Supersymmetry Searches at the LHC

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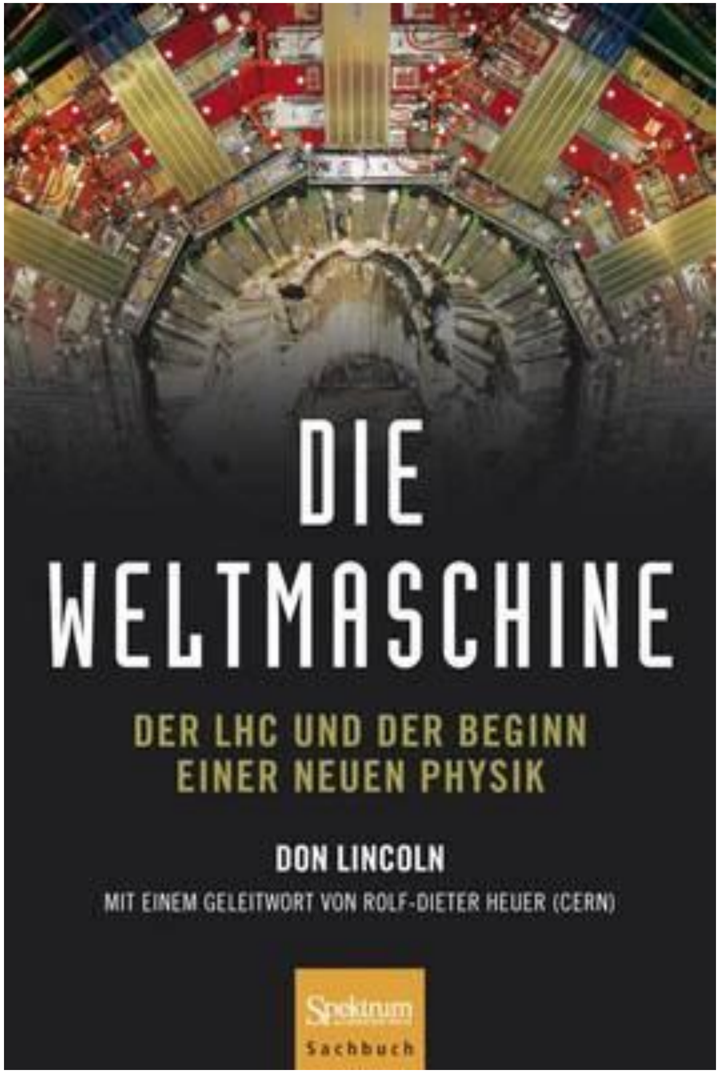
On behalf of the CMS and ATLAS Collaborations

Physics in Collision 2012

LHC: clash of the titans: LHC meets SUSY

LHC



vs

SUSY

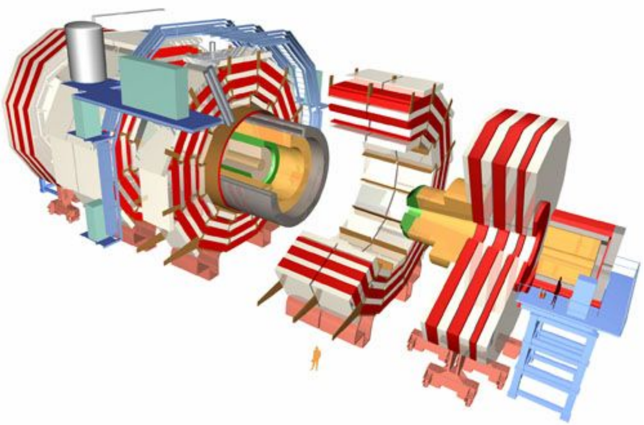
More than 8000 papers since 1990 (Kosower)

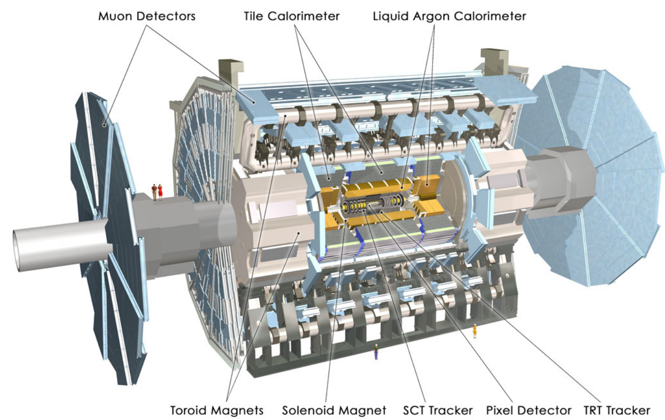
"One day all these trees will be SUSY phenomenology papers"

Searches for SUSY: LHC must pay tribute to LEP experiments, and CDF and D0
But in the end: $\sqrt{s}$ wins, and the LHC luminosity is also pretty good!

Results presented here based on **4-5 fb^{-1}** at **$\sqrt{s}$ = 7 TeV** (2011)
and some analyses have also used **4-6 fb^{-1}** at **$\sqrt{s}$ = 8 TeV** (2012)

CMS





ATLAS

Large amount of results:
- CMS SUSY: 3 notes 8 TeV, 19 papers 7 TeV, 30 notes 7 TeV (2011 data)
- ATLAS SUSY: 4 notes 8 TeV, 24 papers 7 TeV, 24 notes 7 TeV (2011 data)

approximate

See: http://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsSUS
http://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsEXO
http://twiki.cern.ch/twiki/bin/view/AtlasPublic/SupersymmetryPublicResults

Cannot, and will not cover all. (in particular: no indirect/flavour constraints)
Rather, make a selection focusing on consequences for status of SUSY

Outline:

- Supersymmetry, and the SUSY landscape
- Generic searches for coloured sparticles
- Gauge mediated SUSY
- Shift of paradigm: targeted searches for natural SUSY
  - third generation
  - electroweak gauginos
- SUSY escape routes
  - compressed spectra
  - long-lived particles
  - R-parity violation
  - SUSY beyond the MSSM
- The picture anno September 2012, outlook

- SUSY gives rise to partners of SM states with opposite spin-statistics but otherwise same Quantum Numbers.
- SUSY has a deep origin in marrying internal and space-time symmetries

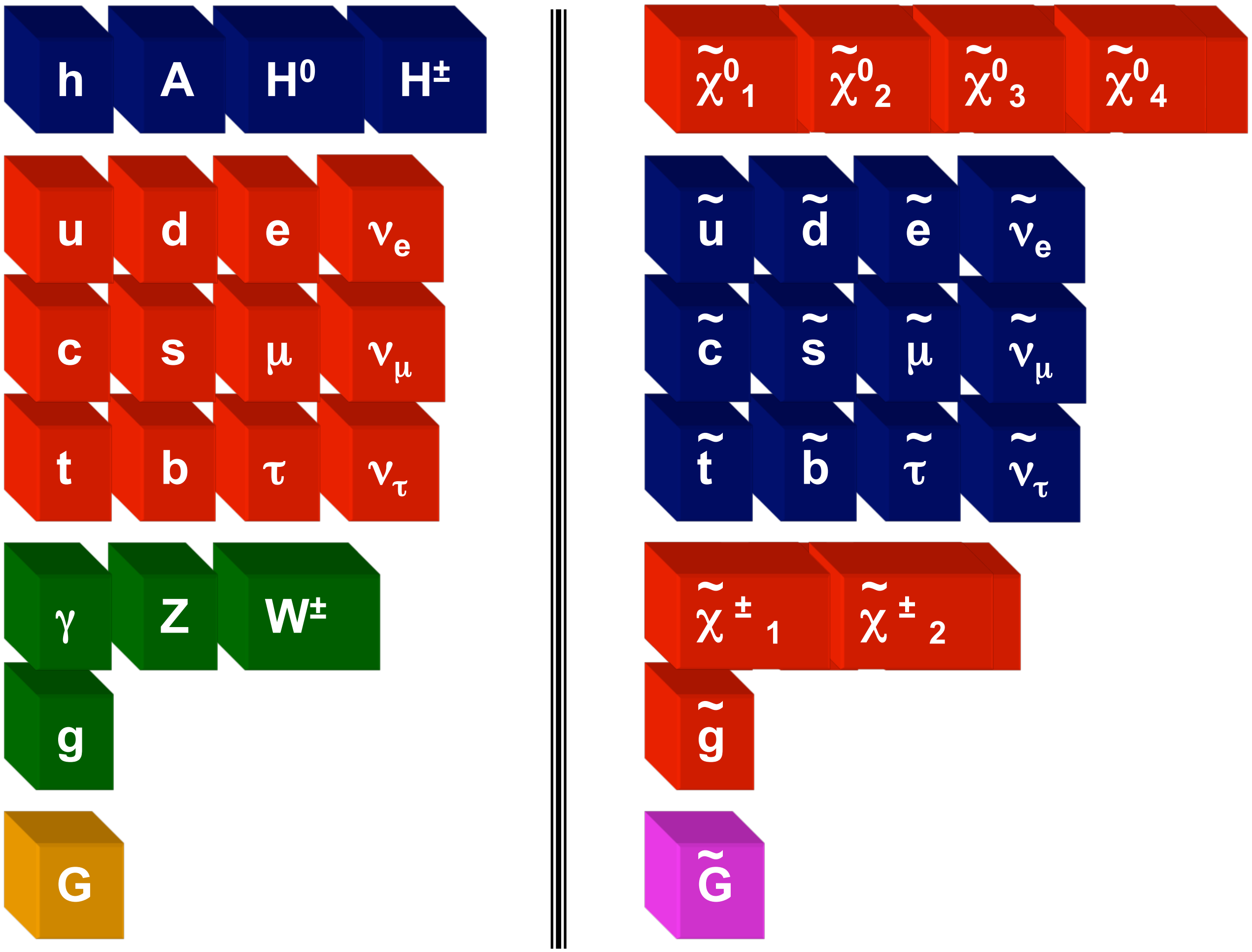
But our interest:

TeV-scale SUSY

hierarchy problem

dark matter

gauge coupling unification



The SUSY landscape:

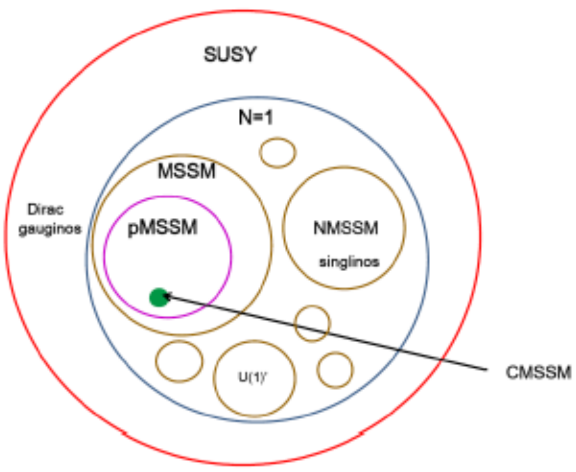
No SUSY particles observed so far: SUSY must be broken or absent

Models for SUSY breaking: gravity-, gauge-, anomaly mediated,…

General MSSM: 105 new parameters
MSUGRA/CMSSM: 5 parameters
intermediate: pMSSM : 19-24 parameters
simplified models

R-parity conservation/violation?
LSP stable and weakly interacting?

SUSY Theory phase space



T. Rizzo (SLAC Summer Institute, 01-Aug-12)

Flavour physics results see no sign of new phenomena beyond the SM.
→ significant constraints on SUSY

However, there is still $(g-2)_\mu$, and a SUSY LSP is still a good dark matter candidate

Observation of a new boson at 125 GeV, consistent with the SM Higgs boson
→ obvious big SUSY implications.

Higgs mass

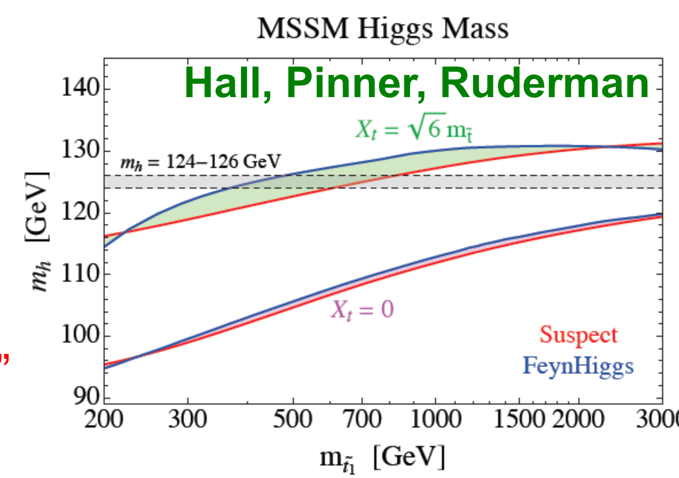
MSSM:

$$X_t = m_t\left(A_t - \mu\cot\beta\right)$$

$$m_h^2 \approx m_Z^2\cos^2 2\beta + \frac{3}{(4\pi)^2}\frac{m_t^4}{v^2}\left[\ln\frac{m_{\tilde{t}}^2}{m_t^2} + \frac{X_t^2}{m_{\tilde{t}}^2}\left(1 - \frac{X_t^2}{12 m_{\tilde{t}}^2}\right)\right]$$

Measured 125 GeV < MSSM maximum of 135 GeV: good!

However: 125 GeV is heavy for SUSY
→ high squark masses
→ stop lighter if large L-R mixing and A_t large
→ too massive stop bad for "naturalness"



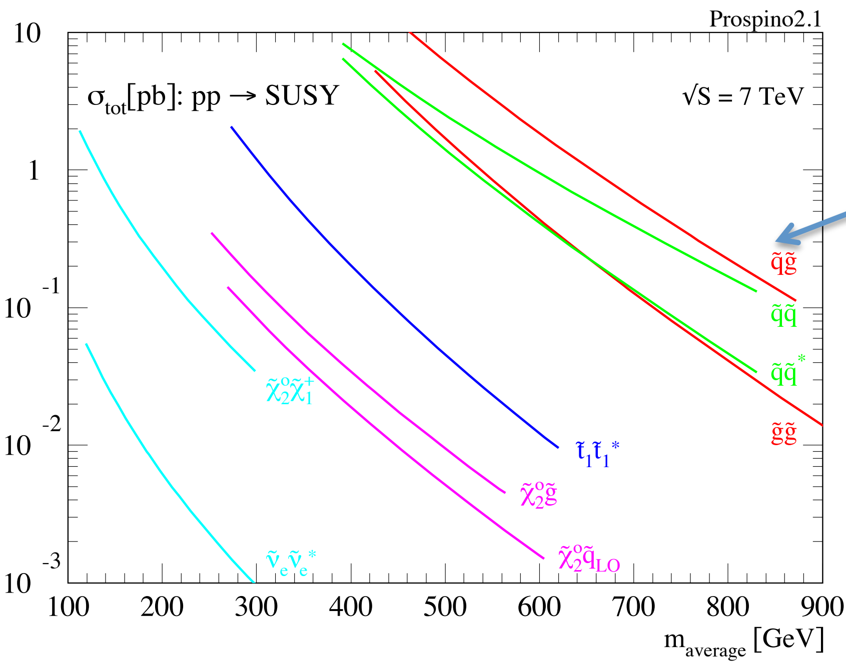
Measurements of couplings (and maybe other Higgses) will tell: SM / SUSY / … ?

High Higgs mass easier to achieve in NMSSM

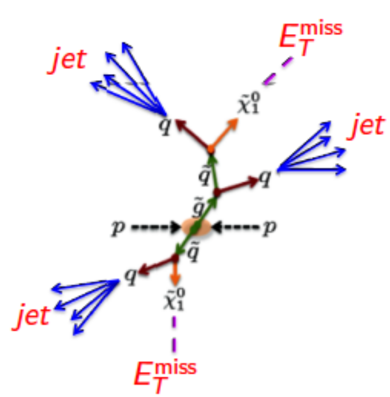
We do not know how SUSY might show up first.
A good start could be:

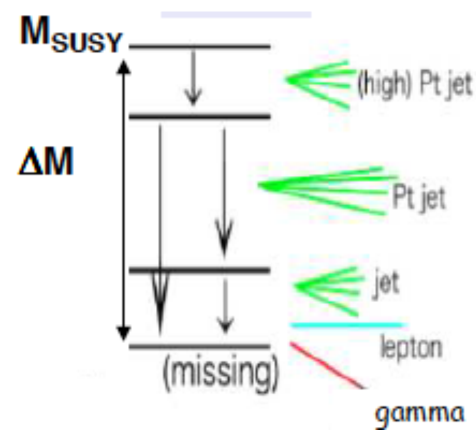
R-parity conservation assumed

Inclusive searches with jets and missing momentum



LHC: sensitivity first to strong production of coloured sparticles: squarks/gluinos





Keep analyses simple, general and robust
Do not overtune on specific models

→ **Wide arsenal of tools: variables to suppress and estimate background**

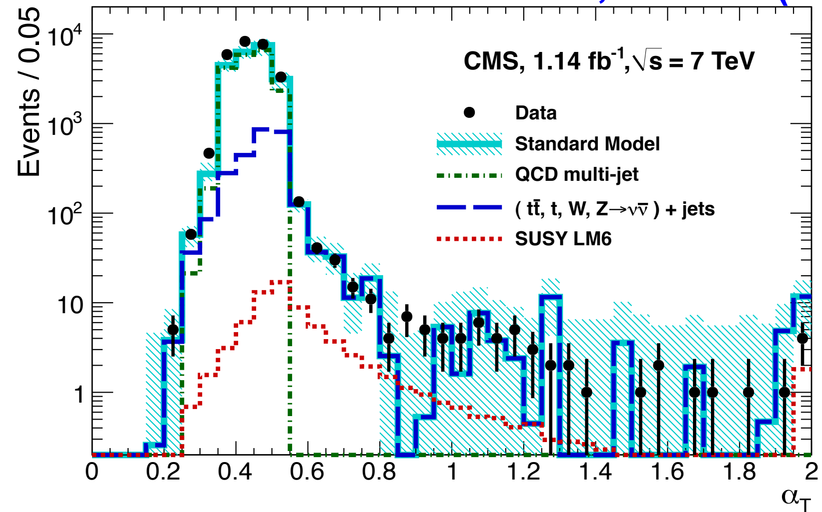
CMS: examples: α_T , razor R, $H_T + H_T^{miss}$, M_{T2}

α_T is a robust variable designed for a strong suppression of QCD

$$\alpha_T = \frac{E_T^{j2}}{M_T^{dijet}} = \frac{E_T^{j2}}{\sqrt{H_T^2 - \not{H}_T^2}} = \frac{E_T^{j2}}{2E_T^{j1}E_T^{j2}(1-\cos\Delta\phi_{j1j2})}$$

- perfectly balance dijet system $\alpha_T = 0.5$
- imbalanced back-to-back configuration $\alpha_T < 0.5$
- for multi-jet events, jets are merged into two pseudo-jets (minimizing ΔH_T)

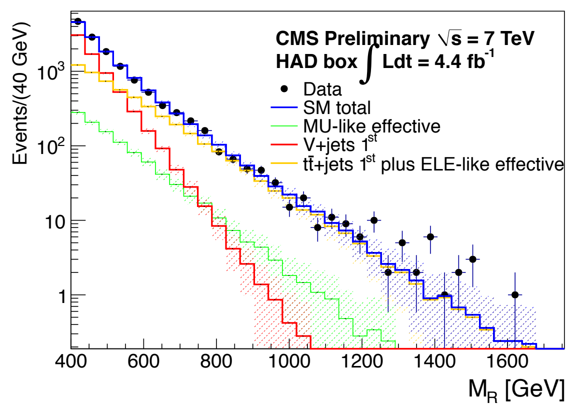
PRL 107, 221804 (2011)



razor $R \equiv \frac{M_T^R}{M_R}$.

$$M_R \equiv \sqrt{(E_{j_1} + E_{j_2})^2 - (p_z^{j_1} + p_z^{j_2})^2}$$

$$M_T^R \equiv \sqrt{\frac{E_T^{miss}(p_T^{j1} + p_T^{j2}) - \vec{E}_T^{miss} \cdot (\vec{p}_T^{\,j1} + \vec{p}_T^{\,j2})}{2}}$$



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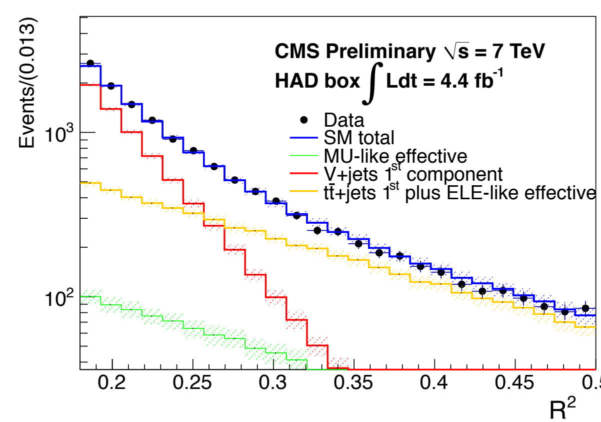


ATLAS example: effective mass $M_{eff} = \Sigma\, p_T^{jets} + E_t^{miss}$ ($+\, p_T^{lepton}$)

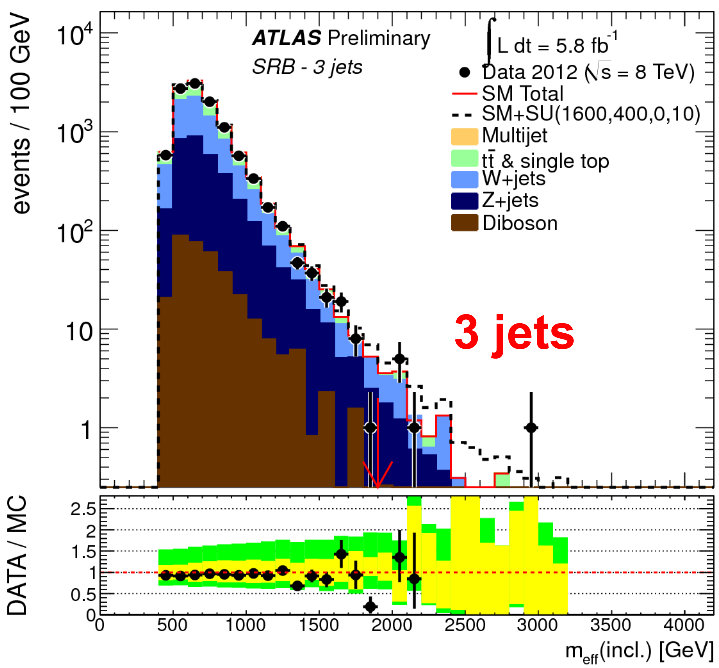
5 signal regions (2-≥6 jets)
each with loose/medium/tight

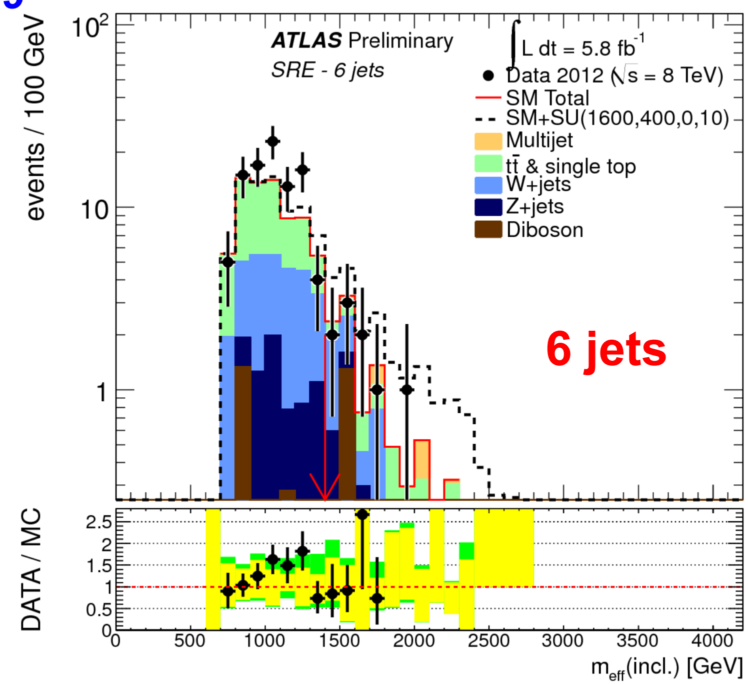
Each SR has 4 control regions
for background estimation

