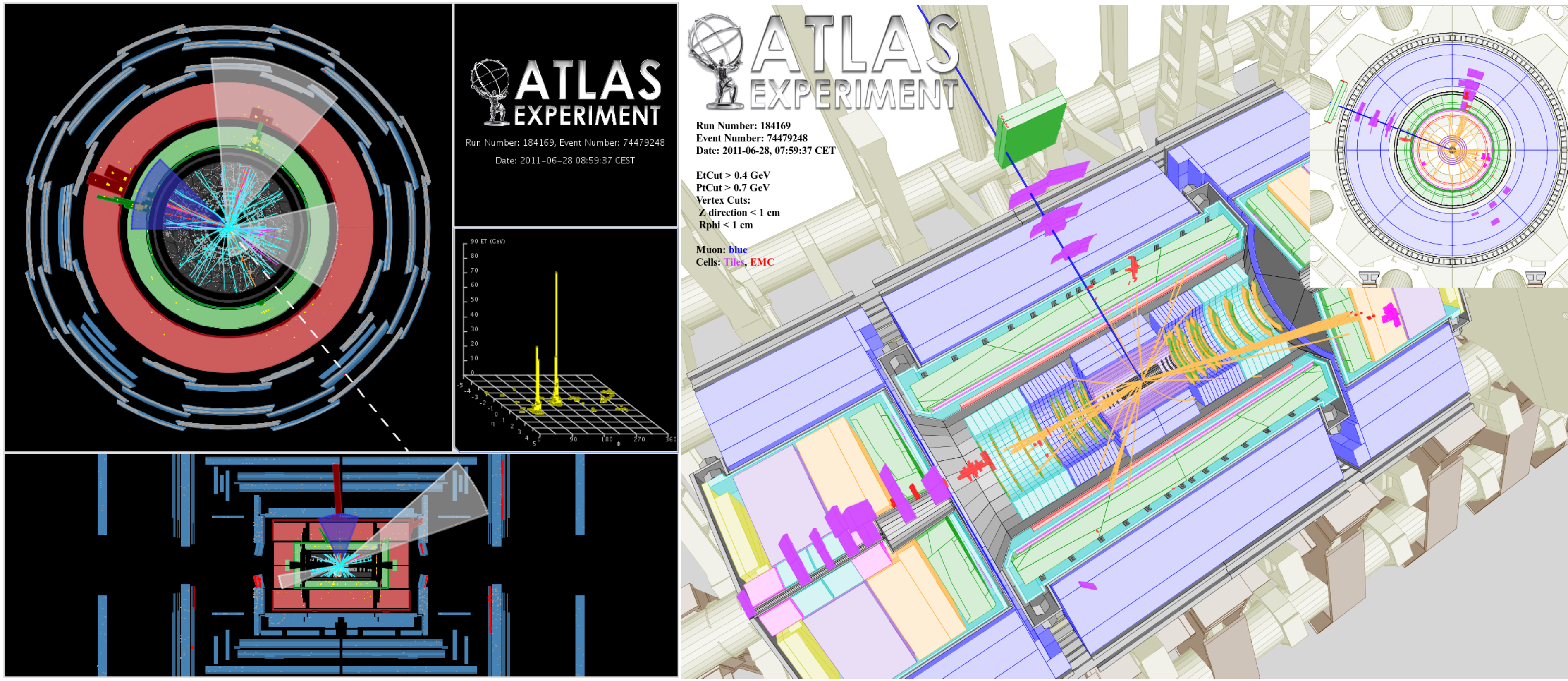


The Latest on SUSY and Z' Searches at the LHC

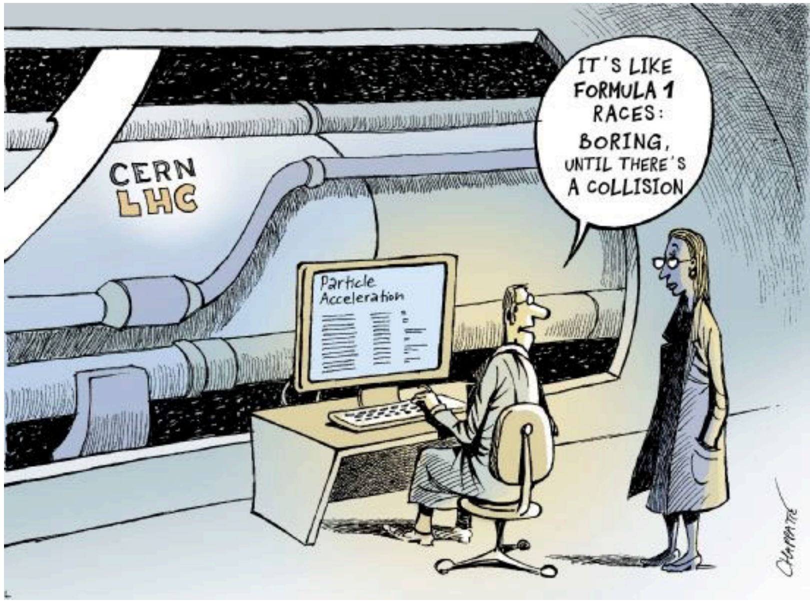
Zach Marshall (Penn)

New Developments in Gravity, Cosmology and Strings

22 March 2013

Overview

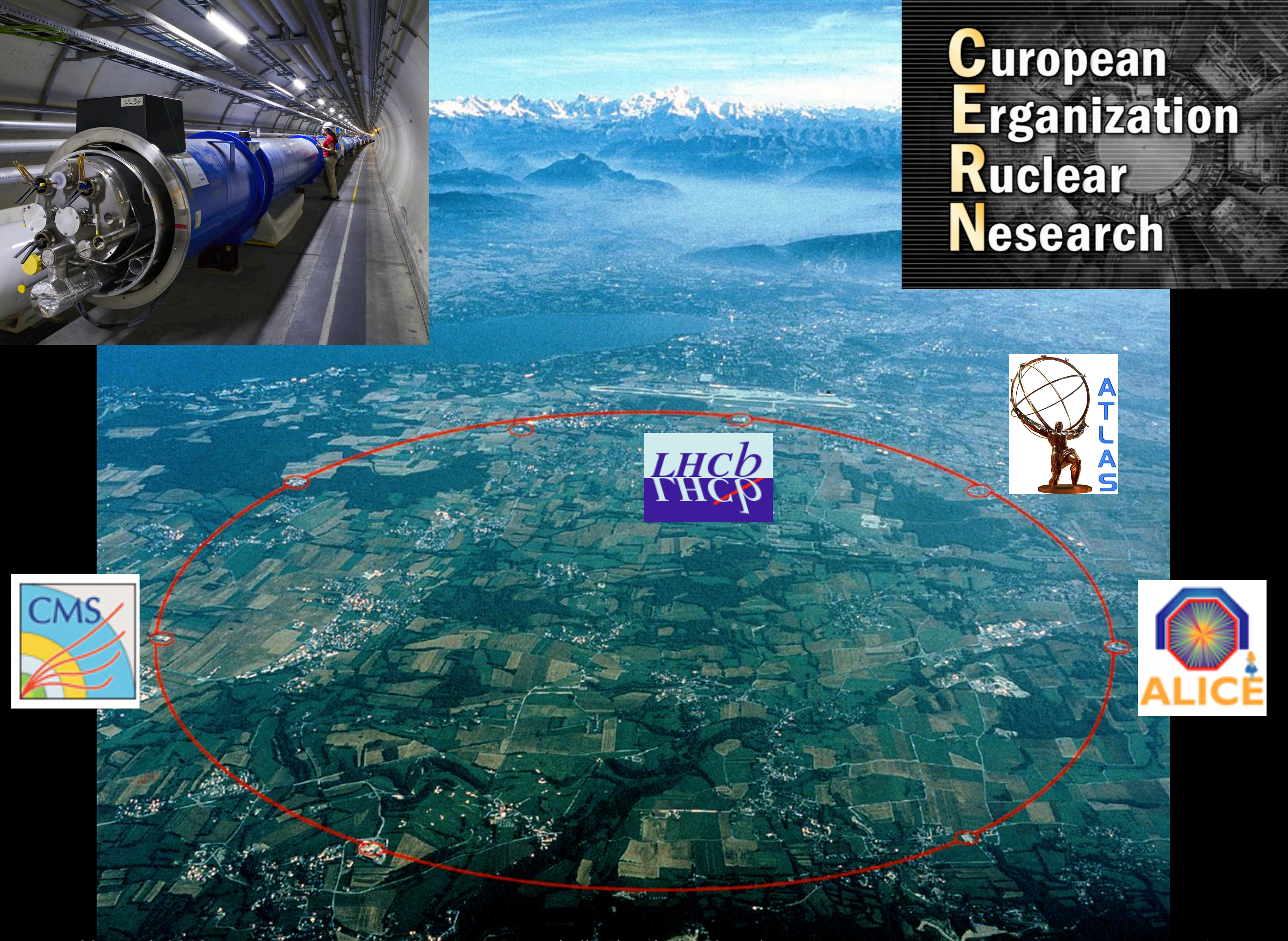
- Quick introduction to ATLAS, CMS, and the LHC
- A word about the Higgs and B_S
- Z' Searches
- State-of-the-art SUSY searches
- New tools for the *next* searches



- Early punchline:
  - We have limits on *many* models and *many* processes
  - Still, we know we are not covering everything
  - If there are important things we are missing, please speak up!
  - If you want help understanding limits on your specific model, just ask!
    - Generally graduate students are *very happy* to have this kind of work!!

