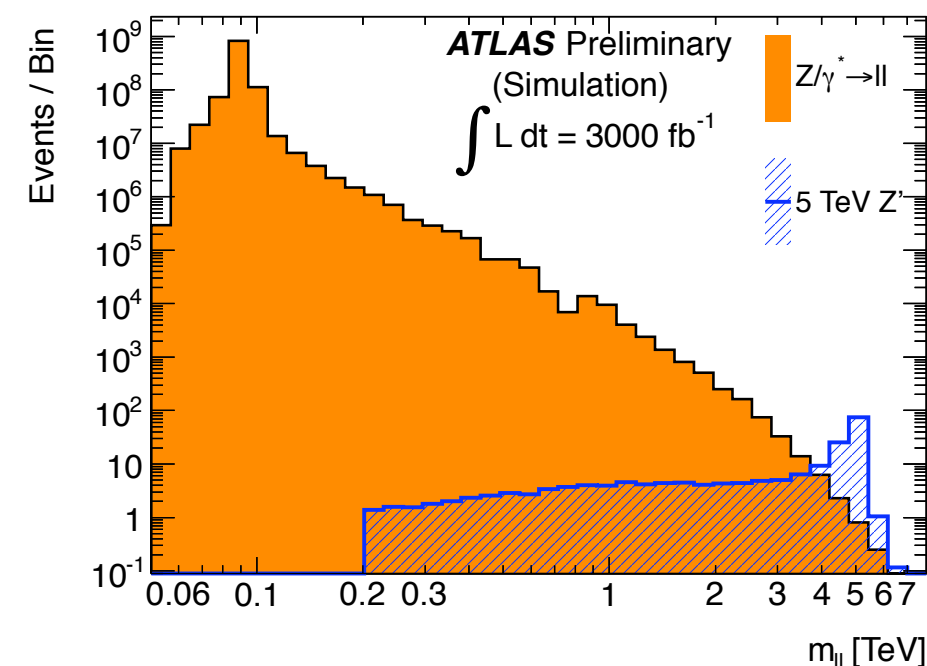
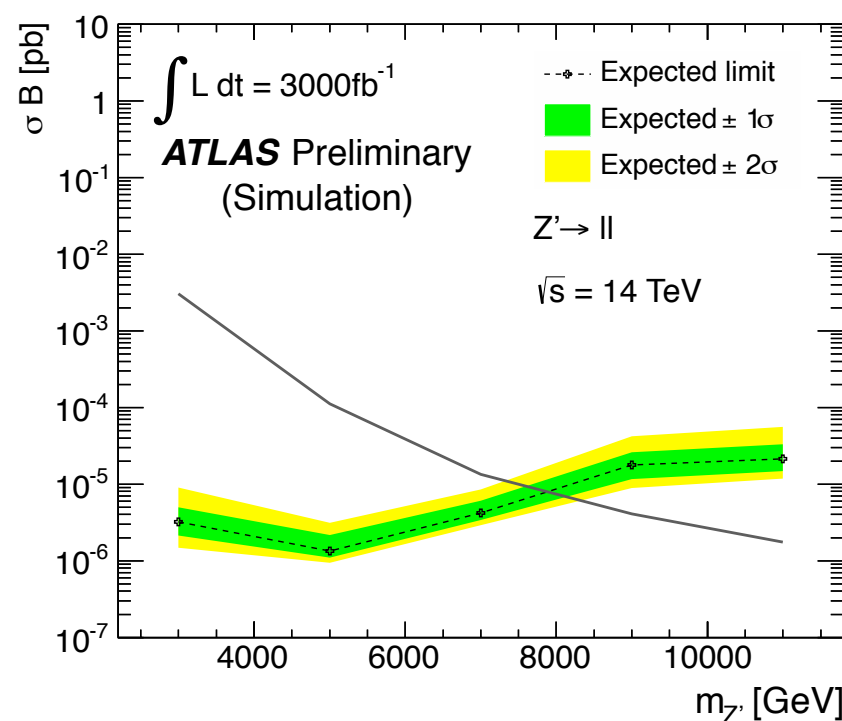
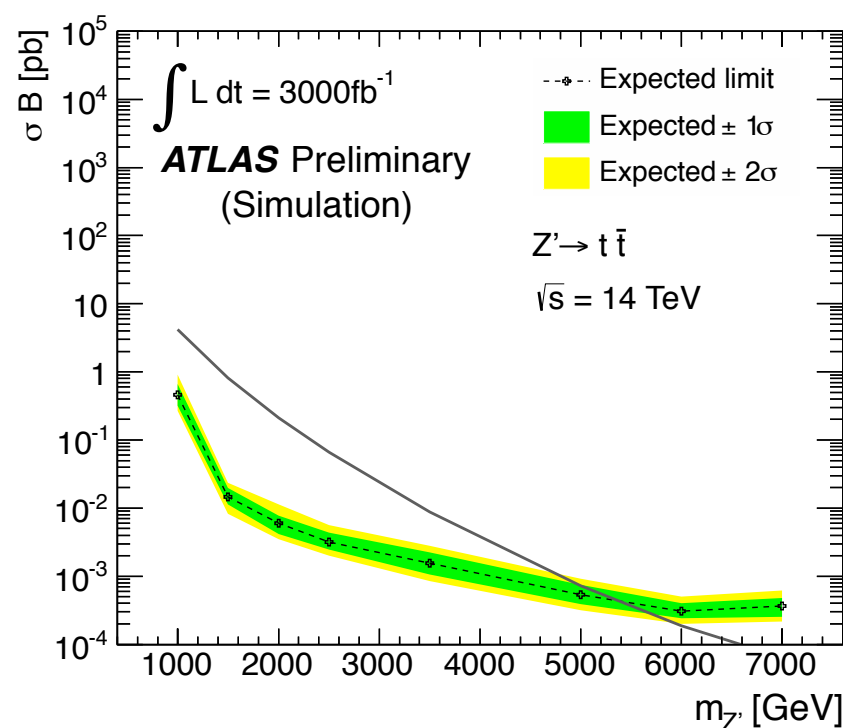
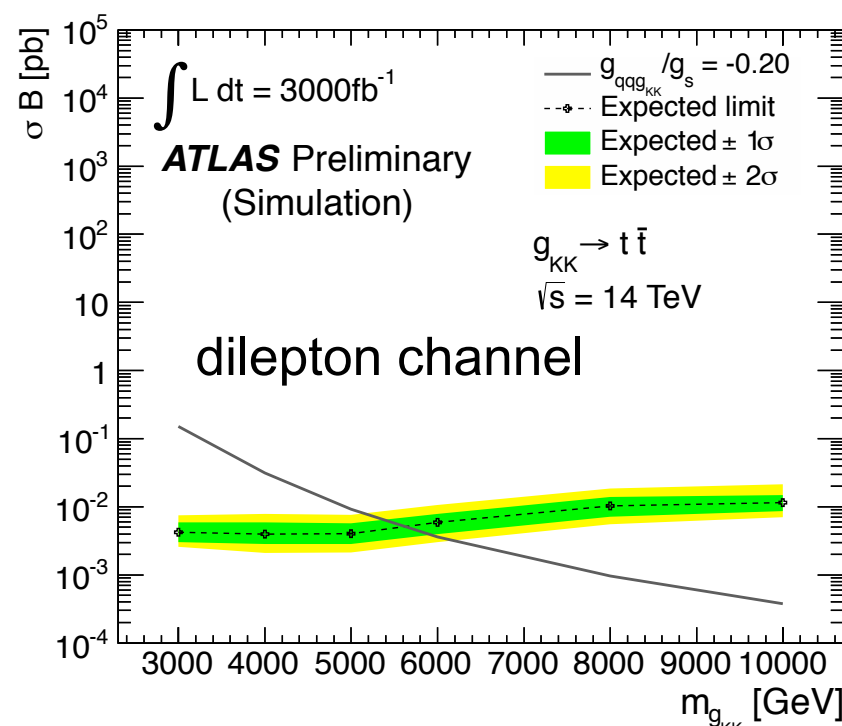
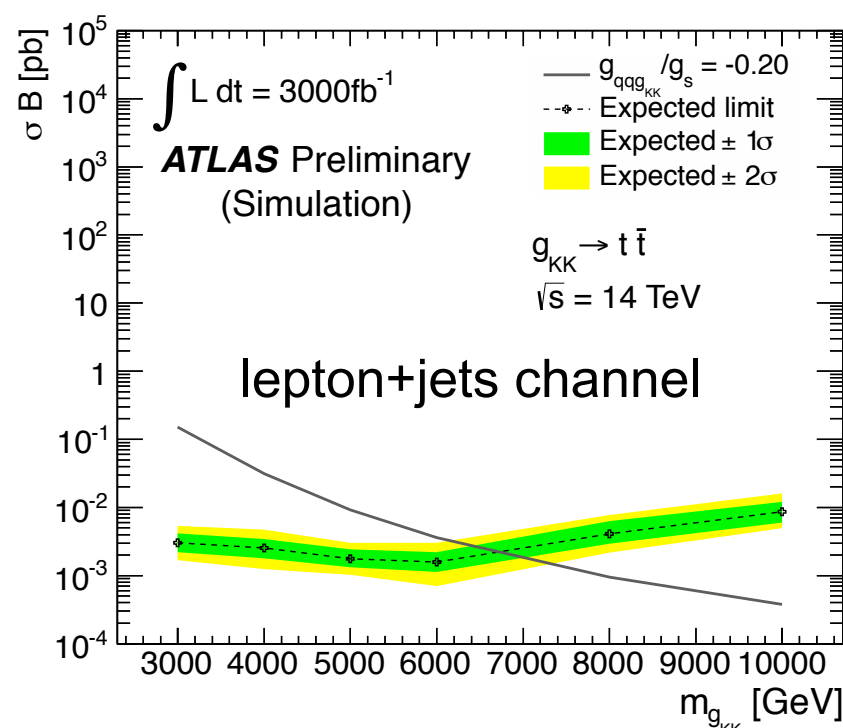


Current limit $\sim 1.8 \text{ TeV}$ for squark and gluino masses

