A personal view of some of the recent LHC BSM results from ATLAS and CMS

IOP HEPP & APP, QMUL, 2012

Christopher Lester
University of Cambridge

I struggled here ...

- What does audience want?
- Long list?
- Not found anything.
- List of things the LHC has not found could go on and on.
- If interested in something specific (long lived mars-bars) go look it up!
- Astroparticle physicists, HEP, students, others.

What are the questions we would like to have answered?

- "Has the LHC made particles from which dark matter might be made?"
- "Has the LHC found weird particles (heavy resonances?) that could make high energy cosmic rays, or change the local ratios of the fluxes of positrons/electrons or anti-protons/protons? (etc)
- "Has the LHC found evidence of new CP violating mechanisms or interactions that would affect baryon anti-baryon asymmetries or early universe?"

Simple answer:

No.

(and if the LHC had found any of things you'd have heard about it somewhere else first, I'm sure)

So what, then, is the point of this talk?

- Good to see a big list of all the things that the LHC has looked for and **not** found?
  - Yes, that's helpful. That's all information.
- Big list of cuts?
  - Some find this helpful, but no substitute for the original papers. Slides only half true. Signal regions have multiplied many-fold.
- May be more useful to think a bit about
  - **what** these searches actually constrain.
  - Which searches are absent.
  - Where emphasis or focus has changed.

(1)

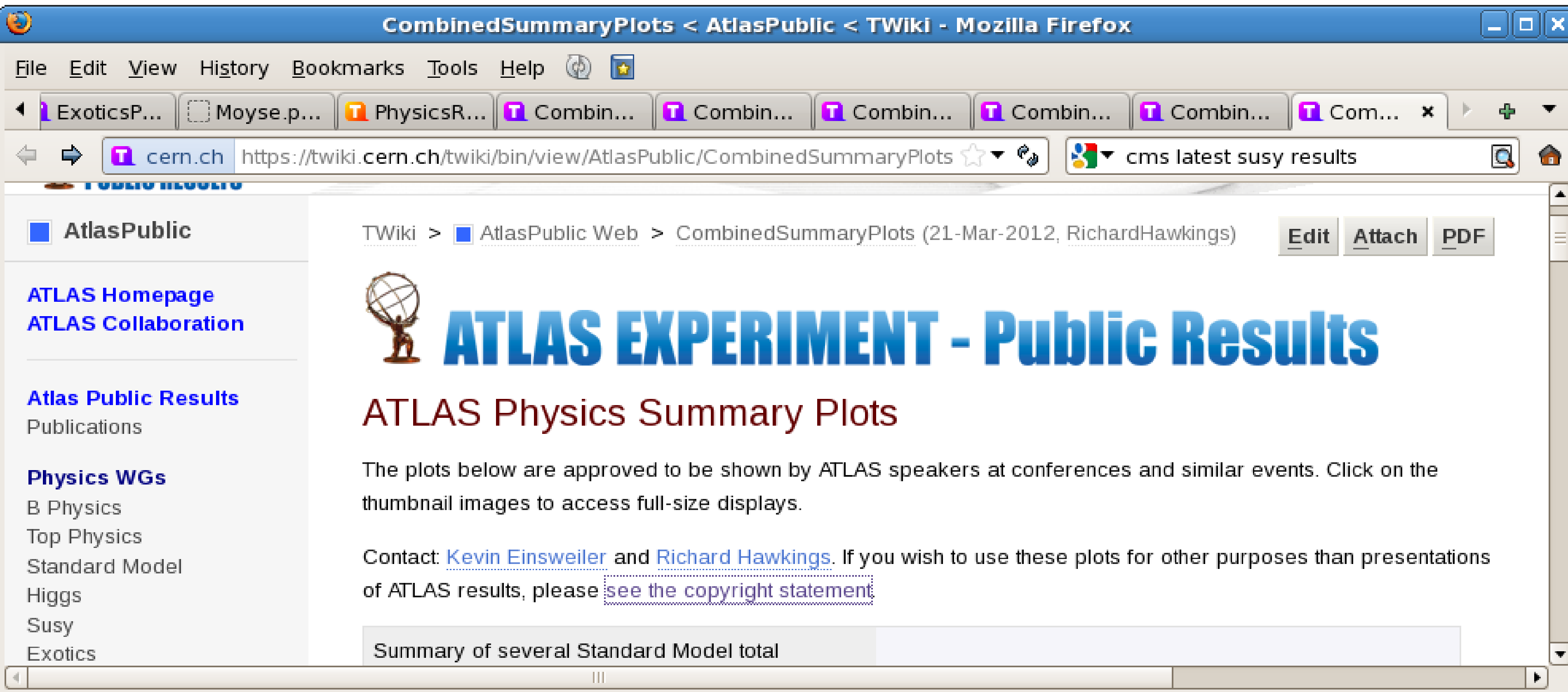
Big lists of searches

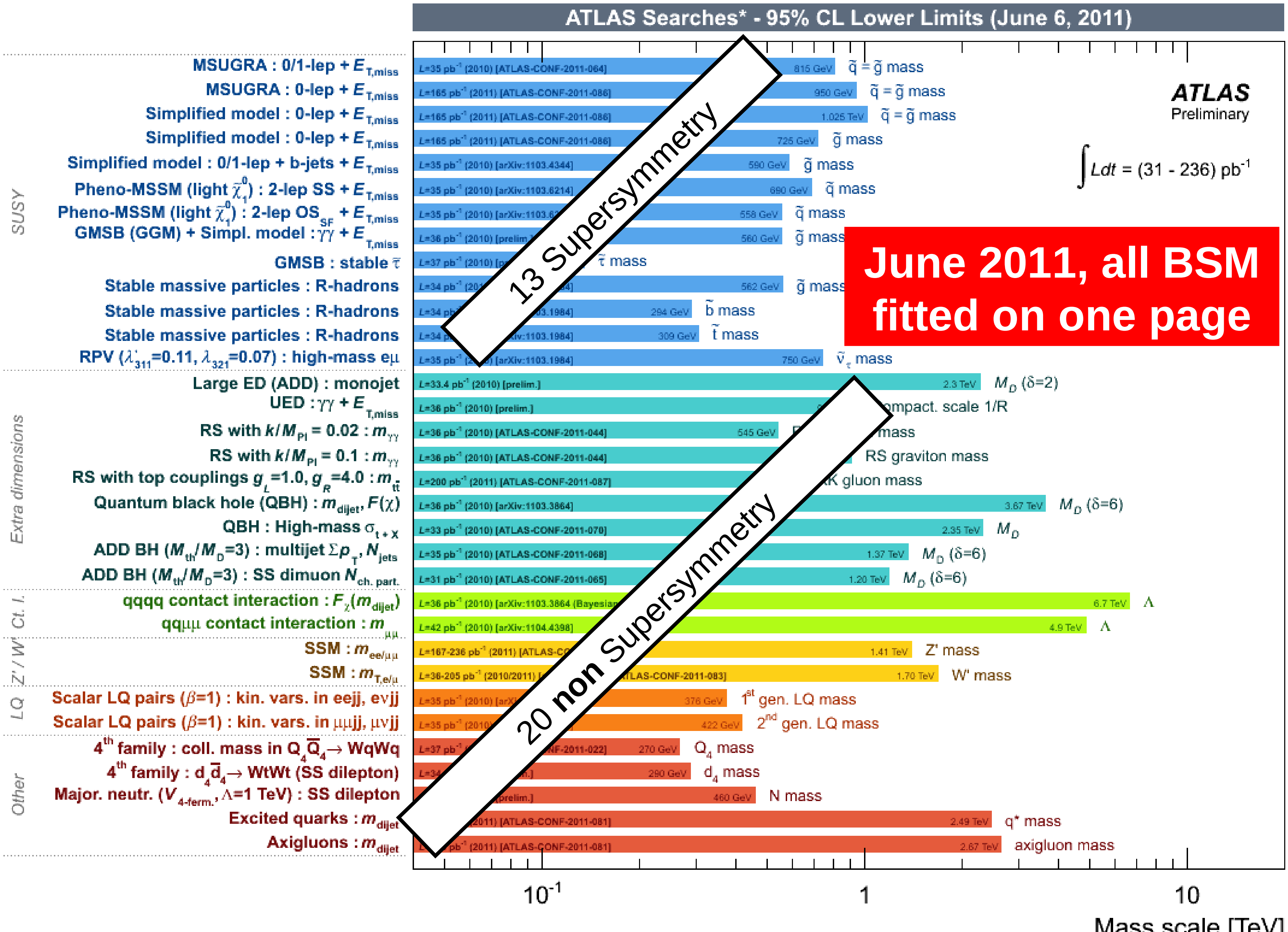
(Changes 2011 to 2012)

ATLAS list

- ATLAS summary of many BSM (and SM) results is maintained at:

https://twiki.cern.ch/twiki/bin/view/AtlasPublic/CombinedSummaryPlots





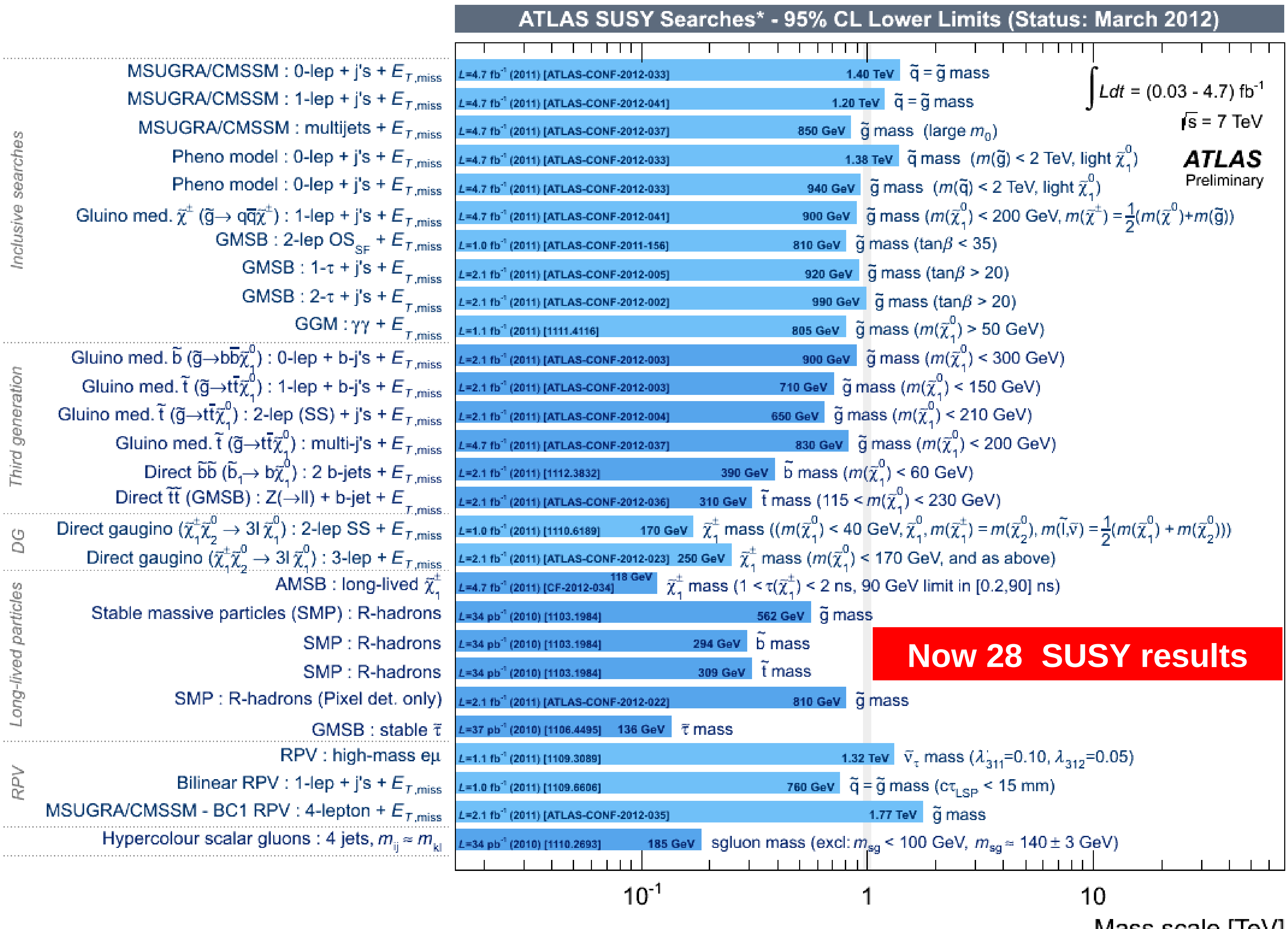
*Only a selection of the available results shown

Summary plot no longer fits on one page!

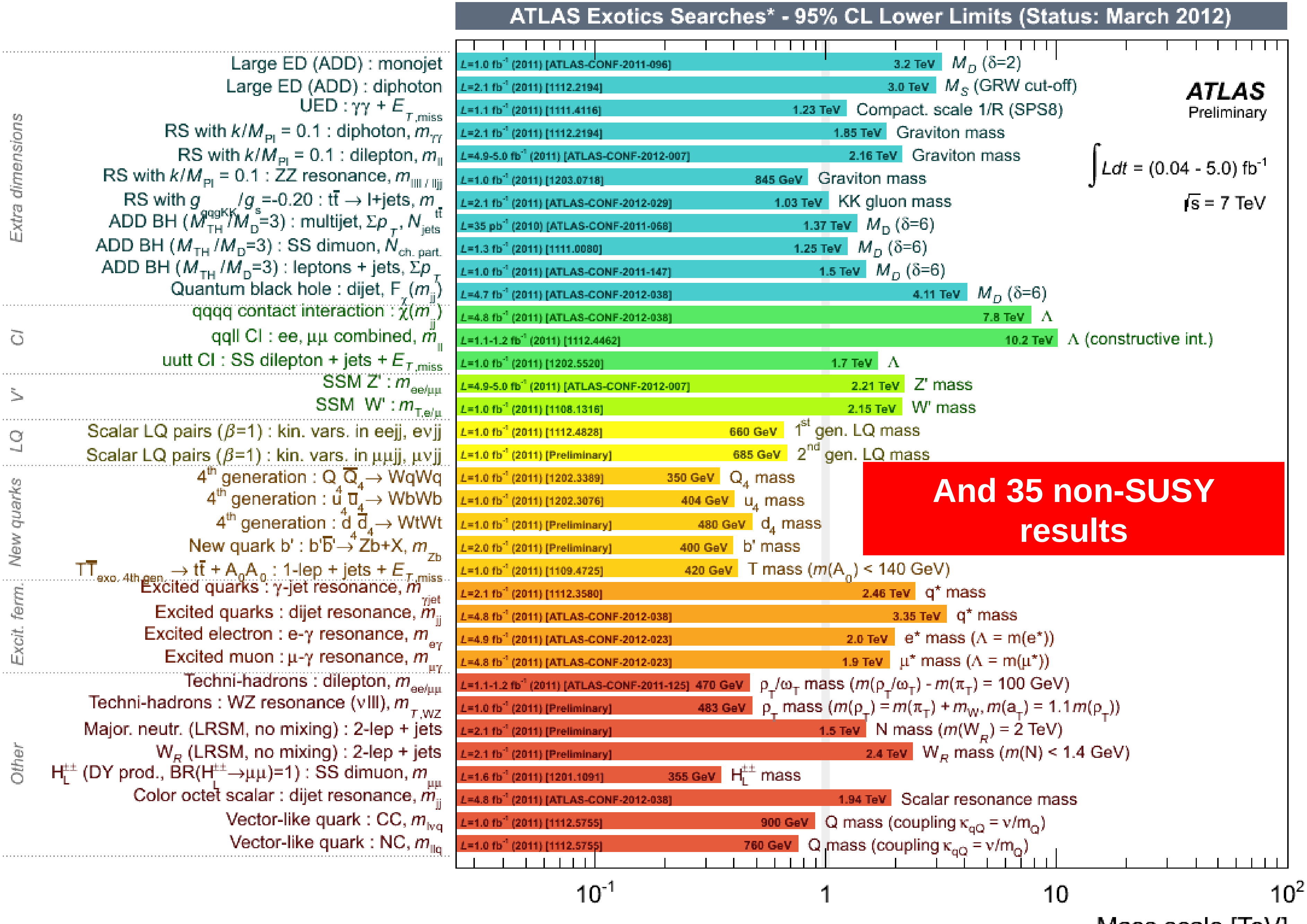
Summary plots need to be summarised!

[high-resolution download option available]

[B.R. Webber, March 2012, “Oh don't tell me they've published another paper!]



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



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

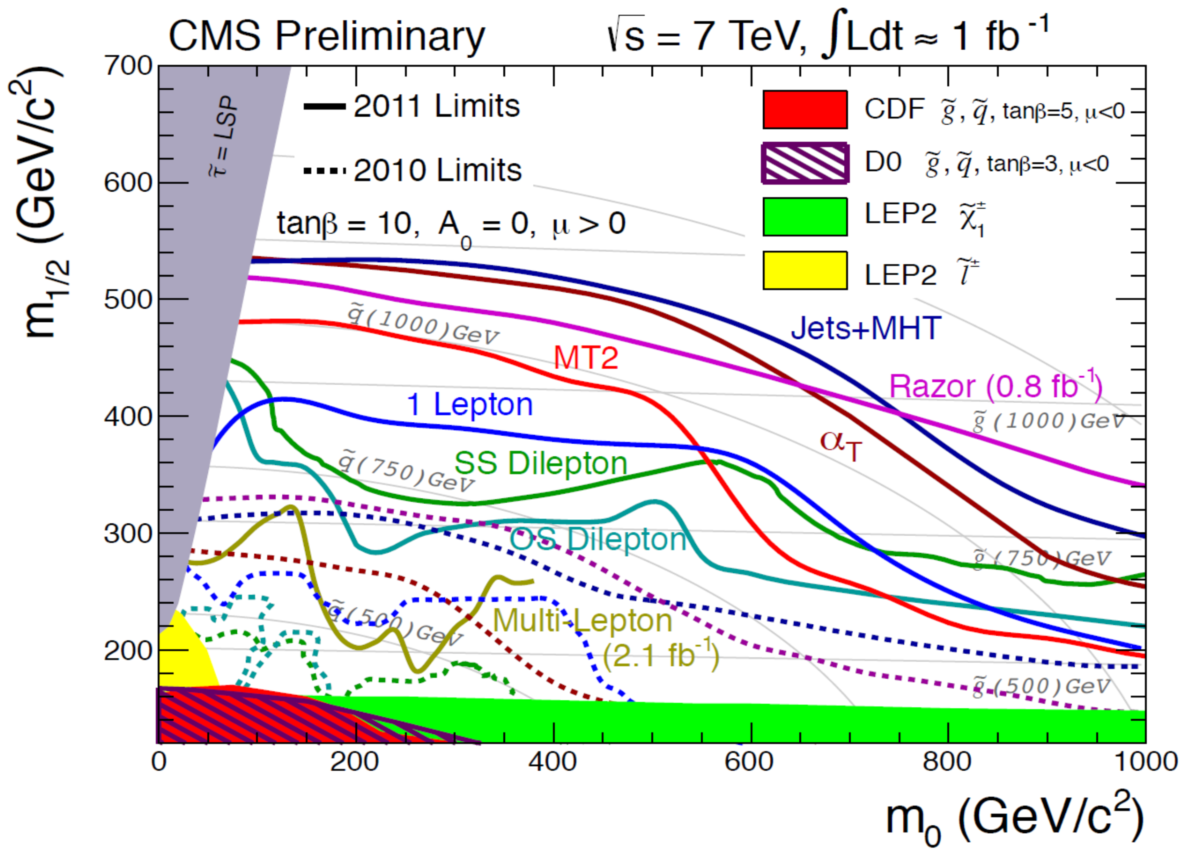
CMS long-list

- Similar lists available (updated to end 2011)