Important Note

- I don't want to give you an encyclopedia of results here!
- CMS Results for
  - SUSY https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsSUS
  - Exotics https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsEXO
- ATLAS Results for
  - SUSY https://twiki.cern.ch/twiki/bin/view/AtlasPublic/SupersymmetryPublicResults
  - Exotics https://twiki.cern.ch/twiki/bin/view/AtlasPublic/ExoticsPublicResults
- We are all updating results now for summer conferences with the full 2012 dataset
  - Expect updated results SOON for many of these searches
- Much of what I'll say is to assist you in interpreting our results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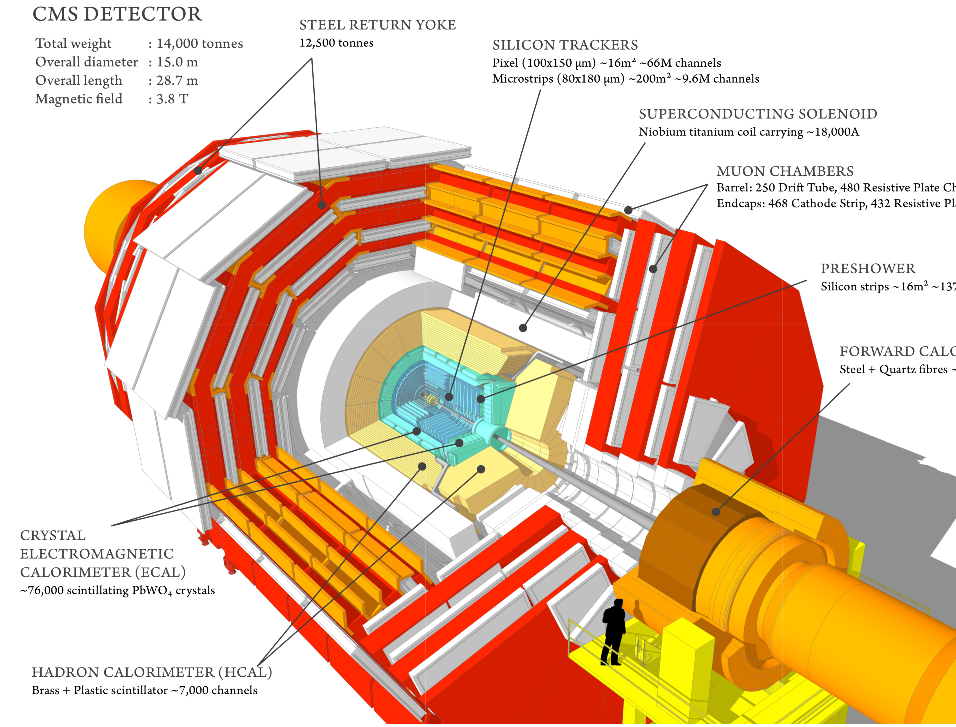
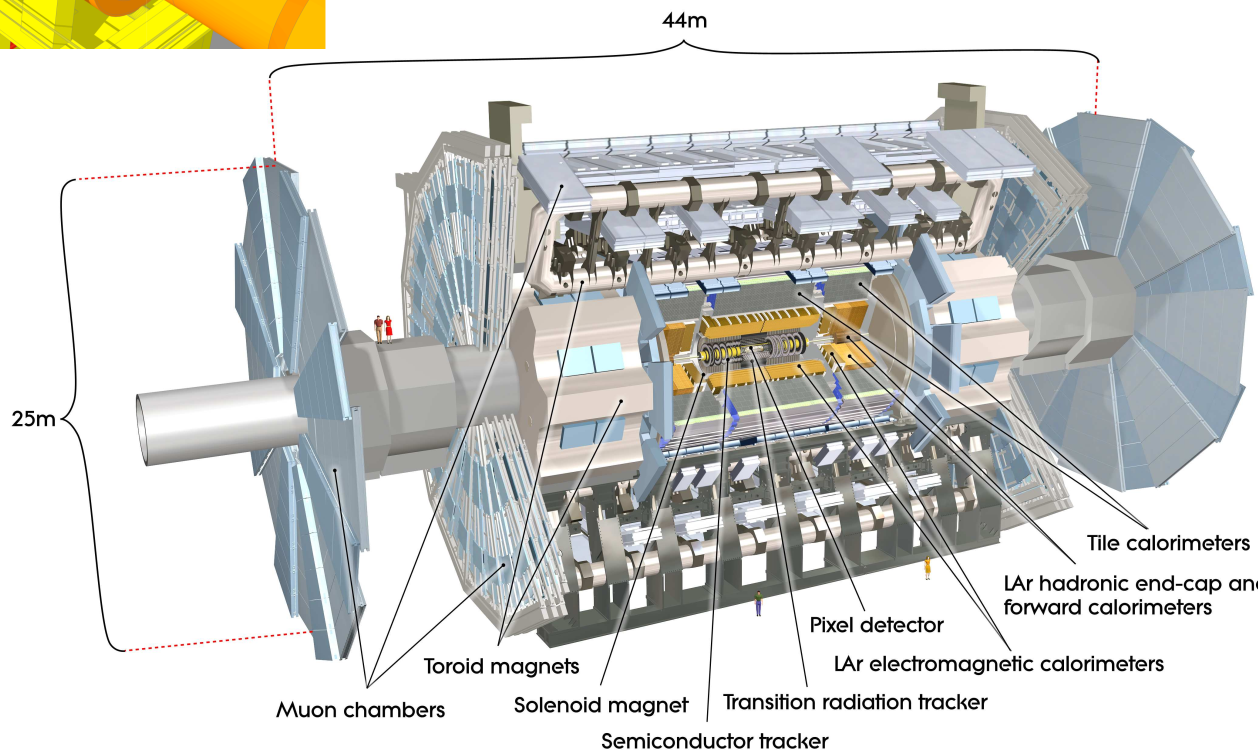
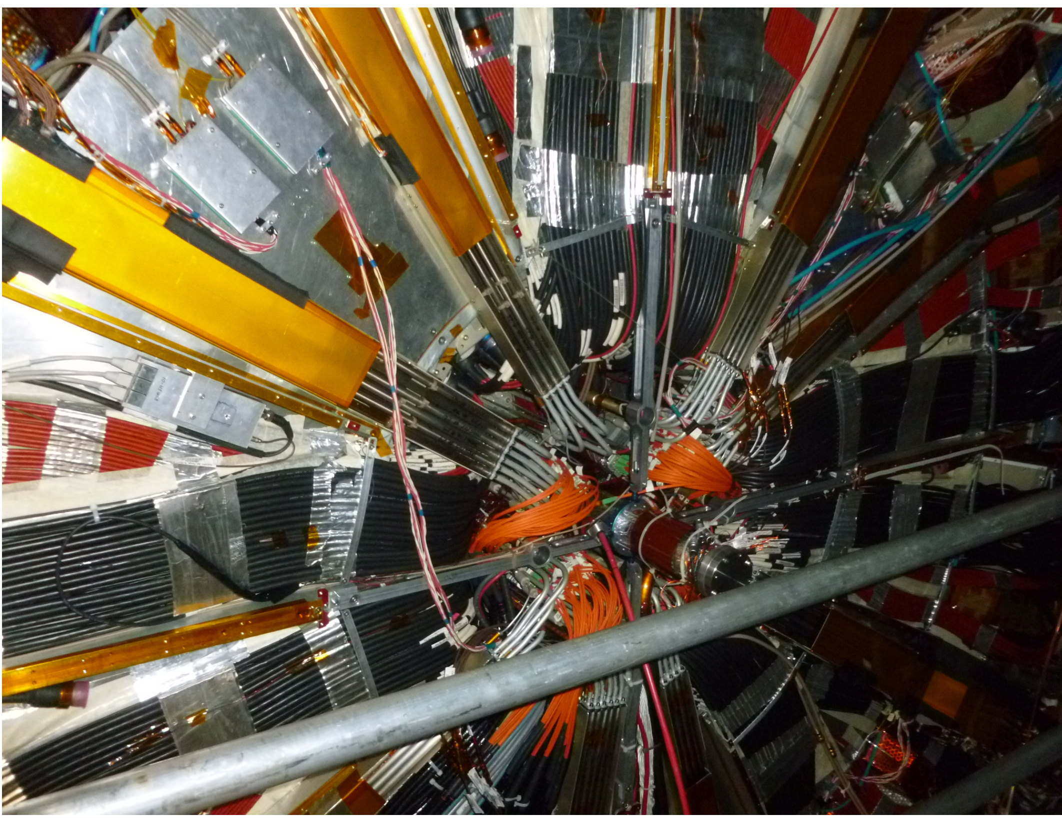


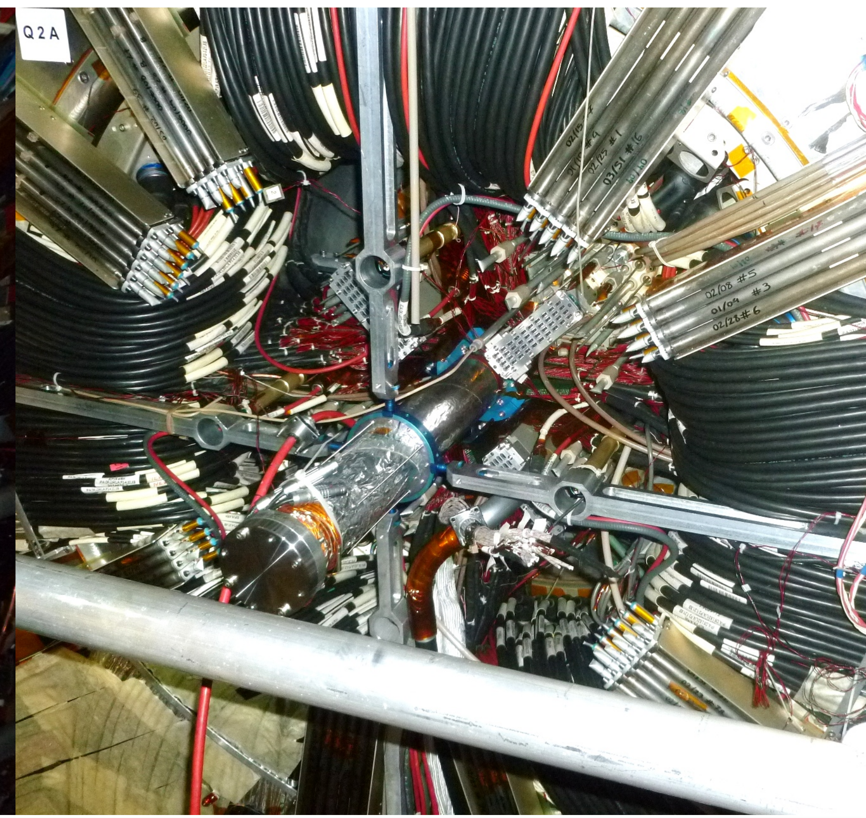
- Two giant cameras, both engineering marvels
- 100M channels, 95% efficient for data collection



Detector Opening!!