8 TeV data

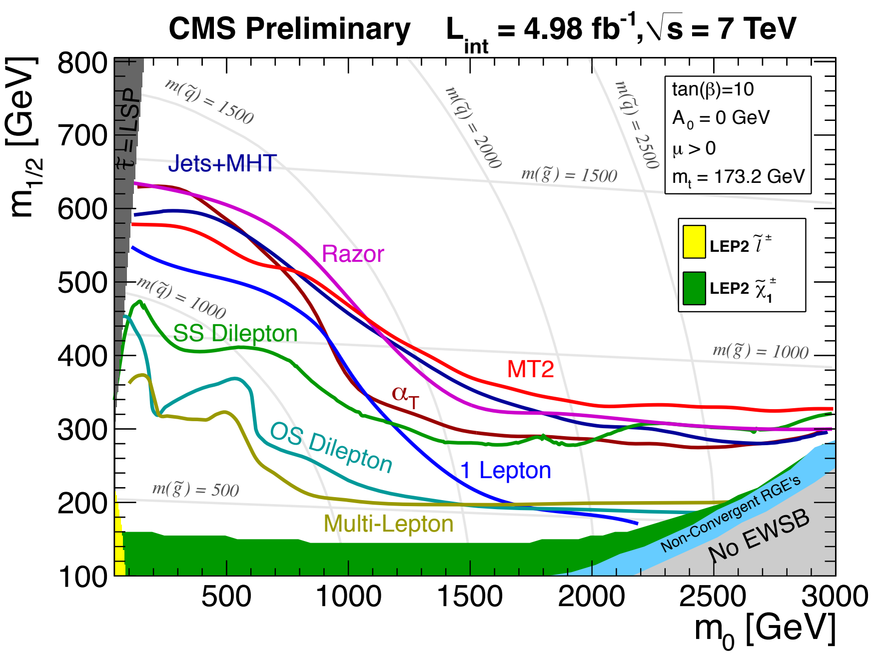
Requirement	Channel				
	A 2-jets	B 3-jets	C 4-jets	D 5-jets	E 6-jets
E_T^{miss}[GeV] >	160				
$p_T(j_1)$ [GeV] >	130				
$p_T(j_2)$ [GeV] >	60				
$p_T(j_3)$ [GeV] >	–	60	60	60	60
$p_T(j_4)$ [GeV] >	–	–	60	60	60
$p_T(j_5)$ [GeV] >	–	–	–	60	60
$p_T(j_6)$ [GeV] >	–	–	–	–	60
$\Delta\phi$(jet, E_T^{miss})$_{min}$ [rad] >	0.4 (i = {1, 2, (3)})		0.4 (i = {1, 2, 3}), 0.2 (p_T > 40 GeV jets)		
$E_T^{miss}/m_{eff}(Nj)$ >	0.3/0.4/0.4 (2j)	0.25/0.3/– (3j)	0.25/0.3/0.3 (4j)	0.15 (5j)	0.15/0.25/0.3 (6j)
m_{eff}(incl.) [GeV] >	1900/1300/1000	1900/1300/–	1900/1300/1000	1700/–/–	1400/1300/1000

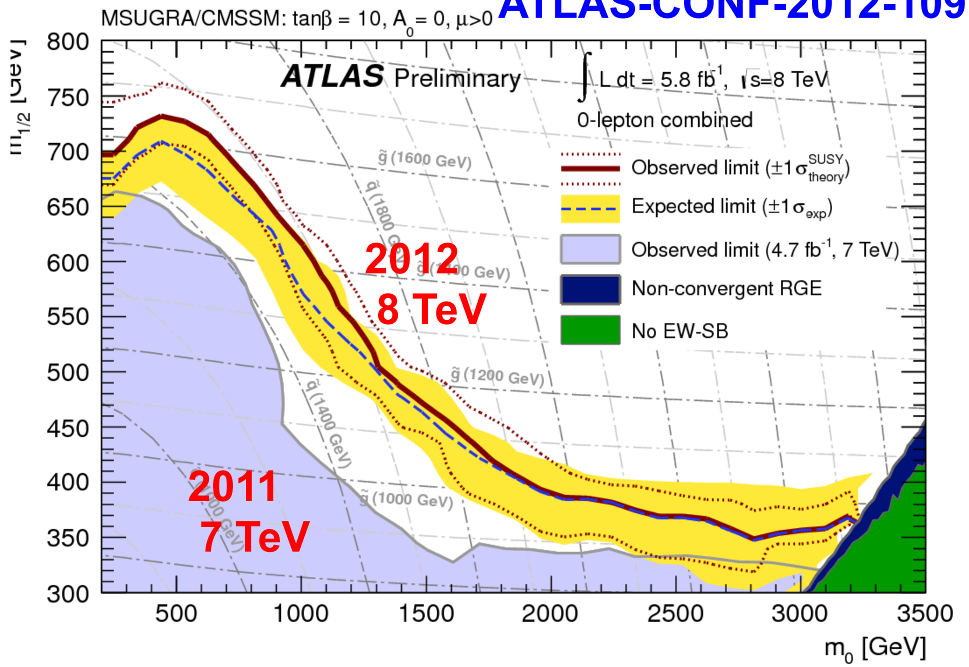
ATLAS-CONF-2012-109





MSUGRA/CMSSM interpretation





ATLAS-CONF-2012-109

Multiple analyses, multiple methods: no excess above SM observed

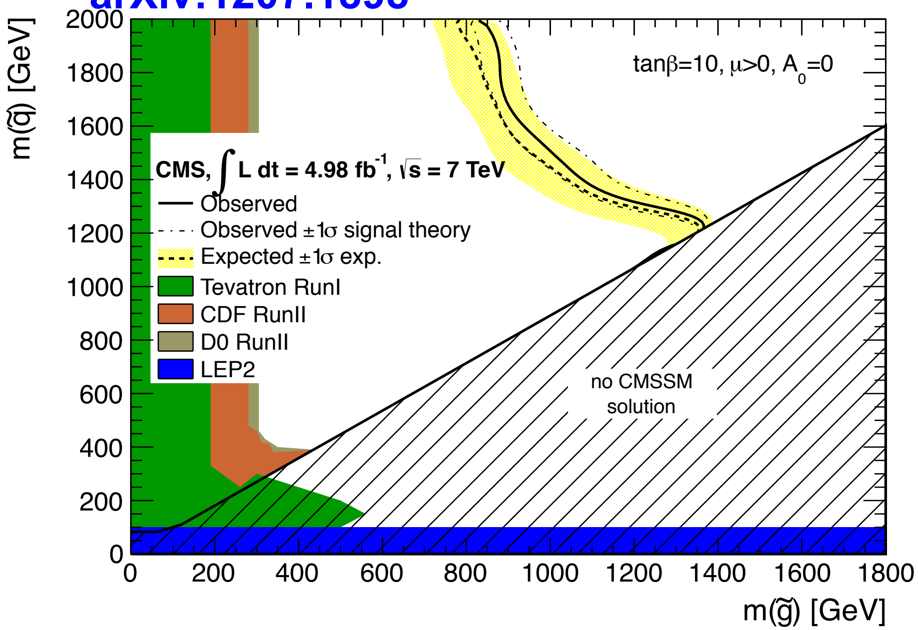
tan β = 10, A_0 = 0, μ > 0: $m_{1/2}$ < 350 GeV excluded

only weak dependence on tan β up to ~40 or so
disfavours SUSY interpretation of $(g-2)_\mu$

MSUGRA/CMSSM interpretation

in terms of squark and gluino masses:

arXiv:1207.1898



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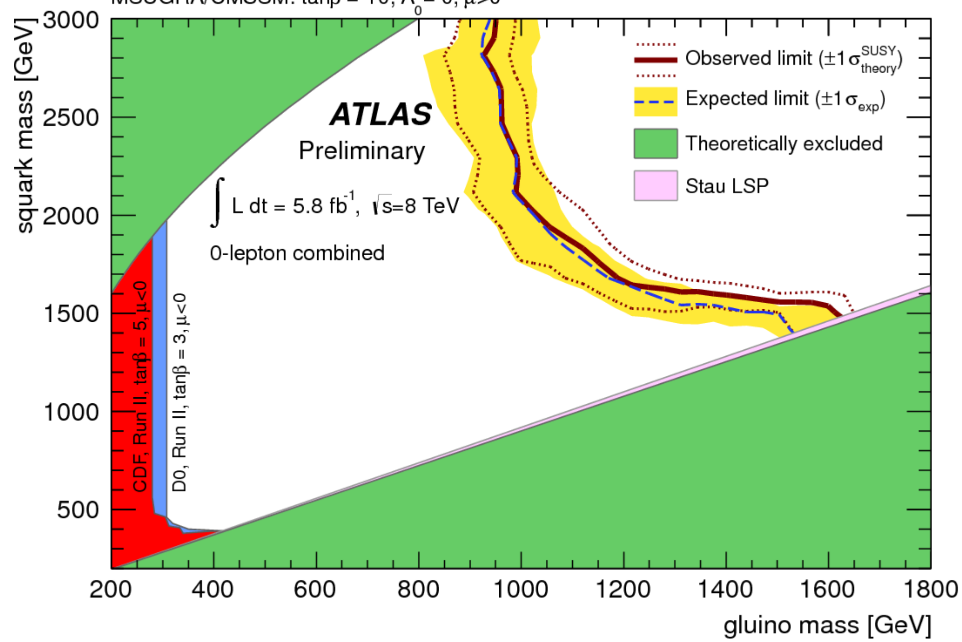
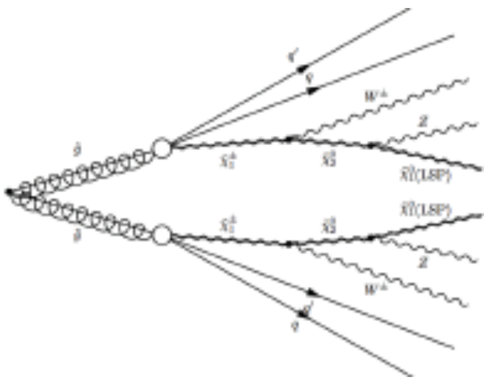


For equal squark and gluino masses: m < 1500 GeV excluded

for all squark masses: gluino m < 950 GeV excluded

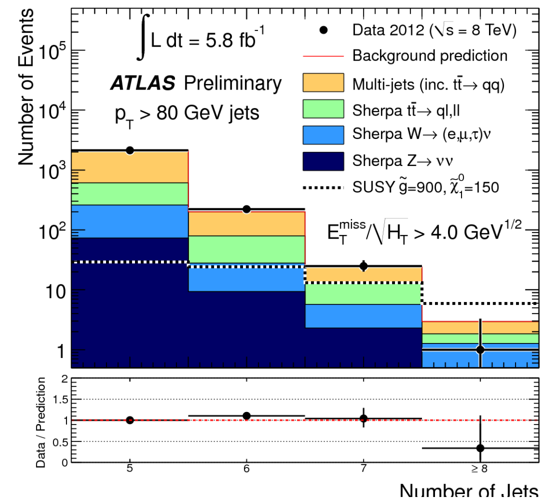
for all gluino masses: squark m < 1400 GeV excluded

Long decay chains: searches specific for gluino pair production

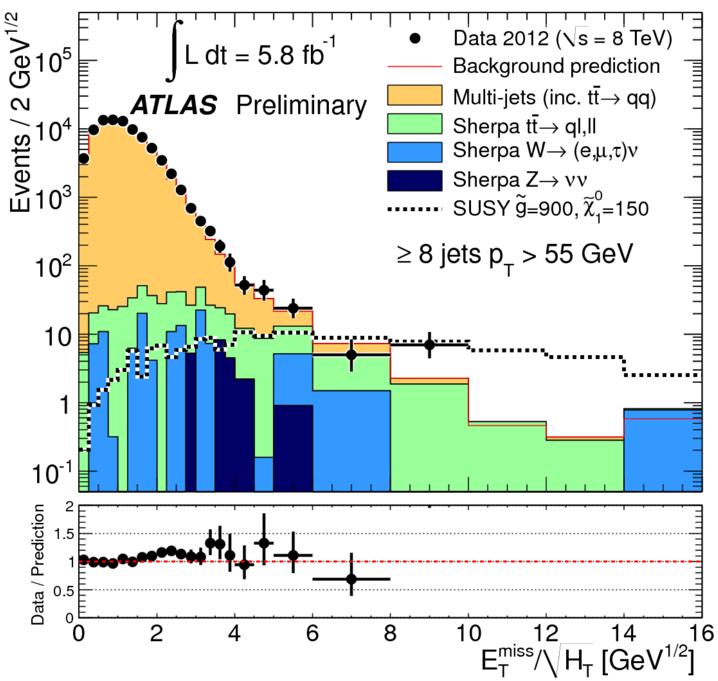


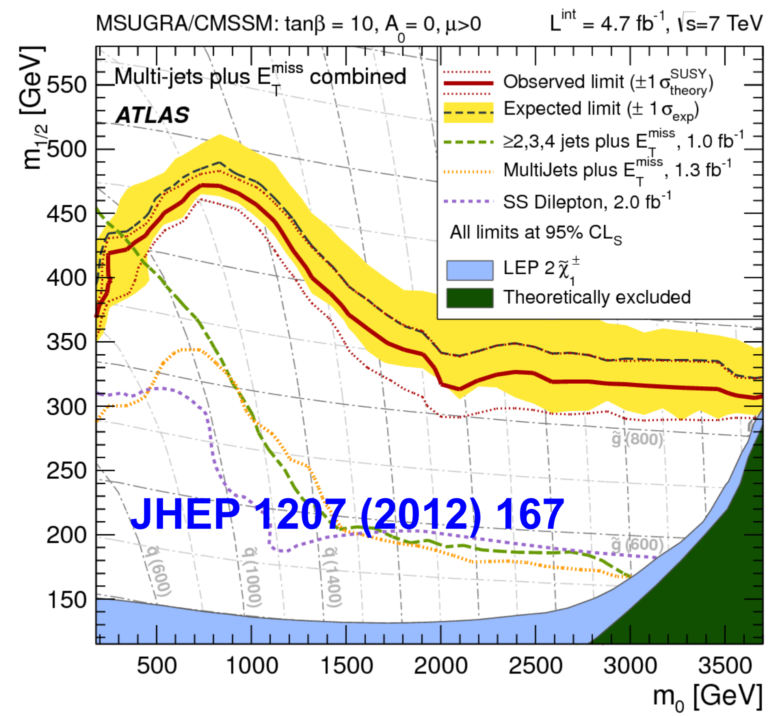
ATLAS: ≥ 6-9 jets

cut on E_T^{miss} significance
$\cong E_T^{miss} / \sqrt{H_T}$



ATLAS-CONF-2012-103





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Searches with one isolated lepton and jets

Sensitive to gauginos in decay chains.
Requirement of isolated lepton good against QCD multi-jet background.
Background dominated by top-quark pairs and W+jets

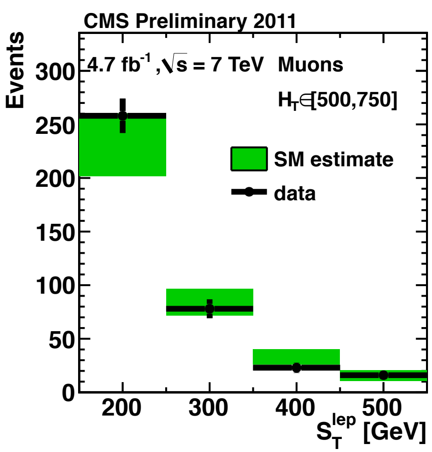
Also di-lepton and multi-lepton analyses exist in CMS / ATLAS

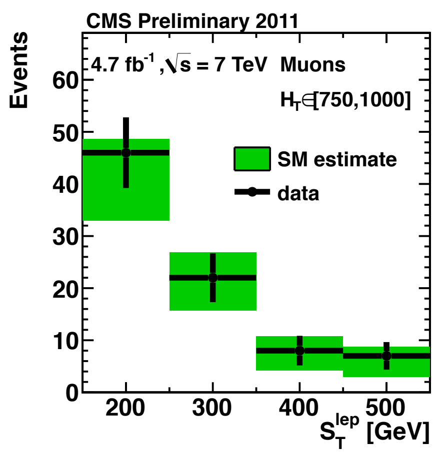
Example: CMS analysis of one isolated lepton + jets

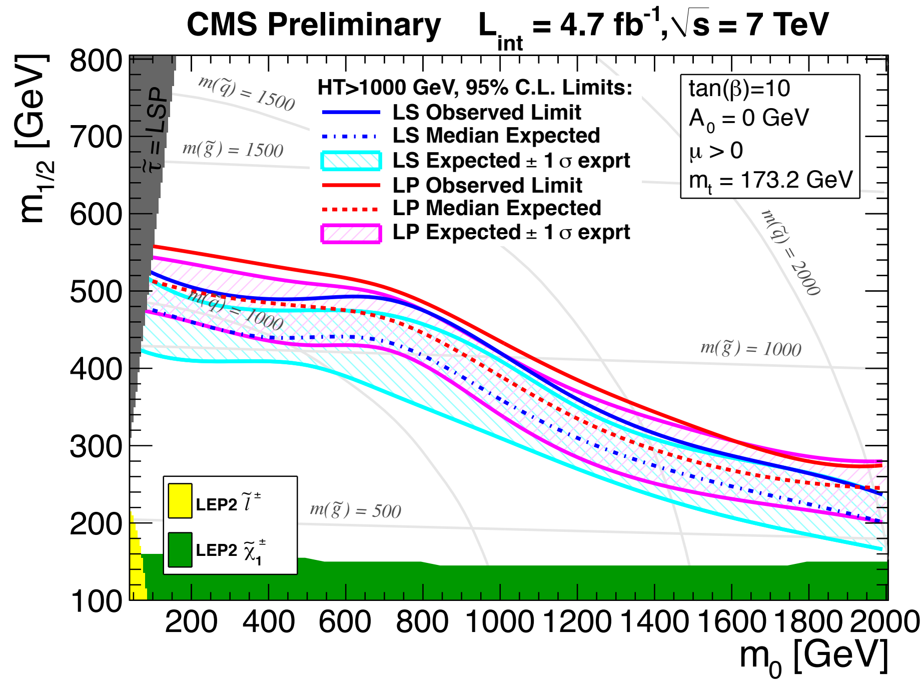
2 data-driven background prediction methods:

- lepton p_T spectrum → E_T^{miss} spectrum
- predict bg using helicity angle of lepton in W frame: use W polarization

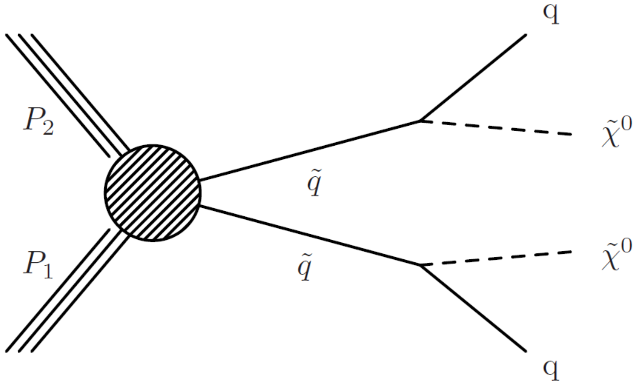
PAS-SUS-12-010

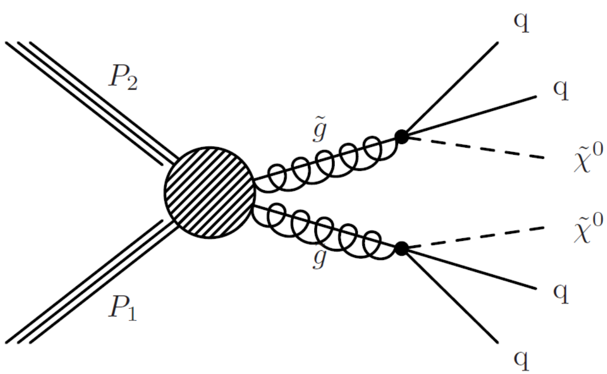






Relaxing the constraints: simplified models

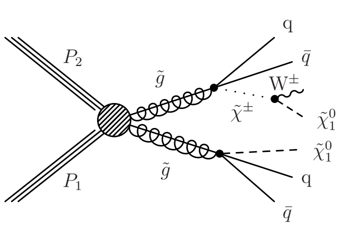


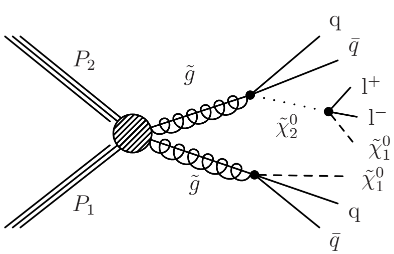


A simplified model is defined by an effective Lagrangian describing the interactions of a small number of new particles. Simplified models can equally well be described by a small number of masses and cross-sections. These parameters are directly related to collider physics observables, making simplified models a particularly effective framework for evaluating searches and a useful starting point for characterizing positive signals of new physics.

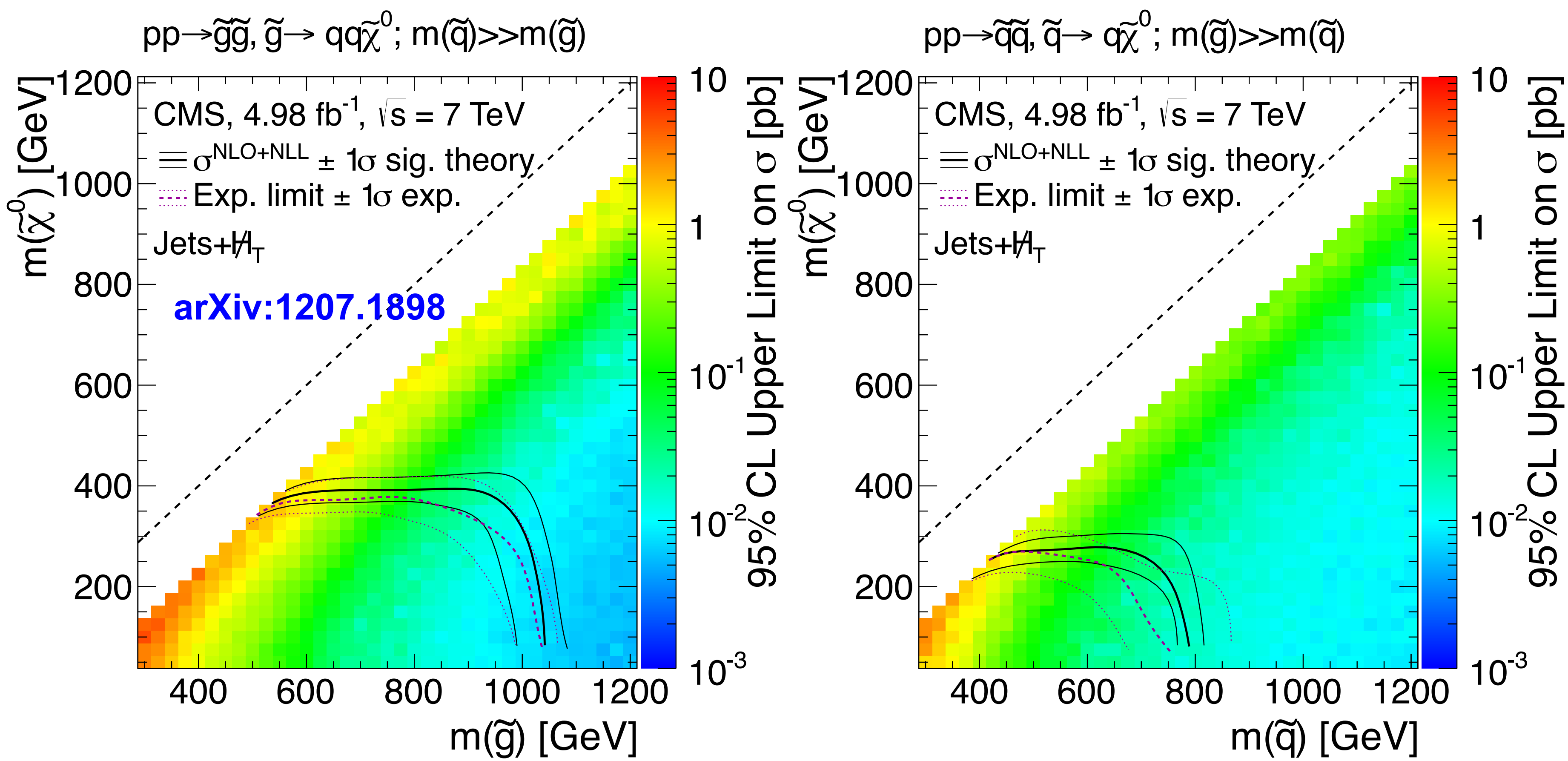
D.Alves et al., arXiv:1105.2838

Can build in more complexity by extending simplified model set





CMS: large collection of simplified model interpretations in PAS-SUS-11-016, but also in other papers/notes.