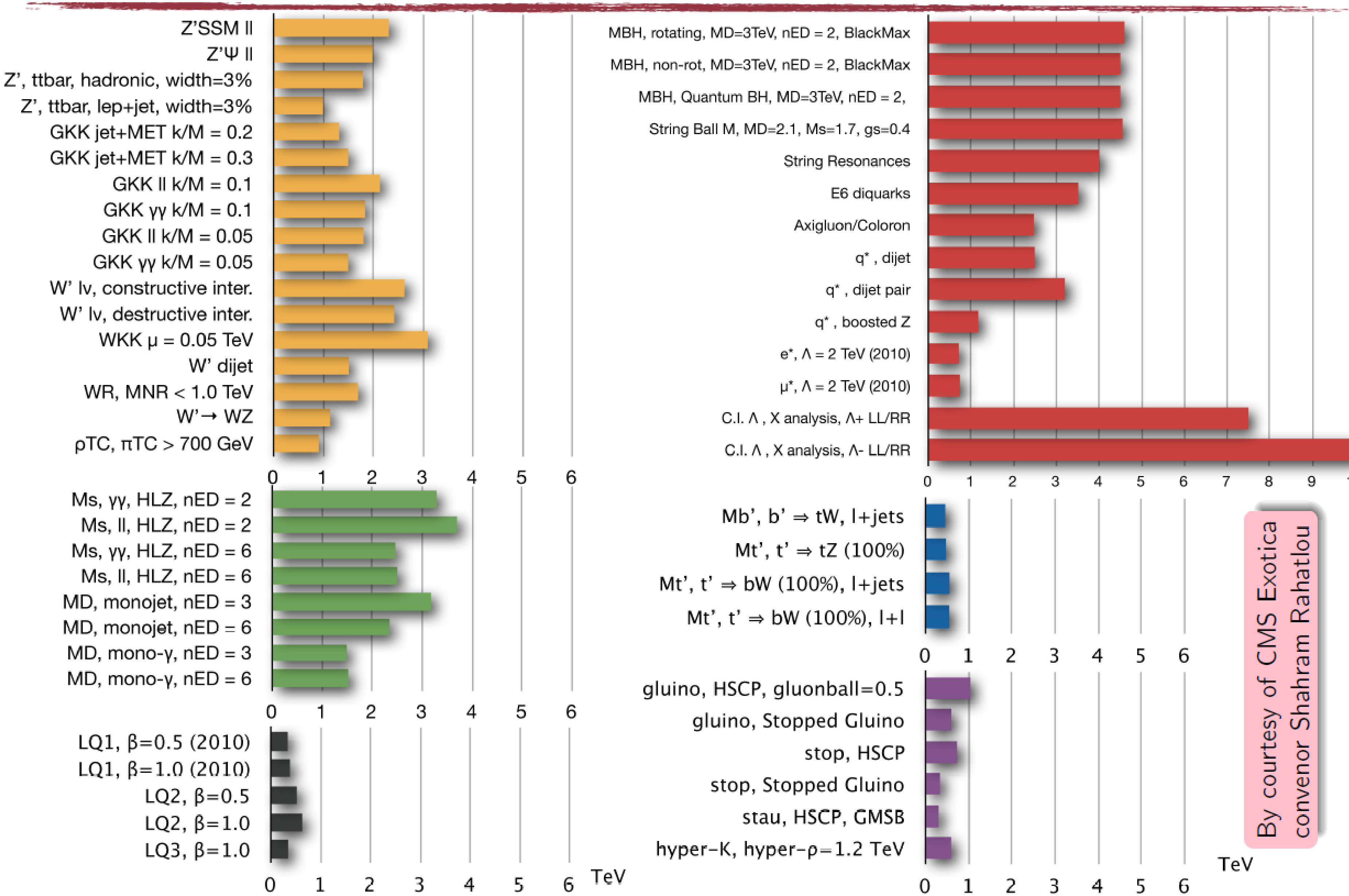
  https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsSUS

  https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsEXO

- including famous spaghetti plot:



Grand Summary Moriond 2012



So the lists have grown.

What are the new items?

Lars Sonnenschein,

Nice categorisation of ATLAS & CMS exotics results post HCP2011

http://moriond.in2p3.fr/QCD/2012/MondayMorning/Sonnenschein.pdf

Outline

Introduction

Searches for TeV scale gravity

- Black holes (CMS)
- TeV scale gravity signatures (ATLAS)
- Extra Dimensions in $\gamma\gamma$ (CMS)
- ED in $\gamma\gamma + \ell\ell$ (ATLAS)
- Large ED in $\mu\mu + ee + \gamma\gamma$ (CMS)
- Dark Matter + LED in $\gamma + E_T^{\text{miss}}$ (CMS)
- LED/Unpart. in Mono-Jet + E_T^{miss} (CMS)
- RS gravitons in jet + E_T^{miss} (CMS)

Searches in lepton production

- $W' \rightarrow \ell\nu$ ($\ell = e, \mu$) (CMS)
- Multileptons (CMS)
- Excited leptons (ATLAS)
- Contact Interactions in dilepton events (ATLAS)

Searches in lepton + jet production

- 1st generation Lepto Quarks (ATLAS)
- 2nd generation Lepto Quarks (ATLAS)
- Heavy bottom quarks to Zb (ATLAS)
- Heavy bottom like quark (CMS)
- Heavy neutrinos (ATLAS)

Searches in jet production

- Search in dijet angular distribution (CMS)
- Search for heavy vector-like quarks (ATLAS)

Searches for long-lived charged particles

- Heavy Stable Charged Particles (CMS)
- Light Higgs $\rightarrow$ long-lived $\pi_v \pi_v$ (ATLAS)

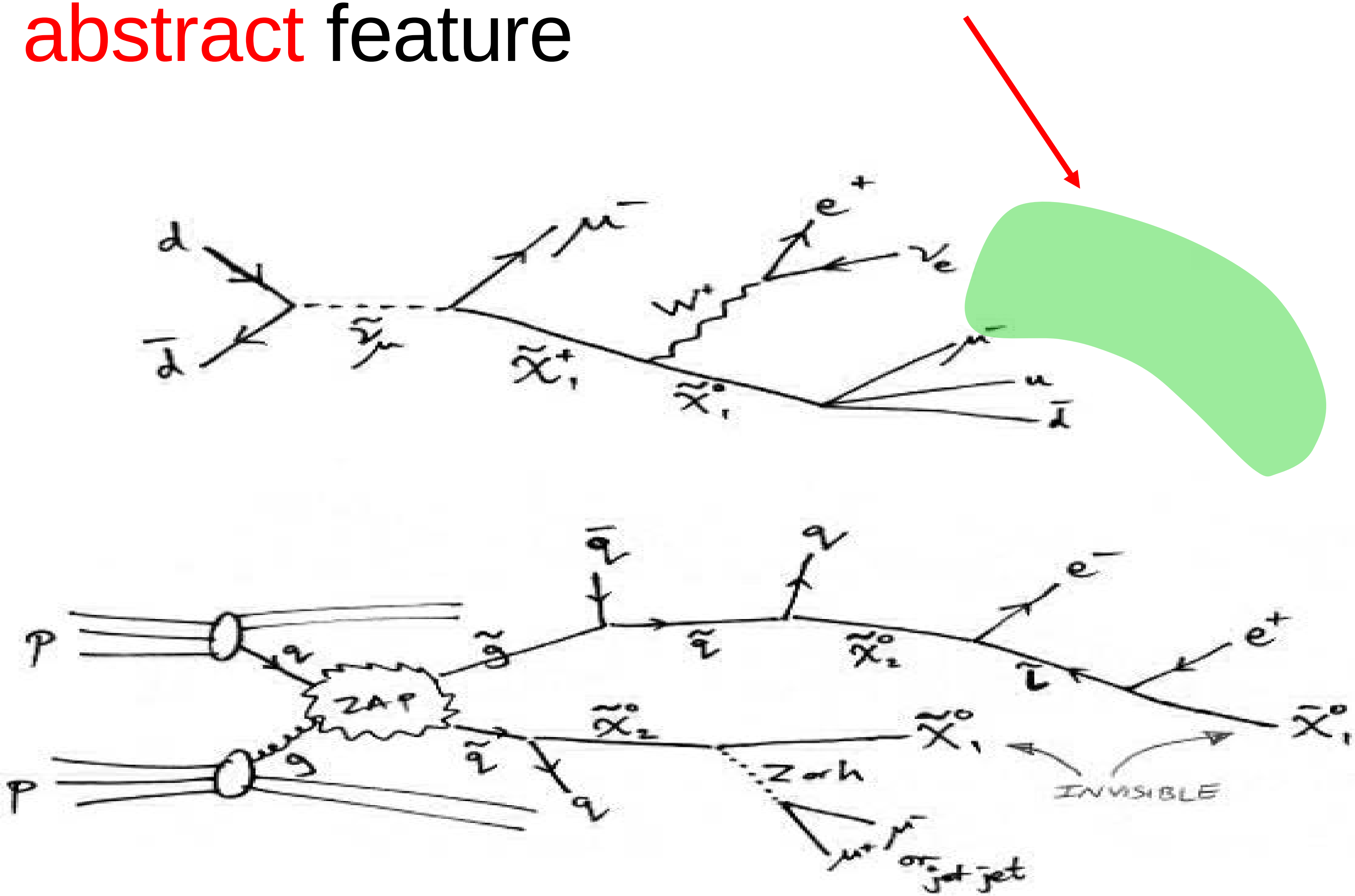
Conclusions

All these were searches “for something” -

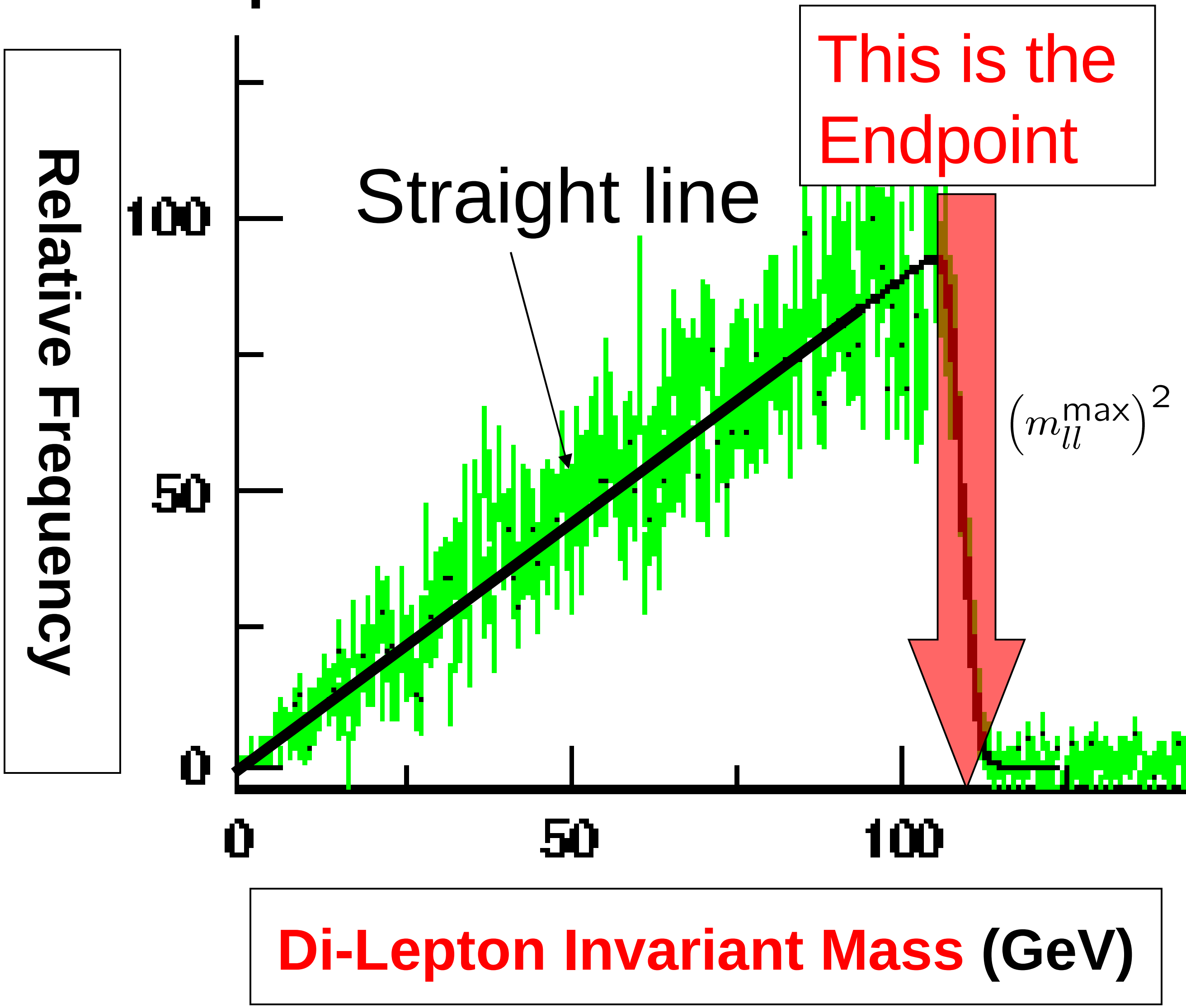
- what does that mean?

CMS 2-lepton search for this abstract feature

SUS-11-011-pas



Dilepton invariant mass distribution

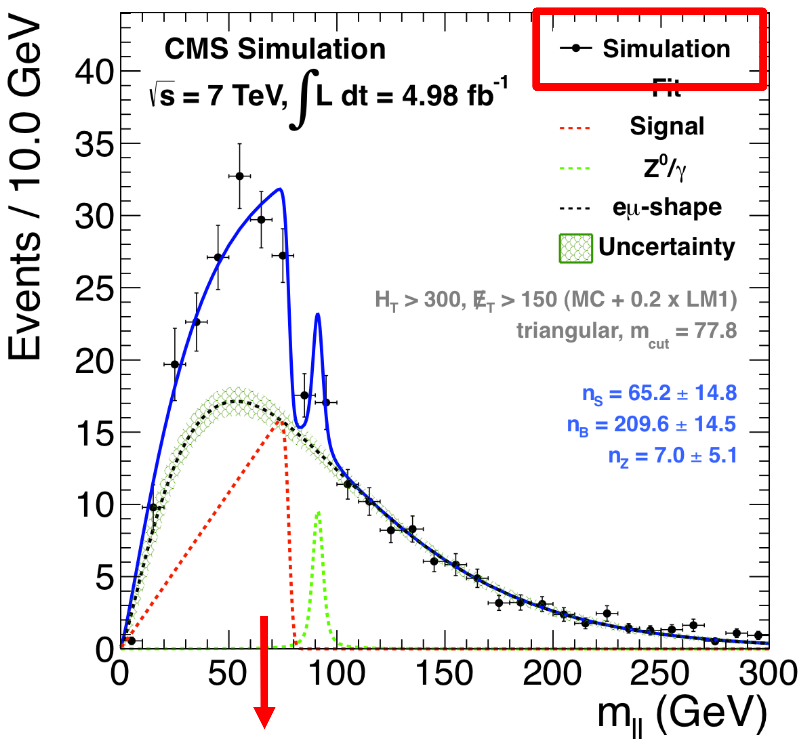


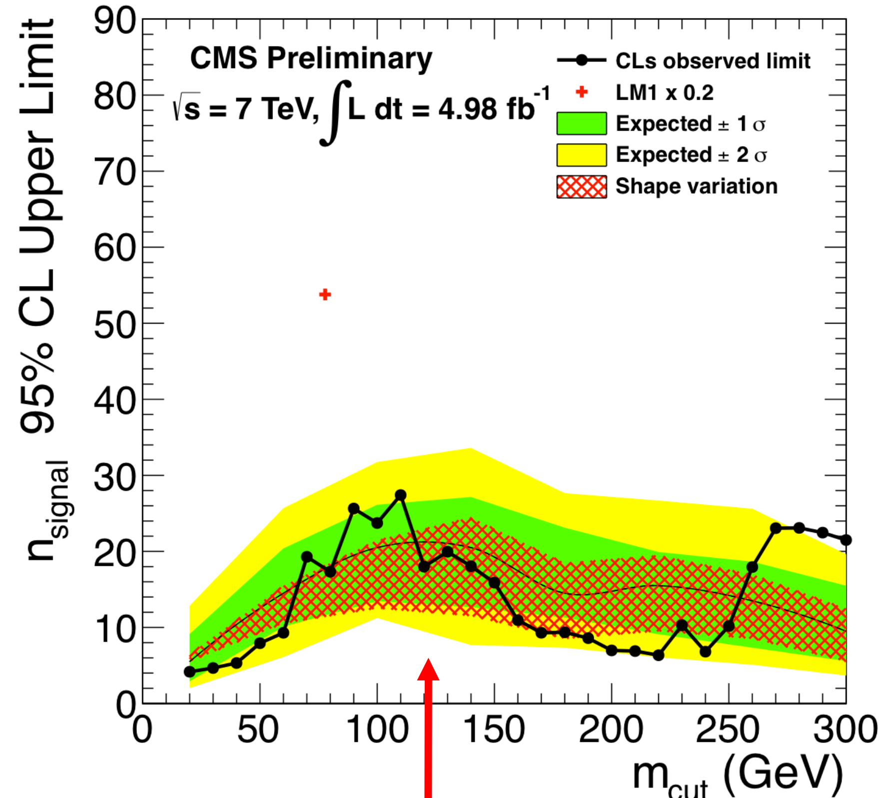
$$\left(m_{ll}^{\max}\right)^2 = \frac{\left(m^2_{\tilde{\chi}^0_2} - m^2_{\tilde{l}_R}\right)\left(m^2_{\tilde{l}_R} - m^2_{\tilde{\chi}^0_1}\right)}{m^2_{\tilde{l}_R}}$$

CMS 2 lepton + 2 jet search

SUS-11-011-pas

We require the presence of at least two jets with $p_T > 30\,\mathrm{GeV}/c$ and $|\eta| < 3.0$, separated by $\Delta R > 0.4$ from leptons passing the analysis selection with $p_T > 10\,\mathrm{GeV}/c$. The anti-k_T clustering





Note the way the result is expressed

Figure 6: CLS 95% confidence level upper limit on the signal yield as a function of the endpoint in the invariant mass spectrum, mcut, assuming a triangular shaped signal (black dots and line). The hatched band shows the variation of the expected limit assuming two alternate signal shapes. A benchmark SUSY scenario with the dilepton mass shape and 20% of the expected LM1 yield is shown for the position of the kinematic edge in this model mcut = 78 GeV.

Have fixed idea,

Unlikely consequences,

Ask for them all,

Suppresses backgrounds.

Consequence:

Easier to set “impressive” looking limit – but coupled to the model assumption.

Good for ruling models out.

Less good for reassuring you about the SM.