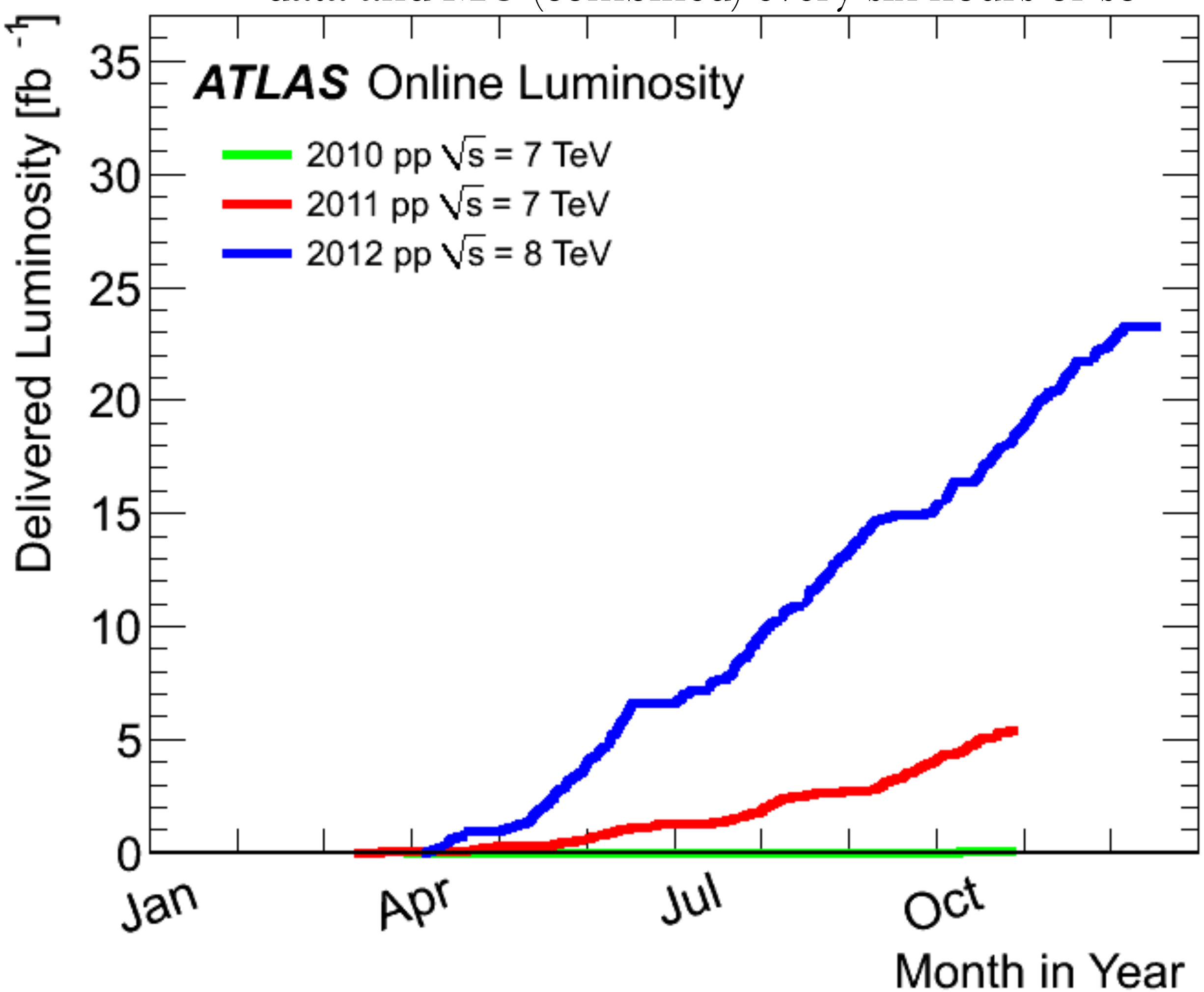
- Just a reminder: we all have two years off ;-)
- ATLAS, CMS, and the LHC have a huge amount of work to do over the next months, and it will be a minor miracle if nothing goes wrong
- Expect a large number of search results ~now, and a large number of measurements next year





Data Volumes

- We have collected *huge* volumes of data
  - In terms of *storage space*, ATLAS collects as much data as all LEP experiments data and MC (combined) every six hours or so



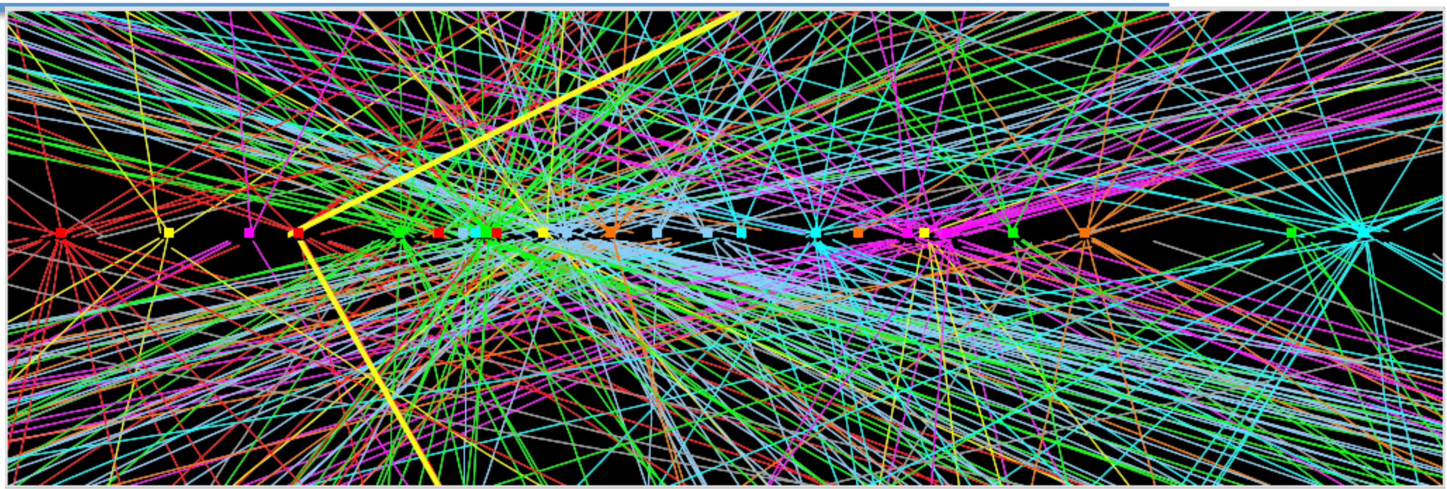
Searches **NOW!**
Measurements for Moriond 2014