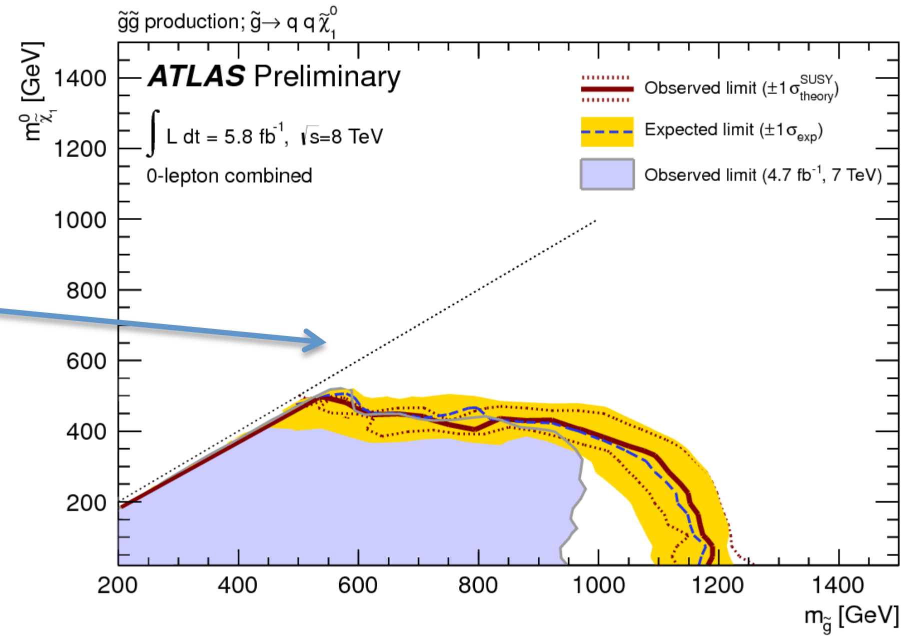


Note assumptions: only gluino/gluino or squark/squark production
100% branching ratios as shown
Neutralino masses left free: gluino/squark limits collapse for heavy neutralinos

ATLAS

(conclusions agree with those of CMS)

gluino pair production



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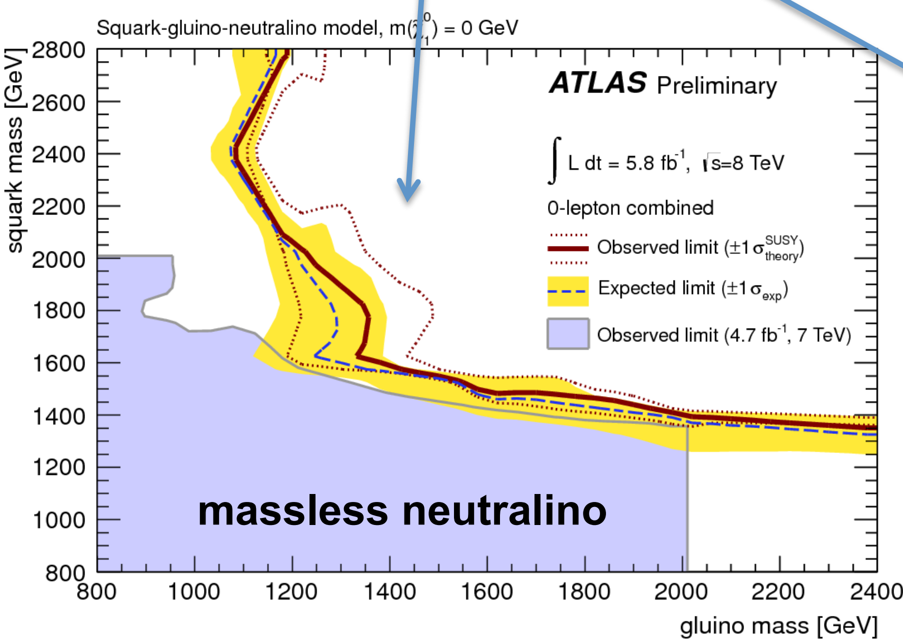
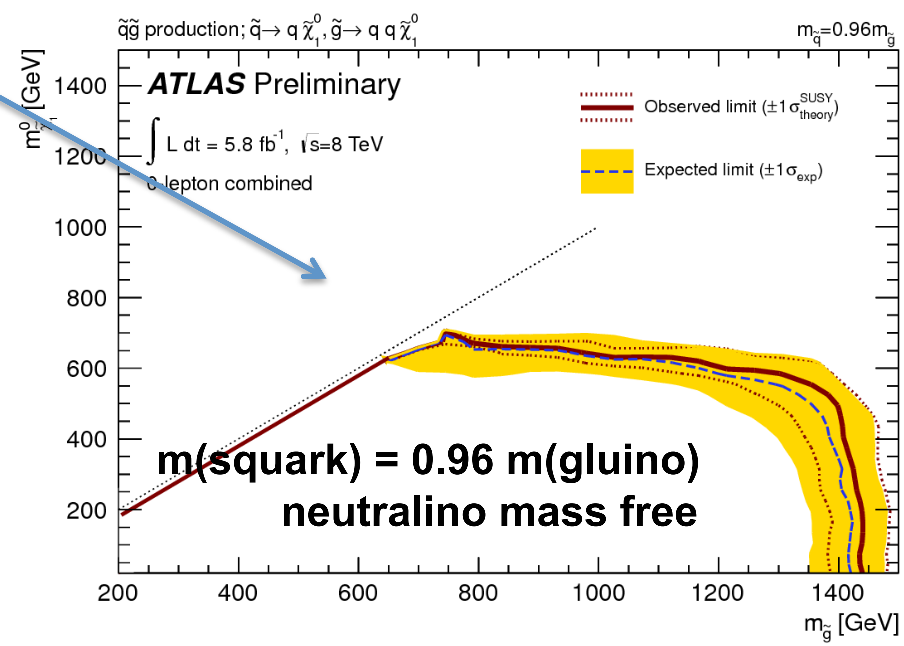
squark + gluino production





Gauge mediation

SUSY breaking from hidden sector could be mediated by gauge interactions

Light gravitino LSP,   several candidates for NLSP:

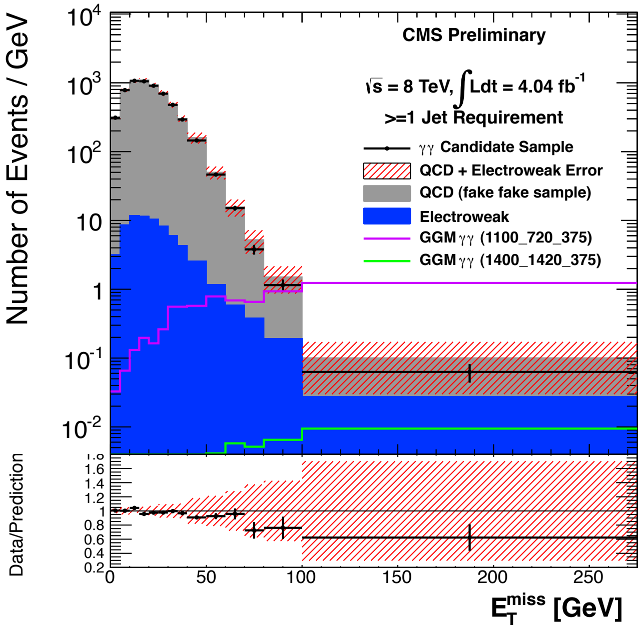
- stau: stau → tau + gravitino
- any slepton → lepton + gravitino
- neutralino → X + gravitino

Neutralino NLSP: decay depends on bino/wino/higgsino mixture

- bino-like: neutralino → photon + gravitino
- wino-like: neutralino → Z + gravitino
- higgsino-like: neutralino → h + gravitino

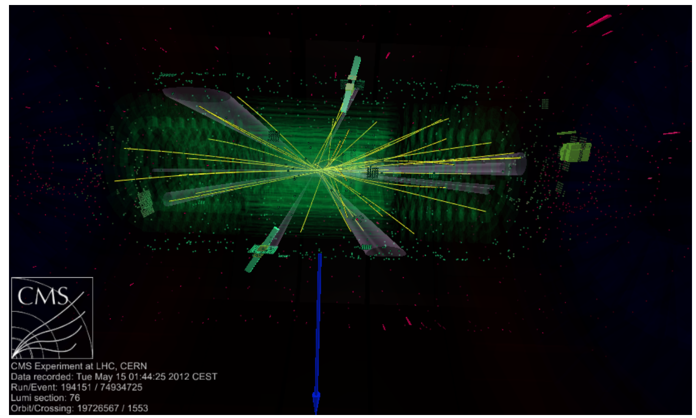
Searches for combinations of photons/Z/h + E_T^{miss}
NLSP could decay promptly, or with significant lifetime

Neutralino NLSP: photon + MET, di-photon + MET in **CMS**



E_T^γ > 40/25 GeV; E_T^{miss} > 100 GeV: 17.5 bg exp.
11 observed

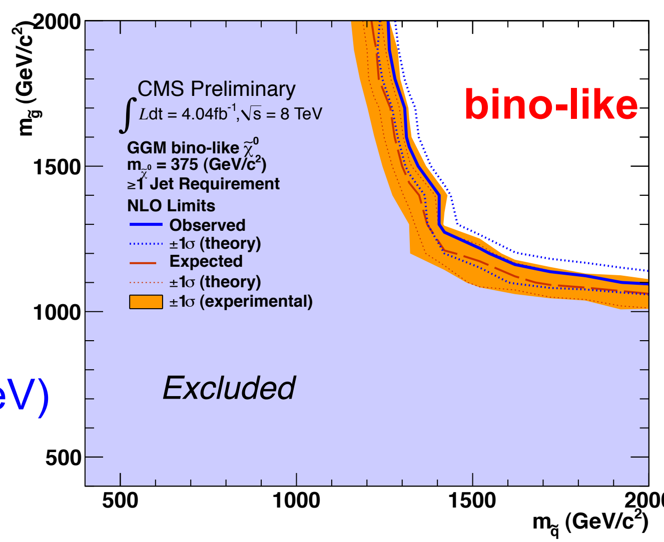
PAS-SUS-12-018

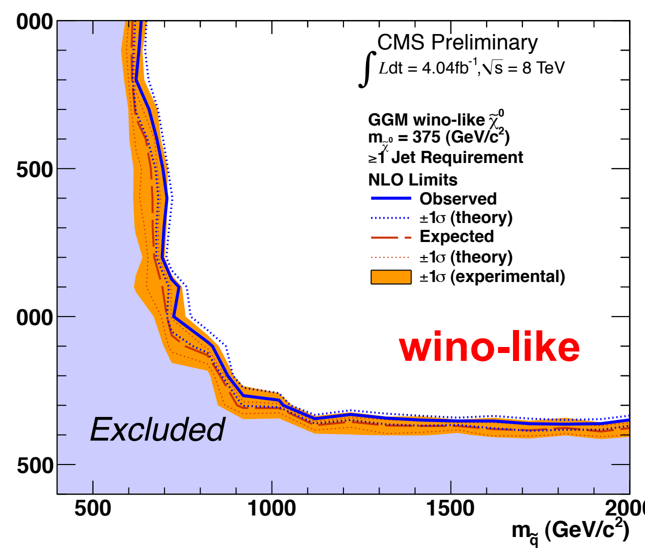


γ's 133/132 GeV
E_T^{miss} 143 GeV

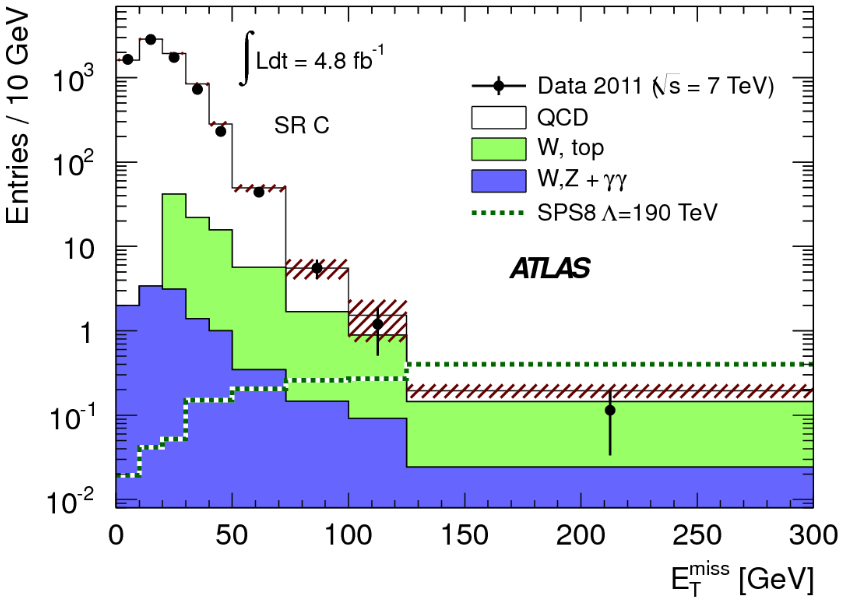
Interpretation in General Gauge Mediation

(assumed $m_{\tilde{\chi}}$ = 375 GeV)





Di-photon + MET in **ATLAS**

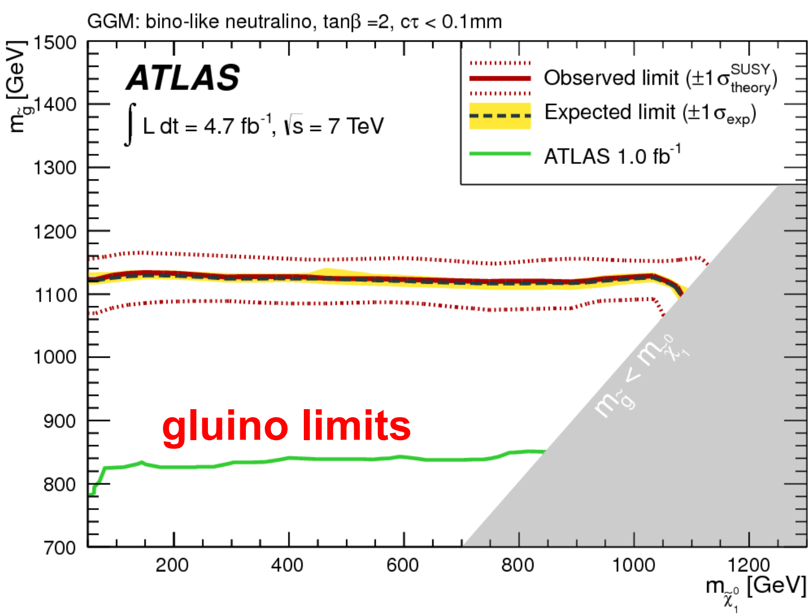


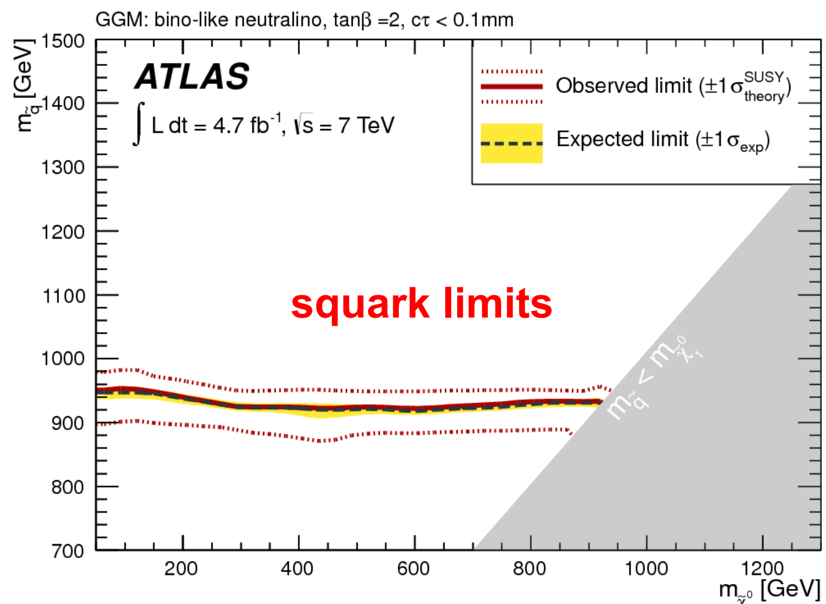
arXiv:1209.0753

E_T^{γ} > 50/50 GeV;

E_T^{miss} > 125 GeV: 2.11 bg exp.
2 observed

Interpretation for bino-like neutralino
(Neutralino mass free parameter)



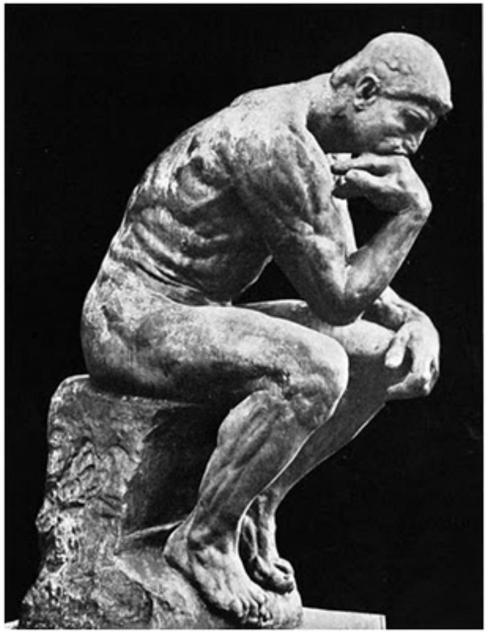


These results impose severe constraints on SUSY

- constrained models like MSUGRA/CMSSM have a hard time
  - best fits towards ever higher m_0, $m_{1/2}$
  - note that limits on weakly interacting particles are derived limits only (from squarks/gluinos)

- squarks of the 1st and 2nd generation, gluinos must be above ~ TeV scale (unless heavy neutralinos)

Rethinking our options…

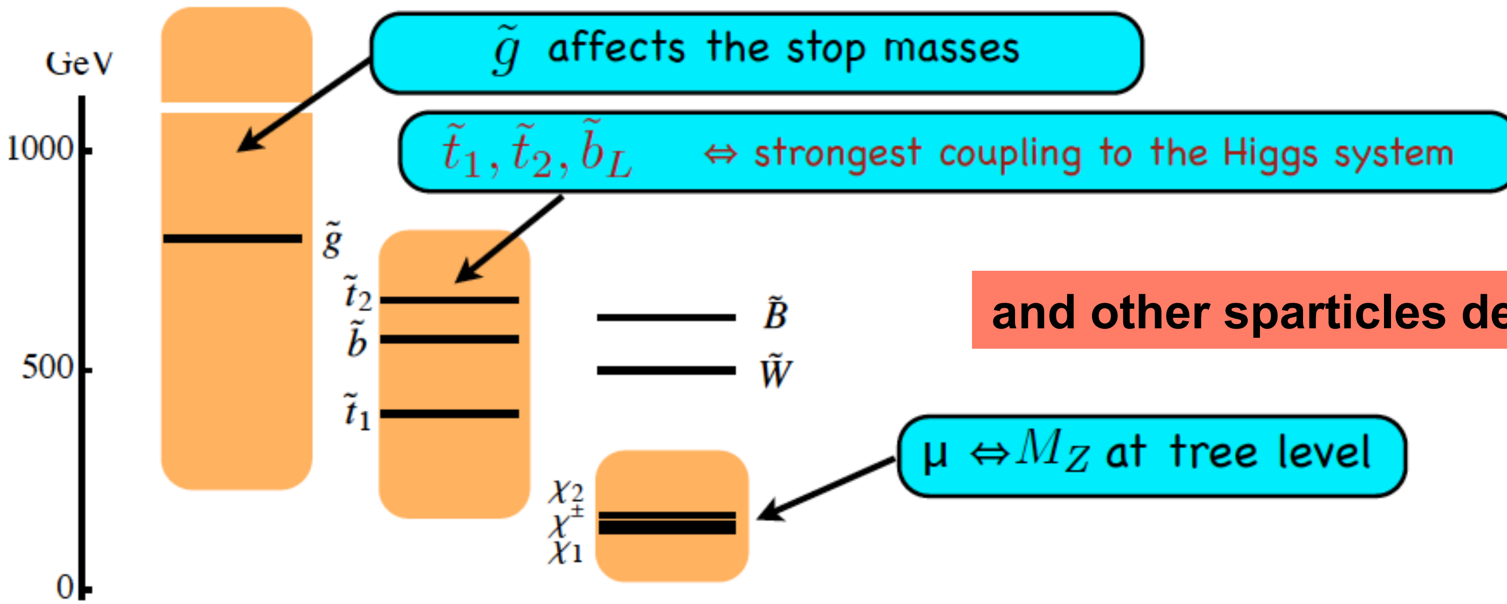


Shifting emphasis:

Not only look for inclusive SUSY, but focus on measurements that probe the real motivations for TeV-scale SUSY:

- Naturalness (1): 3rd generation: stop, sbottom
  (mass related to m_H)

- Naturalness (2) + Dark matter: gauginos
  (mass related to μ, μ related to m_Z)



and other sparticles decoupled?