(2)

Interpretation of results over last year:

movement from

“Unified models” to so-called

“Simplified Models” (typically masses)

cMSSM interpretation

CMS: 4.4/fb, Search for supersymmetry with the razor variables at √s = 7 TeV CMS-PAS-SUS-12-005

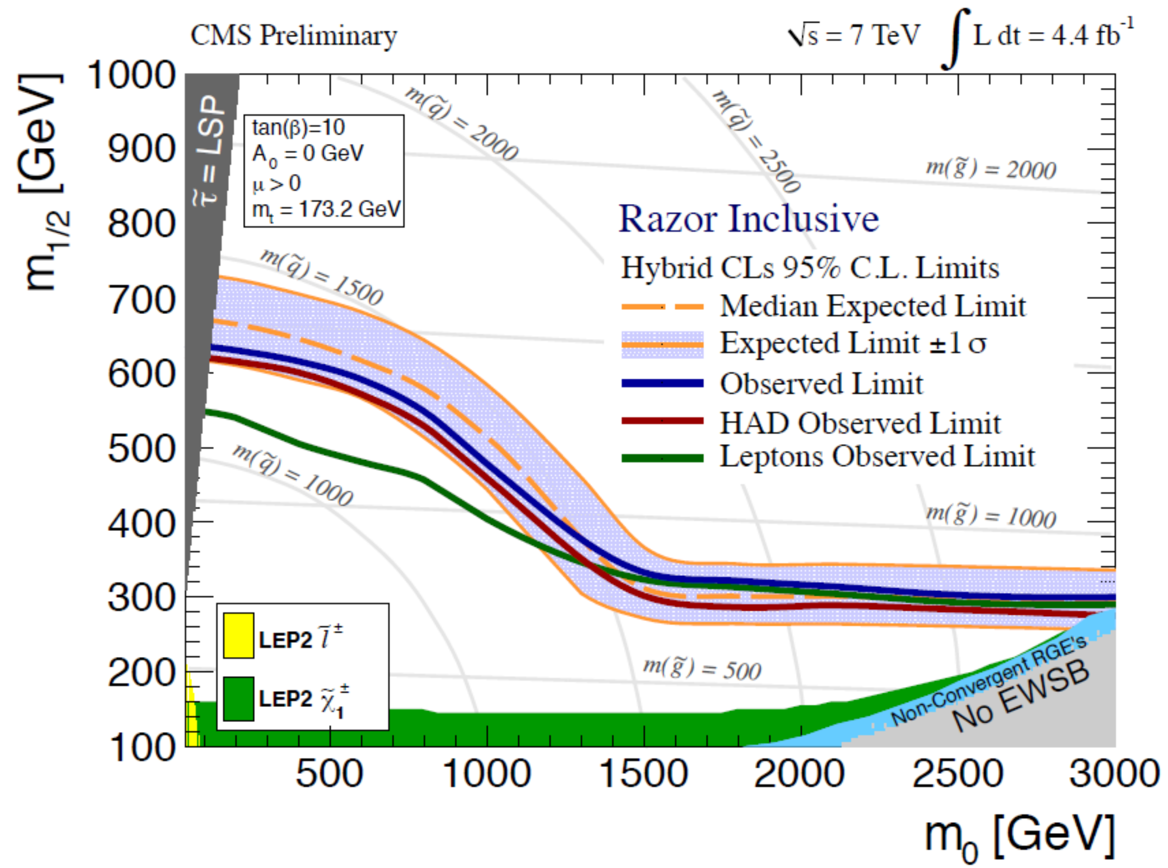
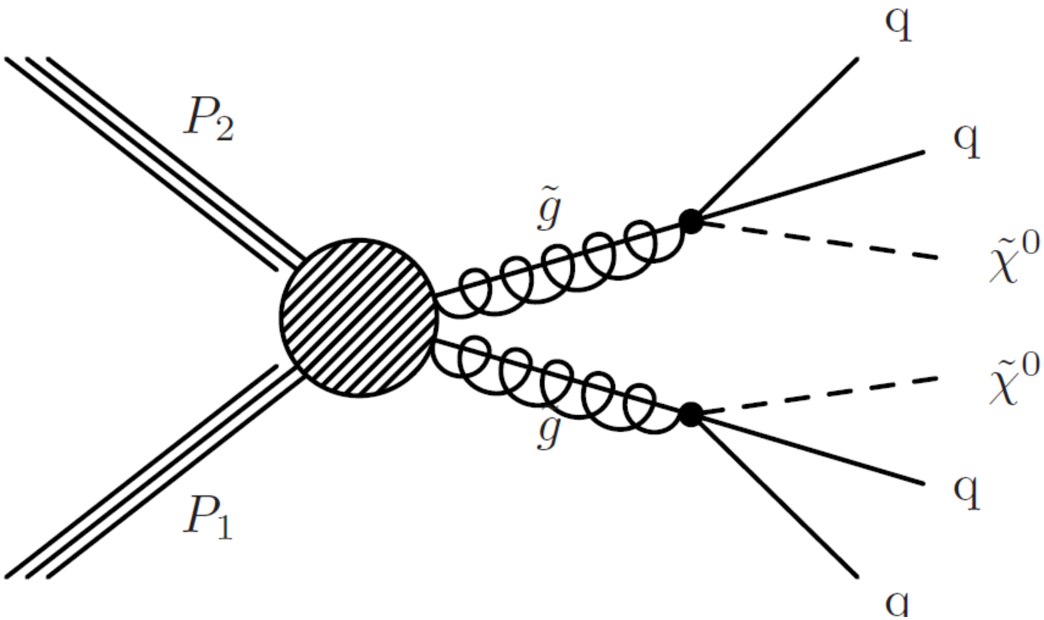


Figure 12: Observed (solid blue curve) and median expected (dot-dashed curve) 95% CL limits in the $(m_0, m_{1/2})$ CMSSM plane with $\tan\beta = 10$, $A_0 = 0$, $\text{sgn}(\mu) = +1$ from the razor analysis. The ± one standard deviation equivalent variations in the uncertainties are shown as a band around the median expected limit. Shown separately the observed HAD-only (solid crimson) and leptonic-only (solid green) 95% CL limits.

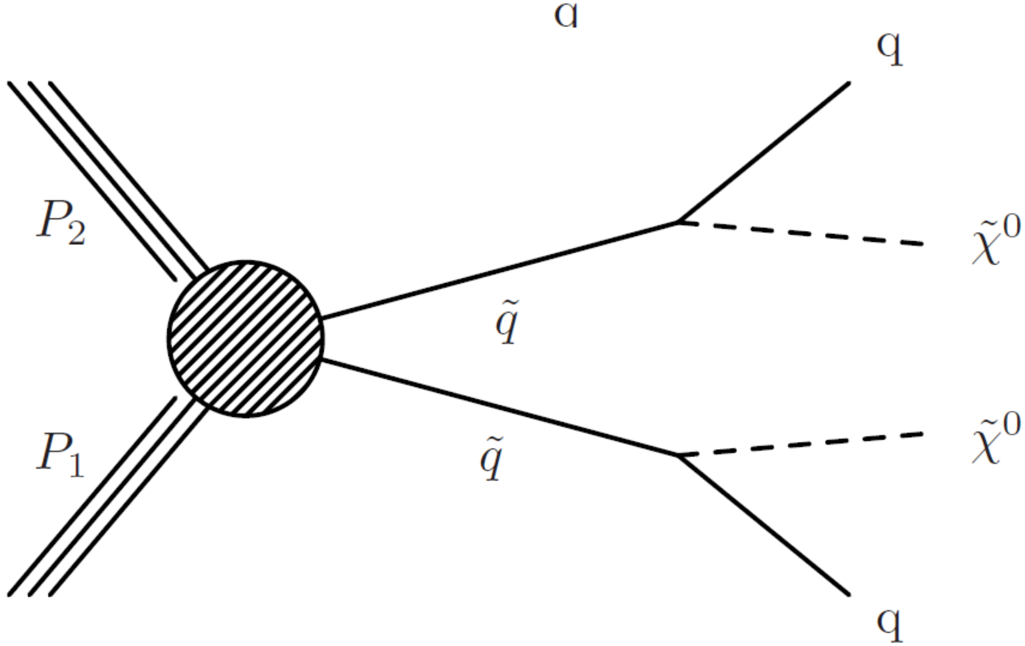
From CMS SUS-11-003



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.

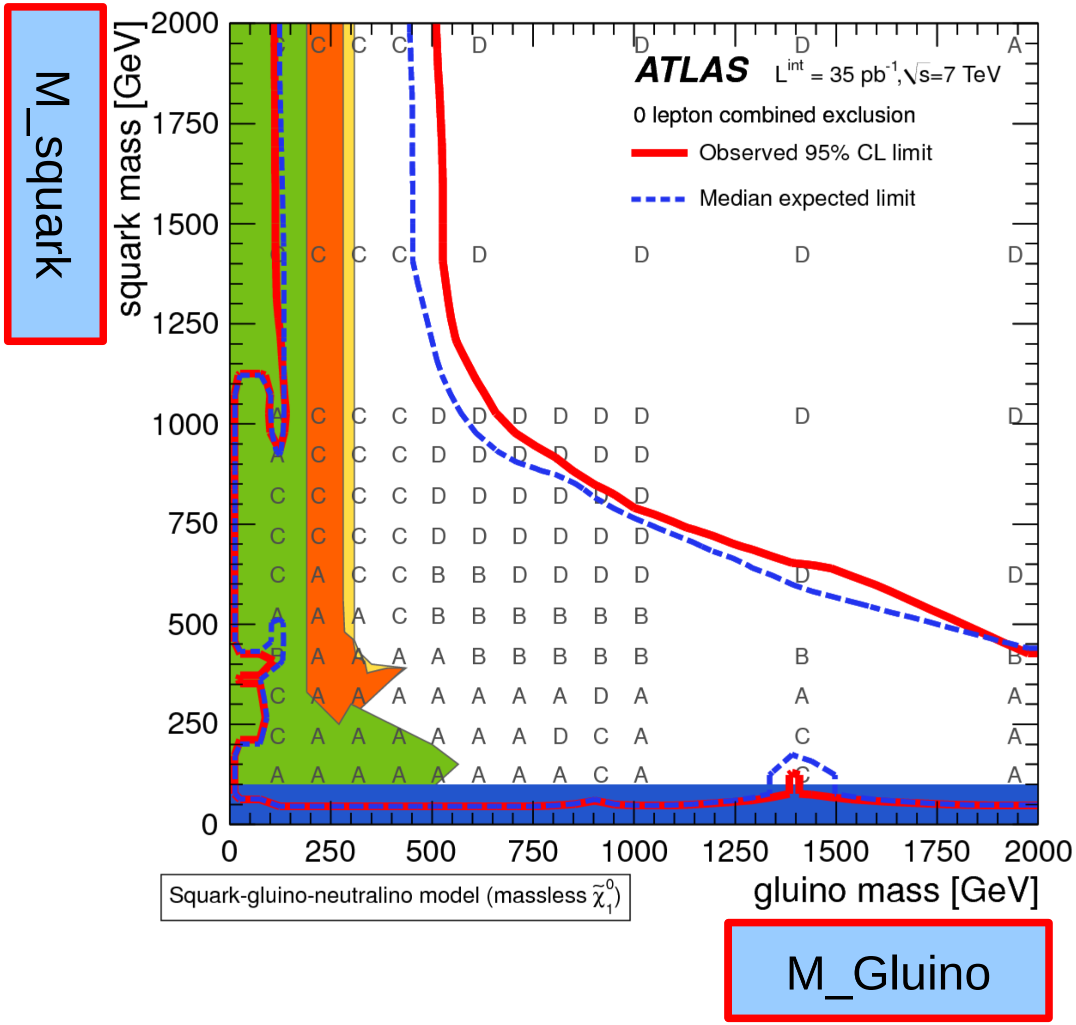
D.Alves et al., arXiv:1105.2838

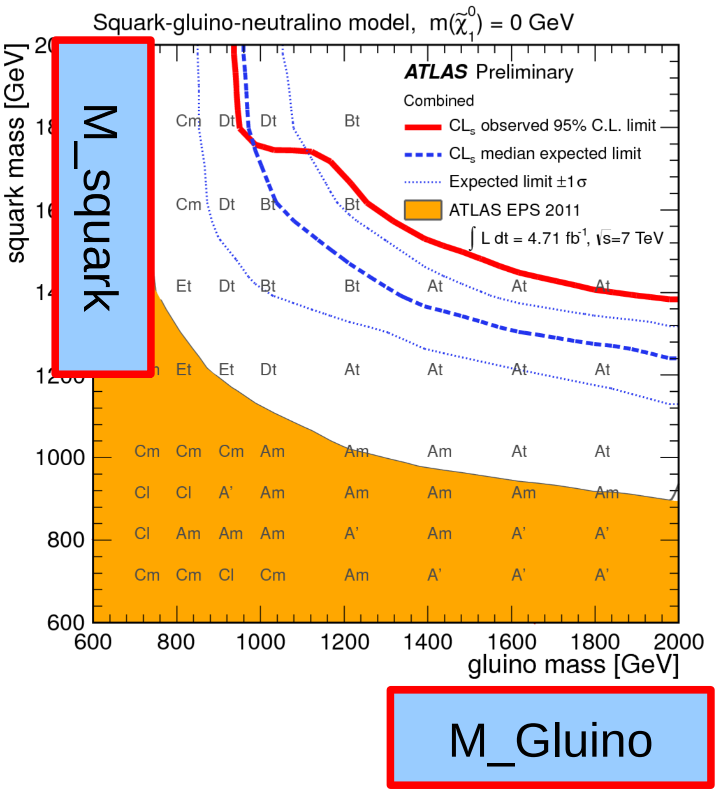
From CMS SUS-11-003



Simplified Models

ATLAS, 35/pb → ATLAS, 4.7/fb

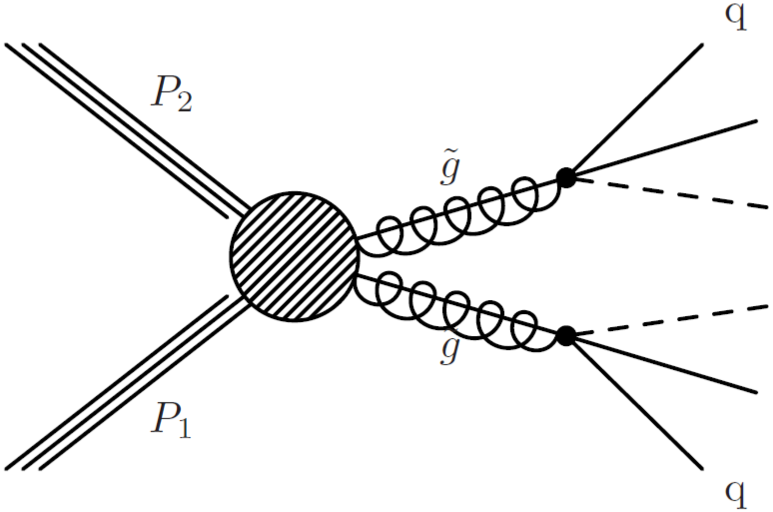


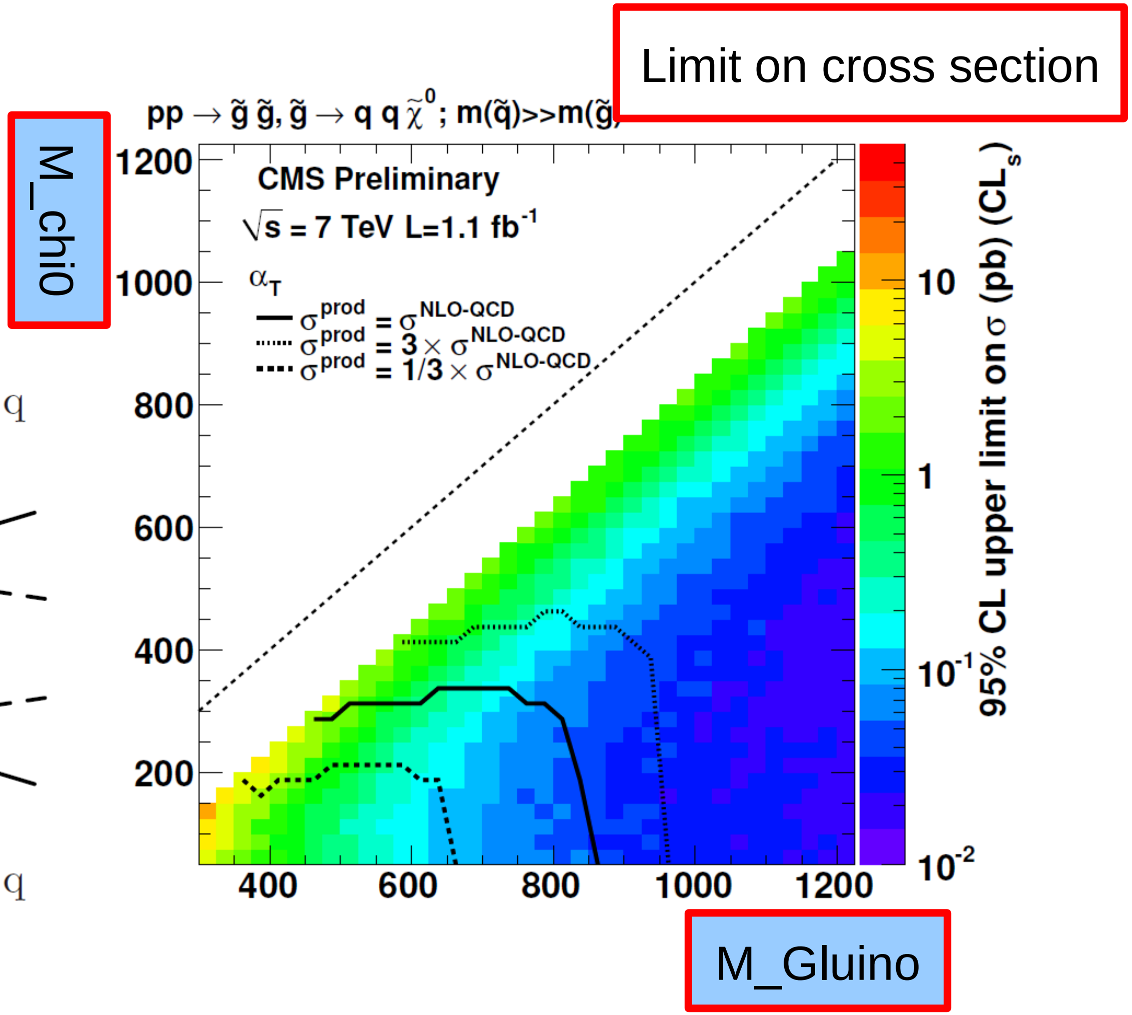


ATLAS-CONF-2012-033

0 lepton + >=(2-6) jets + Etmiss

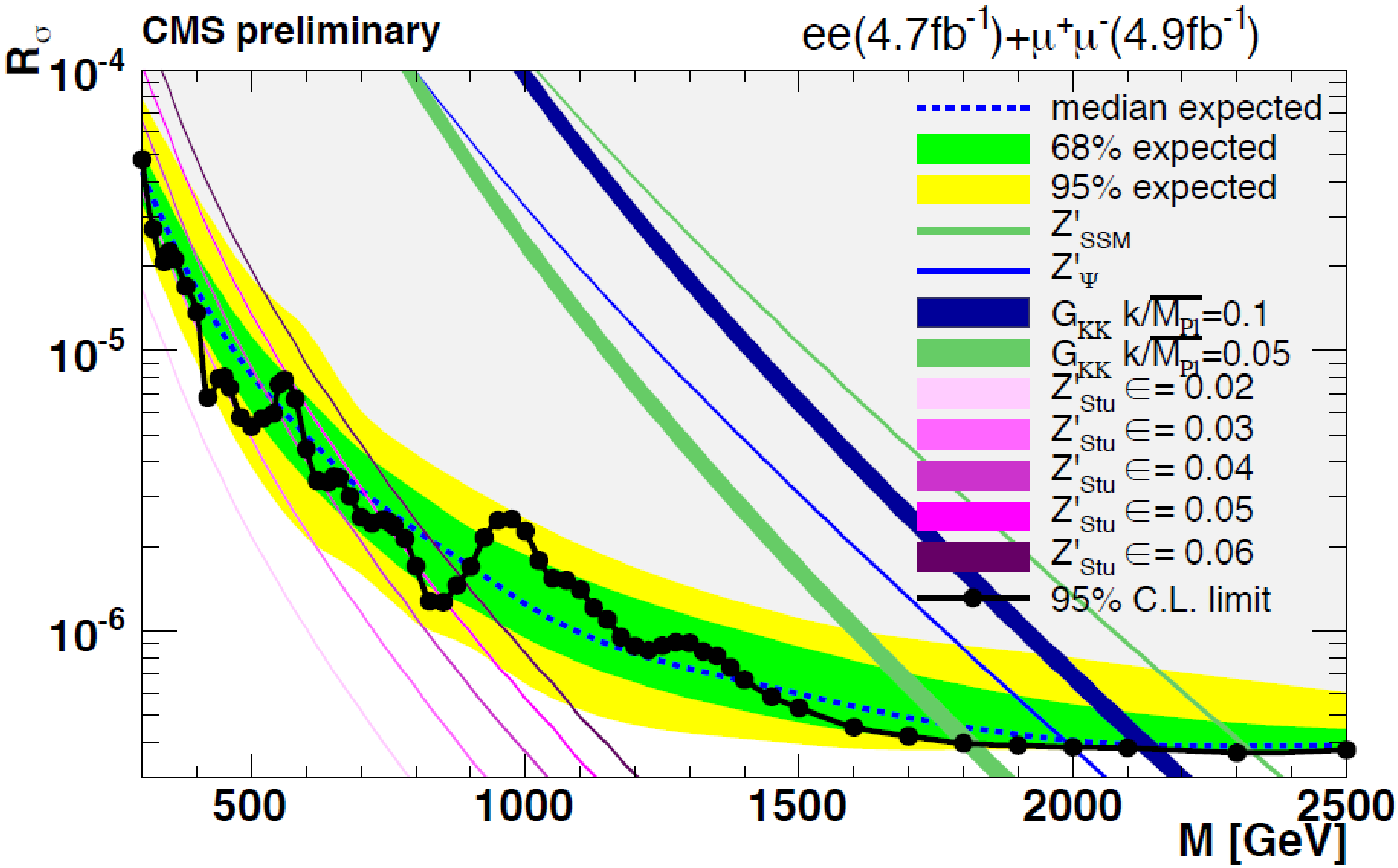
Depth rather than exclusion





CMS - Search for supersymmetry in all-hadronic events with αT. SUS-11-003

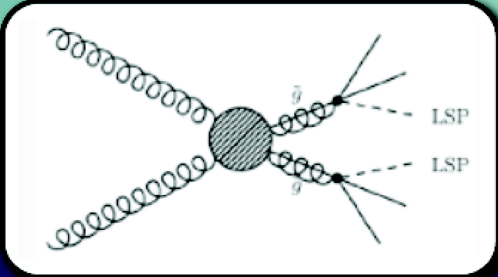
CMS EXO-11-019 – Additional Bosons



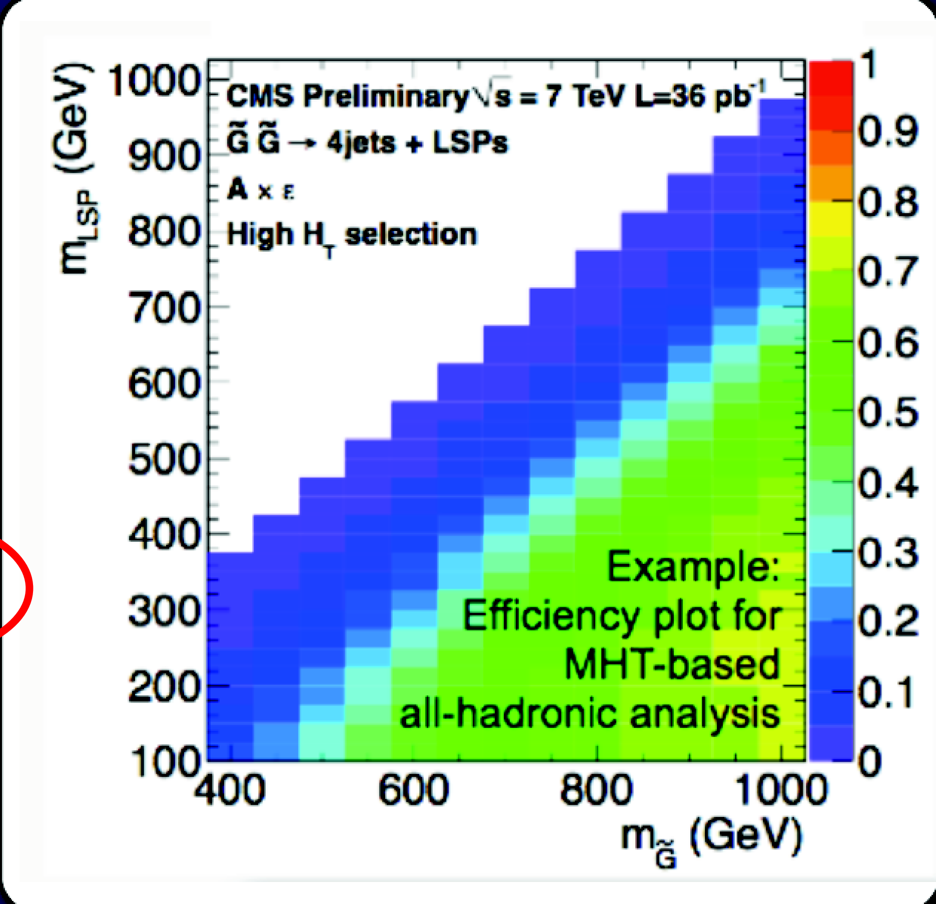
We need to remember depth, not just reach!