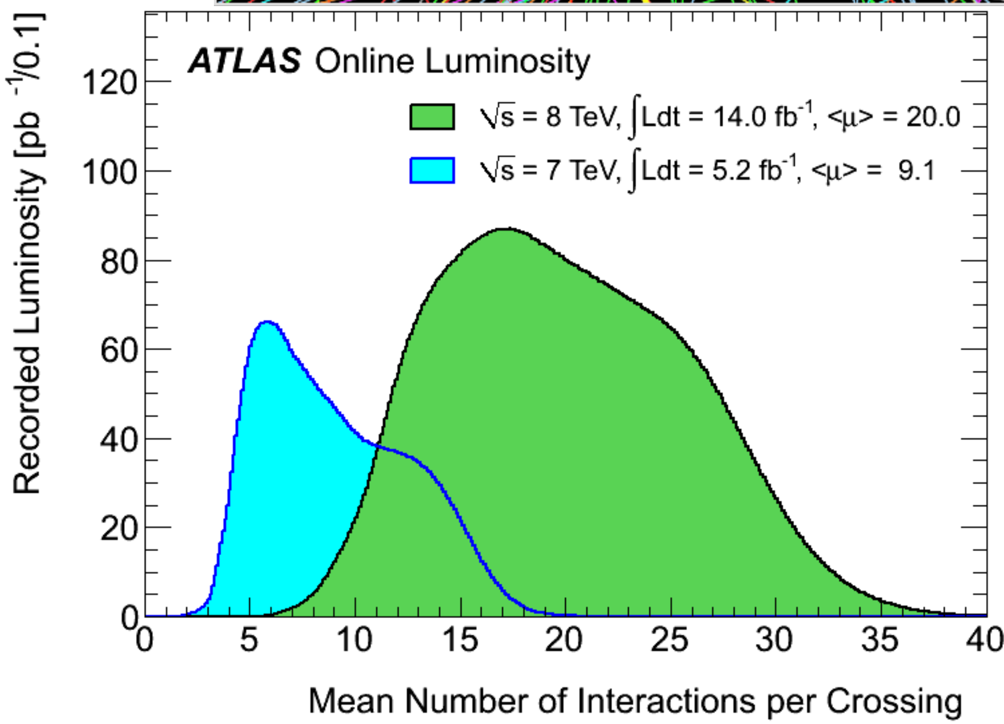
Full Tevatron dataset

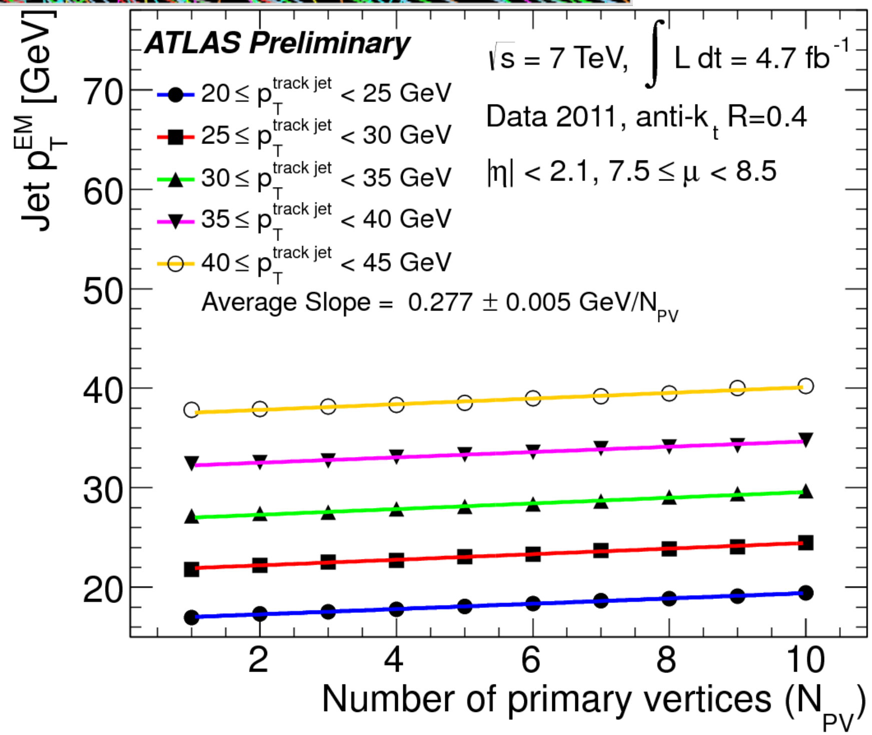
Published searches,
Preliminary measurements

Standard Model measurements

The Cost: Pile-Up

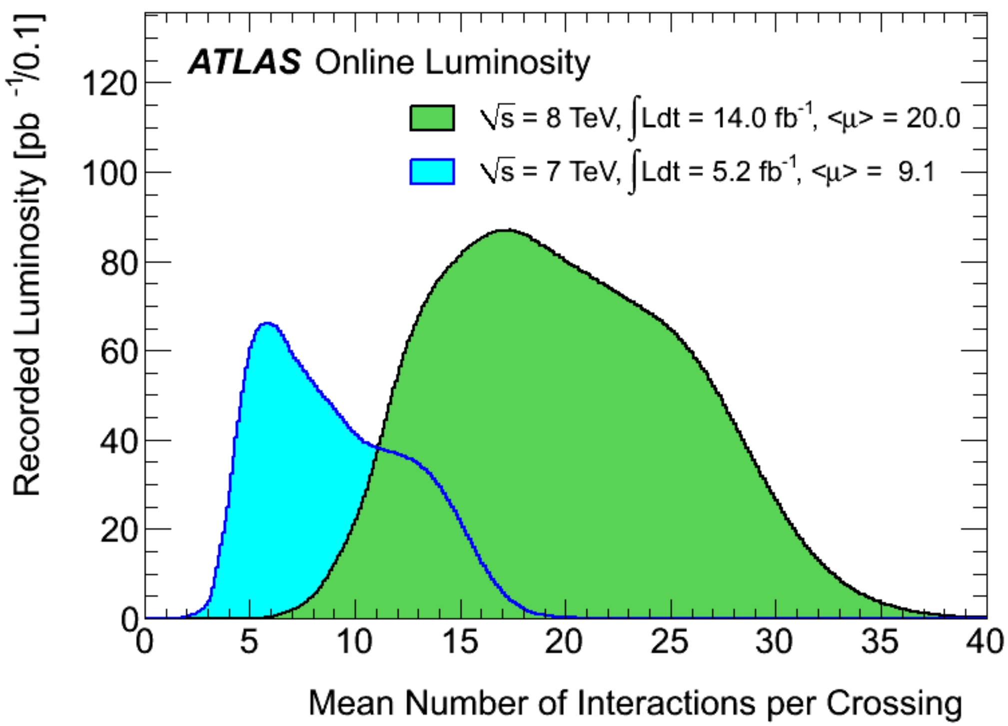


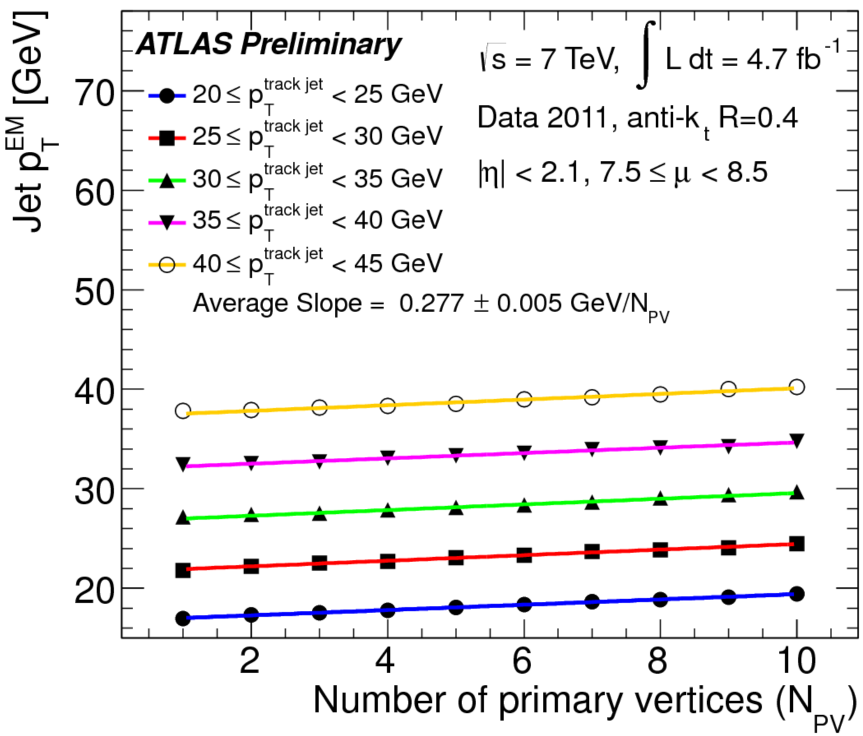




The Cost: Pile-Up

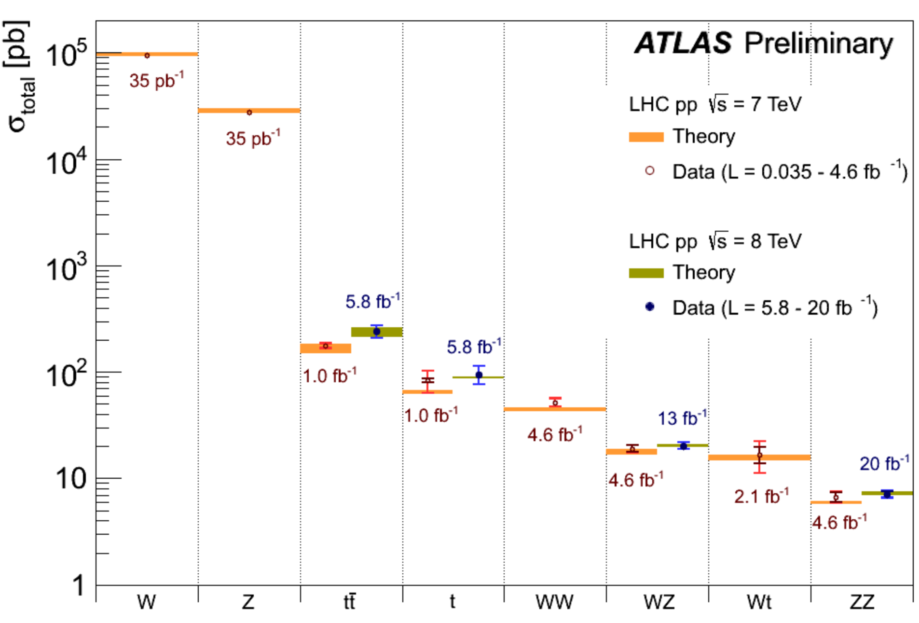
- In 2011, and even more in 2012, additional pp collisions in each bunch-crossing is a *major* experimental challenge
  - Probably the primary reason measurements are slow to come out
  - To find a *bump*, we don't really need to correct for these, as long as they are well modeled by our MC (but beware if you're running PGS!)