(R. Barbieri, ICHEP 2012)

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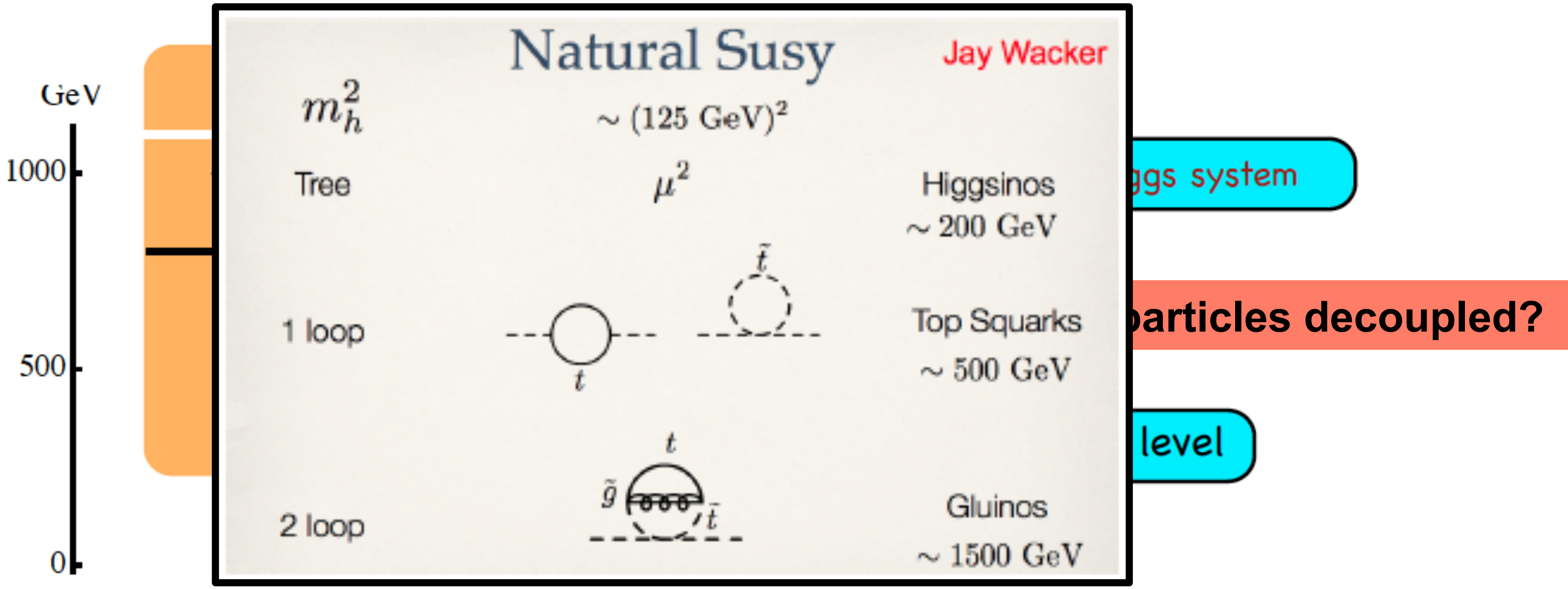
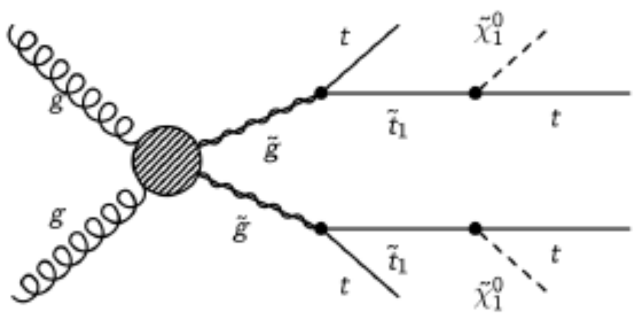


(R. Barbieri, ICHEP 2012)

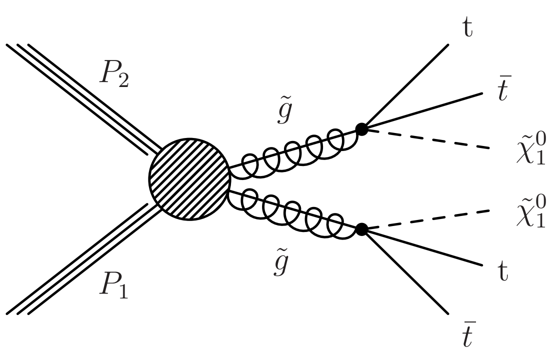
Stop and sbottom production

Gluino-mediated:

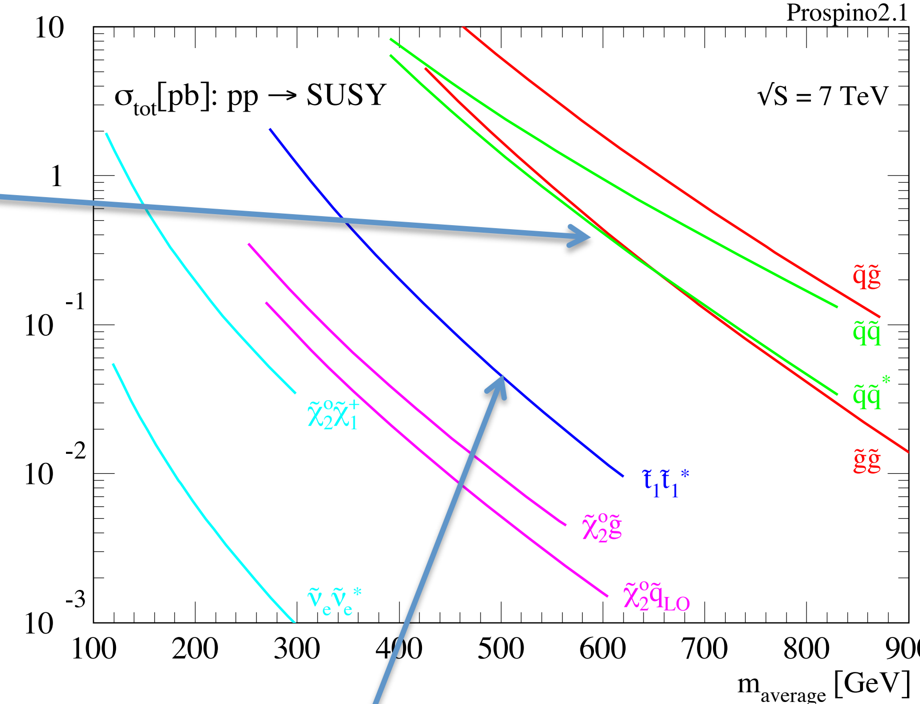
large cross section, if gluino not too heavy and significant Br to 3rd generation



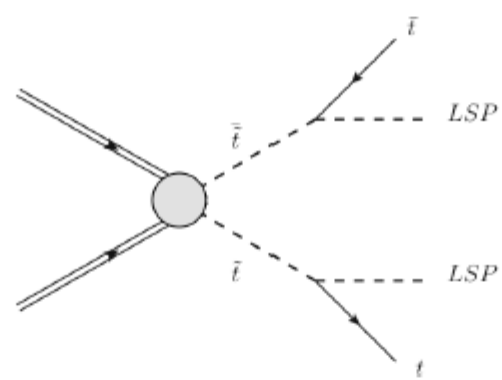
for m(stop) < m(gluino)



for m(stop) > m(gluino)



Direct production:



small cross section, top-like final state

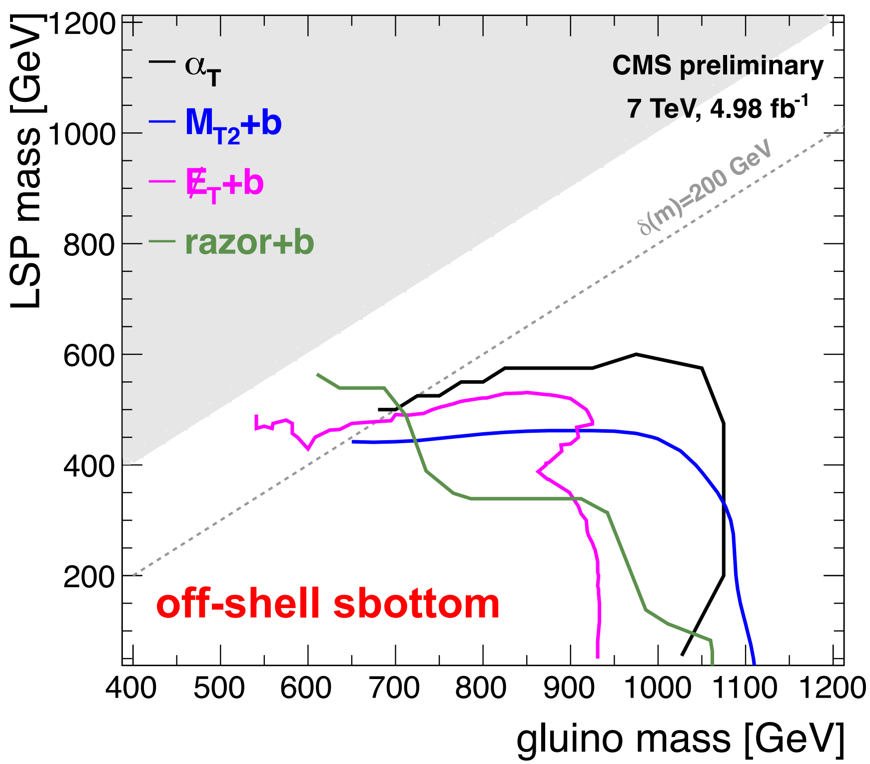
gluino-mediated sbottom production

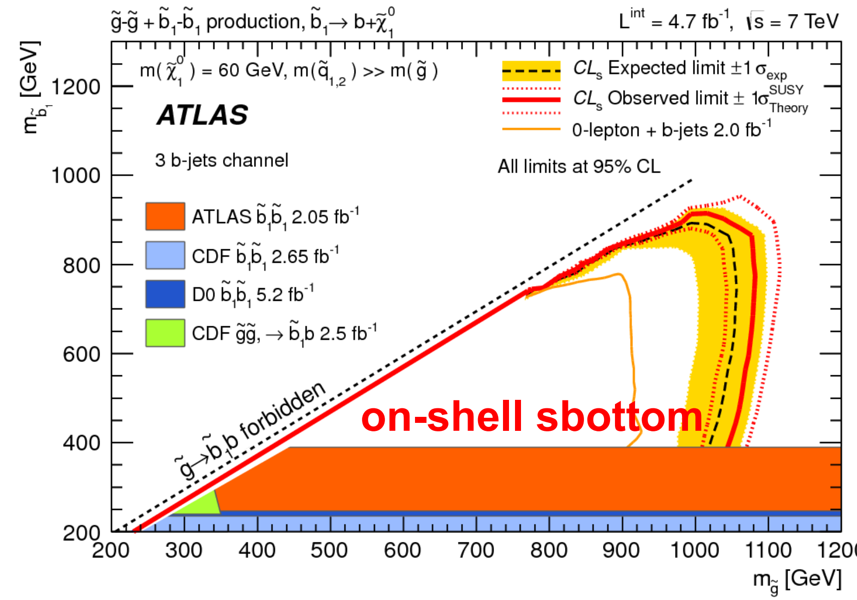
arXiv:1207.4686

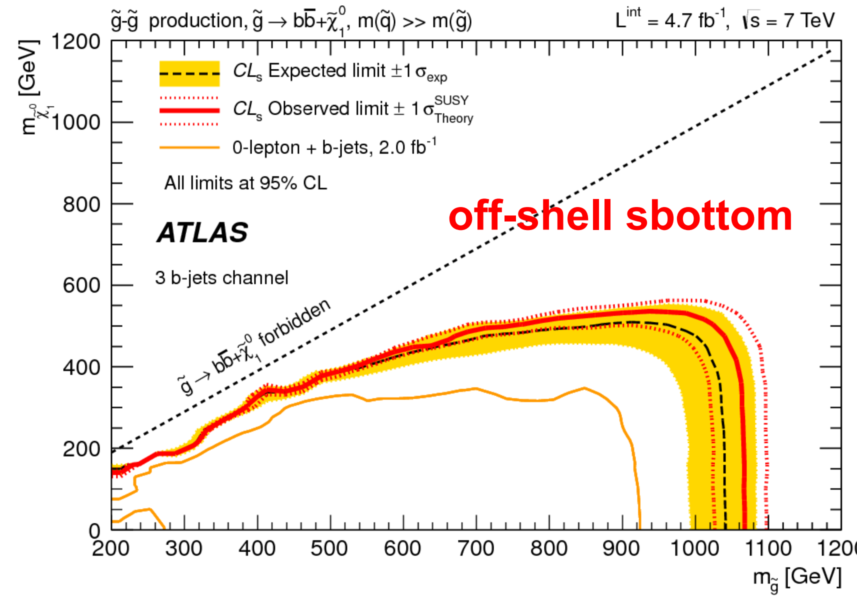
ATLAS: 3 b-jets + E_T^{miss}

CMS: hadronic analyses + b-tag

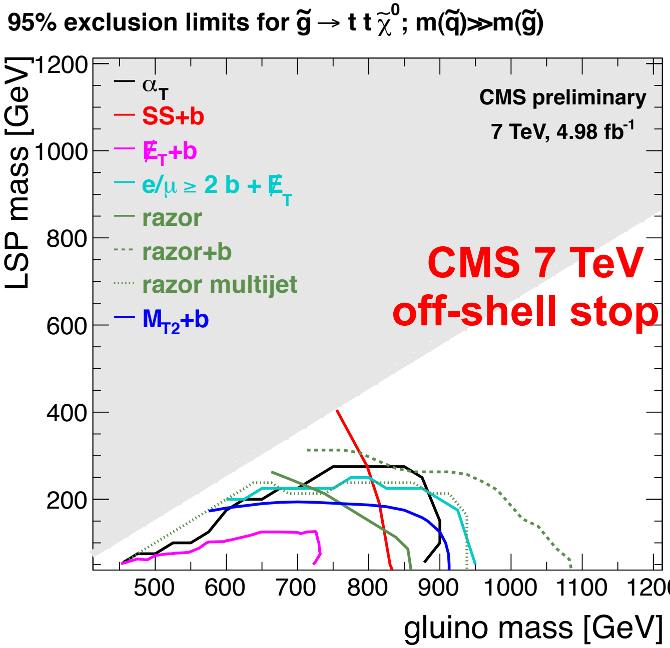
95% exclusion limits for $\tilde{g} \rightarrow b\,b\,\tilde{\chi}^0$; $m(\tilde{q}) \gg m(\tilde{g})$

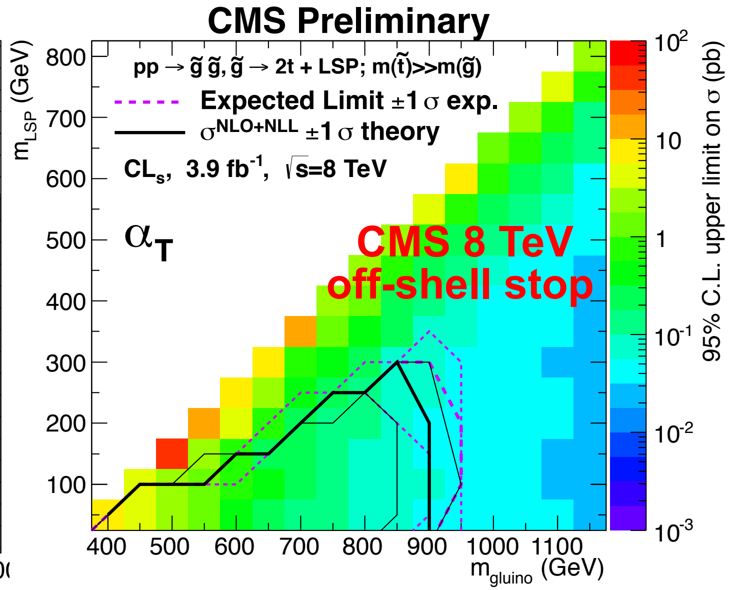






gluino-mediated stop production



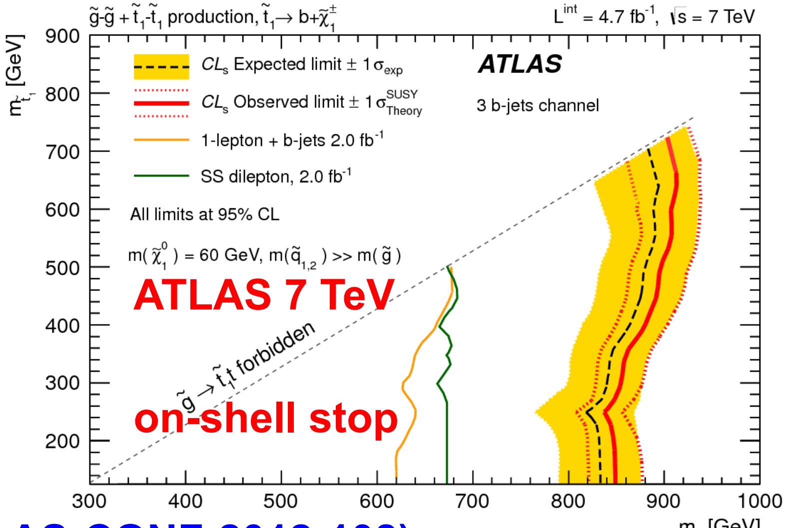


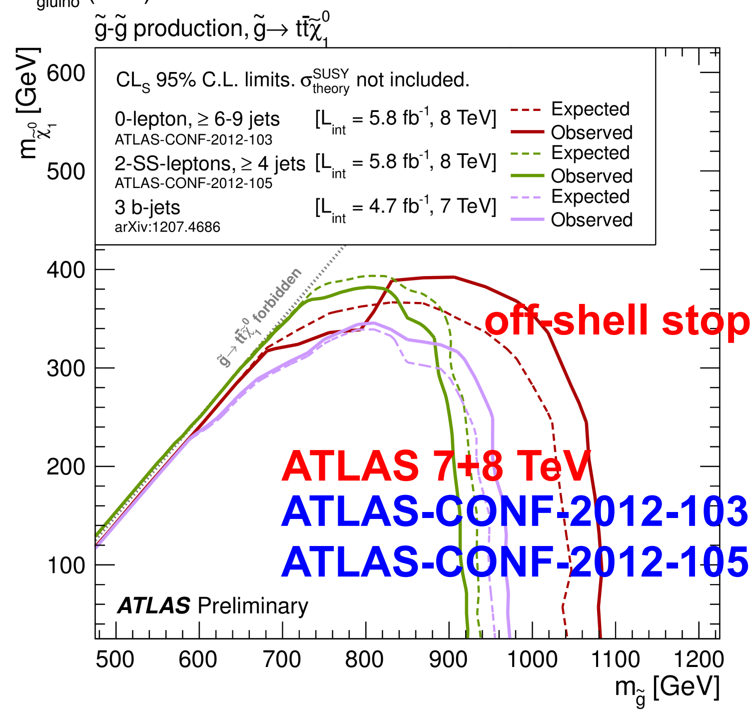
CMS:

hadronic analyses + b-tag

same-charge dilepton + b-tag

ATLAS-CONF-2012-058





ATLAS

multijets

same-charge dileptons

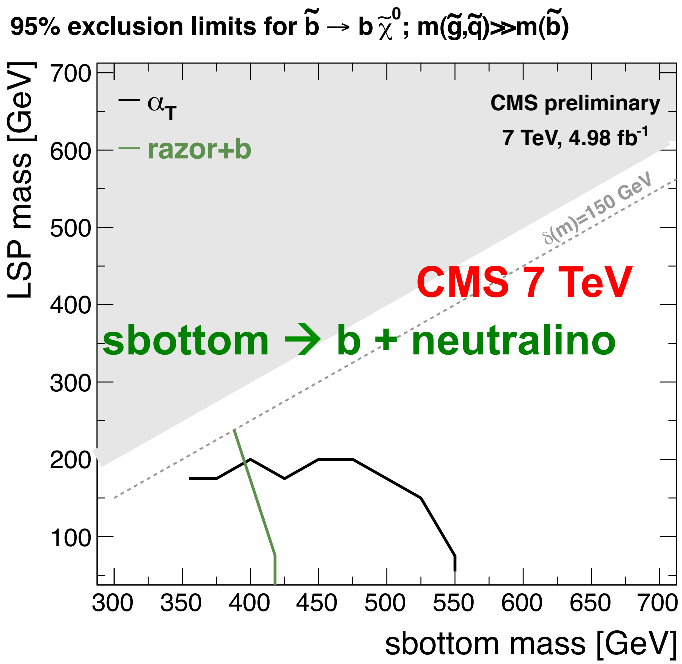
3-bjets

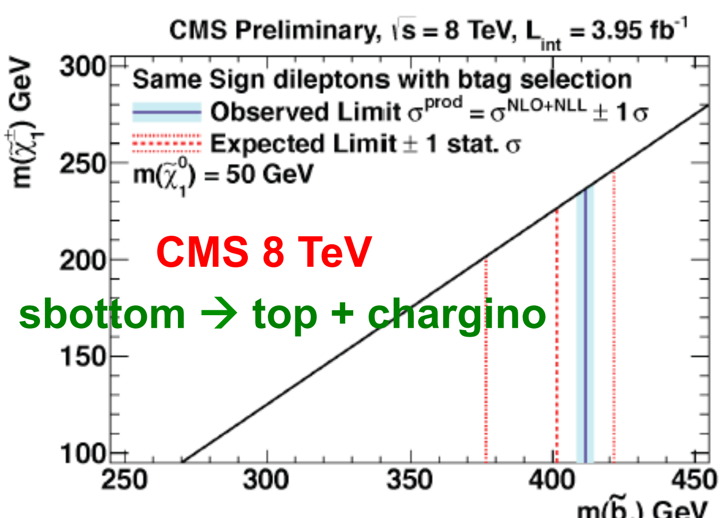
3 leptons (ATLAS-CONF-2012-108)

Direct sbottom pair production

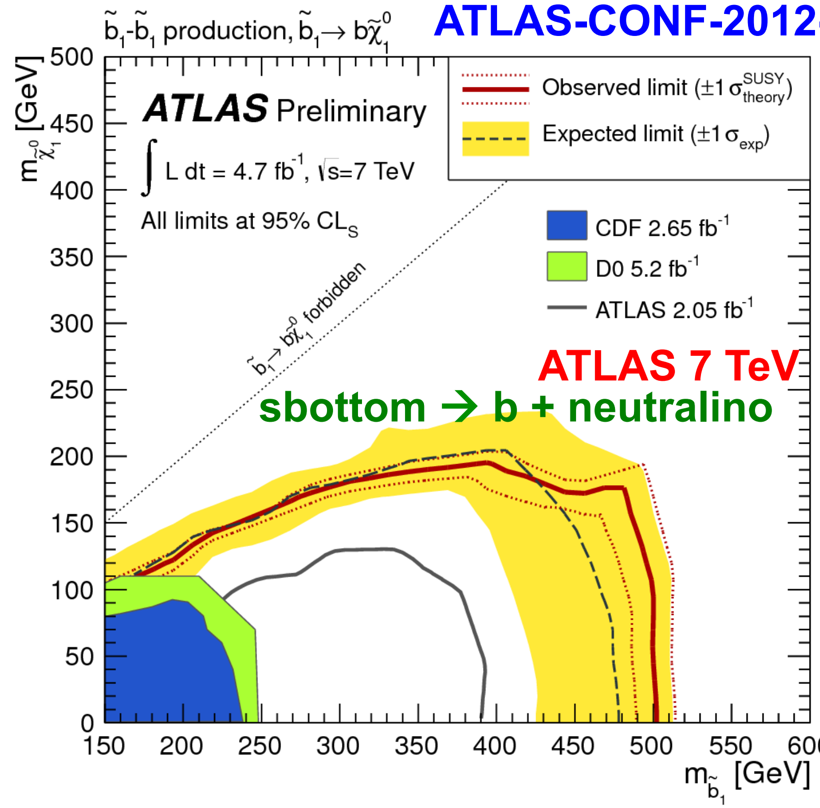
CMS: hadronic analyses + b-tag
same-charge dilepton + b-tag