(Slide from Tim Tait)

Simplified Models



- One can step away from specific MSSM assumptions by working with simplified models.
  - These are phenomenological sketches of theories with some basic particles and decays built into them.
- The experimental collaborations have been willing to explore casting their SUSY searches into this framework, allowing for a much more flexible interpretation of limits.



Changes over the last 12 months

- Tendency to shift away from exclusion “reach” to exclusion “depth”
- Increasing tendency to present results in way that encourages re-interpretation
- Theorists are generally very happy with this move from experiment (though always pushing for more)

CMS-PAS-SUS-12-005

Is SUSY in trouble?

- Pre-LHC:

Strong expectation that SUSY, if there, would be light

~< 1 TeV.

- Now:

Direct limits pushed higher and higher: M_{susy}>1TeV ?

Precision flavour physics (LHCb) shows no sign of BSM, M_{susy}>10TeV ?

27 August 2011 Last updated at 06:41 GMT

7.9K Share

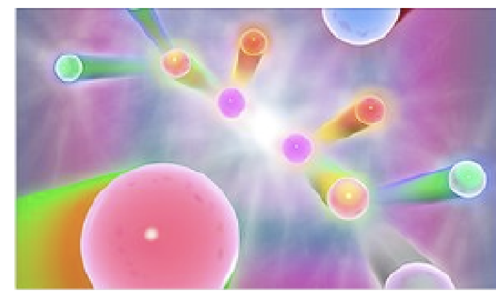
LHC results put supersymmetry theory 'on the spot'

By Pallab Ghosh
Science correspondent, BBC News

Results from the Large Hadron Collider (LHC) have all but killed the simplest version of an enticing theory of sub-atomic physics.

Researchers failed to find evidence of so-called "supersymmetric" particles, which many physicists had hoped would plug holes in the current theory.

Theorists working in the field have told BBC News that they may have to come up with a completely new idea.



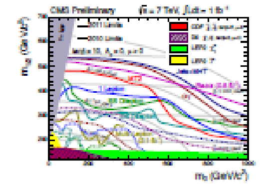
Supersymmetry predicts the existence of mysterious super particles.

(Thanks to Sabine Kraml for slide idea)

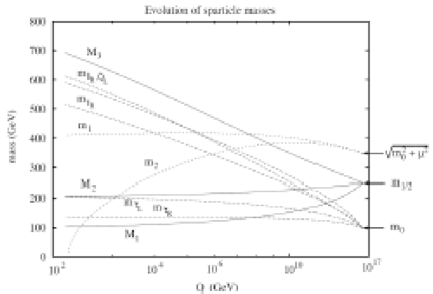
Much more direct briefing “against” the CMSSM

Example

Beware the CMSSM



- CMSSM: Constrained Minimal Supersymmetric Standard Model
- Assumes rather ad-hoc boundary conditions at the GUT scale
  - universal gaugino mass $m_{1/2}$
  - universal scalar mass parameter m_0
  - universal trilinear coupling A_0

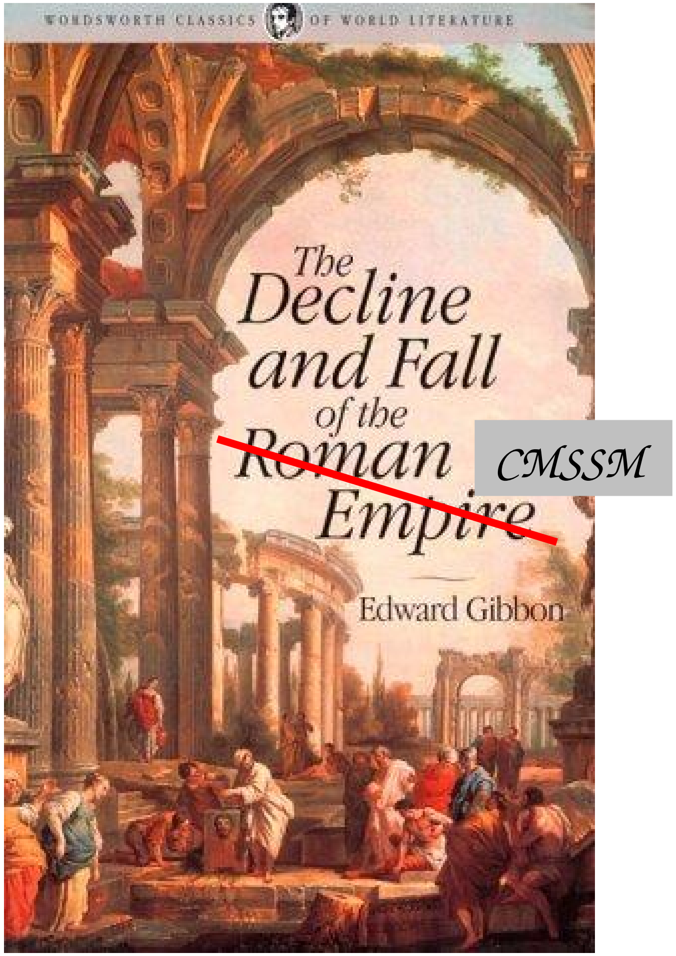


- Consequences:
  - Gluino : wino : bino (LSP) mass roughly 7 : 2 : 1 $\quad m^2_{\tilde\chi^0_1} \sim 0.4\, m_{1/2}, \quad m^2_{\tilde g} \sim 2.8\, m_{1/2}$
  - Squark masses related to gluino mass $\quad m^2_{\tilde Q} \approx m_0^2 + (5 \to 7) m^2_{1/2} \qquad m^2_{\tilde q} \sim m_0^2 + m^2_{\tilde g}$
  - Slepton masses related to gaugino and squark masses $\quad m^2_{\tilde R} \approx m_0^2 + 0.15\, m^2_{1/2}$, $\quad m^2_{\tilde L} \approx m_0^2 + 0.5\, m^2_{1/2}$
- Convenient toy model for benchmark studies, but need to keep in mind that a constrained model gives a constrained phenomenology.

in particular if A0 and tanβ are fixed !

S. Kraml, Rencontres de Moriond EW 2012

Theorists not yet in full scale retreat – but plans scaled back



Napoleon's retreat from Moscow

- Evident retreat from SUSY as unified theory.
- Decline and fall of CMSSM.
- Rise of “p19MSSM” and others
- But, D.o.F.s Are being added to keep models alive.

However

- Remain strong hopes that SUSY can still fix a subset of the original goals (eg naturalness) despite abandoning others (eg dark matter) by specialisation (eg RPV)

- Emphasise simple places Susy could still remain.

(3)
Third generation searches
-
Hot Topic

Why interest in third family?

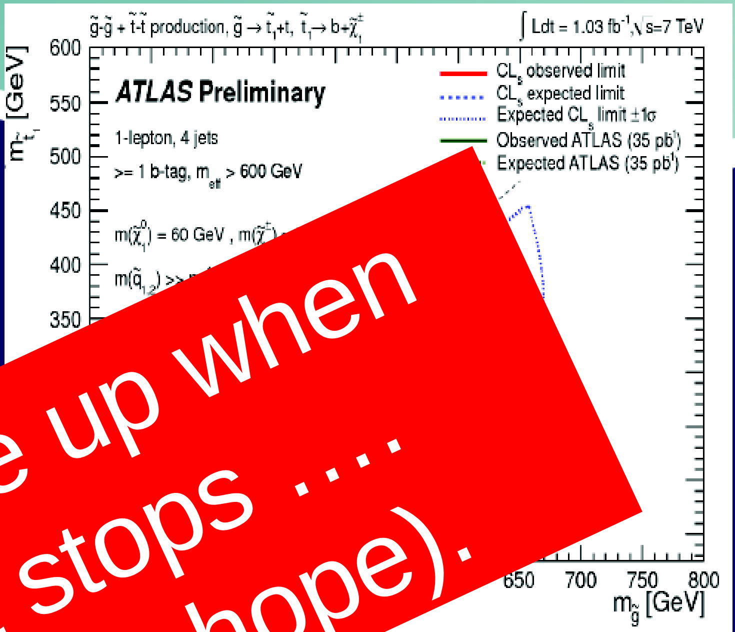
- Naturalness requires SUSY to have fairly light stops (to cancel largest contribution to Higgs mass divergence from top-quark)
- Left-handed stop usually comes with a similar mass sbottom

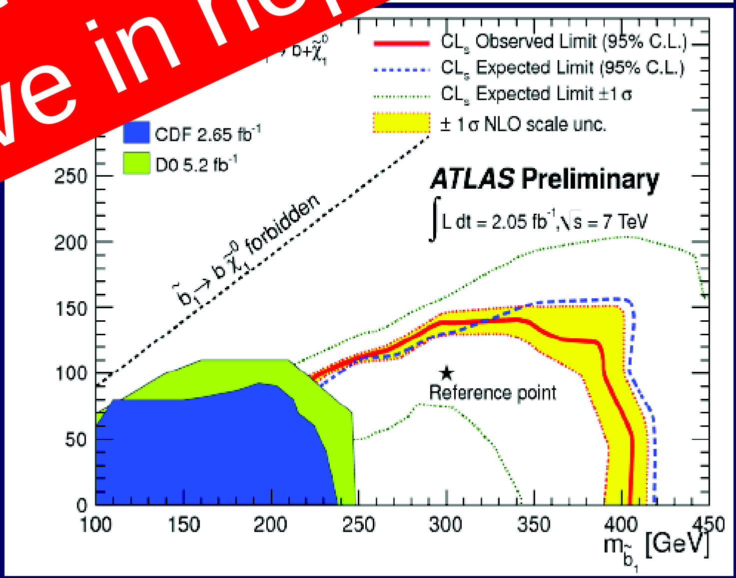
3rd Generation Squarks

(Slide from Tim Tait)

- naturalness requires SUSY to have light(ish) stops.
- The left-handed stop comes along w… a sbottom with a roughly simil…
- The squark masses a… tightly coupled… through th…
- Searches for … are becoming … the next year is likely to … …ightening!

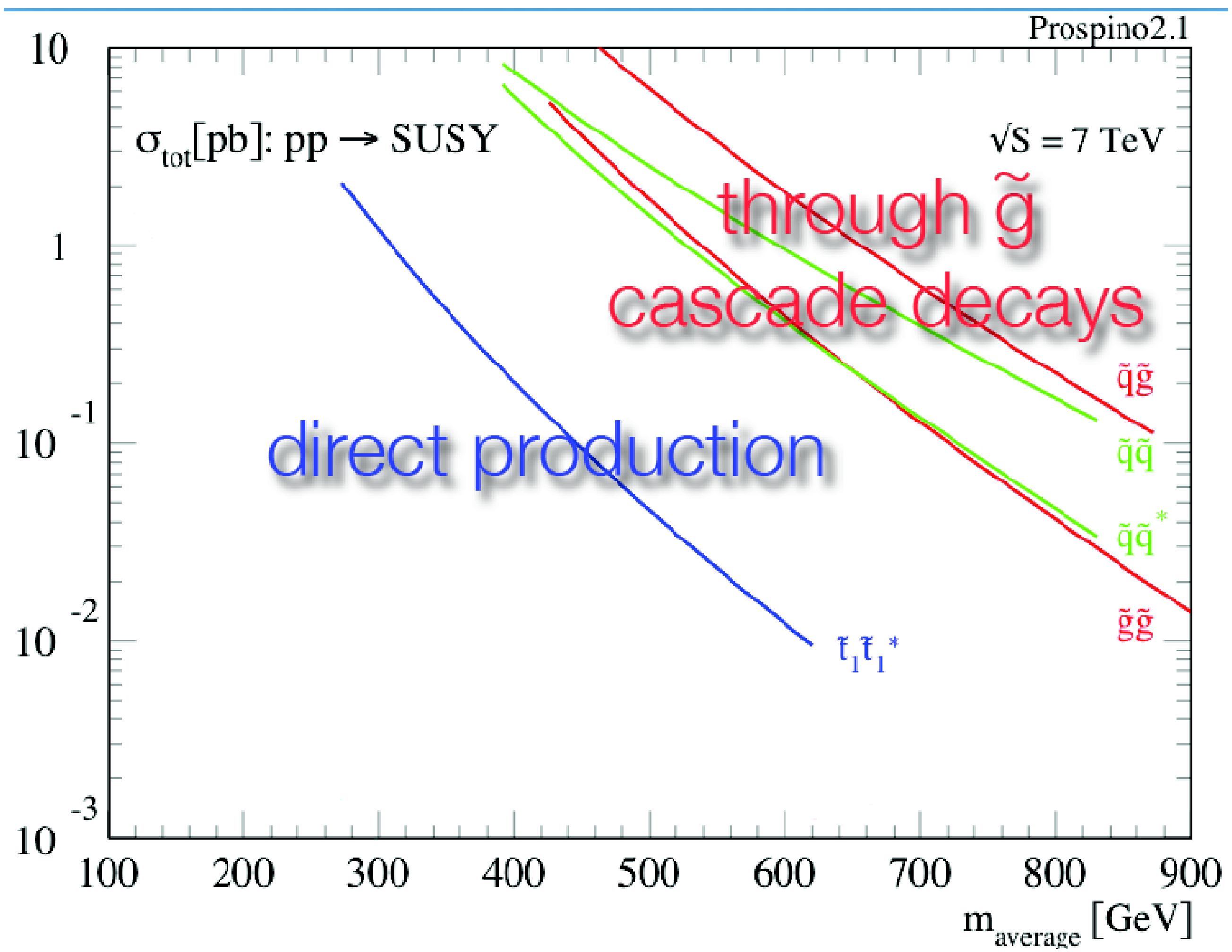
Theorists will give up when we rule out light stops …. …. (well, we live in hope).





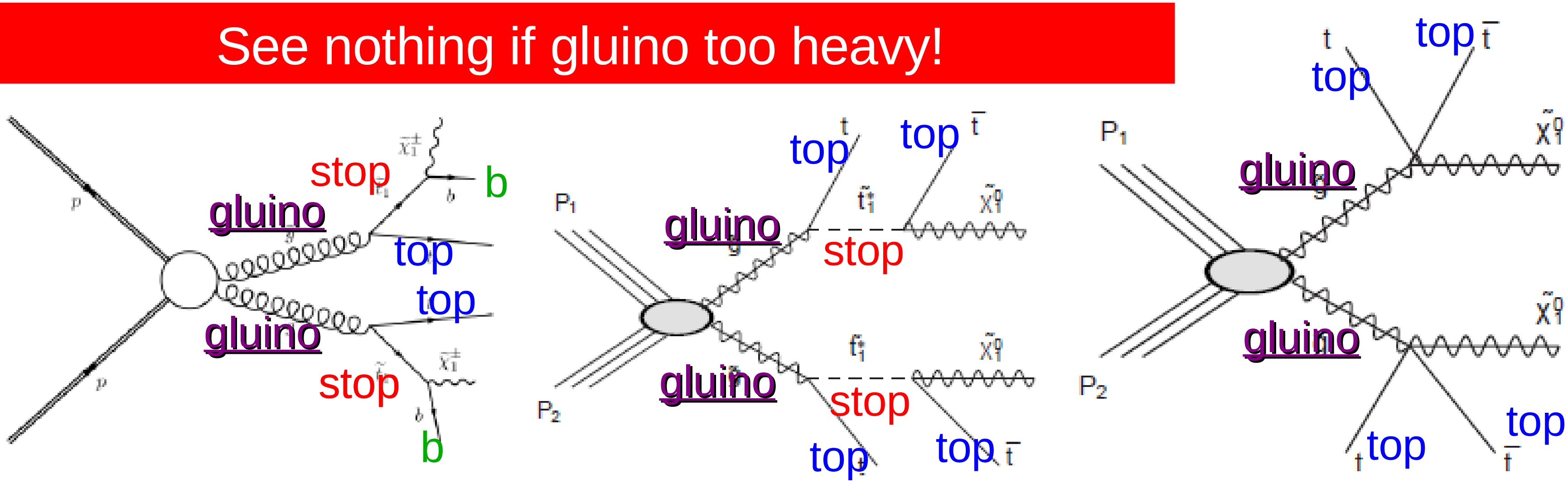
Haven't we ruled out light squarks already?

Direct production of stops is factor 30 below other squarks



Most 3rd family searches are controlled by gluino production

See nothing if gluino too heavy!