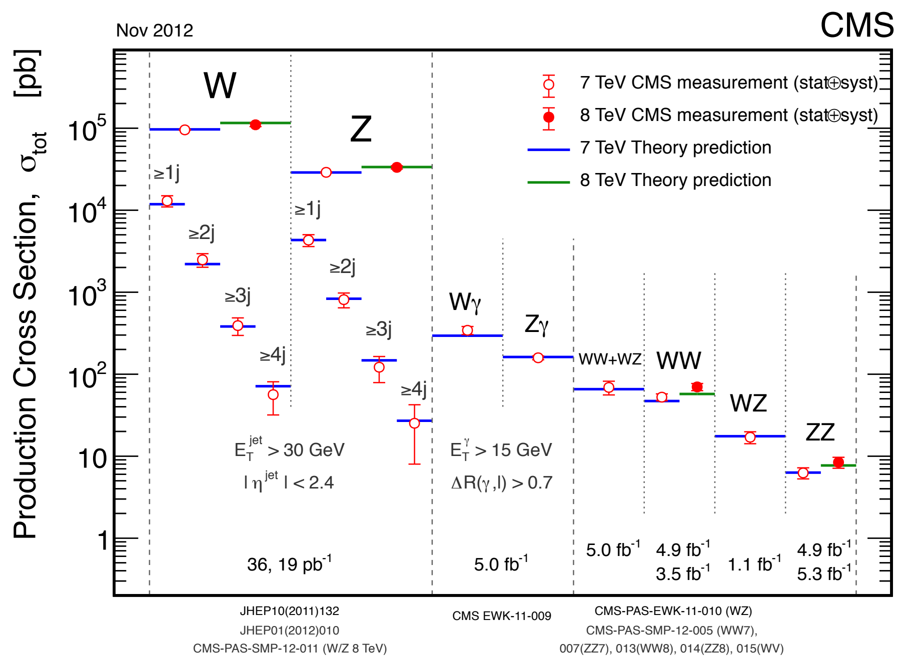




Control of the SM

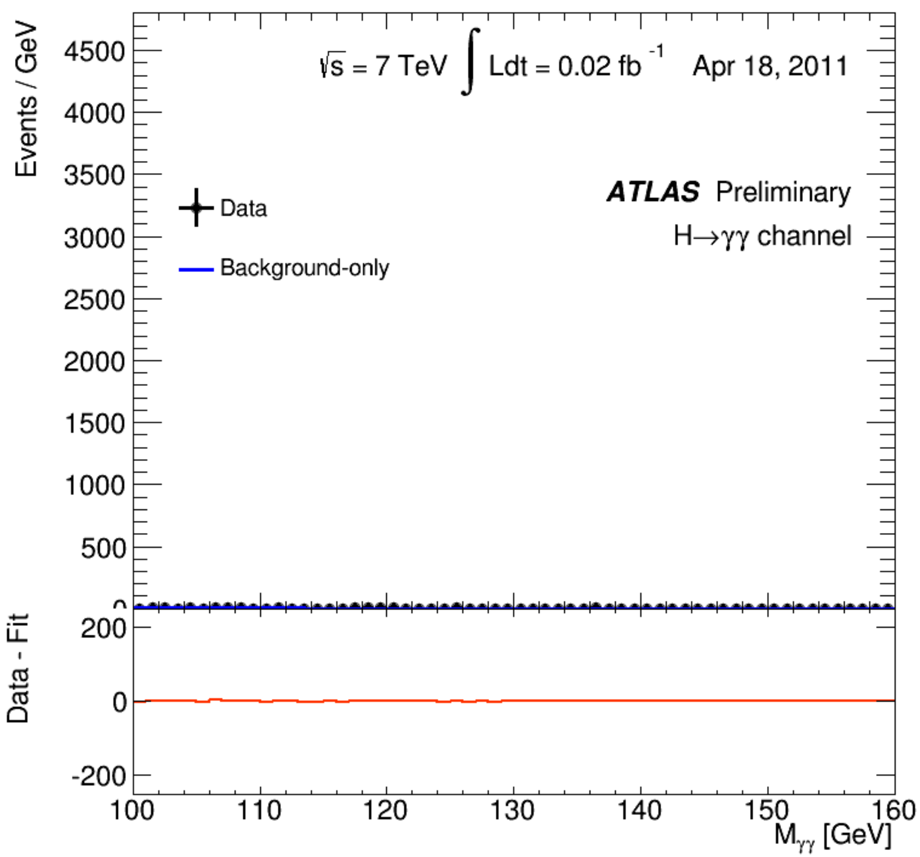
- ATLAS and CMS have both measured cross sections (both "simple" and differential) for most accessible Standard Model processes
- Demonstrates an impressive control of the detector and of backgrounds for the searches that we want to do!
- Only (potentially interesting?) deviations at the moment are in heavy flavor physics (e.g. Wb), and are at the 1-σ level
  - And heavy flavor is *notoriously* difficult to get right for both experimentalists and theorists

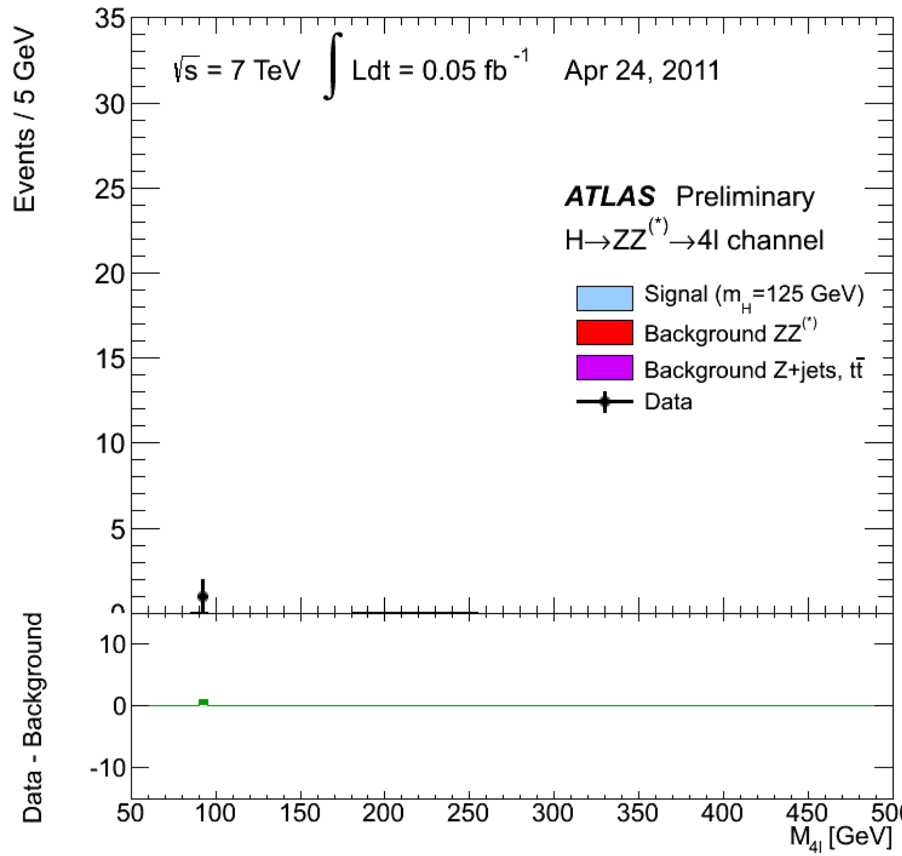




The Elephant in the Room

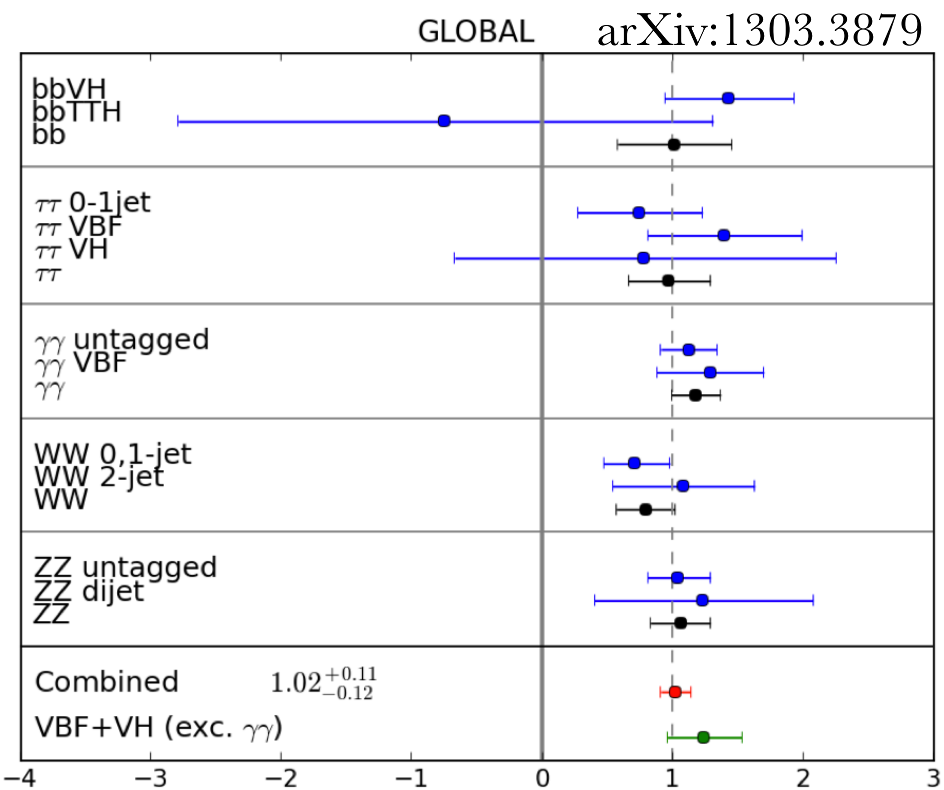
- We do have a very nice Higgs-like boson
- We even have very pretty animations of the thing!