ATLAS: b-tagged jets + con-transverse mass



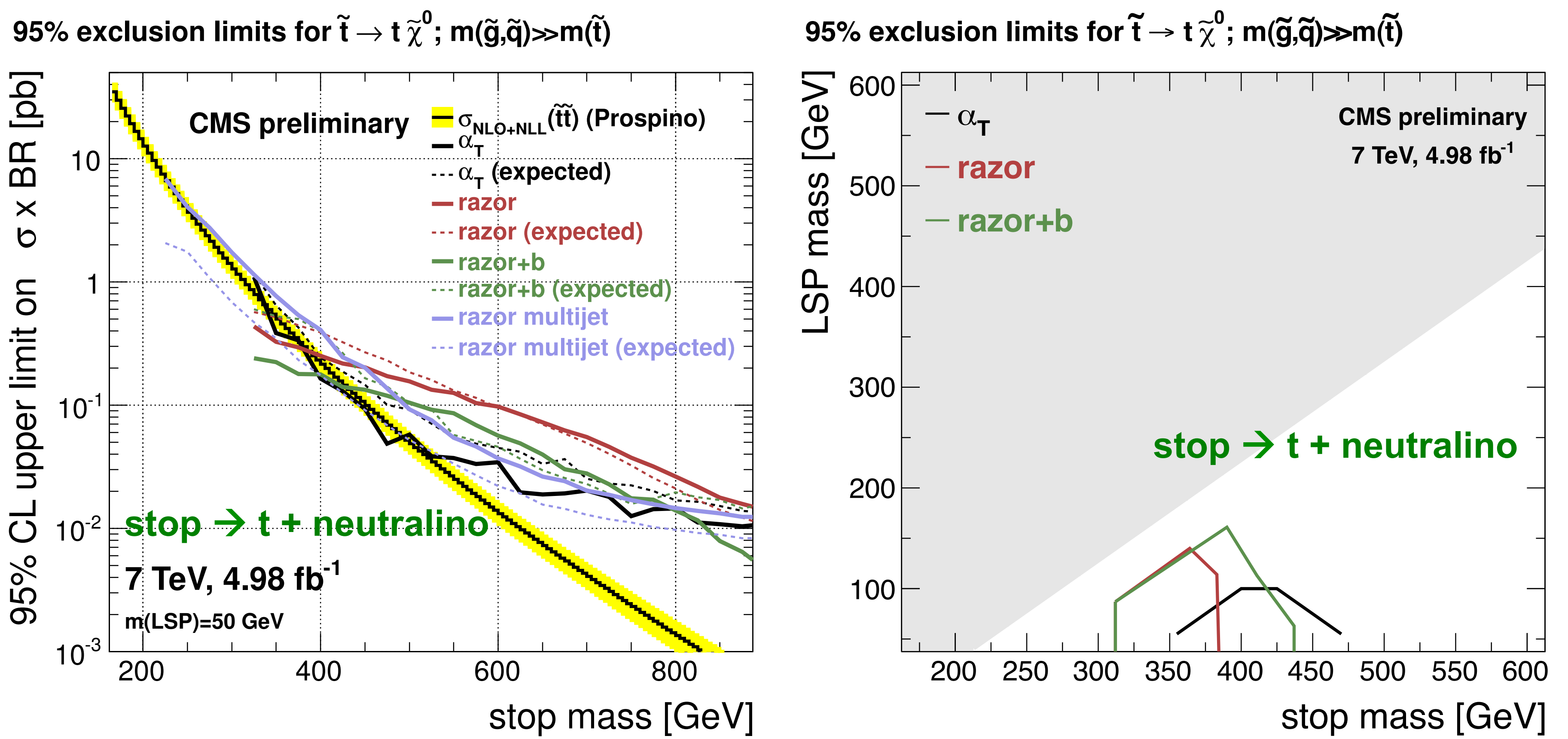


ATLAS-CONF-2012-106



Direct stop pair production

CMS: interpretation of most sensitive multijets + E_T^{miss} analyses

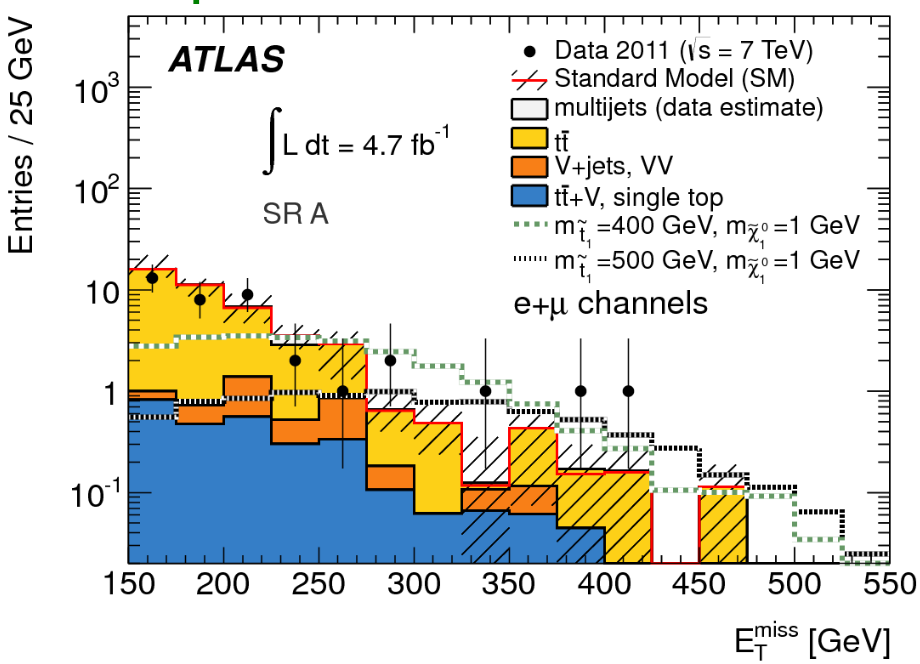


Direct stop pair production

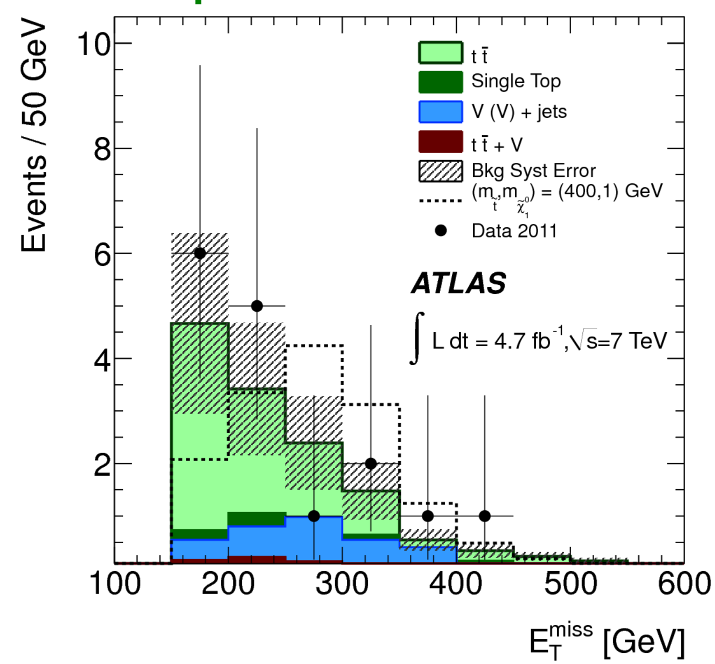
ATLAS: dedicated analyses:

very light stop, stop → b chargino: 2 soft leptons **(arXiv:1208.4305)**
light stop, stop → b chargino: lepton(s) + b(s) + $\sqrt{s}_{min}^{(sub)}$ **(arXiv:1209.2102)**
medium stop, stop → t neutralino: 2 leptons + jets + M_{T2} **(ATLAS-CONF-2012-071)**
heavy stop, stop → t neutralino: 1 lepton **(arXiv:1208.2590)**
heavy stop, stop → t neutralino: 0 lepton **(arXiv:1208.1447)**

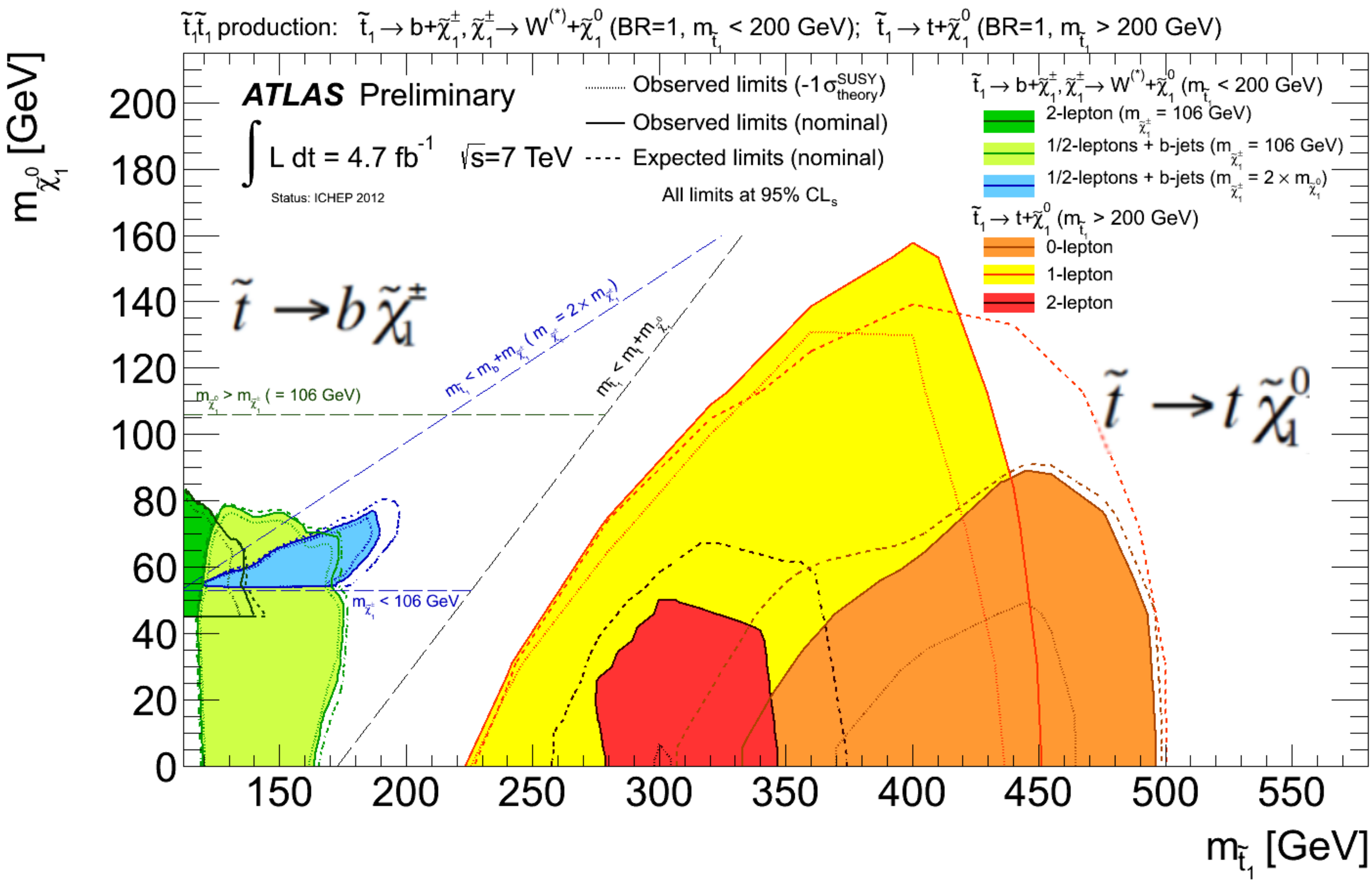
1-lepton **arXiv:1208.2590**



0-lepton **arXiv:1208.1447**



ATLAS: direct stop exclusions:



The attack on “light” stops has started!

This is **NEW**!

Stop hiding behind the top?
Or above 500 GeV?

More detailed scrutiny of top-like events
But: running against the limit of understanding of top
(different MC generators show different behaviour)

or longer stop decay cascades

stop → charm + neutralino: difficult!

more results to come

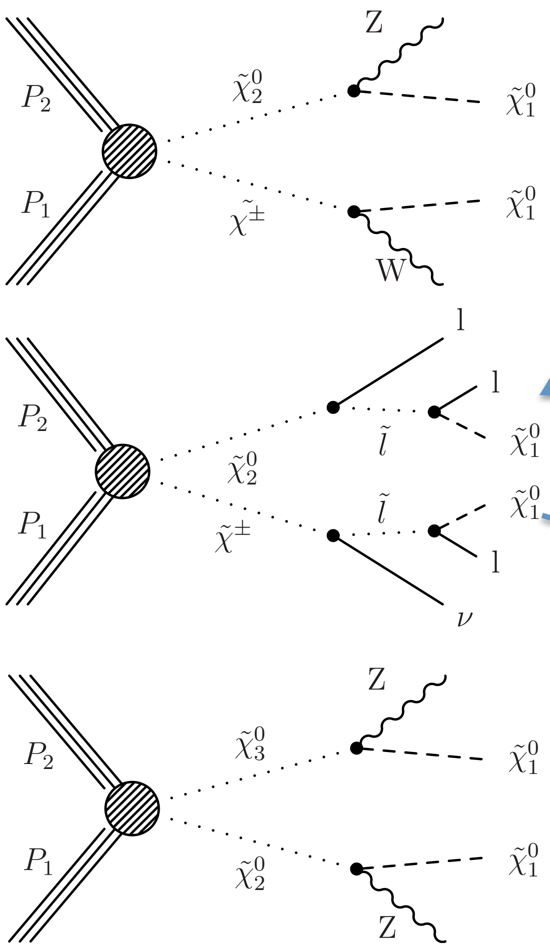
Gauginos

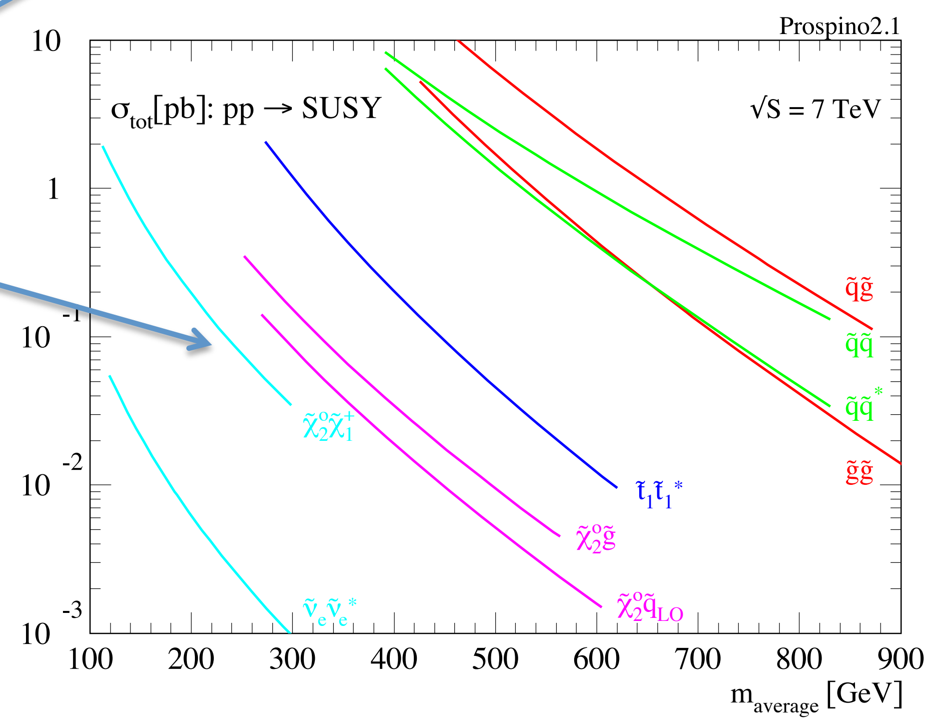
The SUSY partners of the electroweak gauge bosons + Higgses

Weak production: small cross sections, significant backgrounds

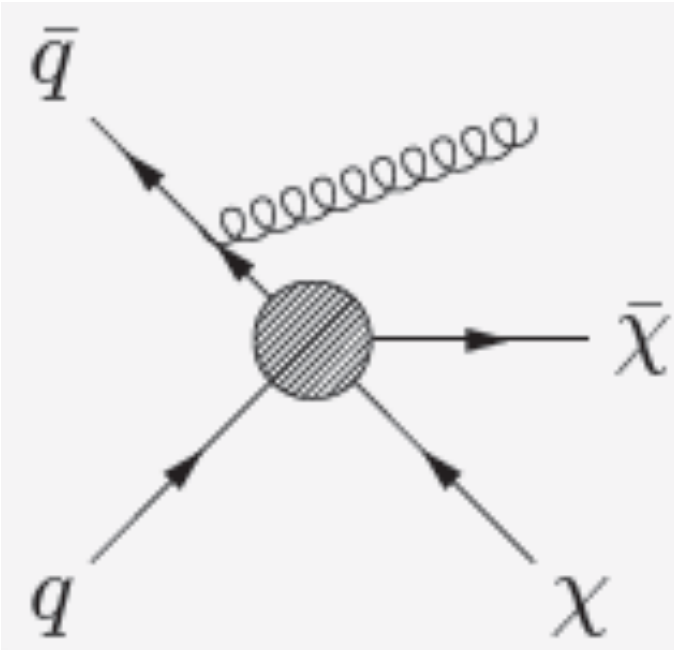
require leptons in the final state

free parameter: leptonic Br of gauginos
(boosted with light sleptons)





Direct production of DM particles (e.g. neutralino LSP)



mono jet / mono photon analyses

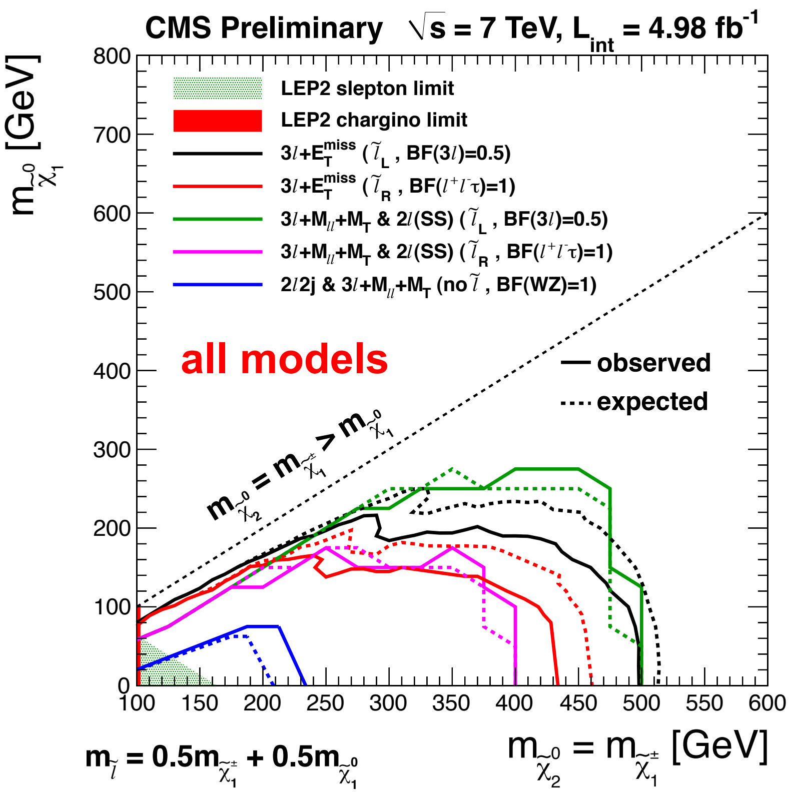
Covered in talk of Francesco Santanastasio (Saturday morning)

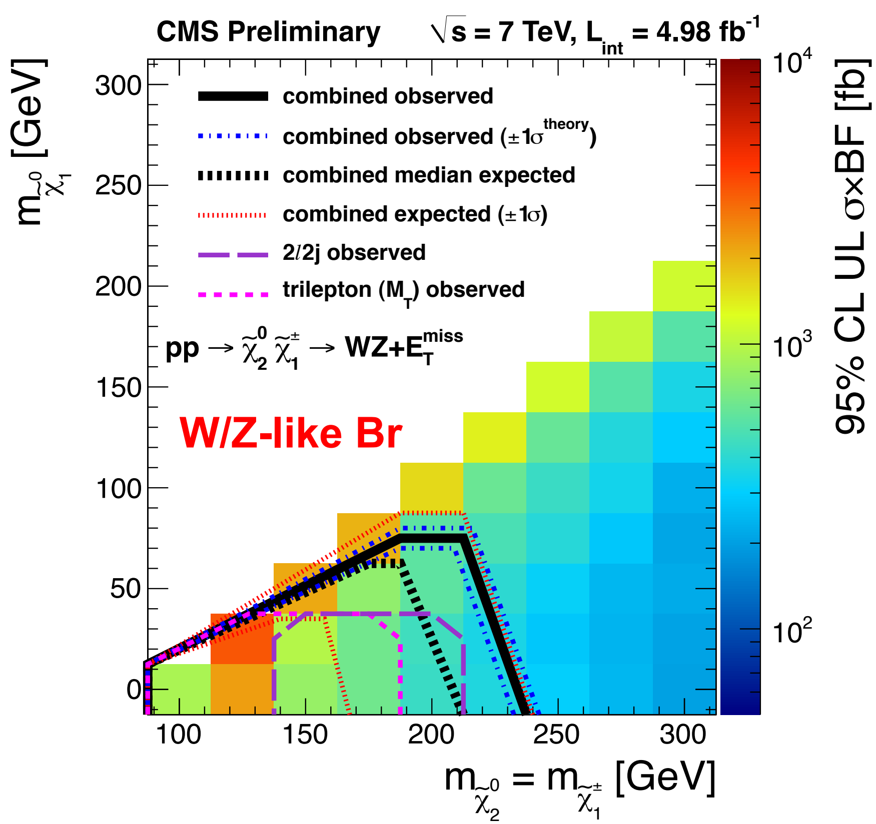
Heavier gauginos in **CMS**: $\tilde{\chi}_1^{\pm}\tilde{\chi}_2^0$, $\tilde{\chi}_2^0\tilde{\chi}_3^0$

Models considered:

- Heavy sleptons: decay via W/Z emission, W/Z-like Br to leptons
- Light sleptons A: slepton_L (R decoupled), 50% Br to $l^{\pm}$, all flavours
- Light sleptons B: slepton_R (L decoupled): Higgsino-couplings: 100% Br to τ

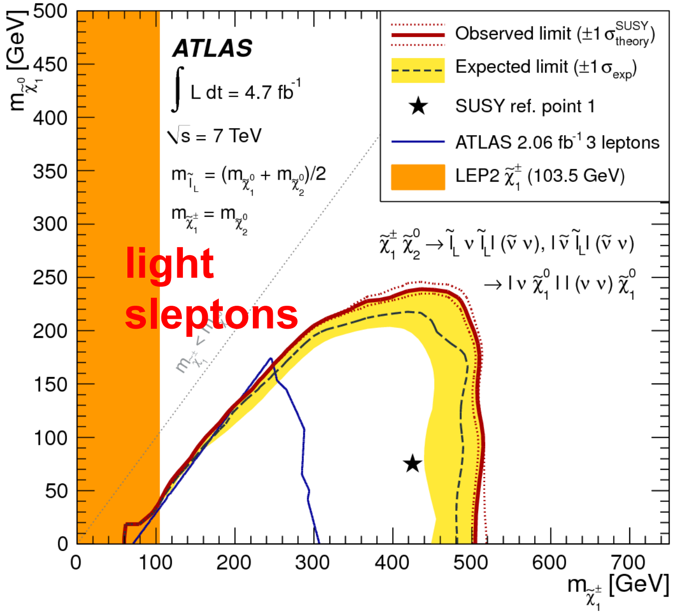
SUS-12006





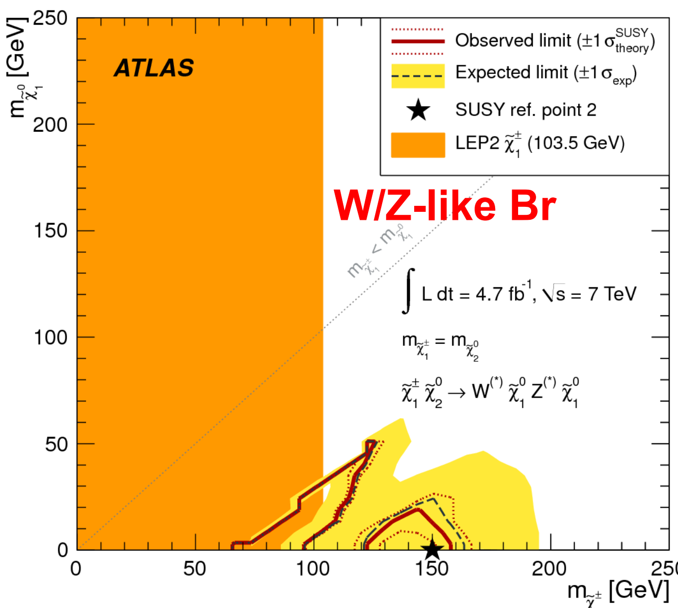
Heavier gauginos in **ATLAS**: $\tilde{\chi}_1^{\pm}\,\tilde{\chi}_2^{0}$, $\tilde{\chi}_1^{+}\,\tilde{\chi}_1^{-}$

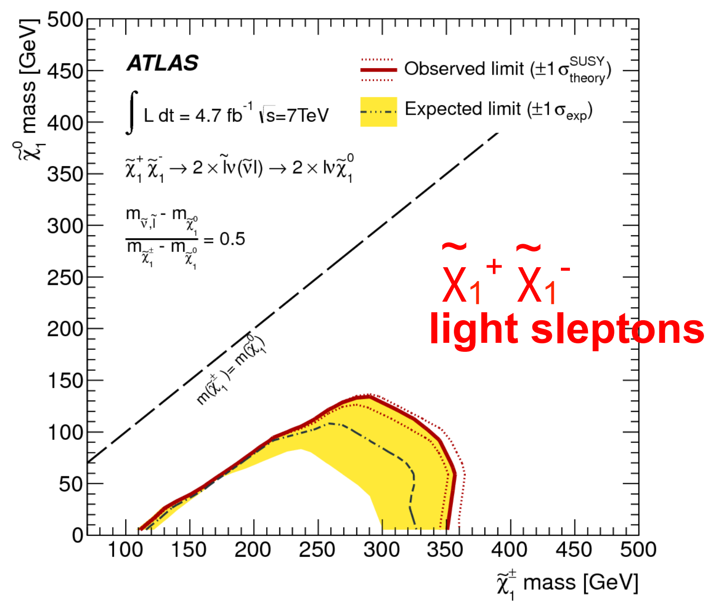
arXiv:1208.2884
arXiv:1208.3144



Models considered:

- Heavy sleptons, W/Z-like Br to leptons
- Light sleptons: slepton_L (like CMS)





The attack on gauginos has started too!