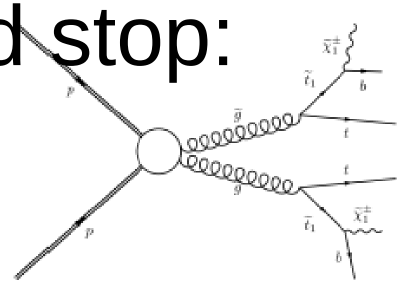
1-ℓ + b-jets + m_{Eff}: ATLAS-CONF-2012-003

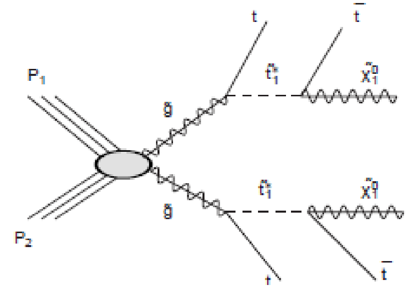
2-ℓ (SS): arXiv:1203.5763, submitted to PRL (ATLAS)

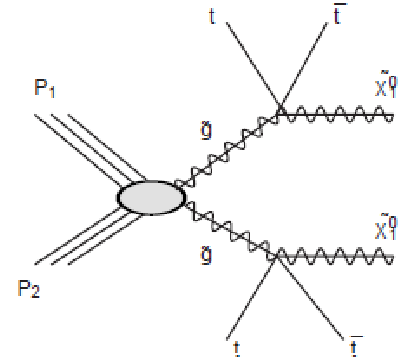
0-ℓ + 6-9 jets: ATLAS-CONF-2012-037

2-ℓ (SS) + b-jets: CMS-PAS-SUS-11-020

Glunino mediated stop:







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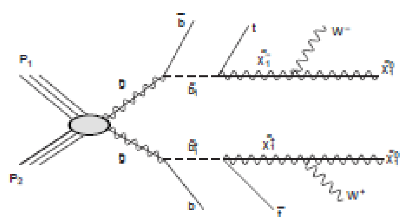
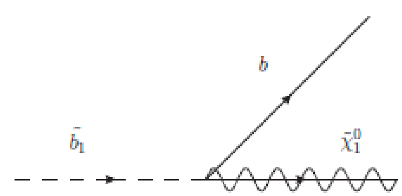
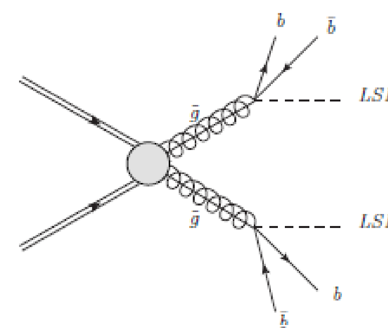
Glunino mediated sbottom:







0-ℓ + b-jets + m_{Eff}: ATLAS-CONF-2012-003

2-ℓ + b-jets :CMS-PAS-SUS-11-020

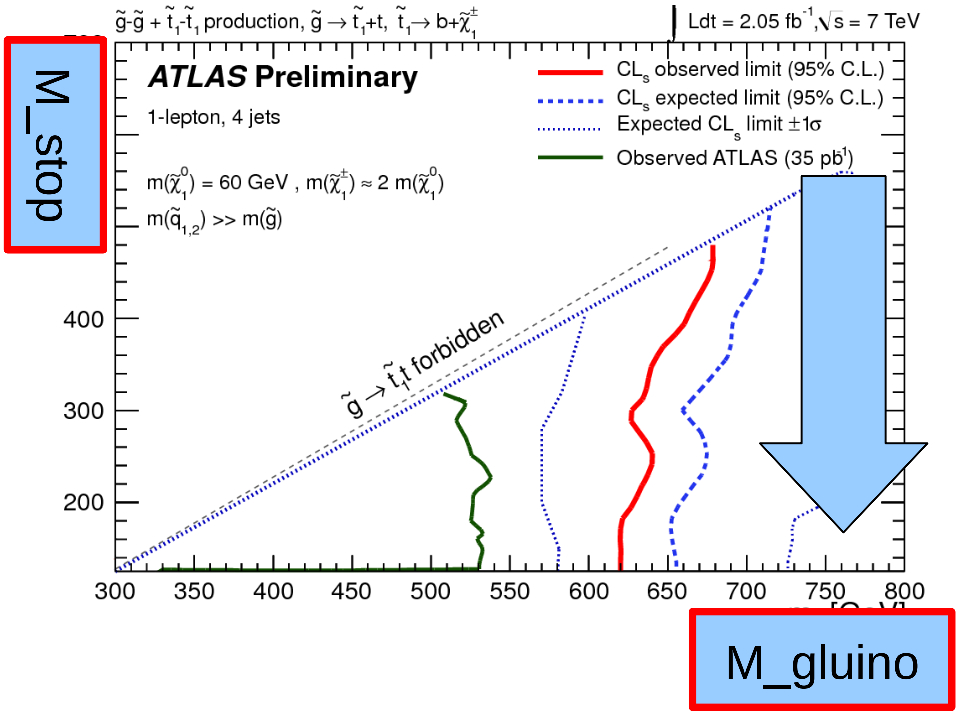
Parts of slide stolen from Alan Tua

ATLAS gluino mediated stop pairs

2.05/fb

	Signal Region	Expected Bkg	Data
electron	$E_T^{miss} > 80$ GeV	39 ± 12	43
muon	$E_T^{miss} > 80$ GeV	38 ± 14	38
electron	$E_T^{miss} > 200$ GeV	8.1 ± 3.4	11
muon	$E_T^{miss} > 200$ GeV	6.3 ± 4.2	6

1 lepton + jets + E_T^{miss}

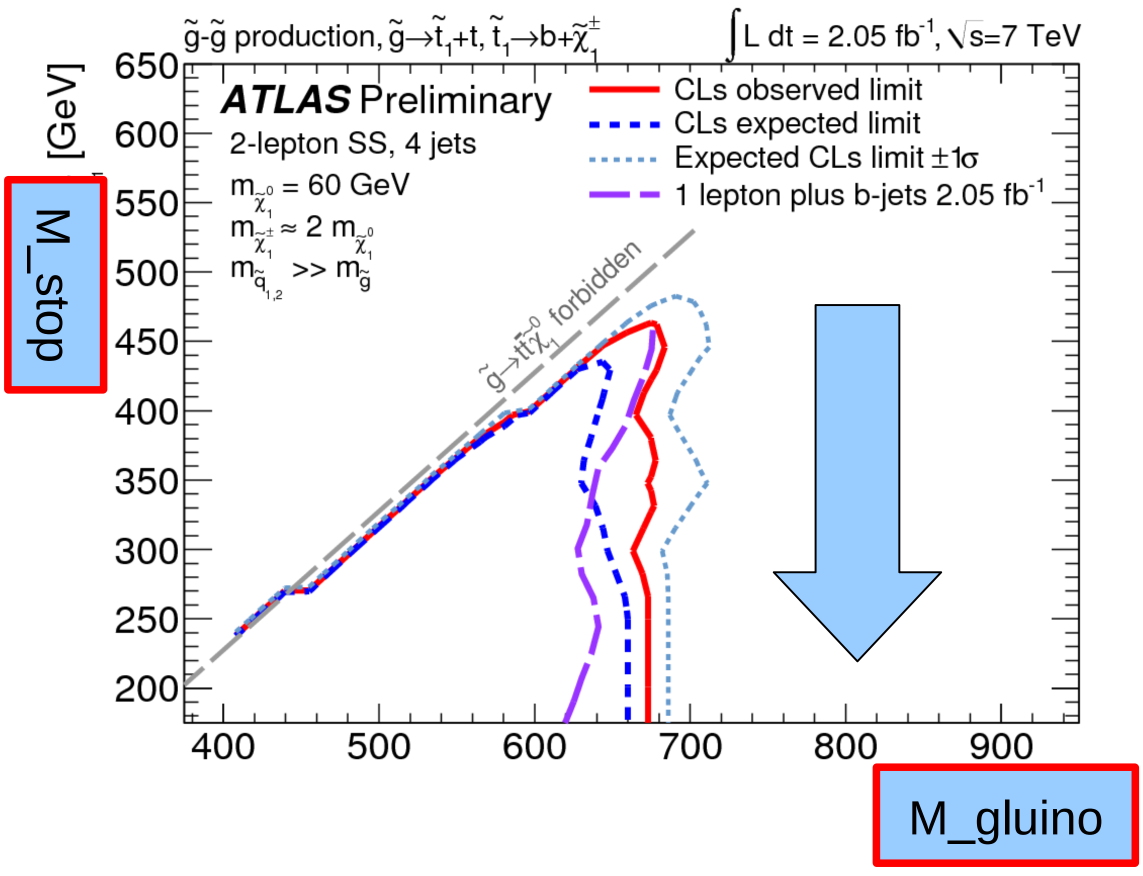


ATLAS gluino mediated stop pairs

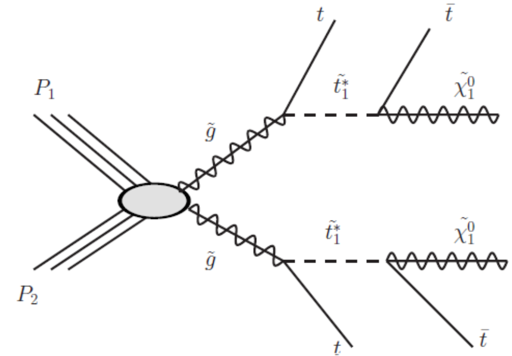
	SR1	SR2
$t\bar{t}$ +X	0.37 ± 0.26	0.21 ± 0.16
Diboson	0.05 ± 0.02	0.02 ± 0.01
Fake-lepton	0.34 ± 0.20	< 0.17
Charge mis-ID	0.08 ± 0.01	0.039 ± 0.007
Total SM	0.84 ± 0.33	0.27 ± 0.24
Observed	0	0
σ_{vis}	<1.6 fb	<1.5 fb

2 same-sign leptons + jets + E_T^{miss}

2.05/fb

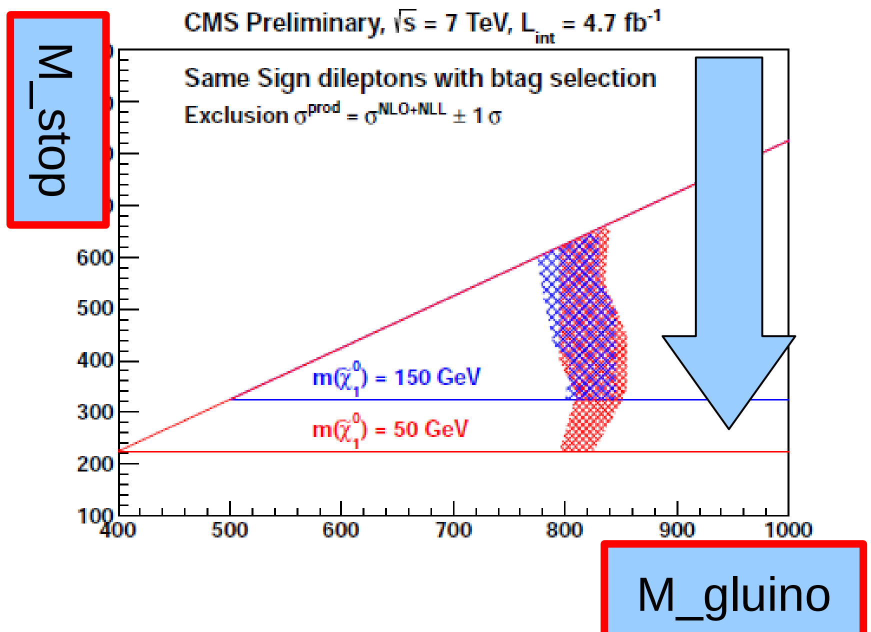


CMS gluino mediated stop pairs



2 SS leptons + 2 bjets, + MET

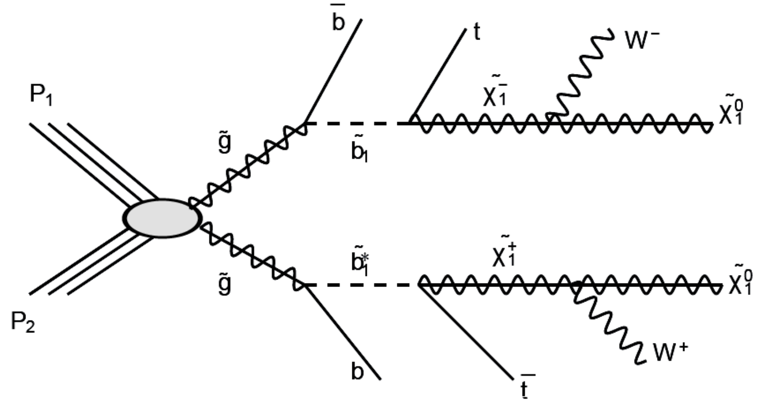
	SR1	SR2	SR3
No. of jets	≥ 2	≥ 2	≥ 2
No. of btags	≥ 2	≥ 2	≥ 2
Lepton charges	$++/--$	$++$	$++/--$
$\not{E}_T$	≥ 30 GeV	≥ 30 GeV	≥ 120 GeV
H_T	≥ 80 GeV	≥ 80 GeV	≥ 200 GeV
q-flip BG	1.1 ± 0.2	0.5 ± 0.1	0.05 ± 0.01
Fake BG	3.4 ± 2.0	1.8 ± 1.2	0.32 ± 0.50
Rare SM BG	3.2 ± 1.6	2.1 ± 1.1	0.56 ± 0.28
Total BG	7.7 ± 2.6	4.4 ± 1.6	0.9 ± 0.6
Event yield	7	5	2
N_{UL} (12% unc.)	7.4	6.9	5.2
N_{UL} (20% unc.)	7.7	7.2	5.4
N_{UL} (30% unc.)	8.1	7.6	5.8

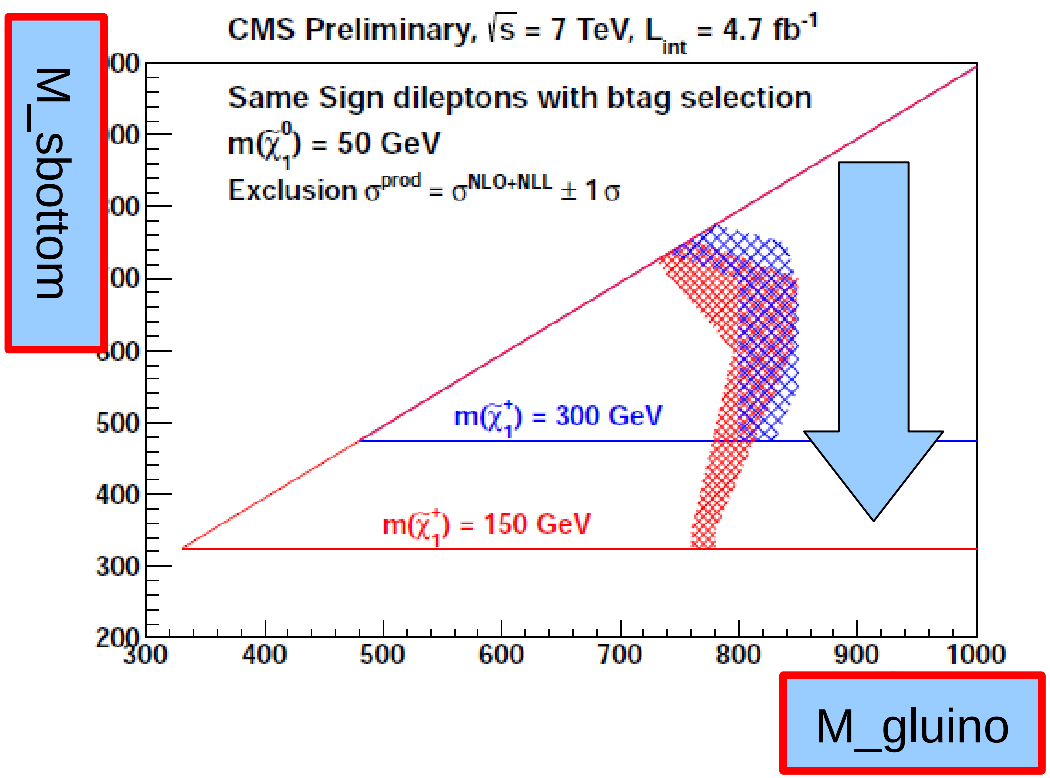


Right: exclusion (95 % C.L.) in the $m(\tilde{t}_1) - m(\tilde{g})$ plane for model A2 (gluino decay to on-shell top squarks) for different choices of the LSP mass.

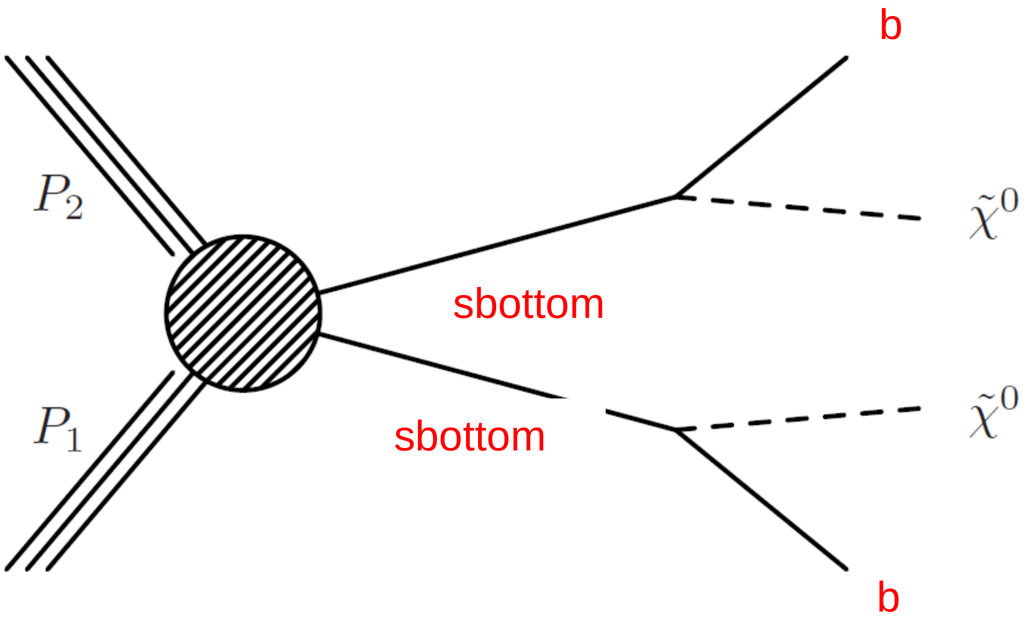
CMS gluino mediated sbottom

Results of preceding analysis (2SS leptons, 2 b-jets+MET) is also interpreted in scenario shown to the right to constrain sbottoms





New **direct** searches for sbottoms



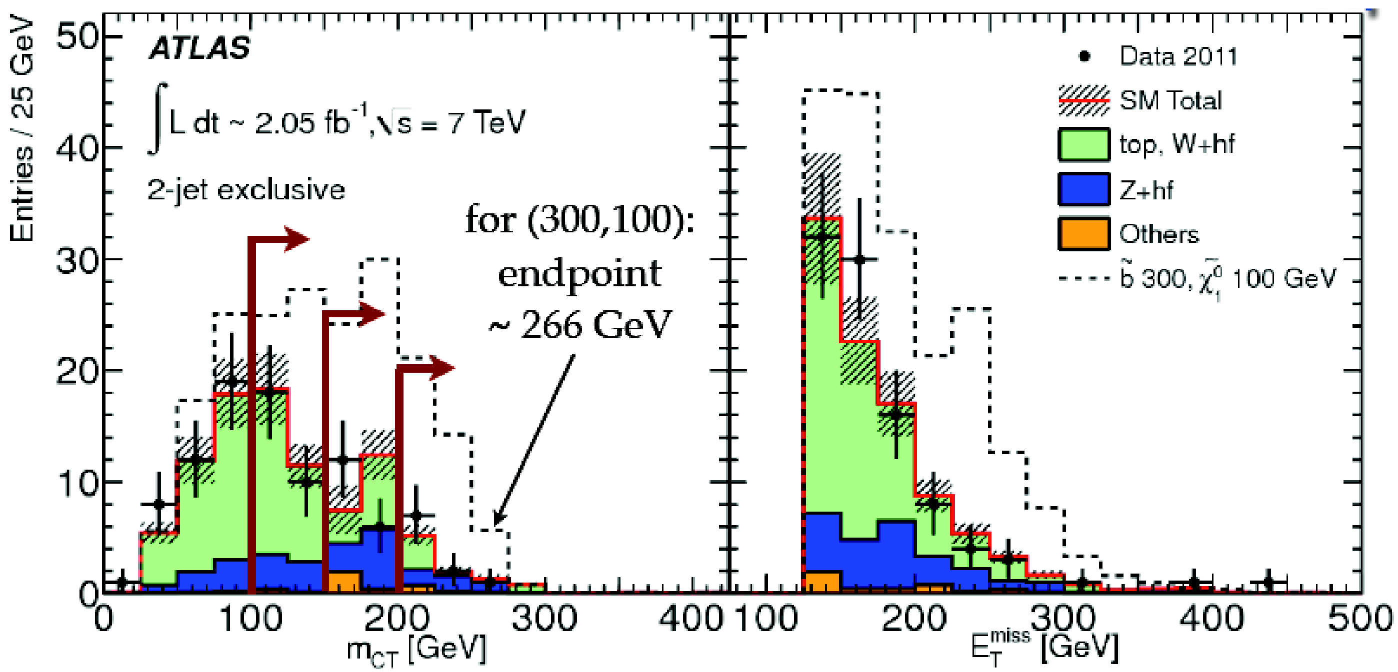
ATLAS direct sbottom arXiv:1112.3832

"contransverse mass": JHEP **03**, 030 (2010)