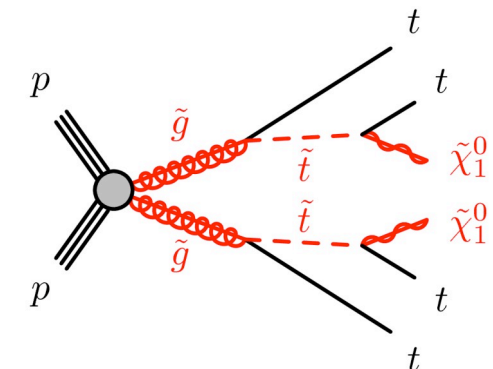
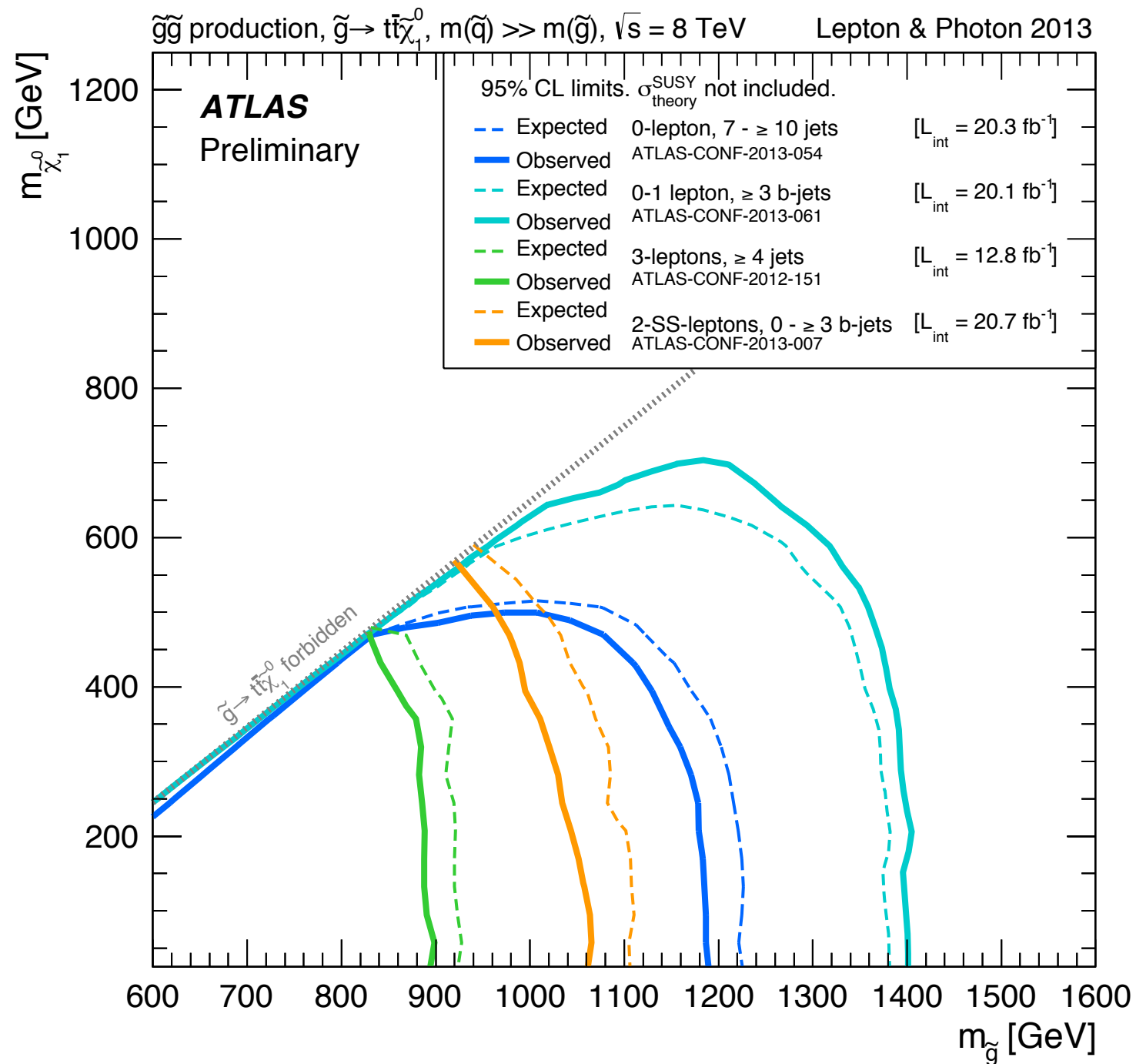


- Search is for WIMP pair production -> **missing Et signature**
- Trigger/select a photon or jet from QED or QCD initial-state or final-state radiation
- New results from **monojet** signature with a “fat jet” which could be from a W or a Z decay
- Complements earlier “inclusive monojet” searches
- Limits placed in context of effective theories of DM interactions with SM particles: spin-independent (D5) and spin-dependent (D9) wit





squark/gluino searches



- Exclusion limit at 95% CL for 8 TeV analyses in the $(m_g, m_{\text{neutralino1}})$ plane for **Gtt simplified model**: a pair of gluinos decays promptly via off-shell stop to four top quarks and two lightest neutralinos (LSP).
- model excluded for $m_g < 1$ TeV