This is also **NEW**!

Most significance with on-shell sleptons

But also starting to get sensitive to W/Z-like Br

Keep on probing $\tilde{\chi}^{\pm} \rightarrow \tilde{\chi}^{0} + W$

$\tilde{\chi}_2^{0} \rightarrow \tilde{\chi}_1^{0} + Z/h$

$\tilde{\chi}^{+}\tilde{\chi}^{-}$ is hard, but maybe even visible in WW cross section?
(**arXiv:1206.6888**)

if |μ| small: higgsino-like regime → degenerate $\tilde{\chi}_2^{0}$, $\tilde{\chi}_1^{0}$, $\tilde{\chi}_1^{\pm}$: difficult!

by-product of ATLAS analysis: first limits on sleptons beyond LEP-2!
(**arXiv:1208.2884**)

SUSY escape routes

Can SUSY pull it off?

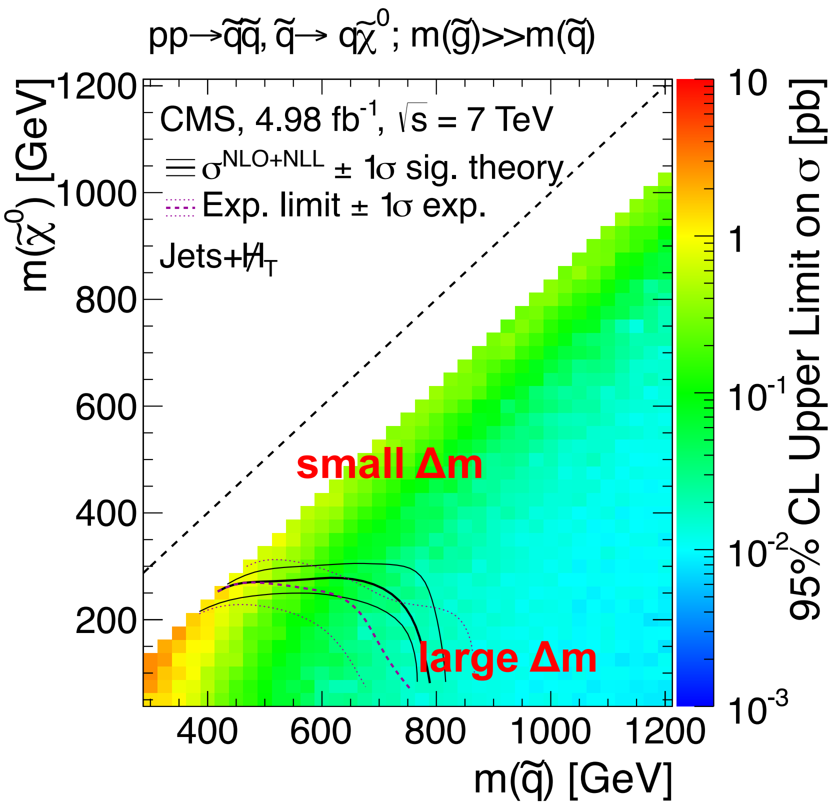
Compressed spectra

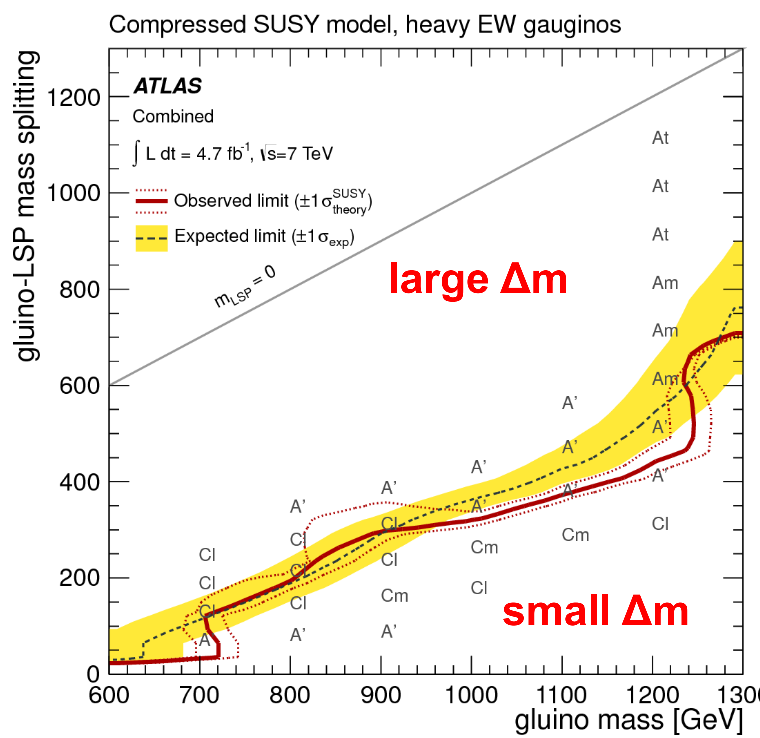
Long-lived particles

R-parity violation

Beyond the MSSM: stealth SUSY, scalar gluons

SUSY with a compressed mass spectrum: small mass gaps



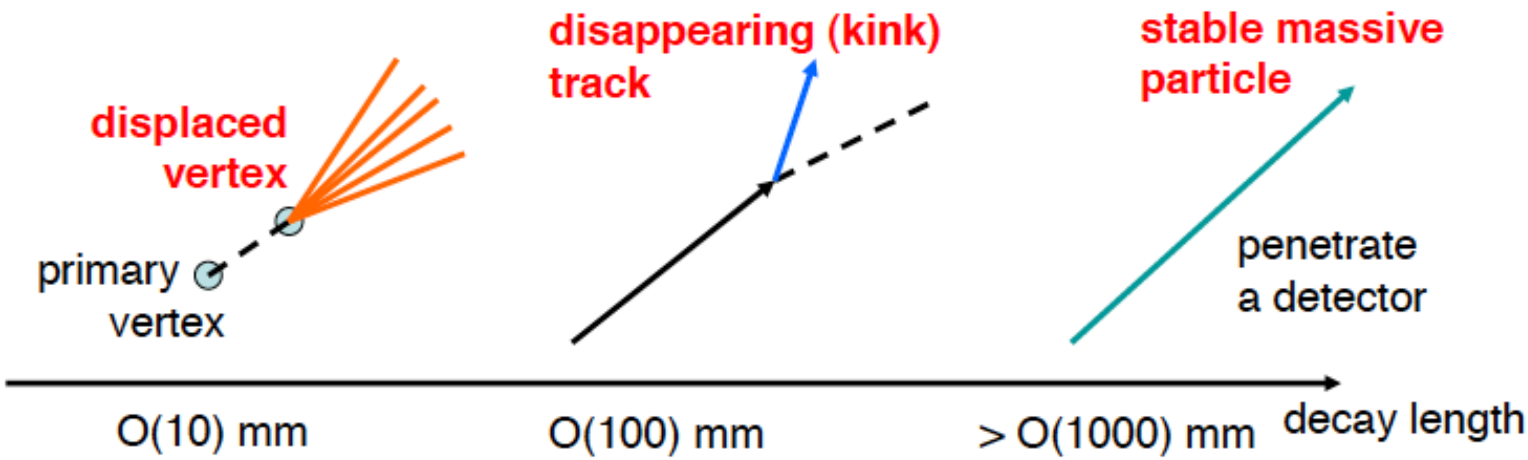


Similar conclusions CMS and ATLAS: squark/gluino limits collapse for small mass gaps

Dedicated analyses under development.
Analysis of "parked data" with lower threshold triggers in 2013

SUSY particles with non-negligible lifetimes

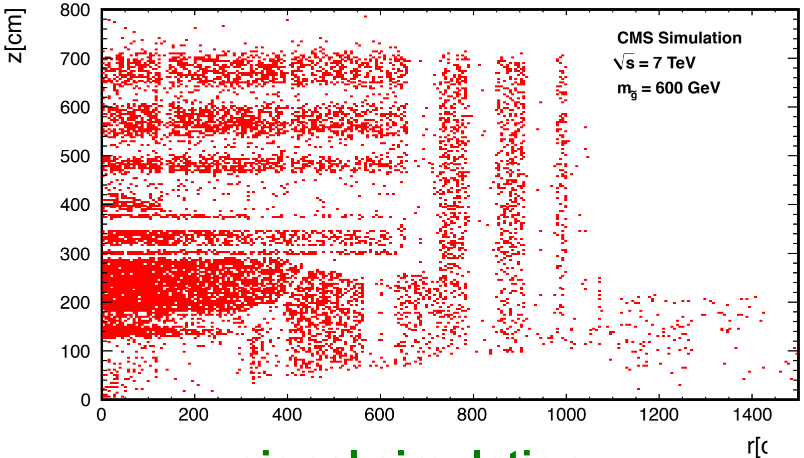
- vertices far away from IP
- disappearing tracks
- R-hadrons   (hadronized gluinos/squarks)
- stopped R-hadrons
- `stable' charged massive particles



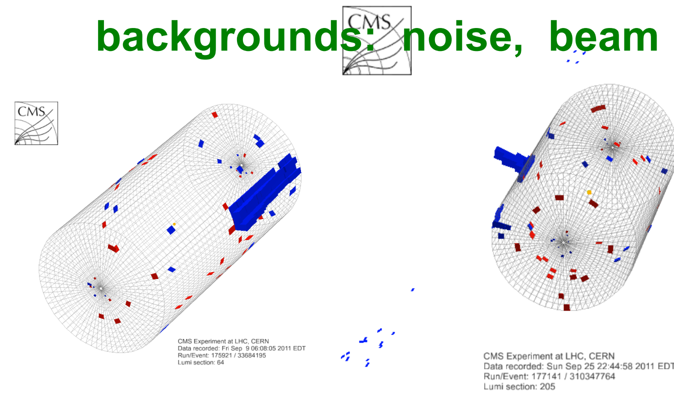
CMS: stopped R-hadrons

246 h trigger livetime
$E_{jet} > 70$ GeV:
8.6 ± 2.4 bg expected
12 events observed

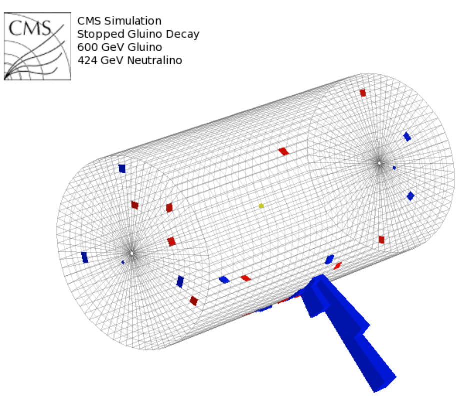
Stop in detector, and decay uncorrelated with beam



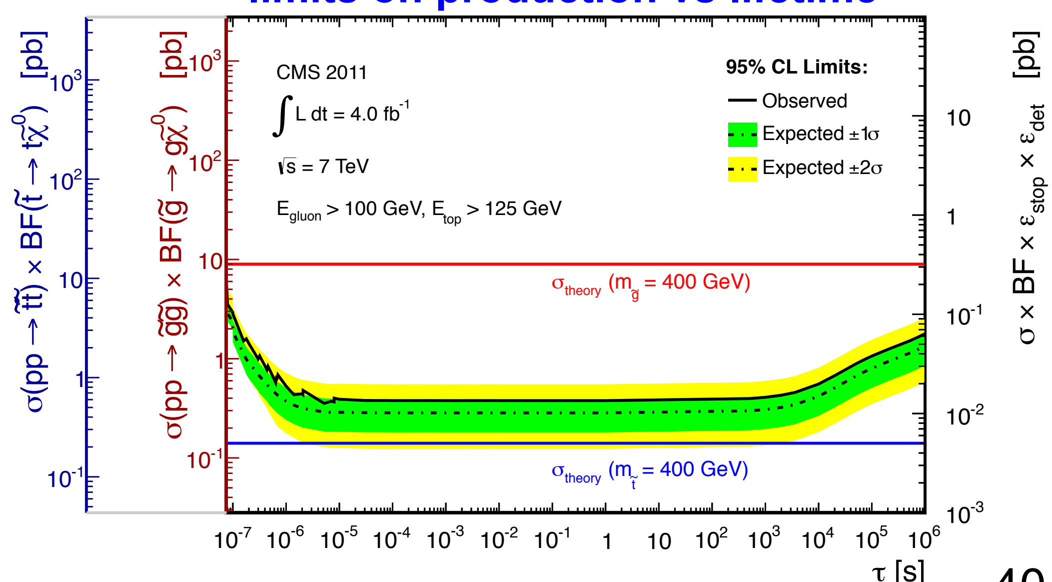
backgrounds: noise, beam halo



signal simulation



limits on production vs lifetime

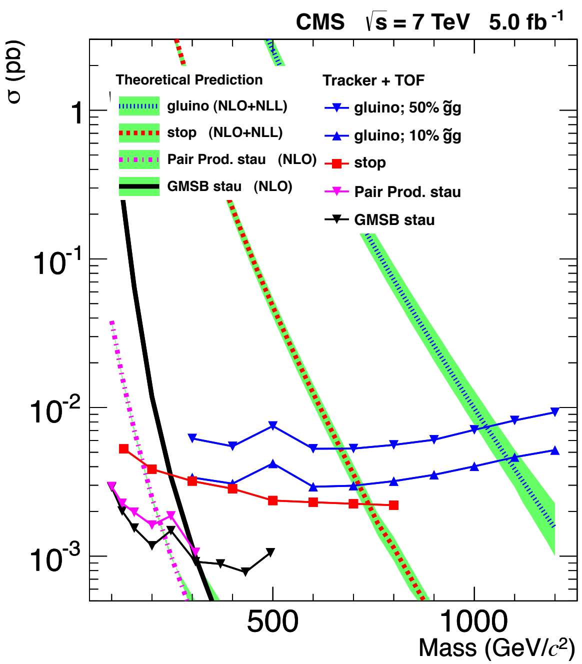


arXiv:1207.0106

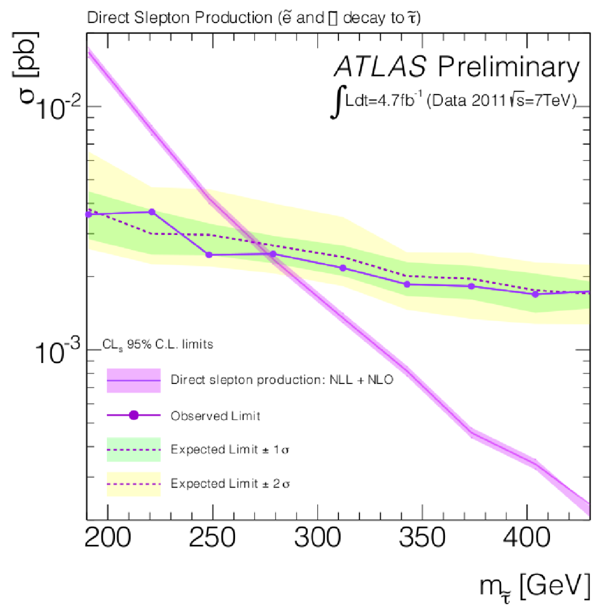
“Stable” charged massive particles

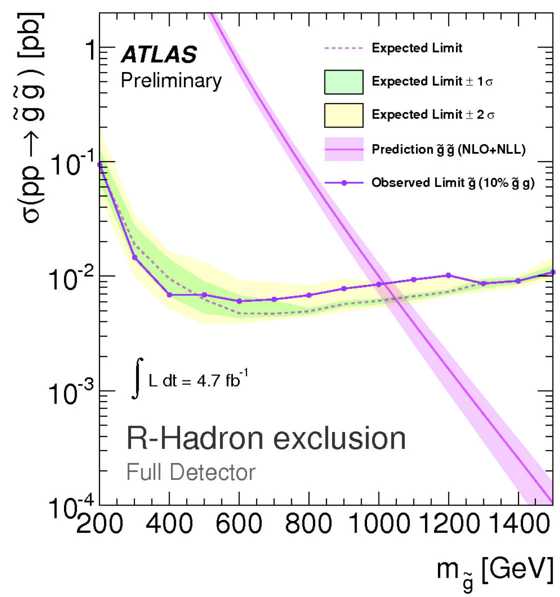
Covered in talk of Francesco Santanastasio (Saturday morning)

CMS **arXiv:1205.0272**



ATLAS **ATLAS-CONF-2012-075**





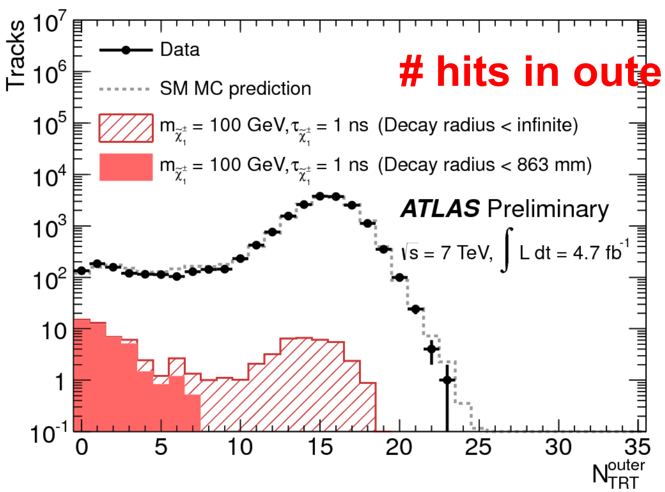
“stable” gluino > 1 TeV
“stable” stop > 700 GeV
“stable” stau > 300 GeV

ATLAS: "disappearing" track

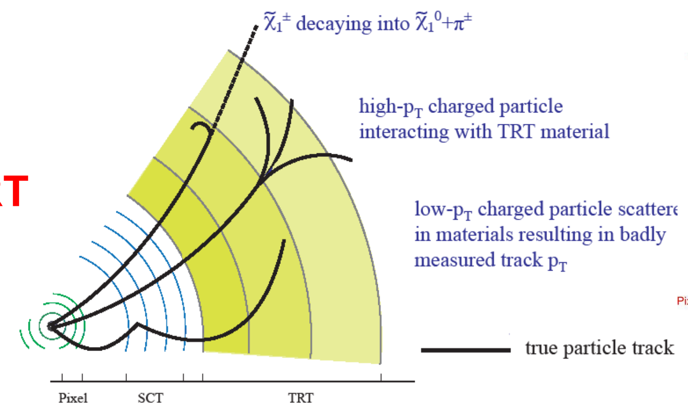
$$\tilde{g}\tilde{g} \rightarrow q\bar{q}'\tilde{\chi}_1^- \, q\bar{q}'\tilde{\chi}_1^-, \quad \tilde{\chi}_1^- \rightarrow \tilde{\chi}_1^0 \pi^-$$