$$m_{CT} = \sqrt{[E_T(b_1) + E_T(b_2)]^2 - [p_T(b_1) - p_T(b_2)]^2}$$

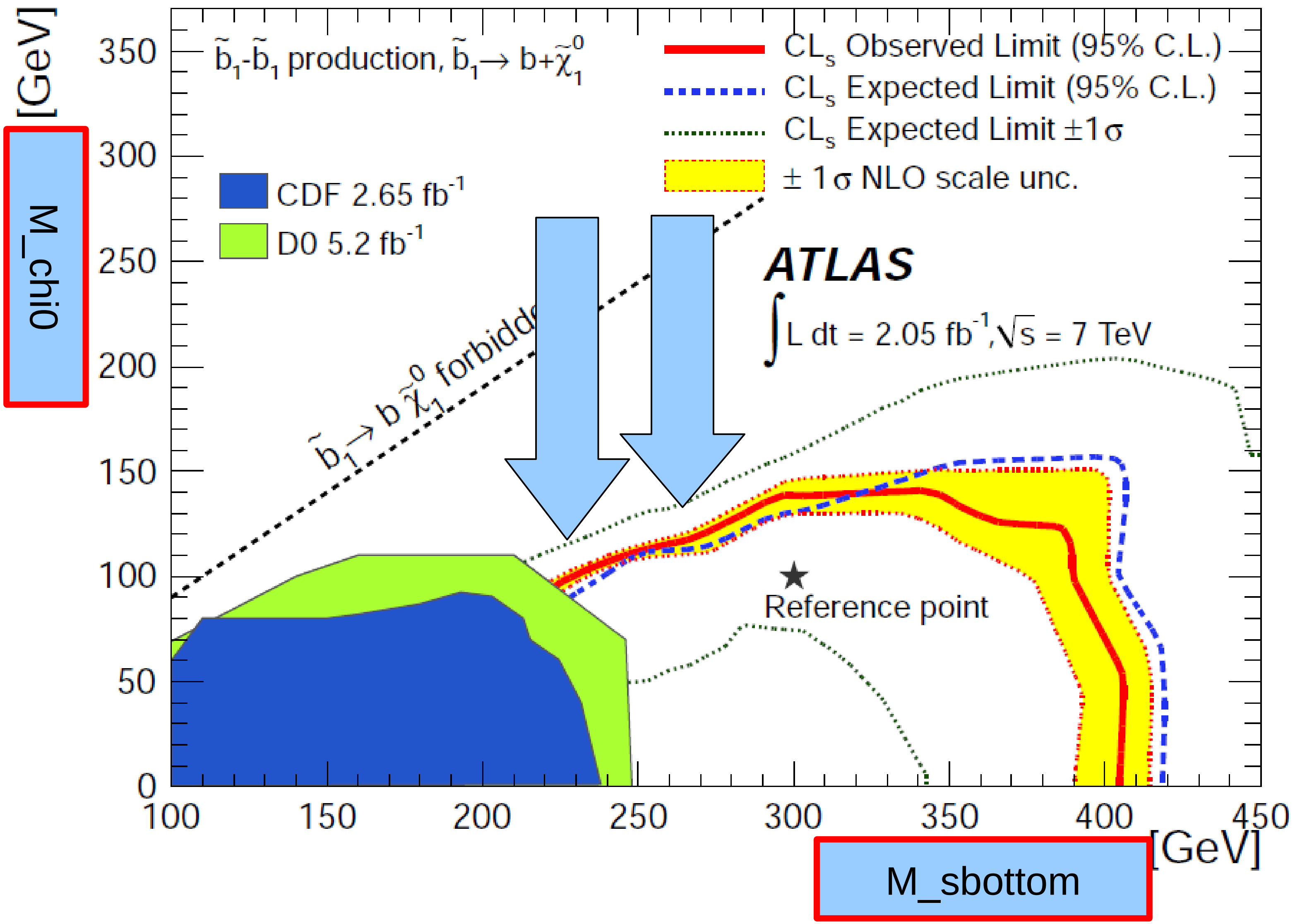
endpoint: 135 GeV (ttbar), $\frac{m_{\tilde{b}}^2 - m_{\tilde{\chi}_1^0}^2}{m_{\tilde{b}}}$ ($\tilde{b}$)

Signal Region	Expected Bkg	Data
$m_{CT} > 0$ GeV	94 ± 16	96
$m_{CT} > 100$ GeV	62 ± 13	56
$m_{CT} > 150$ GeV	27 ± 8	28
$m_{CT} > 200$ GeV	8.1 ± 3.5	10



arXiv 1112.3832, submitted to PRL

ATLAS direct sbottom arXiv:1112.3832



arXiv:1112.3832

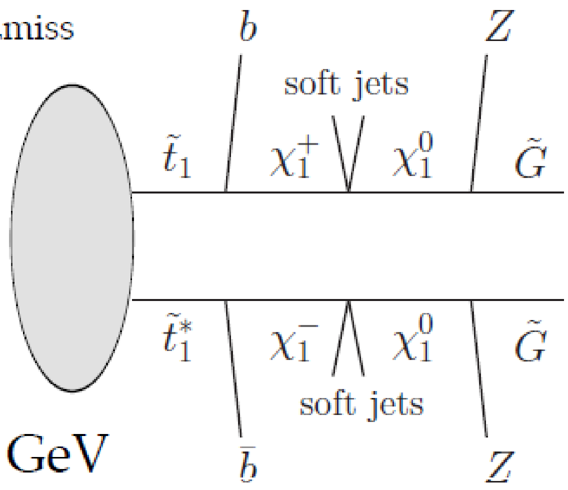
New **direct** search for stops

ATLAS direct (GMSB) stops

- GMSB scenario with gravitino LSP ($m_{\tilde{G}} < 1$ keV), neutralino NLSP [Higgsino-like $\tilde{\chi}_1^0$ considered here]
- **Analysis signature:**
  2 same-flavor leptons + jets + E_T^{miss}
- **Trigger:**
  electron / muon + jet
- **Selection:**
  $86 < m_{ll} < 96$ GeV
  first jet > 60 GeV, one more > 50 GeV
  1 b-tagged jet
  $E_T^{miss} > 50$ (80) GeV

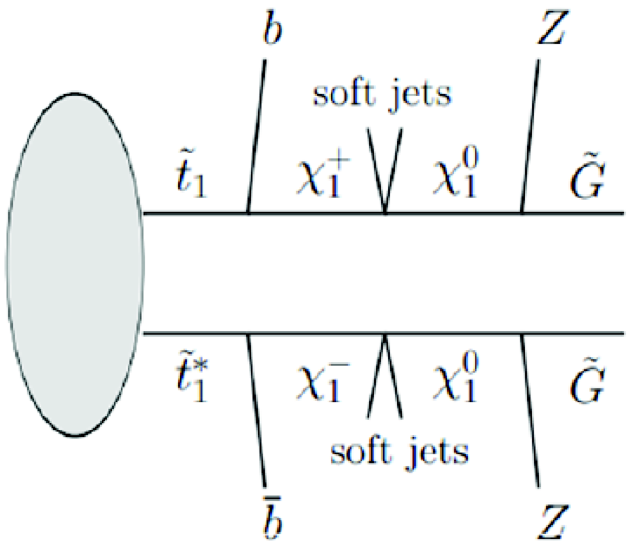
Note: little connection to stop quarks *per se!*

M. Asano, et al., JHEP 1012:019,2010

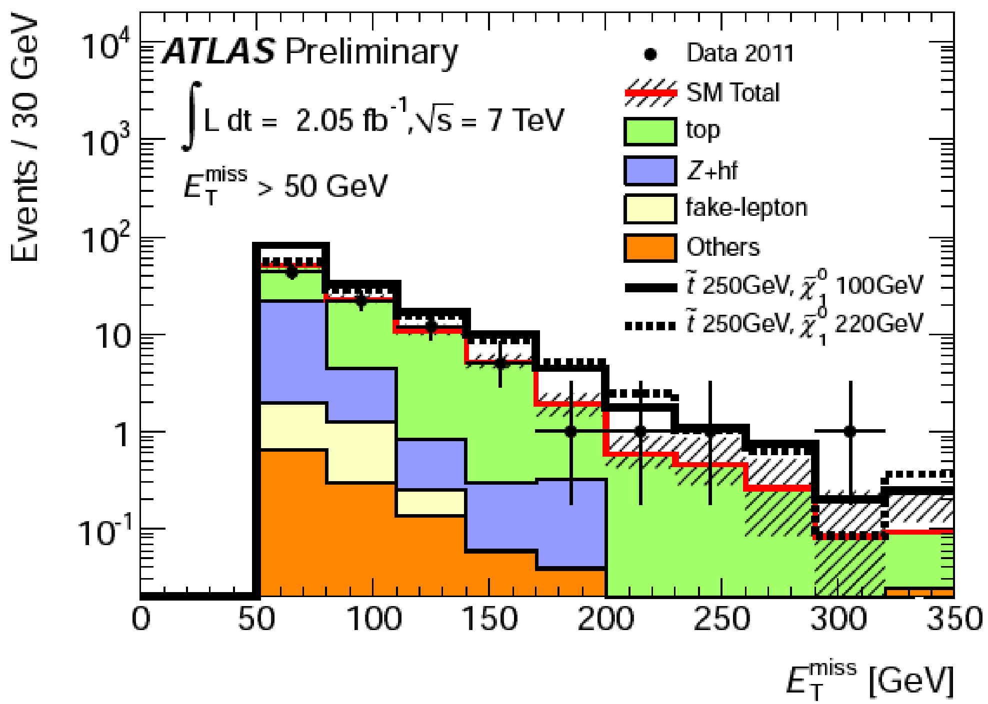


ATLAS-CONF-2012-036

Slide: S. Majewski



	$E_T^{Miss} > 50$ GeV	$E_T^{Miss} > 80$ GeV
	$ee+\mu\mu$	
Data (2.05 fb^{-1})	86	43
SM	92±19	40.7 ± 6.0
top	64.3±7.7	34.8 ± 5.0
Z+hf	24±16	4.2±3.2
fake lepton	2.4 ± 0.9	1.1 ± 0.6
Others	1.2 ± 1.2	0.6 ± 0.6



ATLAS-CONF-2012-036

Light stops possible here

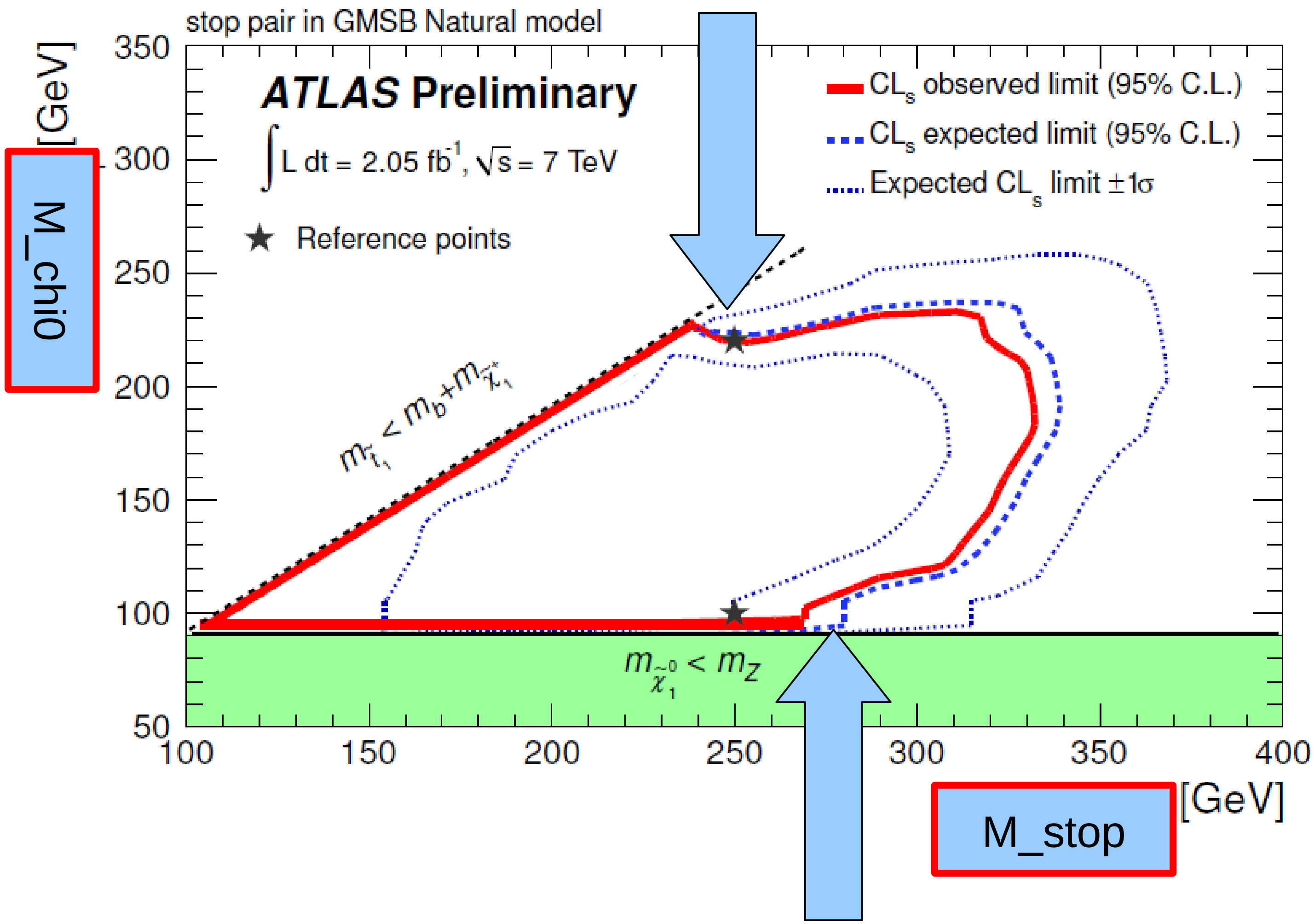


Figure 6: Expected and observed exclusion limits and $\pm 1\sigma$ variation on the expected limit in the $\tilde{t}_1$-$\tilde{\chi}_1^0$ mass plane. The reference points indicated on the plane correspond to the $(\tilde{t}_1,\tilde{\chi}_1^0)$ scenarios of (250,100) GeV and (250,220) GeV, respectively.

ATLAS-CONF-2012-036

Remove GMSB, and the exclusion weakens!

Conclusion: almost no constraints on light stops, and only very weak constraints on light sbottoms.

This aspect of SUSY very much alive!

Slide: S. Majewski

What else in SUSY is missing?
(or not very strongly constrained)

arXiv:1110.6189

Constraints on direct slepton production

CERN-PH-EP-2011-165

Searches for supersymmetry with the ATLAS detector using final states with two leptons and missing transverse momentum in $\sqrt{s} = 7$ TeV proton-proton collisions

Signal Region	OS-inc	OS-3j	OS-4j	SS-inc	SS-2j	FS-no Z	FS-2j	FS-inc
$E_{\mathrm{T}}^{\mathrm{miss}}$ [GeV]	250	220	100	100	80	80	80	250
Leading jet p_{T} [GeV]	-	80	100	-	50	-	-	-
Second jet p_{T} [GeV]	-	40	70	-	50	-	-	-
Third jet p_{T} [GeV]	-	40	70	-	-	-	-	-
Fourth jet p_{T} [GeV]	-	-	70	-	-	-	-	-
Number of jets	-	≥ 3	≥ 4	-	≥ 2	-	≥ 2	-
m_{ll} veto [GeV]	-	-	-	-	-	80-100	-	-

Table 1: Criteria defining each of the three signal regions for the opposite-sign (OS-x) analysis, each of the two signal regions for the same-sign analysis (SS-x) and each of the three regions for the flavour-subtraction (FS-x) analysis. Regions OS-inc and FS-inc are identical.

$$\mathcal{S} = \frac{N(e^{\pm}e^{\mp})}{\beta(1-(1-\tau_e)^2)} + \frac{\beta N(\mu^{\pm}\mu^{\mp})}{(1-(1-\tau_\mu)^2)} - \frac{N(e^{\pm}\mu^{\mp})}{1-(1-\tau_e)(1-\tau_\mu)}$$

	Background	Obs.	95% CL
OS-inc	15.5 ± 4.0	13	9.9 fb
OS-3j	13.0 ± 4.0	17	14.4 fb
OS-4j	5.7 ± 3.6	2	6.4 fb
SS-inc	32.6 ± 7.9	25	14.8 fb
SS-2j	24.9 ± 5.9	28	17.7 fb

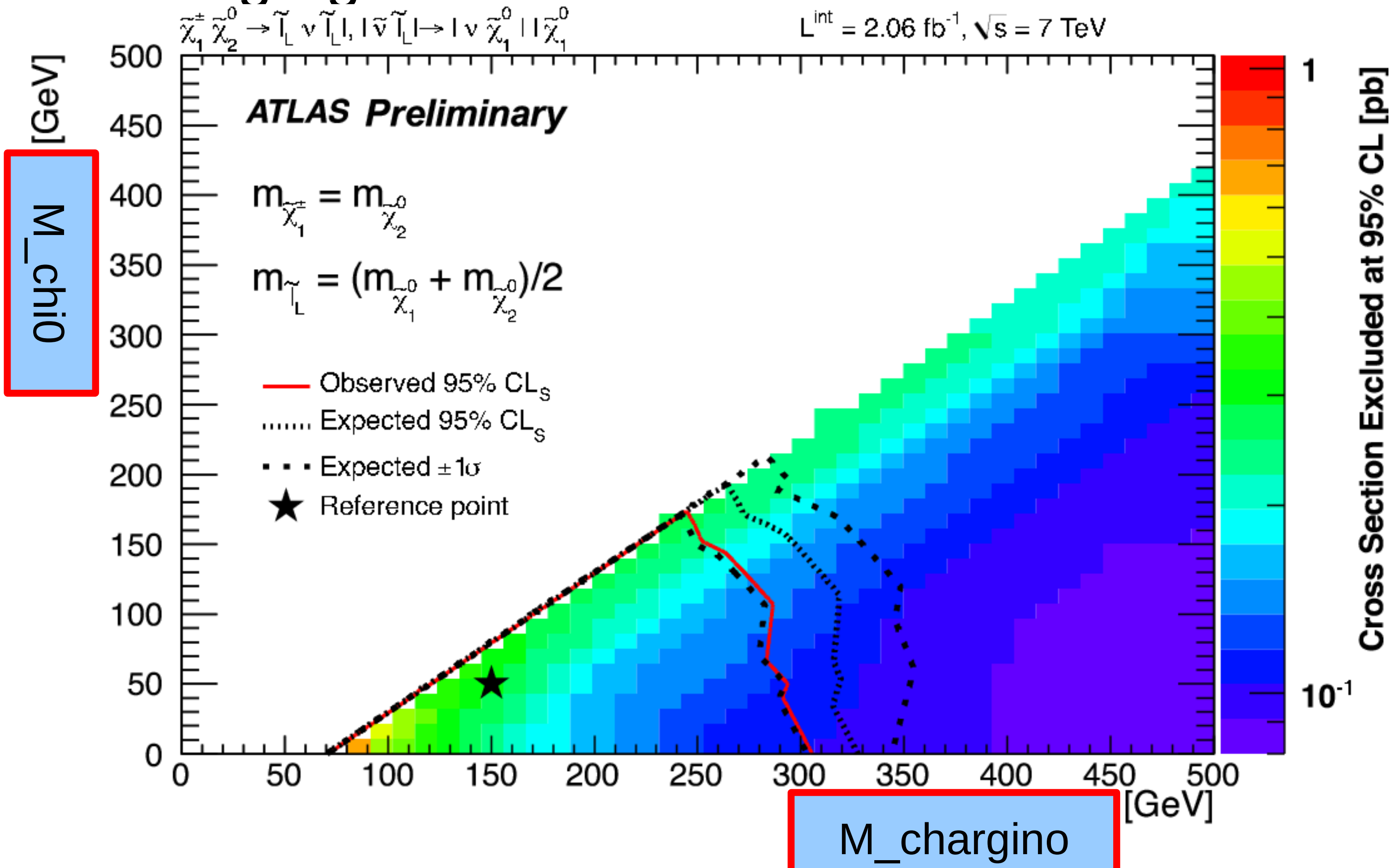
	$\mathcal{S}_{obs}$	$\bar{\mathcal{S}}_b$	Limit $\bar{\mathcal{S}}_s$ (95% CL)
FS-no Z	131.6±2.5(sys)	118.7±27.0	94
FS-2j	142.2±1.0(sys)	67.1±28.6	158
FS-inc	-3.06±0.04(sys)	0.7±1.6	4.5

Rate for direct sleptons expected to be low.

No significant constraints here yet.

ATLAS-CONF-2012-023

- What **is** a search for a chargino?
  - (Chi2,Chi+) production leading to 3 leptons + MET ?
  - Could be ... but what if the chi2 is heavy? Would leave to big bg from WW -> llnunu



So:

u/d squarks are heavily constrained,

but bounds are still very low for
3rd family squarks, sleptons

Chargino constraints are very model dependent.

Everything to play for!

Note the unwanted guest in each analysis:

The jets in the di-(s)lepton search.

The GMSB decay products in the di-stop search.

The chi2 in the chargino search.

All necessary evils – because the job is hard.

Mono-jets super-hard.