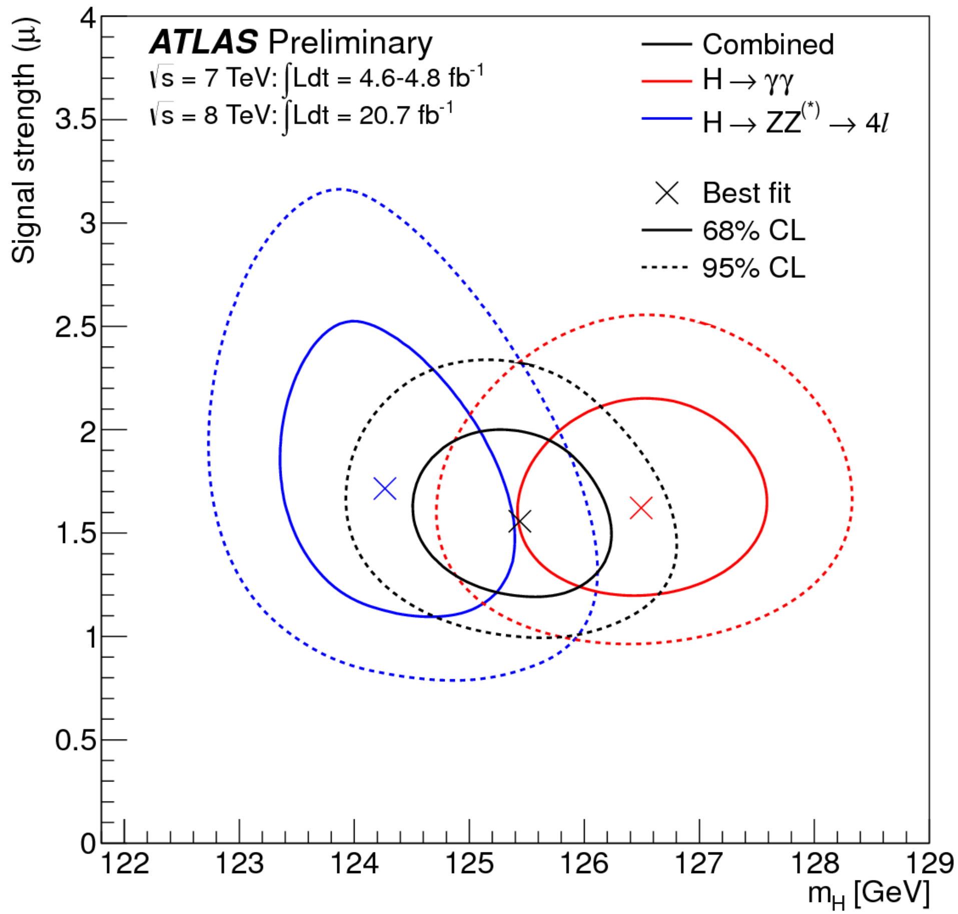




Optimism

- The signal strength is very SM-Higgs like, and the mass discrepancy that we previously saw has been reduced (statistics)
- Any living SUSY model is going to have to include something like this





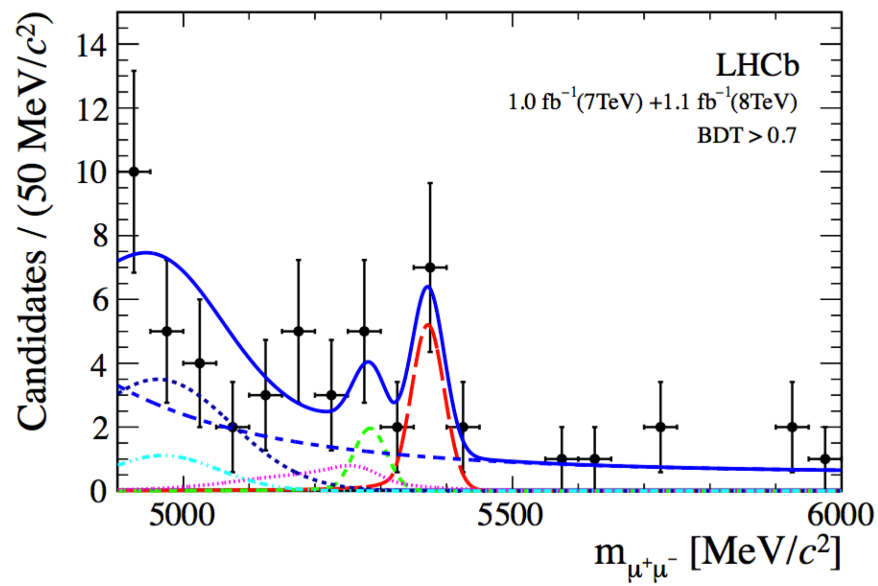
Bad News Into Good News

- Finally, LHCb seems to have B_s>μμ at >3σ
  - This is a very tough search that is now becoming a measurement
- The uncertainty on their measurement actually *relaxes* the bounds on SUSY compared to the upper limit
  - Of course, it's always possible to hide a BR
  - Not panic time yet, but stay tuned for a more precise number soon

Excess of $B_s \to \mu^+\mu^-$ candidates with a signal significance of to 3.5 standard deviations
(bkg only p-value: 5 x 10^{-4})

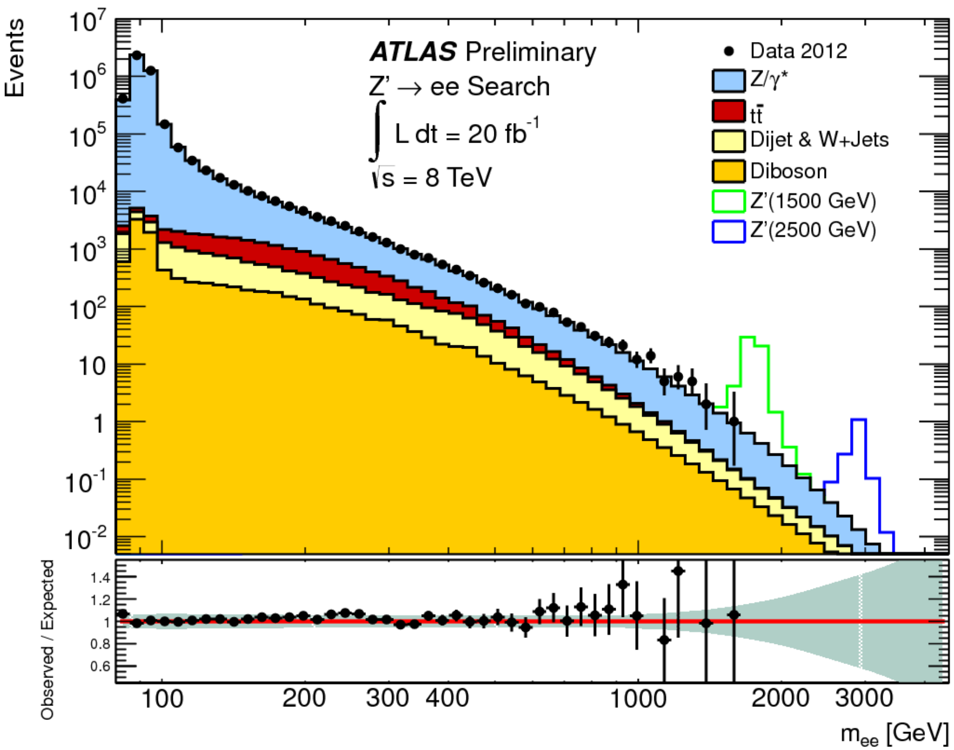
The branching fraction is measured as

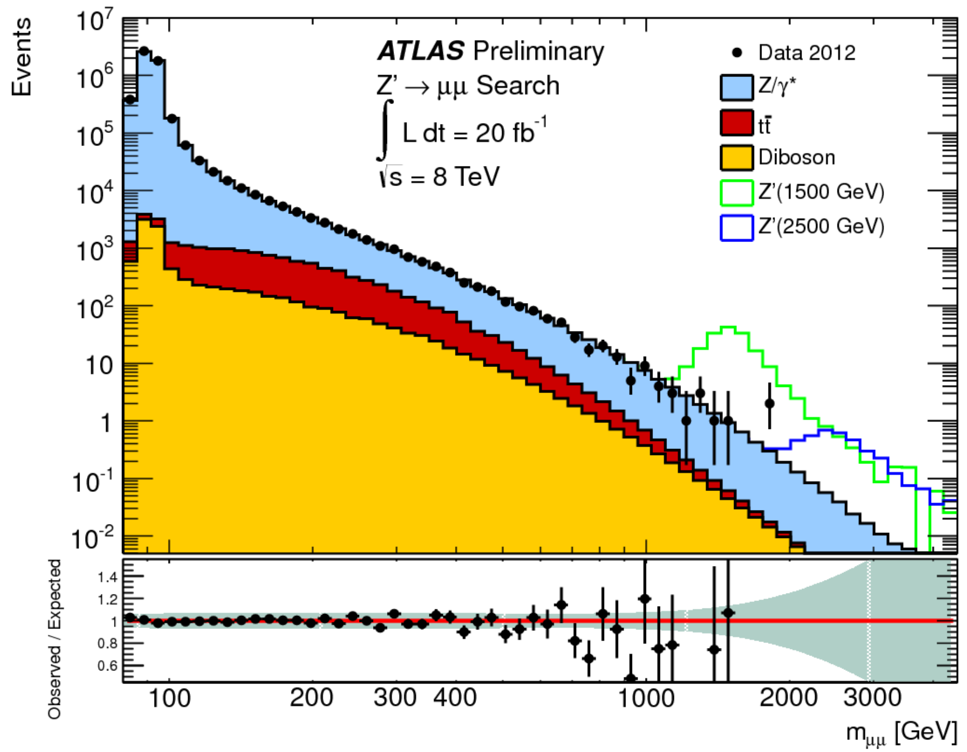
$$\boxed{BR(B_s \to \mu^+\mu^-) = (3.2^{+1.5}_{-1.2}) \times 10^{-9}}$$



Z’

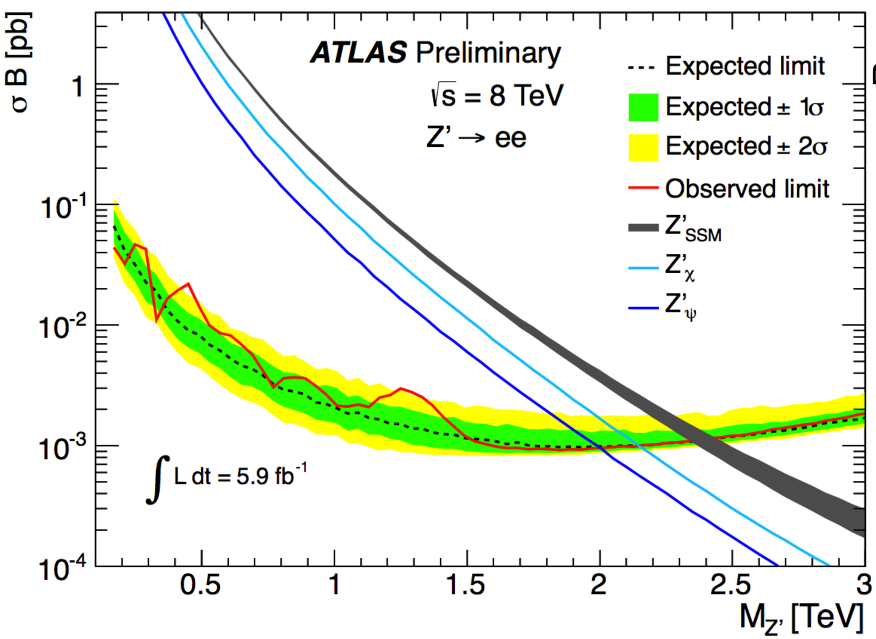
- The simplest Z’ decays are well covered at the LHC
  - Z’→ee/μμ/ττ/qq/tt
- The simplest Z’ is simply not there in an 8 TeV collider
  - For SM-like couplings, ATLAS exclude 2.86 TeV (combining ee and μμ)
  - ττ limits are <1.4 TeV in the SSM (non-SM couplings could make these important) – similar limits for CMS