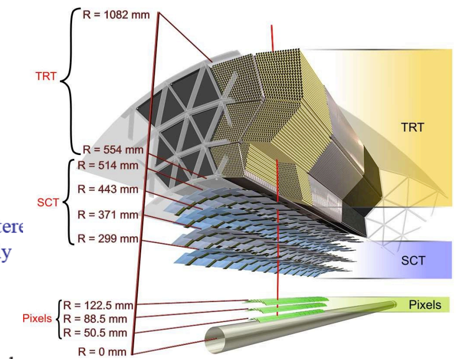
small mass gap: soft pion missed

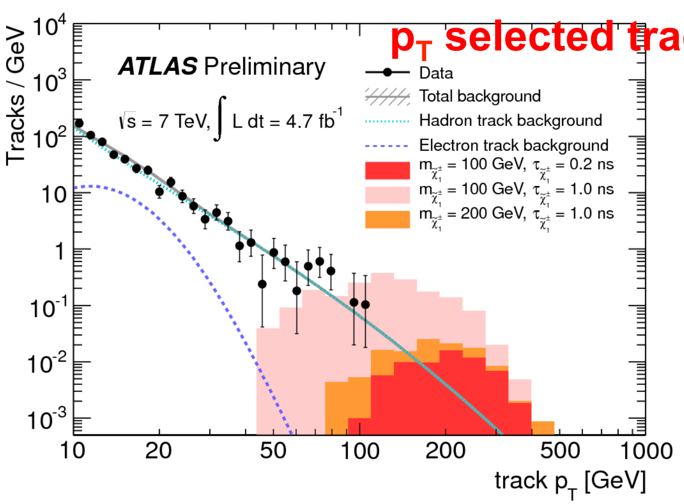
ATLAS-CONF-2012-111



hits in outer TRT





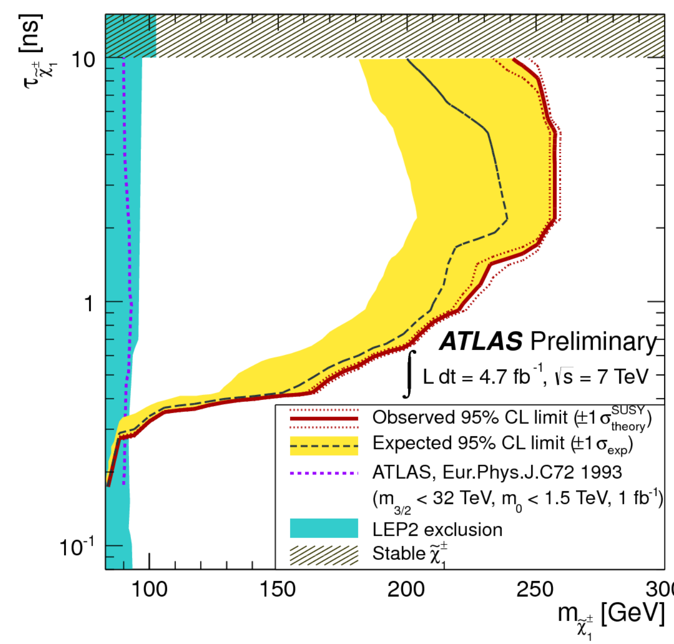


p_T selected tracks

Track selection:
p_T > 10 GeV
N(outer TRT)<5

715 ± 33 bg exp.
710 observed

limits on chargino mass/lifetime



Violation of R-parity: no LSP, much reduced missing momentum

L-number violating terms

$$W_{\not{R}p} = \lambda_{ijk}\hat{L}_i\hat{L}_j\hat{E}^C_k + \lambda'_{ijk}\hat{L}_i\hat{Q}_j\hat{D}^C_k + \epsilon_i\hat{L}_i\hat{H}_u + \lambda''_{ijk}\hat{U}^C_i\hat{D}^C_j\hat{D}^C_k$$

bilinear terms

B-number violating terms

multi-leptons
L-number violation

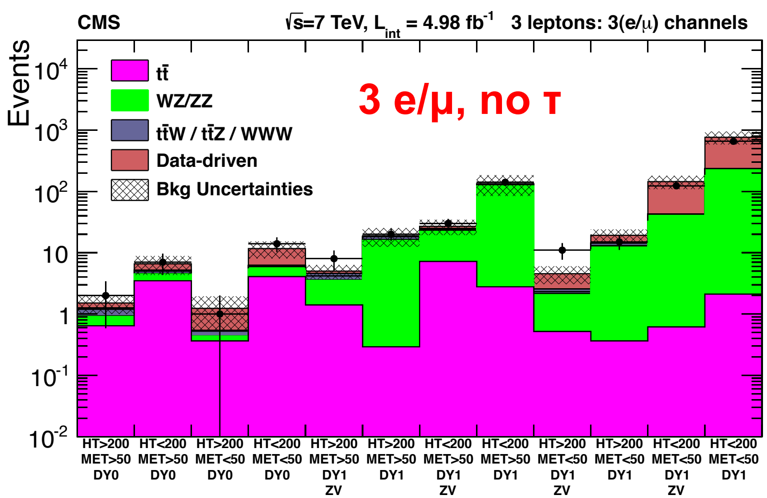
multi-jet resonances

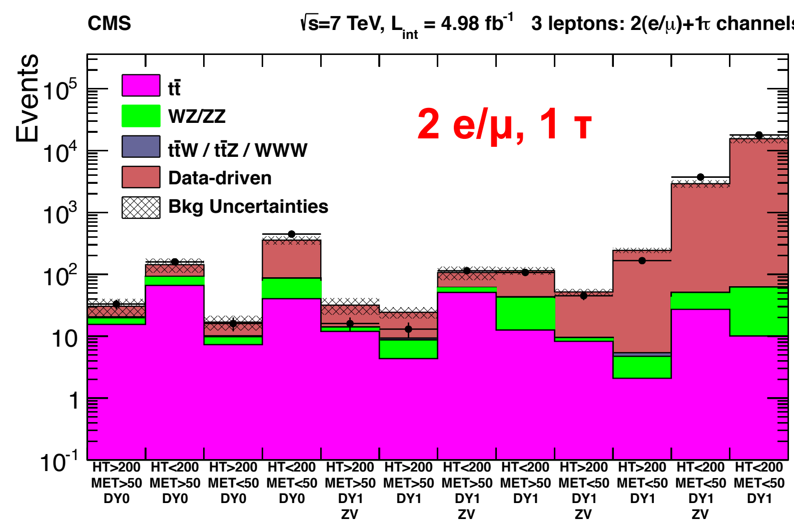
“leptoquarks”
L-number violation

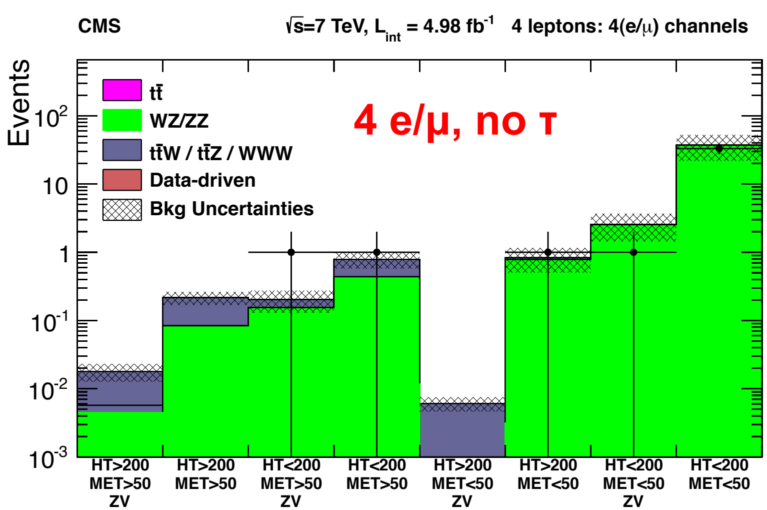
Multilepton final states in **CMS**: 3 or 4 leptons, 0, 1 or 2 τ

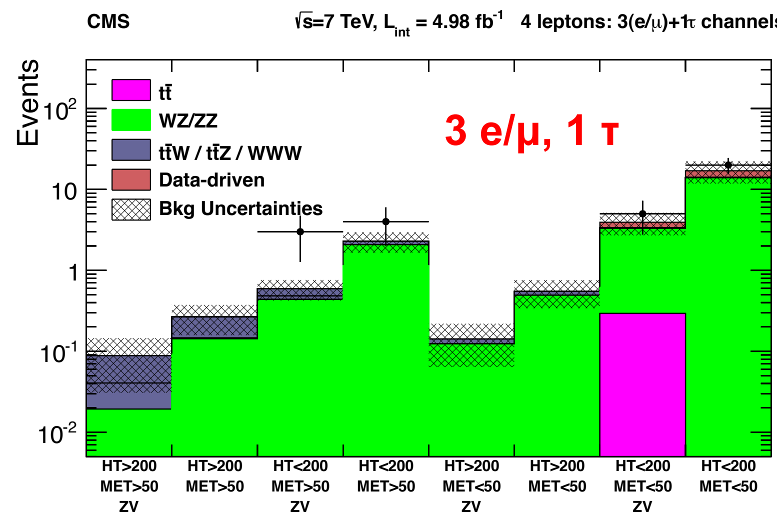
bins of H_T and E_T^{miss}
overall good consistency data – SM expectation

arXiv:1204.5341

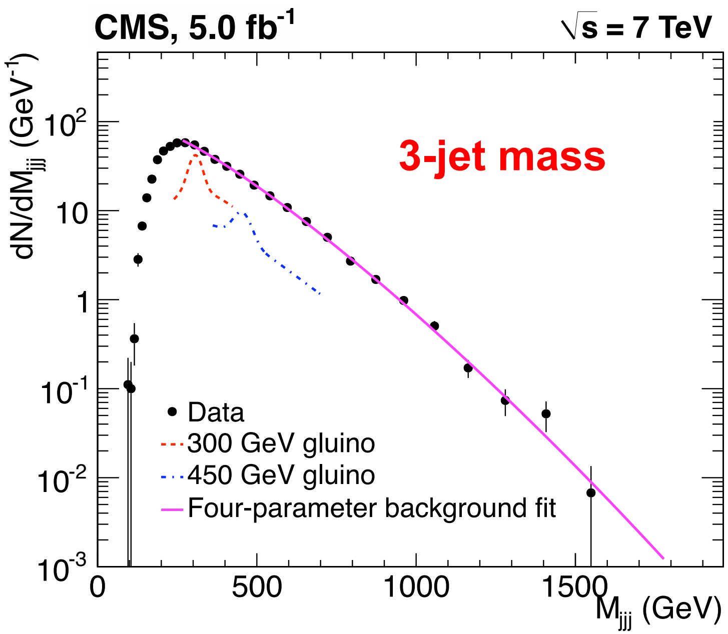


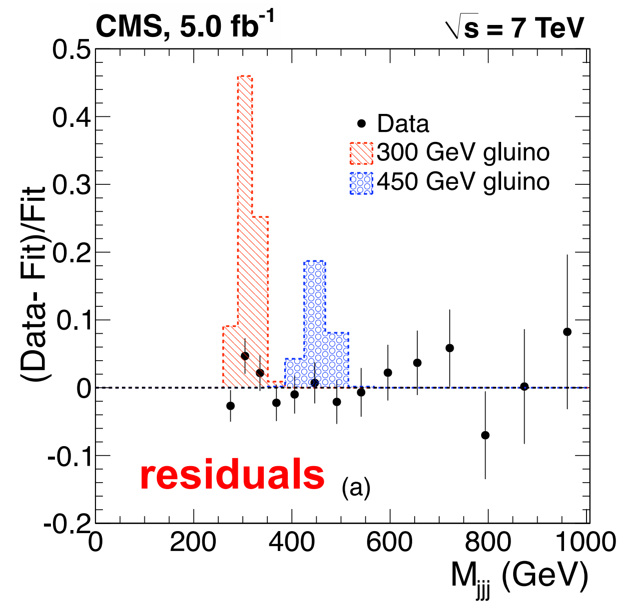






Three-jet resonances in **CMS**

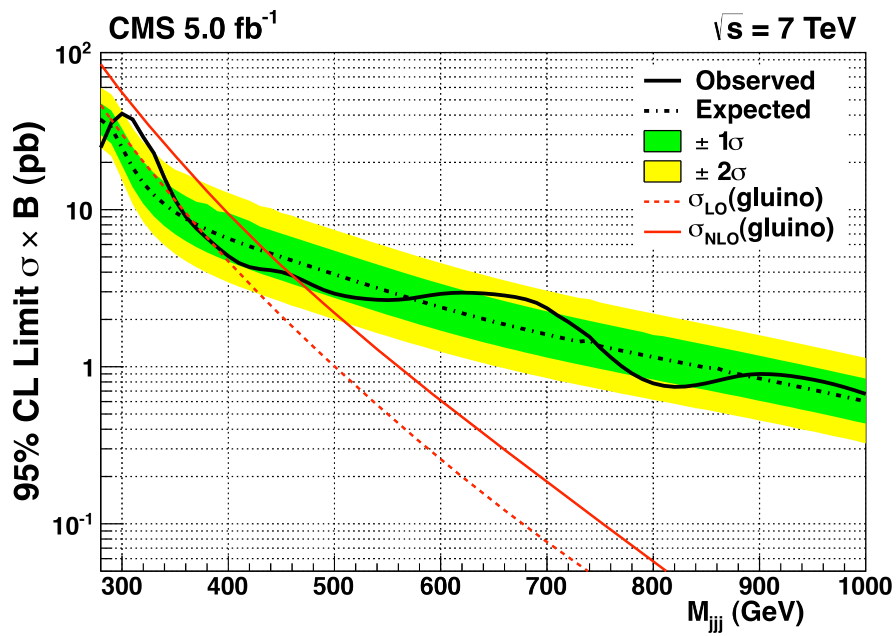




arXiv:1208.2931

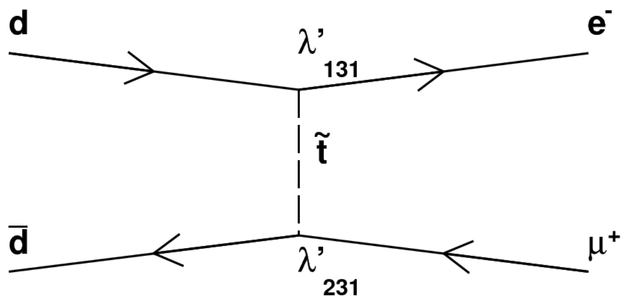
Search for 3-jet resonances in events with high jet multiplicity and large H_T

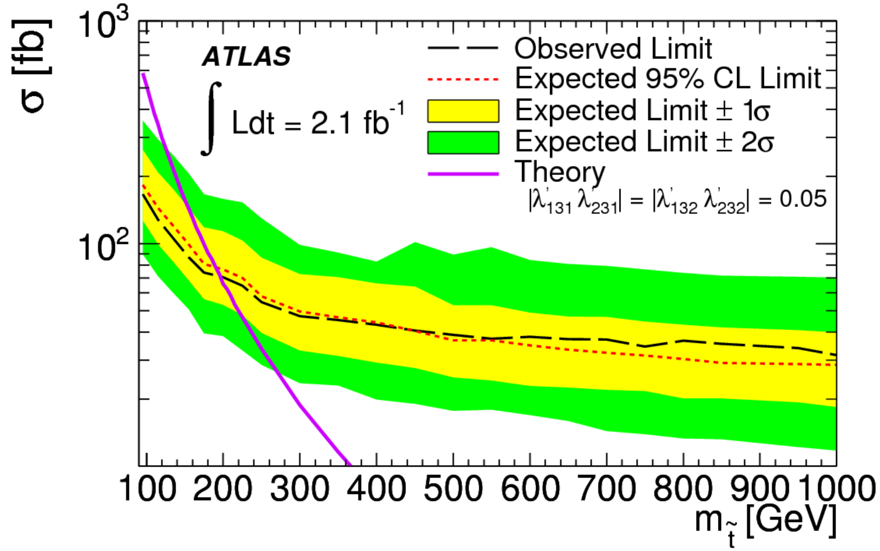
Interpretation: gluino → 3 jets

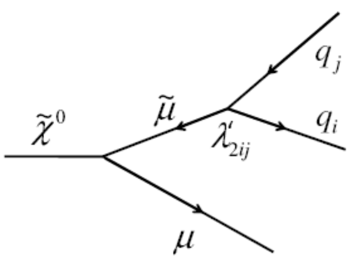


ATLAS: RPV e+μ continuum production

Eur Phys J C 72 (2012) 2040

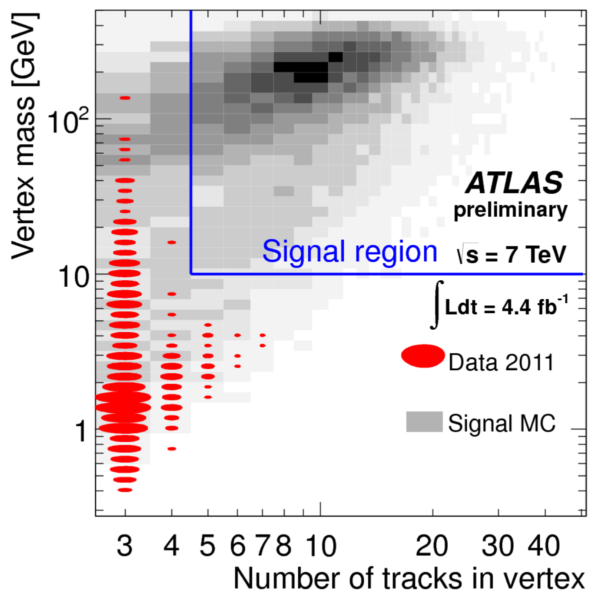




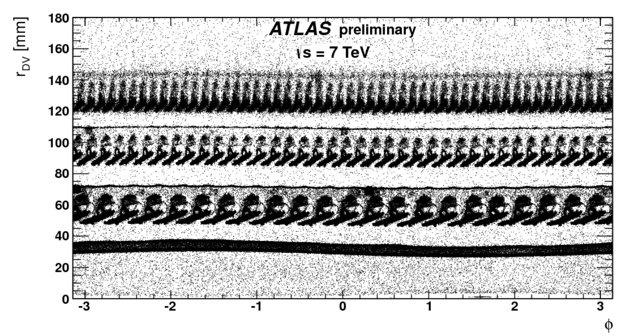


ATLAS: μ + displaced vertex

ATLAS-CONF-2012-113



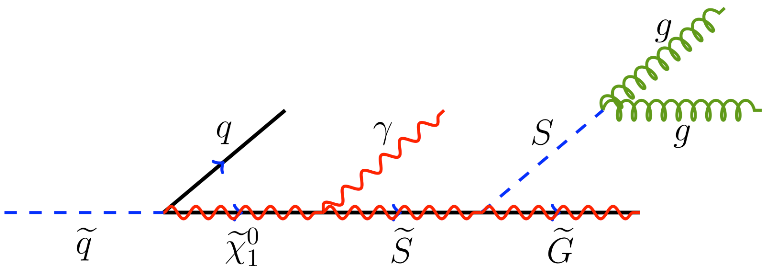
vertex location:
X-raying the detector!