But shows there is much more to be done.

What's in the bedroom?

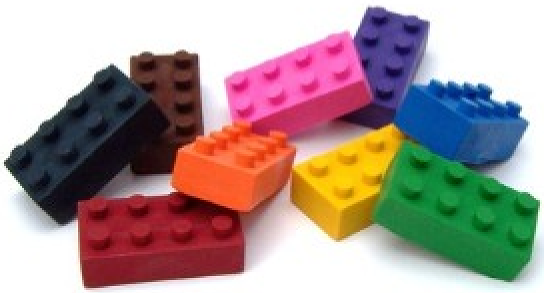

Excluded at more than 5-sigma

Many hopes for some kind of
new or exotic teddy bear,

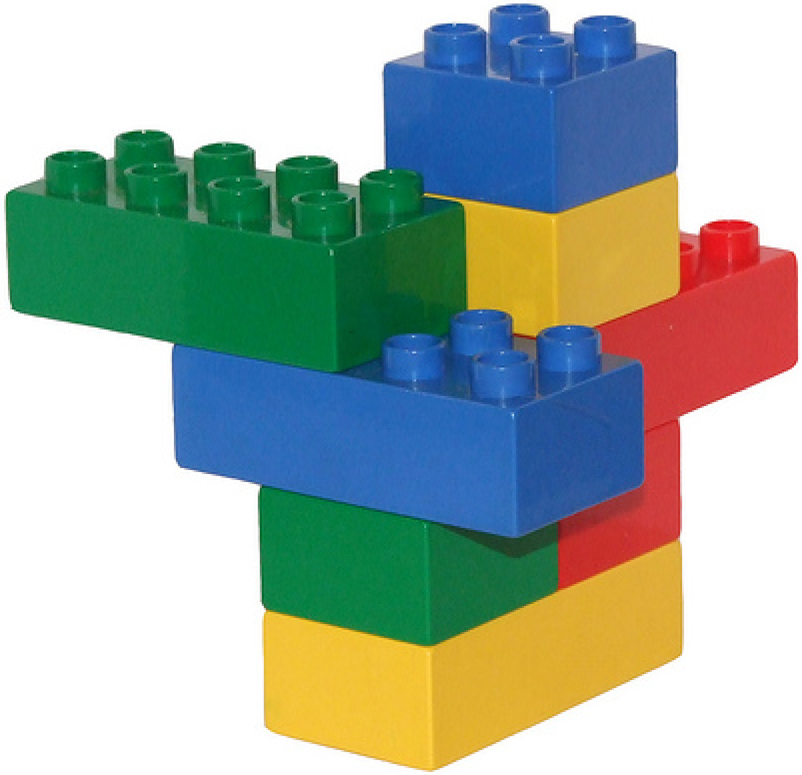
but haven't seen any, so

Place limit: at most two of these at 95% confidence

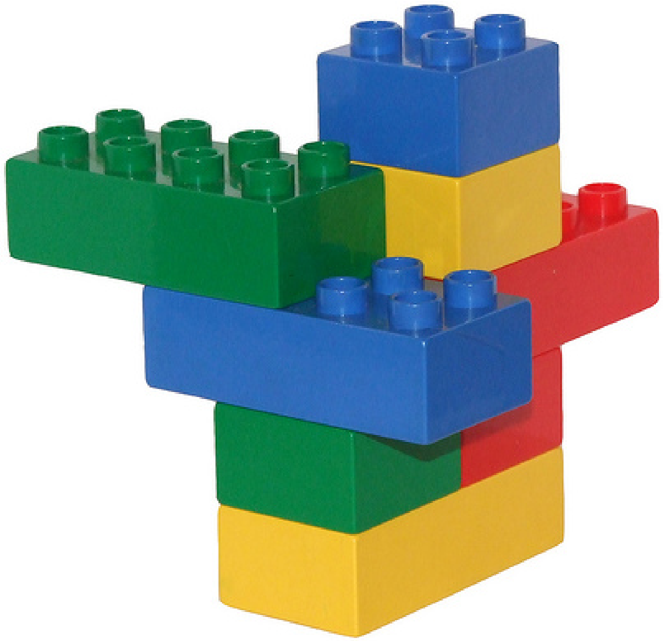
For last 20 years, theorists have predicted that for every Lego brick there might be a "Duplo" super-parner



[The natural size of human toddlers suggests Duplo should be within an order of magnitude of normal Lego size.]



Searches indicate



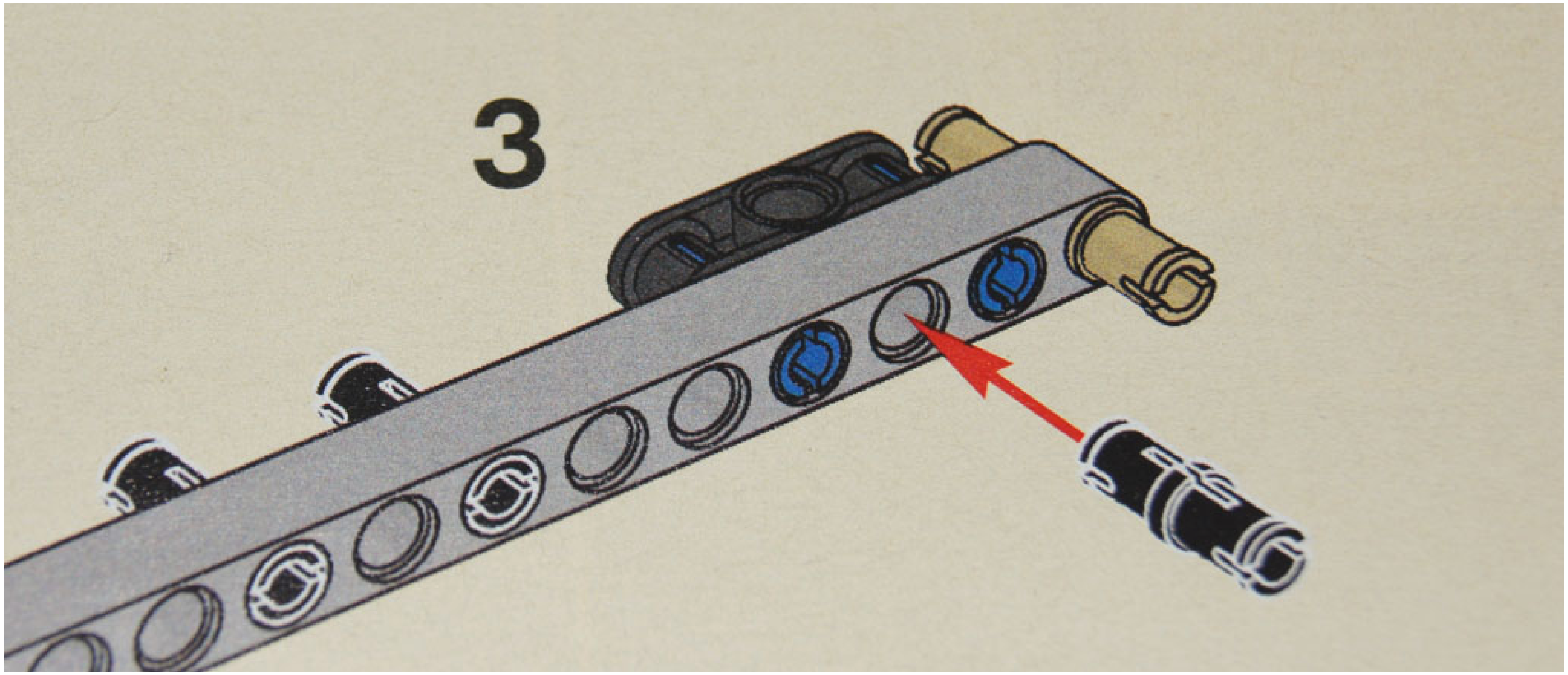
>

It's very easy for small things to hide under this:

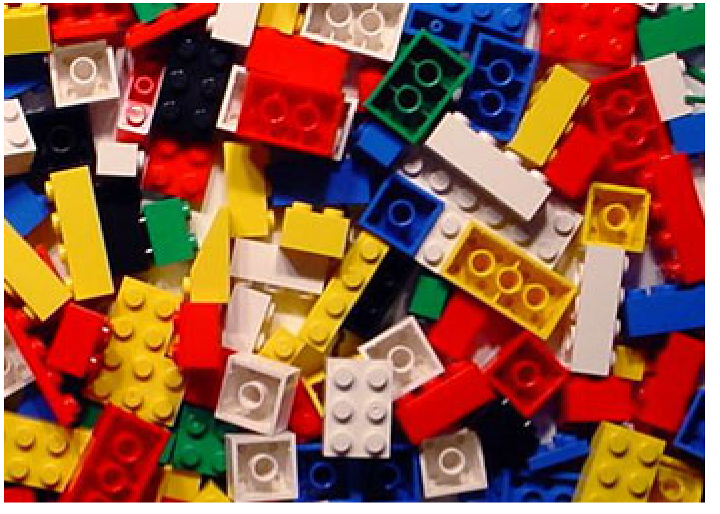
Looking for the black parts is always tricky.

Have frequently found it necessary to accommodate uninvited guests in order to suppress backgrounds

Have looked for black pegs when embedded in easy to spot beams



Exasperated parents now want to know:



Is there **anything** in the room other than Lego ?

Running out of things to look for.

But not running out of places to look.

Motivation shifting, from:

“what we might want to see”

to

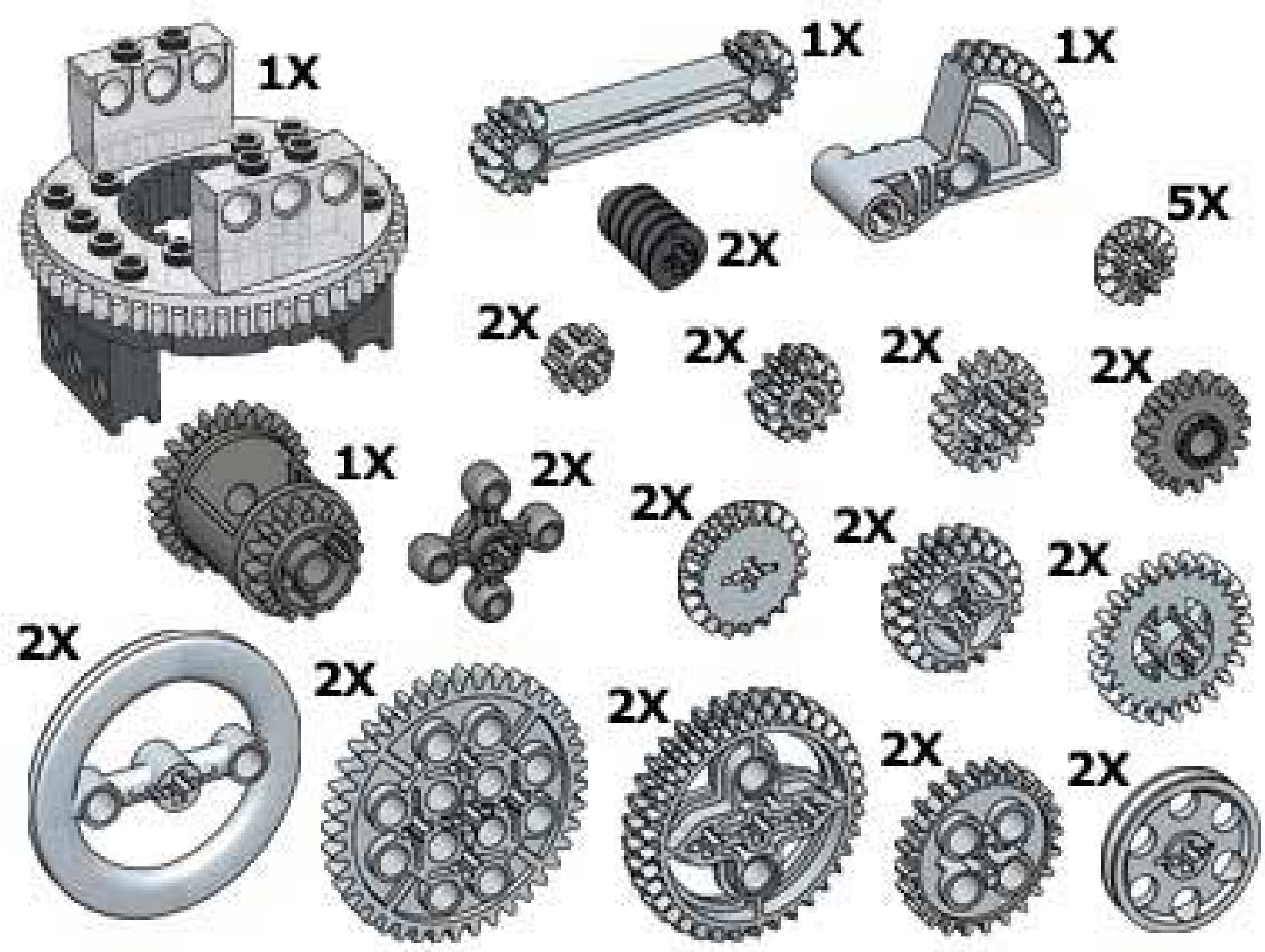
“what we might be unable to explain”

BSM & SM being pushed ever closer.

All these have a non-trivial symmetry under O(3)

Only one is not invariant under CP. Can you find it?

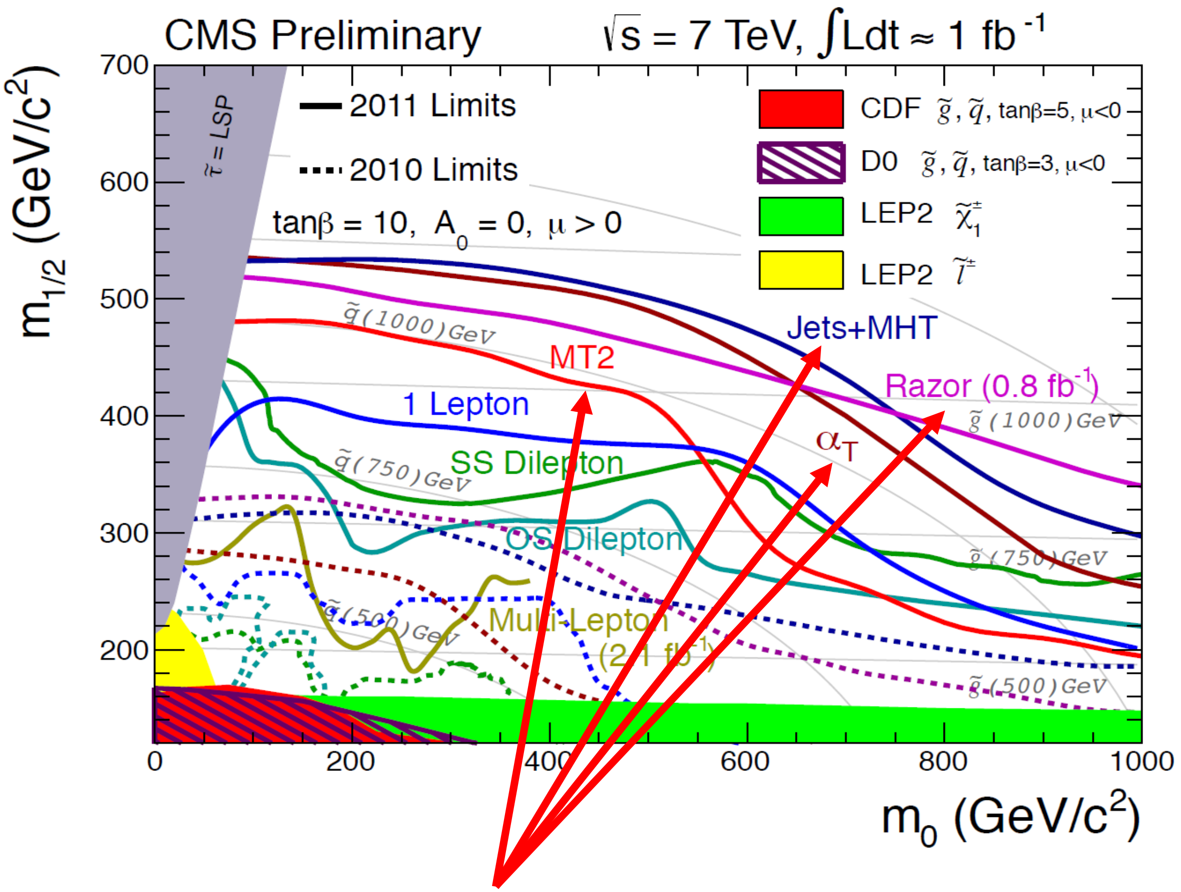
It is hiding among these:



Expect precision theory and precision “SM” measurements to play an ever greater role in the BSM searches of 2012 and beyond.

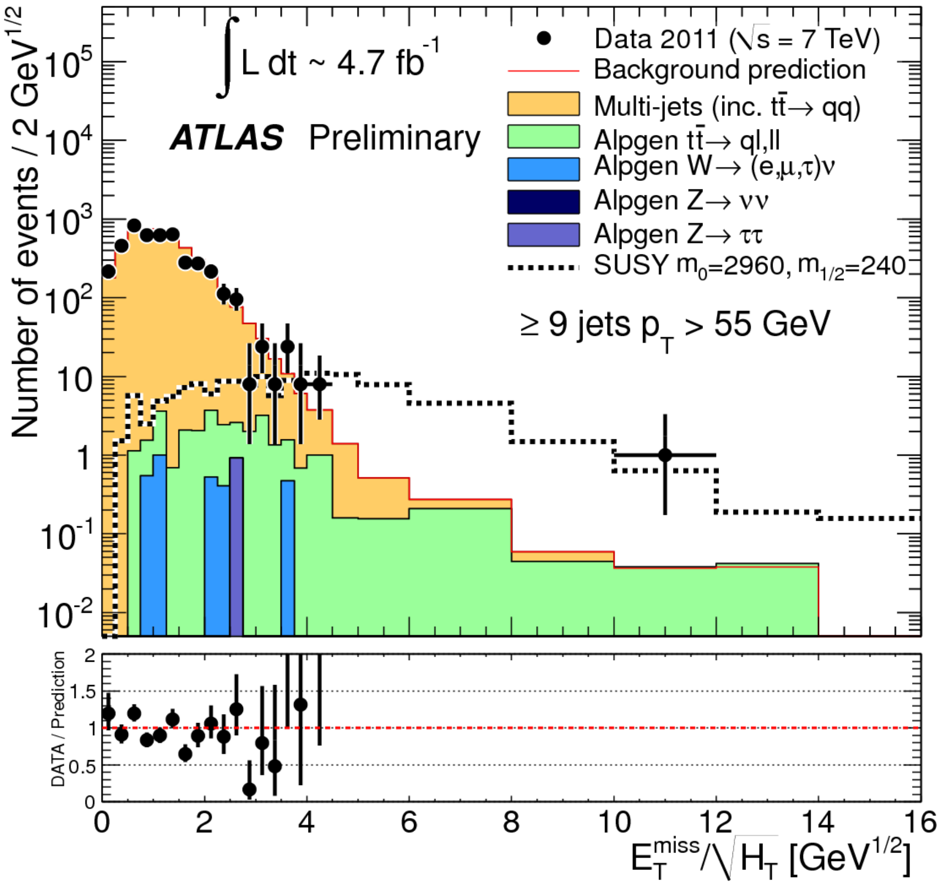
Expect ever more use of clever asymmetries, ratios, detector-driven “measurables” as opposed to “things we'd like to see”.

Creativity of our students is our greatest asset.



No fewer than four different methods of looking in jets + MET from CMS alone, and more coming all the time.

Exclusions based on "0 leptons + 6-9 jets" were not expected one year ago!



Conclusions

- No “new physics” found yet. Expect at least 15/fb data at 8 TeV in 2012
- Read the results as they appear yourself:
  - https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsSUS
  - https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsEXO
  - https://twiki.cern.ch/twiki/bin/view/AtlasPublic/SupersymmetryPublicResults
  - https://twiki.cern.ch/twiki/bin/view/AtlasPublic/ExoticsPublicResults

Evidence for a gradual shift from “the search for ideas” to “the search for the measurable” -- and not just in techniques but in presentation of results.

Also change from exclusion REACH to exclusion DEPTH.

Boundary between SM & BSM beginning to blur.

- Has the LHC demolished Supersymmetry?
  - As a unified theory, yes.
  - As a solution to the higgs hierarchy problem, no.
    - (Light stops: MLSP=90 GeV, MSTOP=260 GeV not ruled out!)
  - As a source of DM, no:
    - Eg no constraints on slepton or chargino production

Great creativity and productivity within the experiments – many superb analyses – and a great time to be giving theorists a hard time!