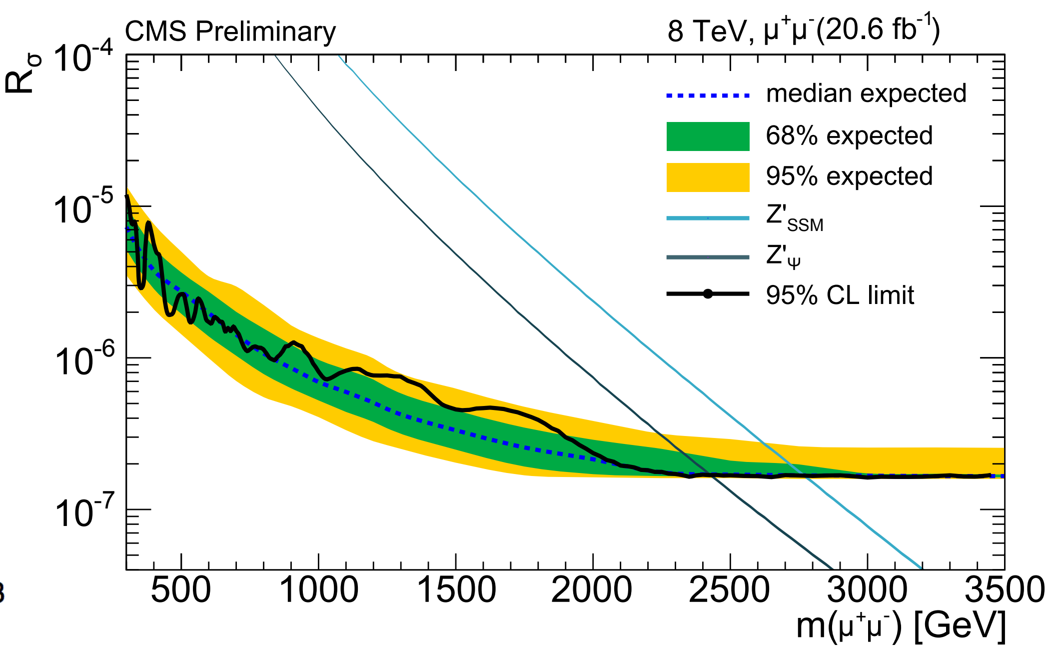




Simplest Z'

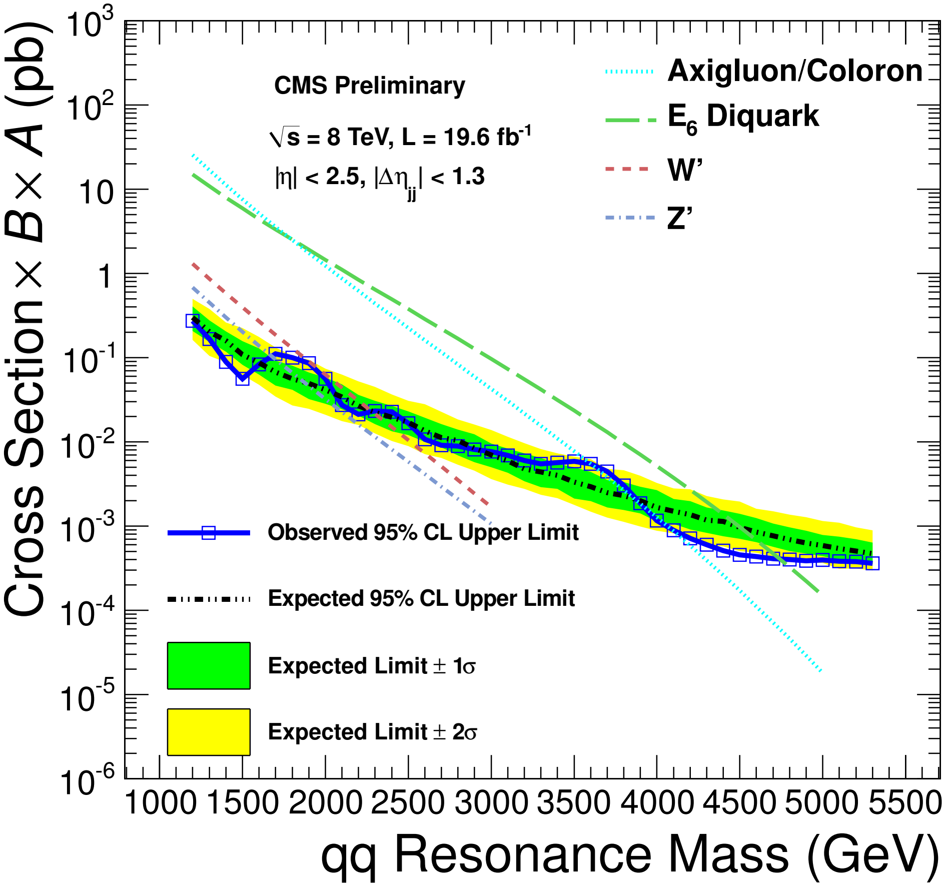
- Generally these limits are given as σ×BR as a function of mass
  - We are aware that there are *many* different models for these branching fractions
  - Pretty easy to add interpretations if they are interesting
- Generally these searches cover very high masses
  - If you are interested in something much lower mass with a much lower σ×BR, our results may not rule it out – always ask if you are curious
  - That assumes it can hide from previous searches and measurements!

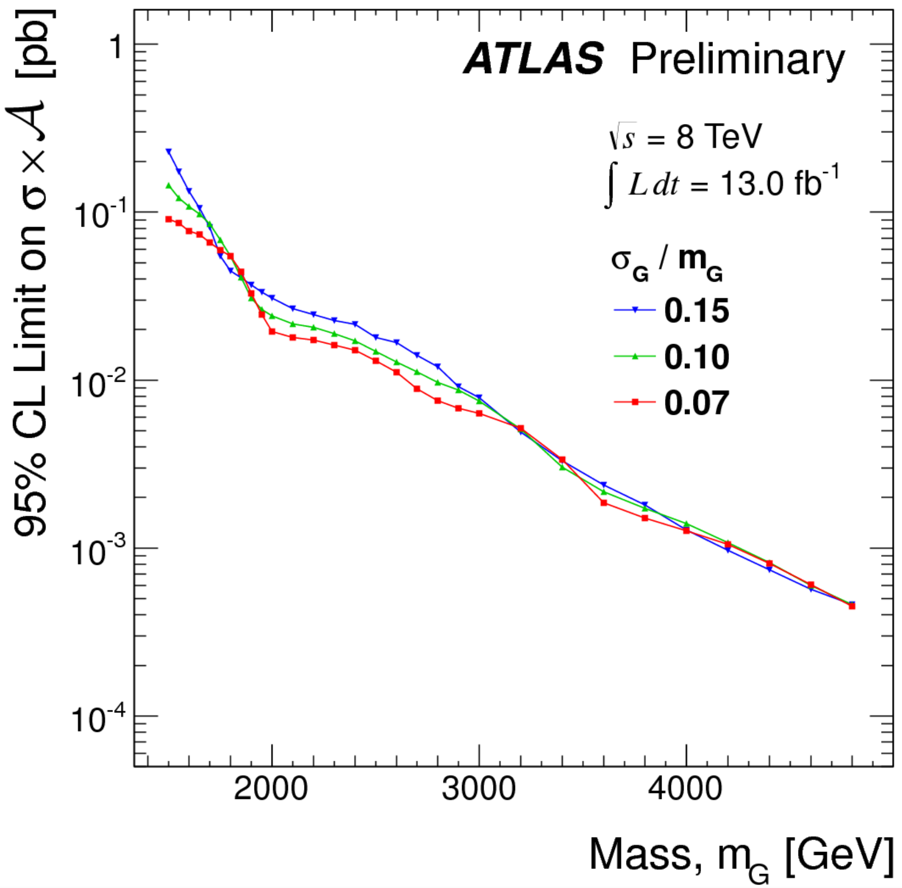




Hadronic Z'

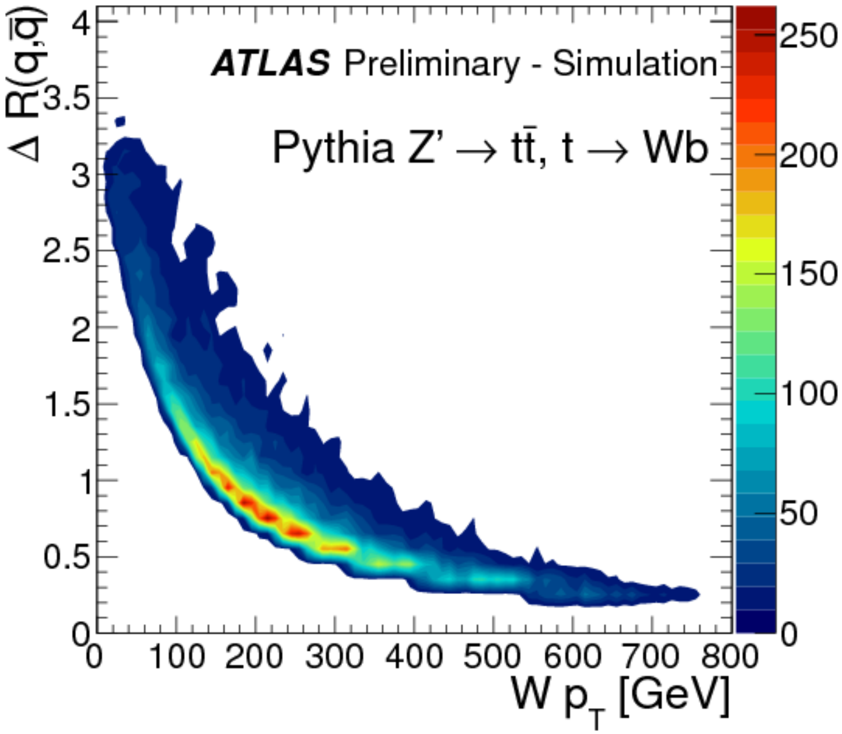
- Searches for any dijet resonances cover Z' →qq
  - One of the first searches done at the LHC
  - Usually the jet energy scale systematics make these limits a bit weaker, while the branching fraction can make them a bit stronger