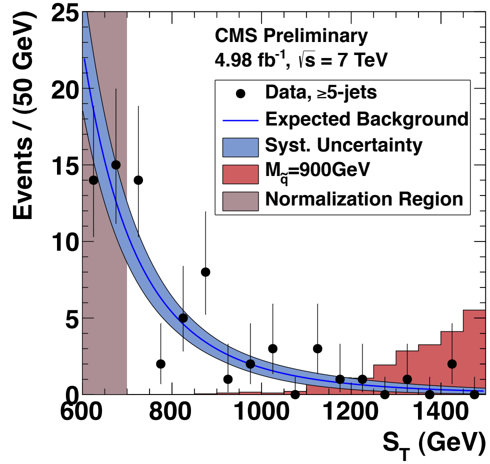
no excess observed

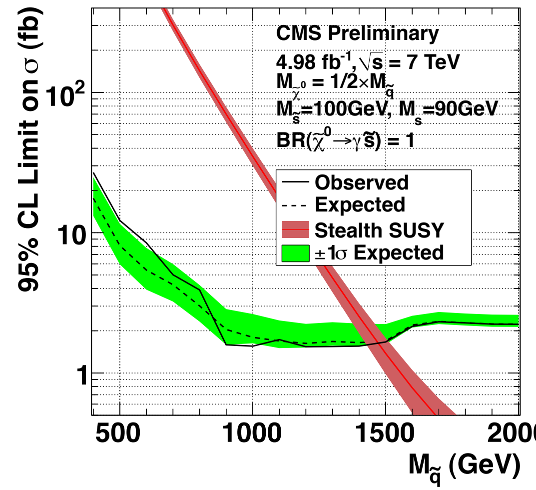
Beyond the MSSM: stealth SUSY in CMS

PAS-SUS-12-014



γ + jets + low E_T^{miss}

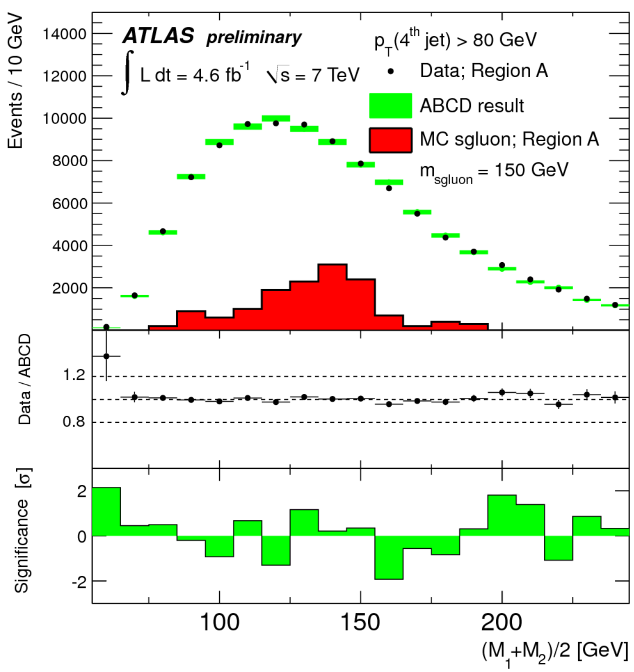


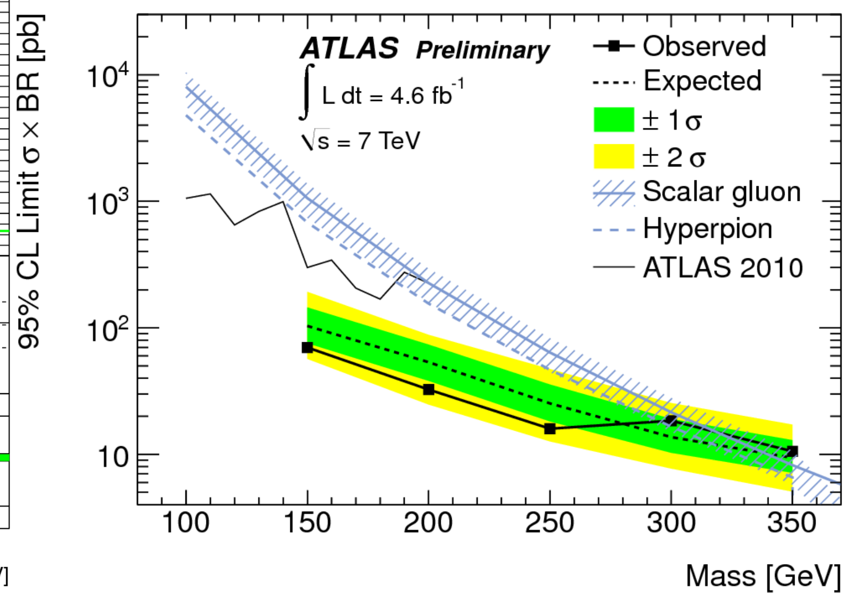


Scalar colour-octets in ATLAS

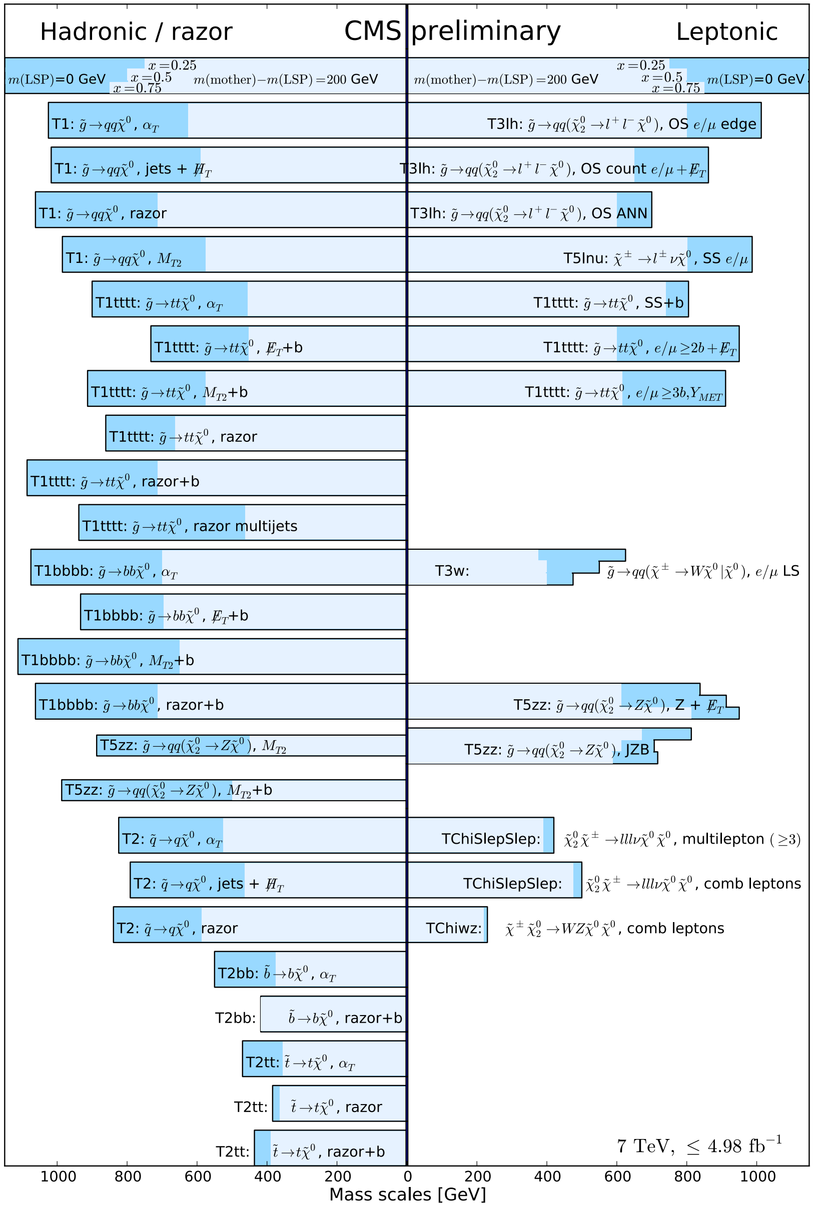
ATLAS-CONF-2012-110

2 di-jet
resonances
per event





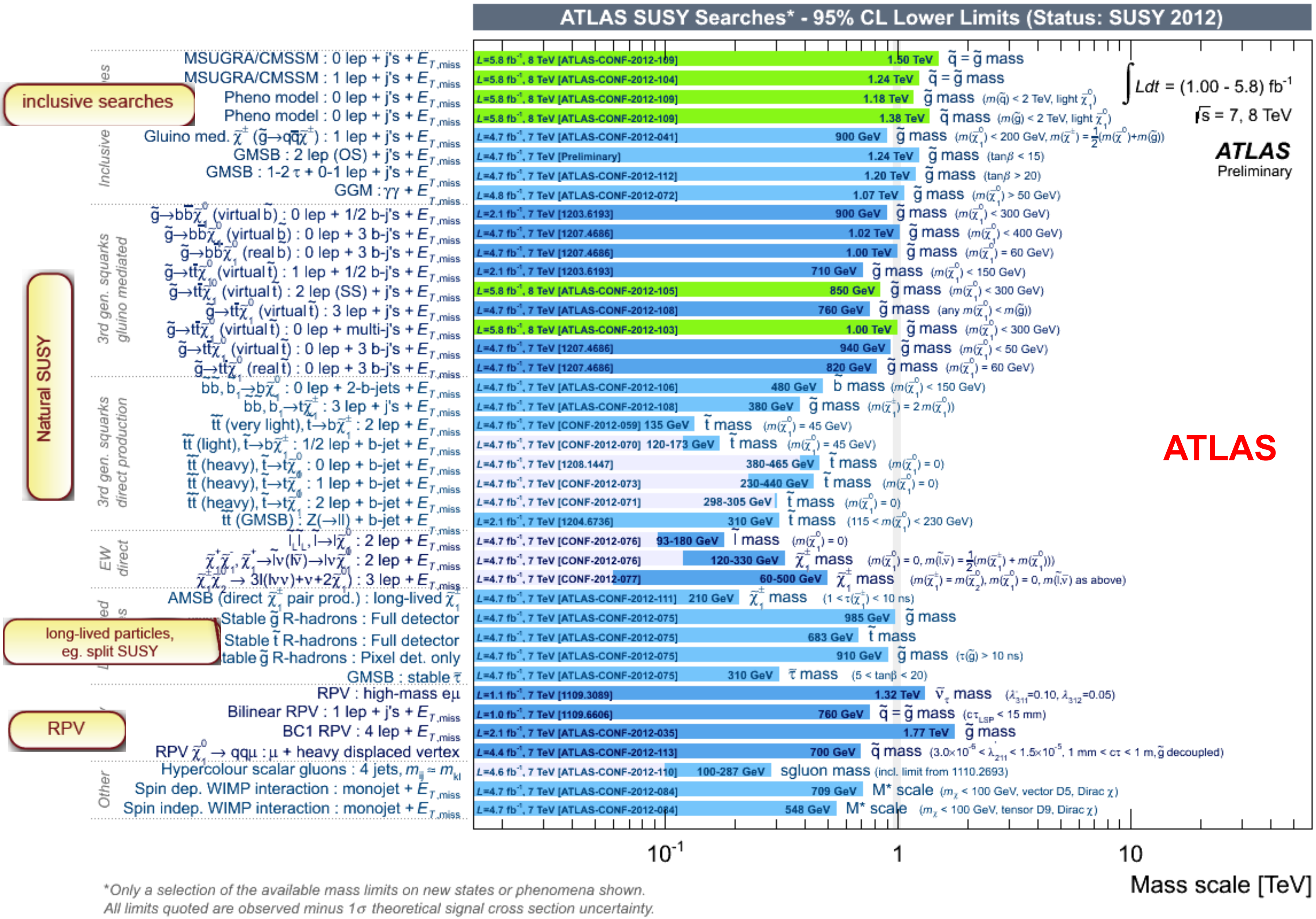
Weak-scale supersymmetry anno September 2012 (1)



CMS

summary of simplified models

Weak-scale supersymmetry anno September 2012 (2)



Weak-scale supersymmetry anno September 2012 (3)

- The sheer amount of results is staggering!
  Many ideas, many methods

- No deviation from SM seen yet

- Puts stringent limits on SUSY

- Starting to probe "natural SUSY" now: 3rd generation, gauginos
  (This is NEW with respect to only half year ago!)
  The burial of natural SUSY is premature, but the attack is real

- Trying to close SUSY escape routes

- Future: even more emphasis on 3rd generation and gauginos
  more emphasis on minimizing holes in analyses
  more emphasis on R-parity violation

Weak-scale supersymmetry anno September 2012 (4)

Often asked: is SUSY dead?

SUSY certainly has a significant PR problem…
(and MSUGRA/CMSSM is on intensive care)

However: **always read the small print**:
(Dissertori: "The IF files")

- Difficult, or impossible, to give `absolute' limits: always assumptions
- Limits collapse when raising m(LSP) above a few hundred GeV
- Inclusive searches assume degenerate 1st and 2nd generation squarks. Limits deteriorate significantly when this is given up.
- Simplified models make strong assumptions on production modes, branching ratios and masses of intermediate states

Outlook:

On the way towards 20 fb^{-1} of data at 8 TeV in 2012

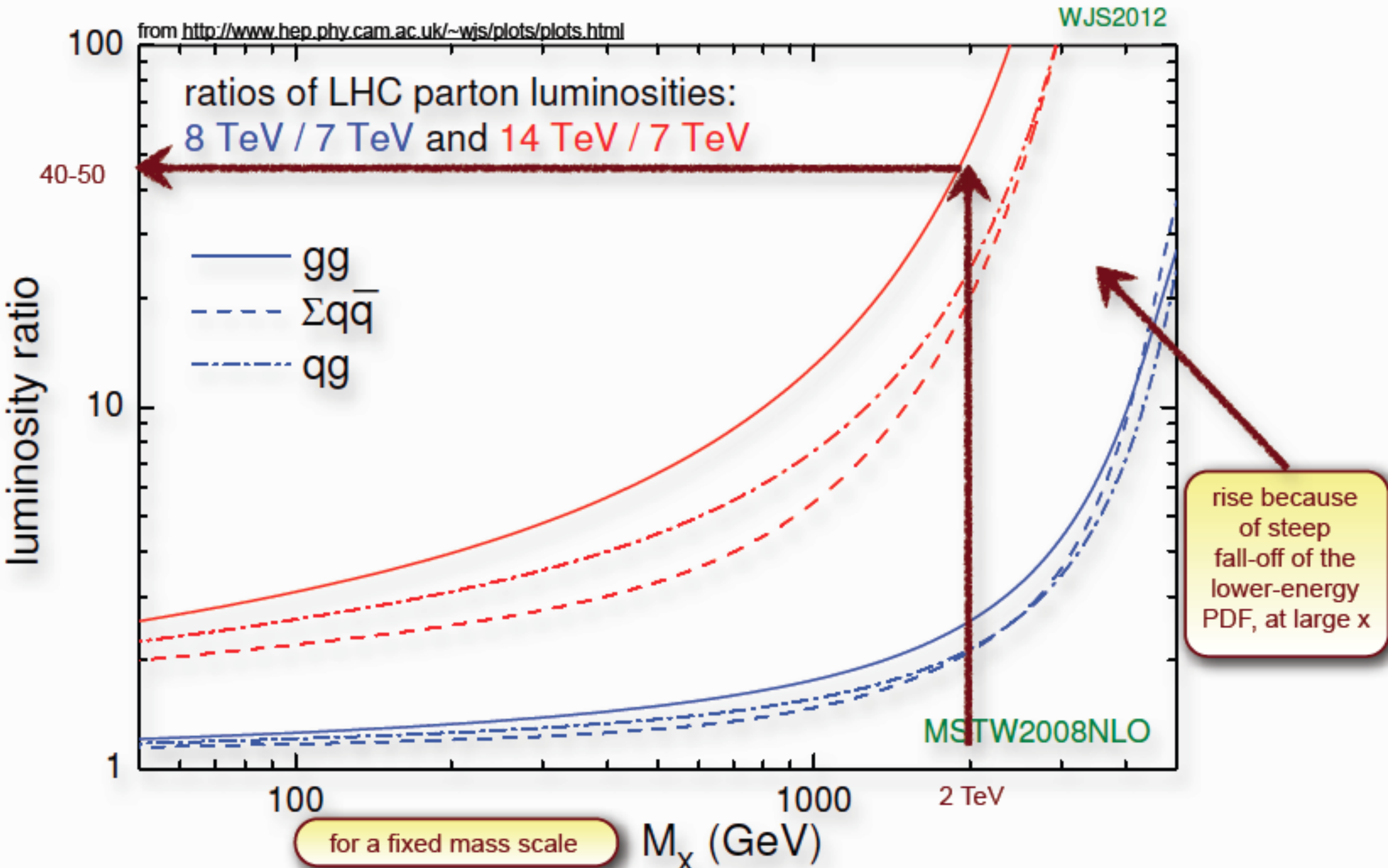
Many analyses in progress, many ideas

Processing of `delayed triggers'

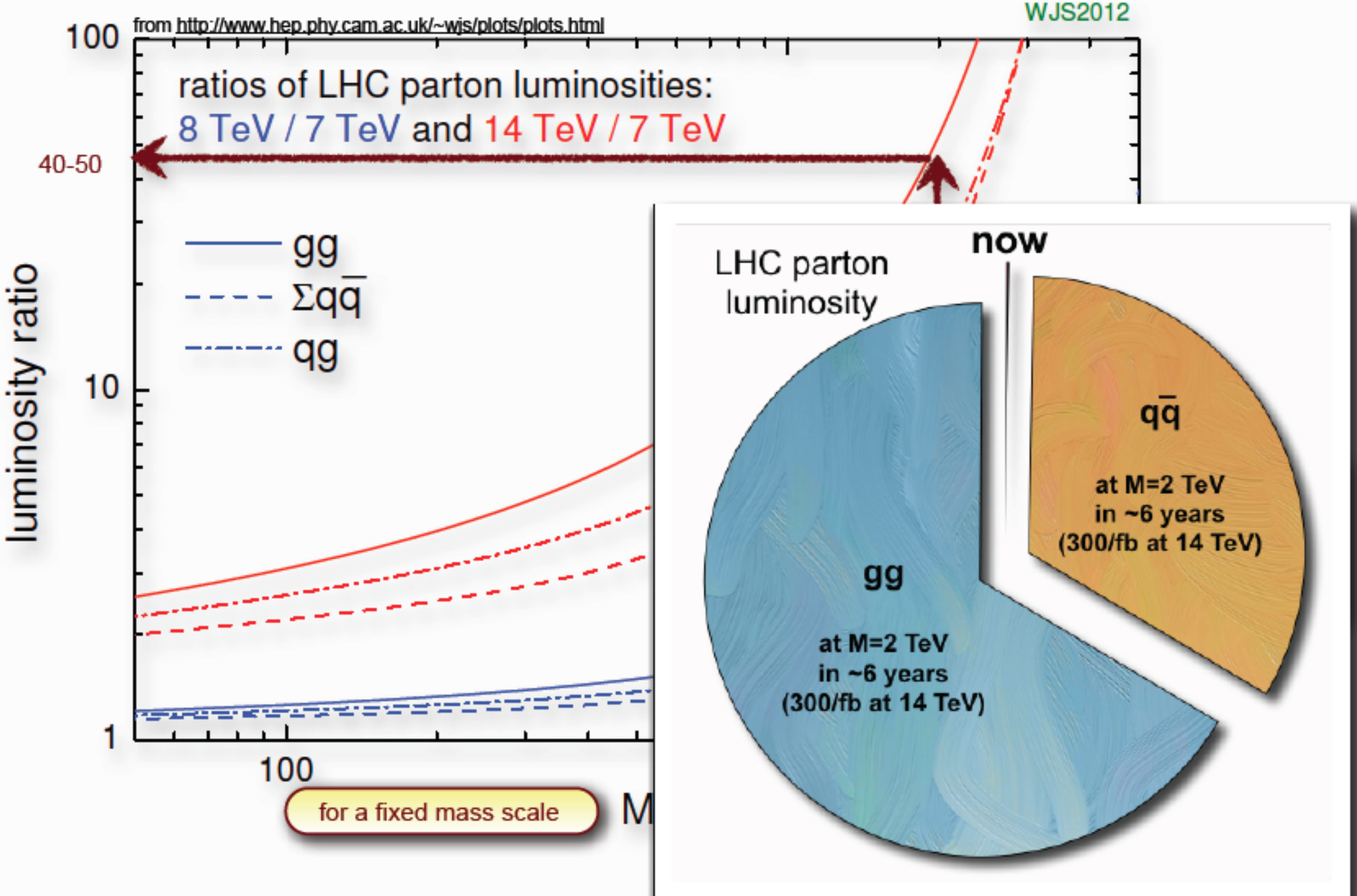
Detailed scrutiny of the Higgs-like 125 GeV boson
Searches for possible heavier bosons

$\sqrt{s}$ at 13 TeV or higher after 2014: it's a new ball game!

Parton luminosities



Parton luminosities



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We are tired of exclusion limits…

Backup

Exclusion limits

❑ Exclusion limits : a new standard ATLAS/CMS procedure (>June 2012)

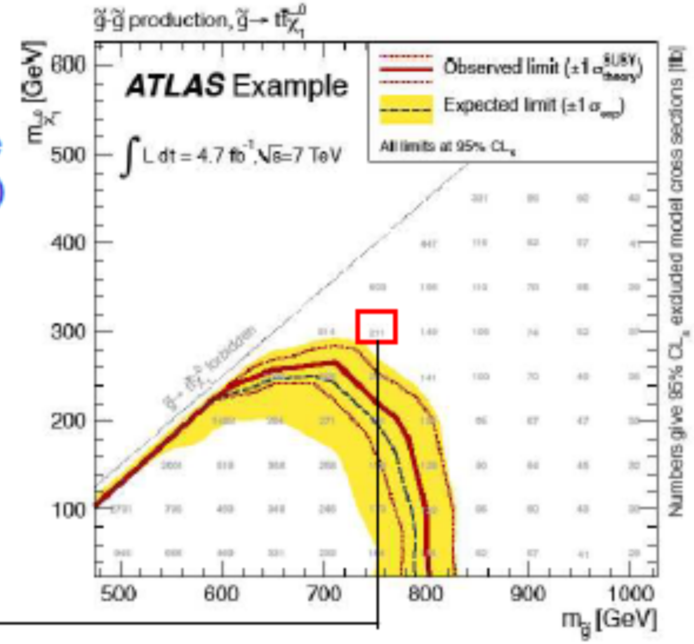
- Ease the life of theorist by separating the signal theoritical and experimental systematics

Expected limit:

- **Central value:** all uncertainties included in the fit as nuisance parameters, except theoretical signal uncertainties (PDF,scales)
- **±1σ band** : ±1σ results of the fit

Observed limit:

- **Central value**: Idem as for expected limit
- **±1σ band** : re-run and increase/decrease the signal cross section by the theoretical signal uncertainties (PDF, scales)



Excluded Model Cross section (SMS) ←

➔ Number quoted in paper correspond to observed -1 σ observed (conservative)

Result reinterpretation

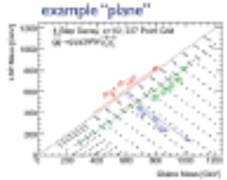
Feel free to reinterpret our results (see back-up slide) **!**

- Acceptance, **ε**, CLs, … are provided for each analyses in HEPData

Refined and extended list of input to HEPdata, starting with winter 2012 results.

- Plots, interpretation (CLs limits) from paper and auxiliary material
- For each signal region, and for all relevant models
  - acceptance (A), defined next page [$A = N_{fiducial}/N_{total}$]
  - efficiency (ε), defined next page [$\varepsilon = N_{fiducial-reco}/N_{fiducial}$]
  - Δ^{tot} total systematic and theoretical signal uncertainty, not including MC stat. unc.
  - CLs value
- For all relevant models
  - Number of generated MC events (can be used to derive all signal MC stat. unc.)
  - σ^{tot} total signal production cross section
  - SUSY Les Houches Accord (SLHA) files
- Relevant models:
  - E.g. small number of simplified models (easy kinematics)
  - no smoothing/interpolation between points

example "plane"



http://hepdata.cedar.ac.uk/

The Durham HepData Project

REACTION DATABASE | DATA REVIEWS | PARTON DISTRIBUTION FUNCTION SERVER | OTHER HEP RESOURCES

Extra resource relating to the paper arxiv:1109.6572 - CERN-PH-2011-145

Experimental acceptance/efficiency and excluded cross section*branching ratios:
    Signal expectations and experimental acceptance/efficiency for M_gluino vs M_squark grid (massless LSP)
    Signal expectations and experimental acceptance/efficiency for CMSSM/MSUGRA grid
SLHA files:
    susy sqgl slha files
    susy CMSSM/MSUGRA slha files

Extra resource relating ot the ATLAS NOTE ATLAS-CONF-2011-155

Experimental acceptance/efficiency and excluded cross section*branching ratio for M_gluino vs M_LSP grid:
    (direct decays) - SHLA files
    (one-step cascade decays, x=1/4) - SHLA files

A user can probe his/her favorite model(s) by:

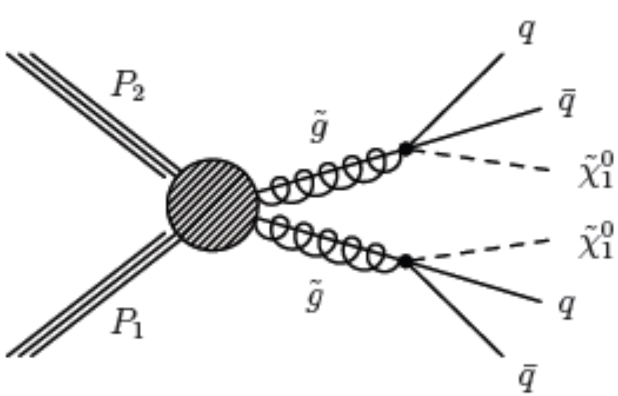
1. take our background estimate (per SR): $N^{tot} \pm \Delta^{tot}$ (numbers in publication)
2. implement event selection (per SR), validate against our acceptance numbers (in HEPdata)
3. implement a detector response, validate against our efficiency numbers (in HEPdata)
4. run on favorite model, and calculate sensitivity/limits using our visible upper limits (from publication)

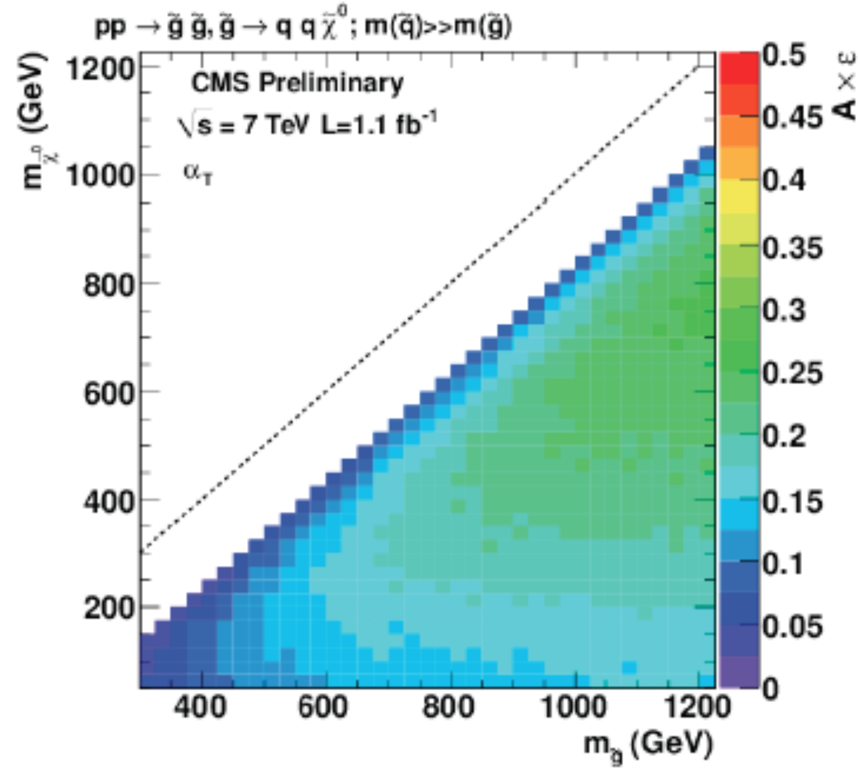
More details: https://indico.cern.ch/getFile.py/access?contribId=1&resId=0&materialId=slides&confId=173341

Avenue 1: SMS efficiency maps

Can be used by a phenomenologist to "calibrate" a "simple" MC

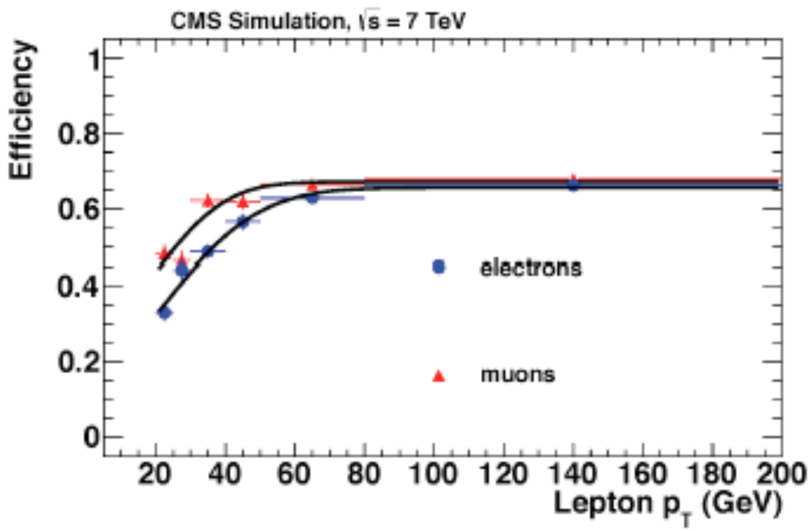
Example efficiency map for α_T search for well defined Simplified Model

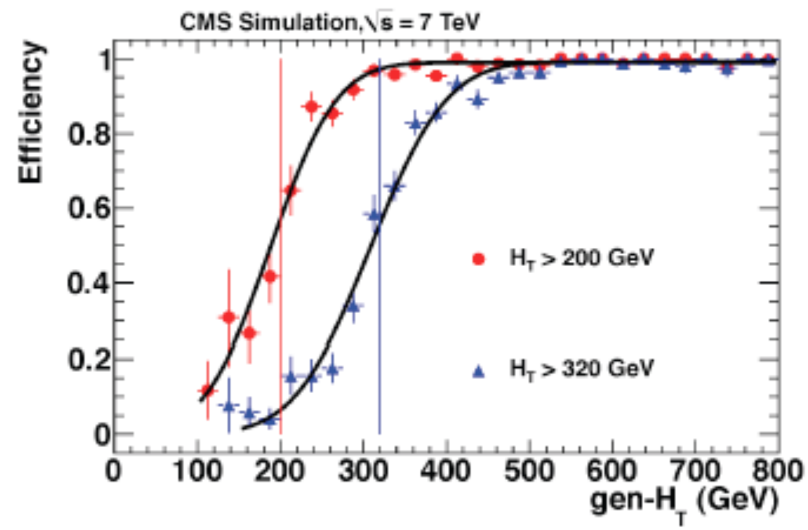




Avenue 2: Provide efficiency and turn on curves

To be used by phenomenologist to “build” a “simple” MC





Example from SameSign dilepton analysis: lepton efficiencies and H_T turn-on curves

Feedback by users of these information appreciated