Old rubbish

- Triangles
- Small mass differences?
- Change in complexity of signal regions?
- Note number of control regions is now 55 !
- Where have limits moved?

Less well tested areas

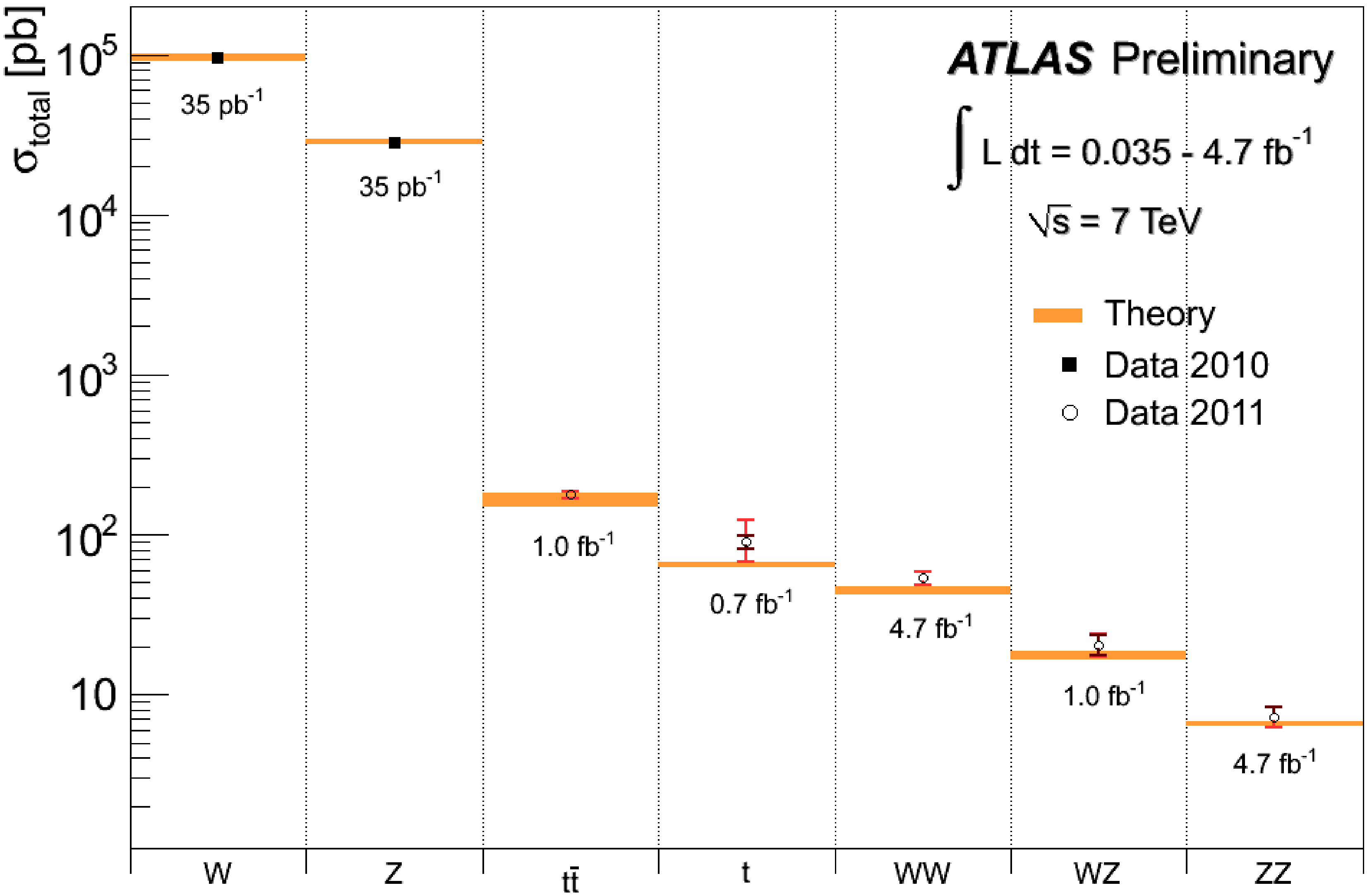
- neutralino mass close to squark or gluino mass
- signatures with not many jets

Search for new physics in events with same-sign dileptons, b-tagged jets and missing energy

The CMS Collaboration

	SR1	SR2	SR3	SR4	SR5	SR6	SR7
No. of jets	≥ 2	≥ 2	≥ 2	≥ 2	≥ 2	≥ 2	≥ 3
No. of btags	≥ 2	≥ 2	≥ 2	≥ 2	≥ 2	≥ 2	≥ 3
Lepton charges	$++/--$	$++$	$++/--$	$++/--$	$++/--$	$++/--$	$++/--$
$\not{E}_T$	≥ 30 GeV	≥ 30 GeV	≥ 120 GeV	≥ 50 GeV	≥ 50 GeV	≥ 120 GeV	≥ 50 GeV
H_T	≥ 80 GeV	≥ 80 GeV	≥ 200 GeV	≥ 200 GeV	≥ 320 GeV	≥ 320 GeV	≥ 200 GeV
q-flip BG	1.1 ± 0.2	0.5 ± 0.1	0.05 ± 0.01	0.3 ± 0.1	0.12 ± 0.03	0.026 ± 0.009	0.008 ± 0.004
Fake BG	3.4 ± 2.0	1.8 ± 1.2	0.32 ± 0.50	1.5 ± 1.1	0.81 ± 0.78	0.15 ± 0.45	0.15 ± 0.45
Rare SM BG	3.2 ± 1.6	2.1 ± 1.1	0.56 ± 0.28	2.0 ± 1.0	1.04 ± 0.52	0.39 ± 0.20	0.11 ± 0.06
Total BG	7.7 ± 2.6	4.4 ± 1.6	0.9 ± 0.6	3.7 ± 1.5	2.0 ± 0.9	0.6 ± 0.5	0.3 ± 0.5
Event yield	7	5	2	5	2	0	0
N_{UL} (12% unc.)	7.4	6.9	5.2	7.3	4.7	2.8	2.8
N_{UL} (20% unc.)	7.7	7.2	5.4	7.6	4.8	2.8	2.8
N_{UL} (30% unc.)	8.1	7.6	5.8	8.2	5.1	2.8	2.8

Inclusive weak boson and top quark cross section measurements by ATLAS



(new)

March 2012, 2.05/fb, arXiv:1203.6193

Search for supersymmetry in pp collisions at $\sqrt{s} = 7$ TeV in final states with missing transverse momentum and b-jets with the ATLAS detector

Abstract

The results of a search for supersymmetry in events with large missing transverse momentum and heavy flavour jets using an integrated luminosity corresponding to 2.05 fb^{-1} of pp collisions at $\sqrt{s} = 7$ TeV recorded with the ATLAS detector at the Large Hadron Collider are reported. No significant excess is observed with respect to the prediction for Standard Model processes. Results are interpreted in a variety of R-parity conserving models in which scalar bottoms and tops are the only scalar quarks to appear in the gluino decay cascade, and in an SO(10) model framework. Gluino masses up to 600–900 GeV are excluded, depending on the model considered.

Eight signal regions:

- 0L, 3j (1b), 500 meff, 130 MET
- 0L, 3j (1b), 700 meff, 130 MET
- 0L, 3j (1b), 900 meff, 130 MET
- 0L, 3j (2b), 500 meff, 130 MET
- 0L, 3j (2b), 700 meff, 130 MET
- 0L, 3j (2b), 900 meff, 130 MET
- 1L, 4j (1b), 700 meff, 130 MET
- 1L, 4j (1b), 700 meff, 200 MET

No excesses seen.

CR plots looks reasonable

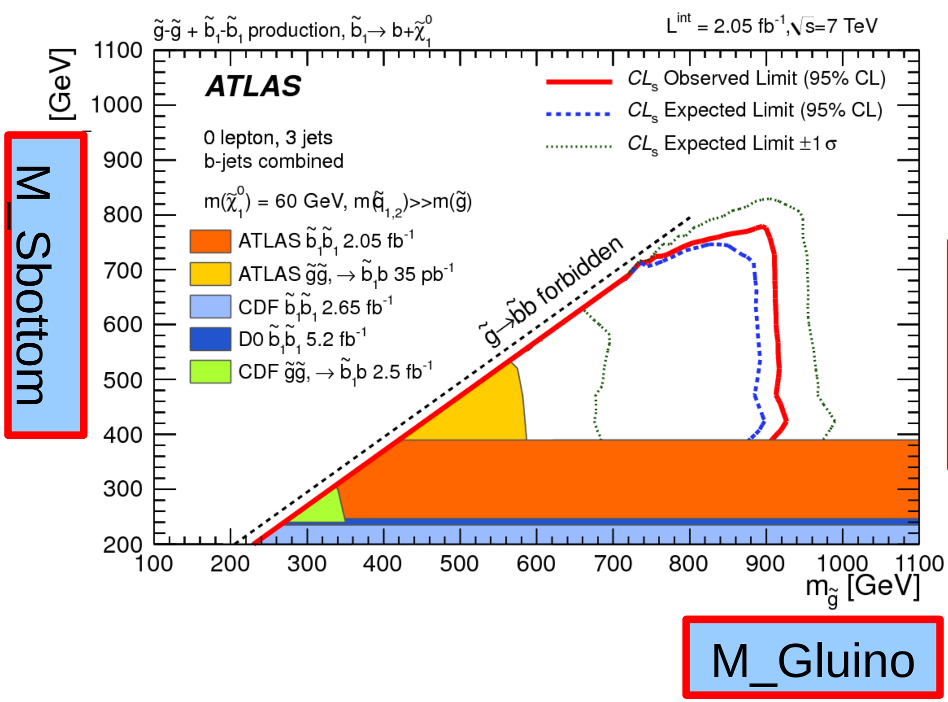
March 2012, 2.05/fb, arXiv:1203.6193

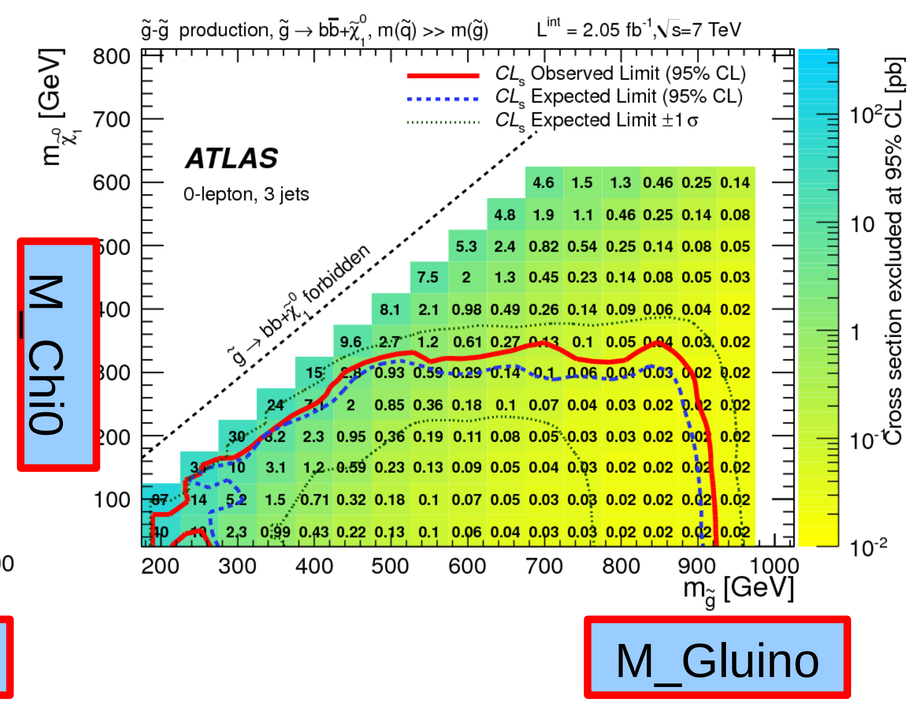
ATLAS b-jets SUSY results

Interpretation dependent on mass spectrum

- $m(\chi) < m(\tilde{b}) < m(\tilde{g})$
- $\tilde{g} \to \tilde{b}b$ and $\tilde{b} \to b\tilde{\chi}^0$
- Exclude: $m(\tilde{g}) < 920$ GeV for $m(\tilde{b}_1) < 800$ GeV

- $m(\chi) < m(\tilde{g}) < m(\tilde{b})$
- $\tilde{g} \to b\bar{b}\tilde{\chi}^0$ via virtual $\tilde{b}$
- Exclude: $m(\tilde{g}) < 900$ GeV for $m(\tilde{\chi}^0) < 300$ GeV

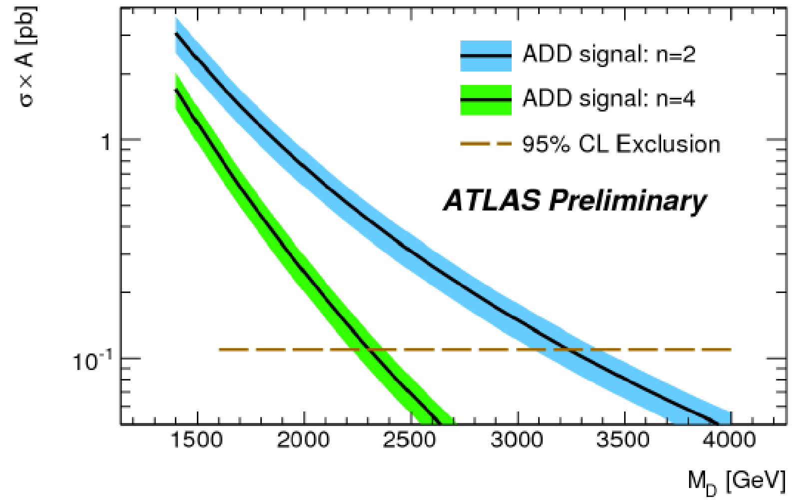




Monojet (jet + MET)

Monojet is a simple and striking signal

- High-p_T jet with no object to balance p_T
- Non-interacting particle created
- Main BG is $Z \rightarrow \nu\nu$
- BSM candidate here is ADD graviton
  - $qq \rightarrow gG$, $qg \rightarrow qG$, $gg \rightarrow gG$
  - Limits set on M_D, the Planck scale for n_{ED} extra dimensions

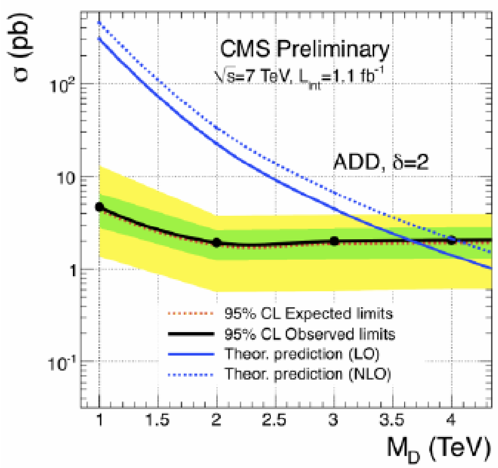


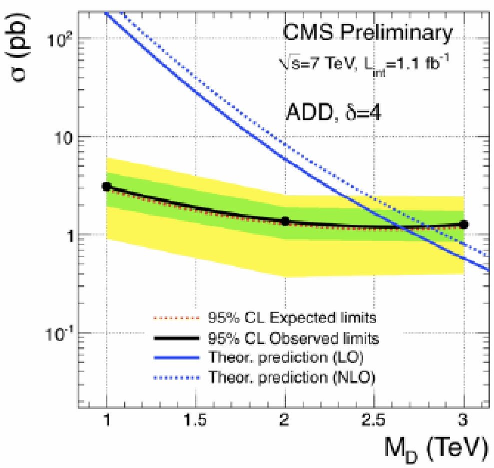
ATLAS result obtained with 1.0 fb^{-1}

- M_D > 3.4 TeV for n_{ED}=2
- M_D > 2.3 TeV for n_{ED}=4
- ATLAS-CONF-2011-096

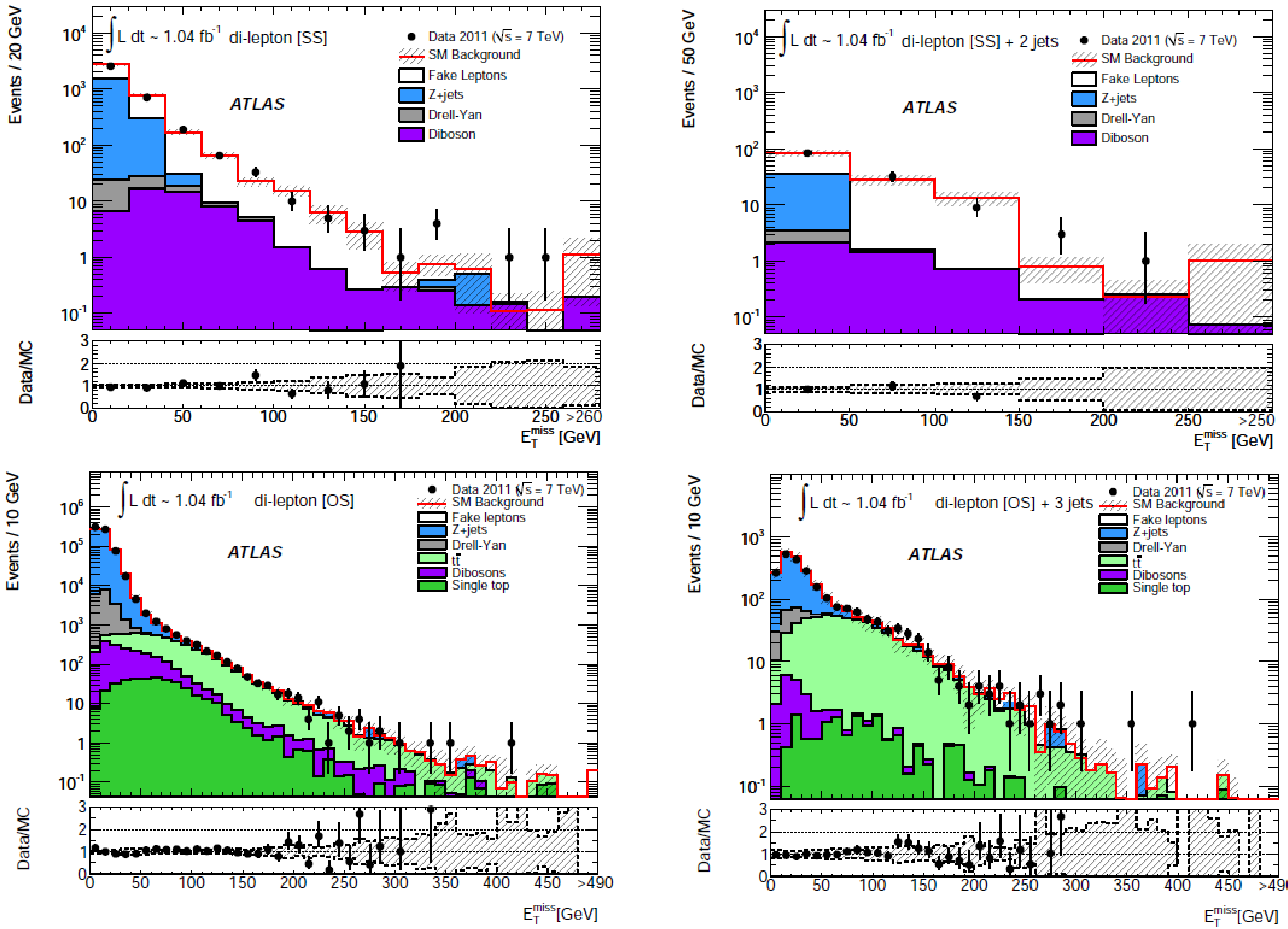
CMS result obtained with 1.1 fb^{-1}

- M_D > 3.7 TeV for n_{ED}=2
- M_D > 2.7 TeV for n_{ED}=4
- Larger with NLO K-factor
- CMS PAS EXO-11-059





Update and DM interpretation described by Steven Worm on Thursday.



∫L dt ~ 1.04 fb^{-1} di-lepton [SS]
ATLAS
Data 2011 ($\sqrt{s}$ = 7 TeV)
SM Background
Fake Leptons
Z+jets
Drell-Yan
Diboson
Events / 20 GeV
Data/MC
E_T^{miss} [GeV]
∫L dt ~ 1.04 fb^{-1} di-lepton [SS] + 2 jets
Events / 50 GeV
∫L dt ~ 1.04 fb^{-1} di-lepton [OS]
Fake leptons
$t\bar{t}$
Dibosons
Single top
Events / 10 GeV
∫L dt ~ 1.04 fb^{-1} di-lepton [OS] + 3 jets