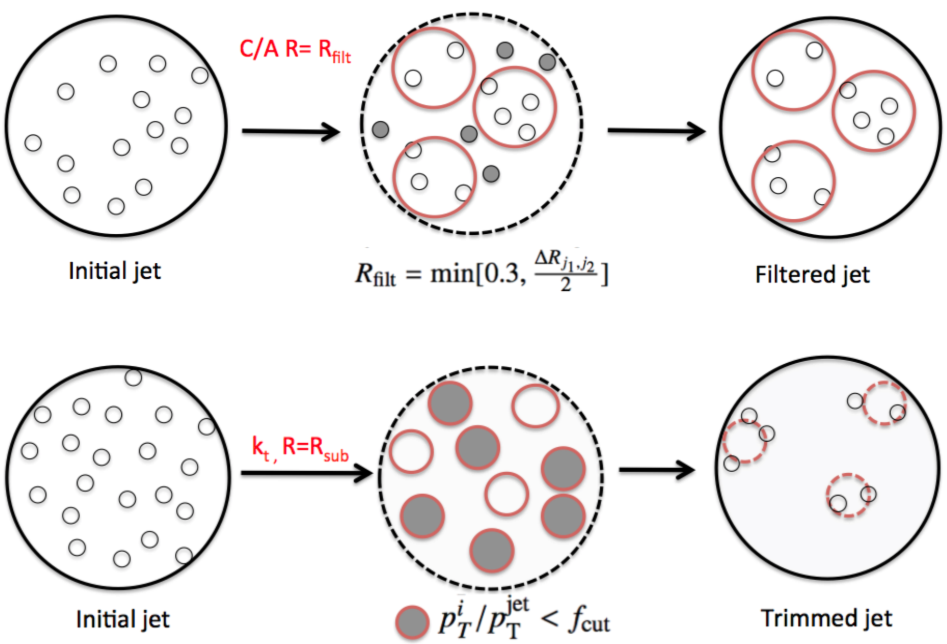




Entering the Boosted Regime

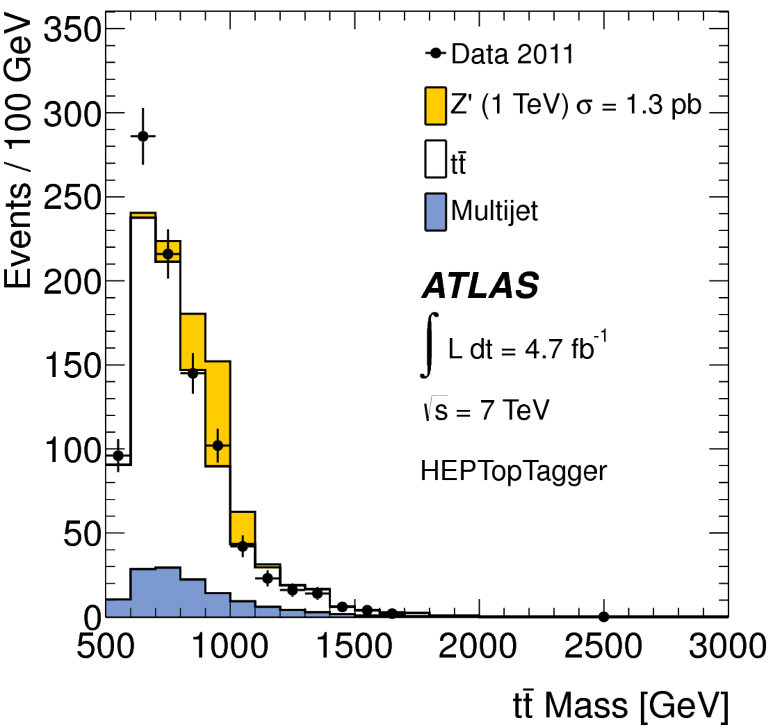
- Once we get to high masses and high boosts, particularly for tt, decay products collimate and we find fewer distinct objects
- Can build large (R=1.0, 1.2, 1.5) jets and look for structure *within them*
  - Good variables and techniques, but need to get the characteristic size right!
- For better control of experimental uncertainties (and pile-up), can also build large jets out of smaller jets (coming soon to papers near you)

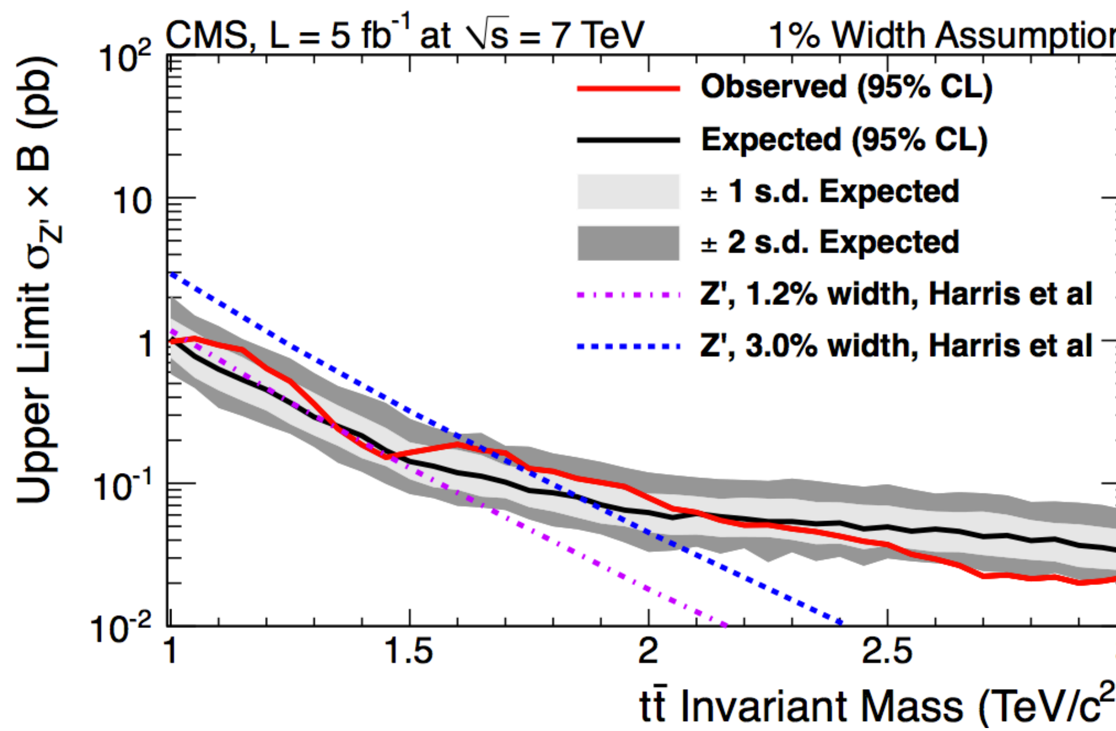




More Exotic Z'

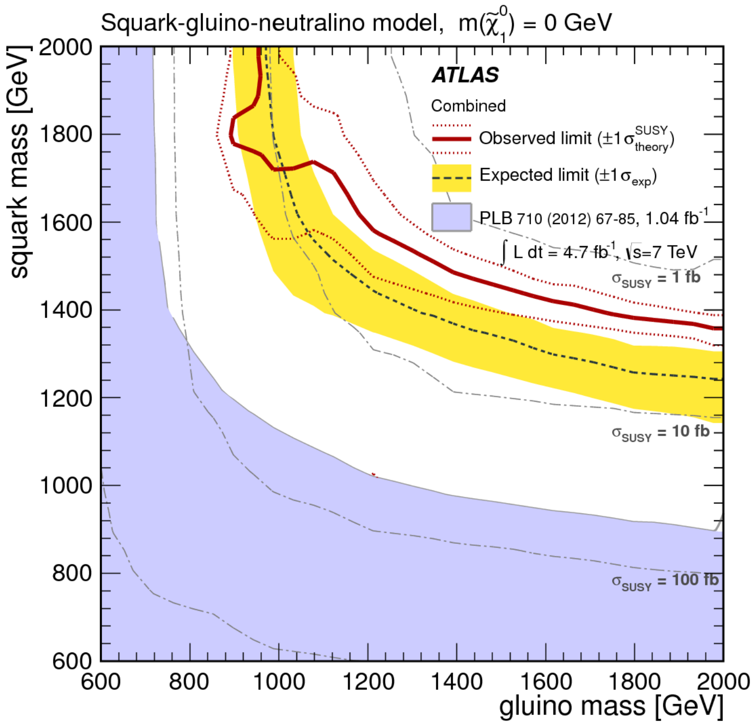
- Both boosted and "standard" searches for these resonances
  - 0.7<Z'<1 TeV for ttbar (100% BR) for ATLAS
  - Comparable limits for CMS, but better demonstration of the width-dependence of the limit!
  - Both have searches with semi-leptonic and all-hadronic decays, since leptons become much less isolated at high boosts

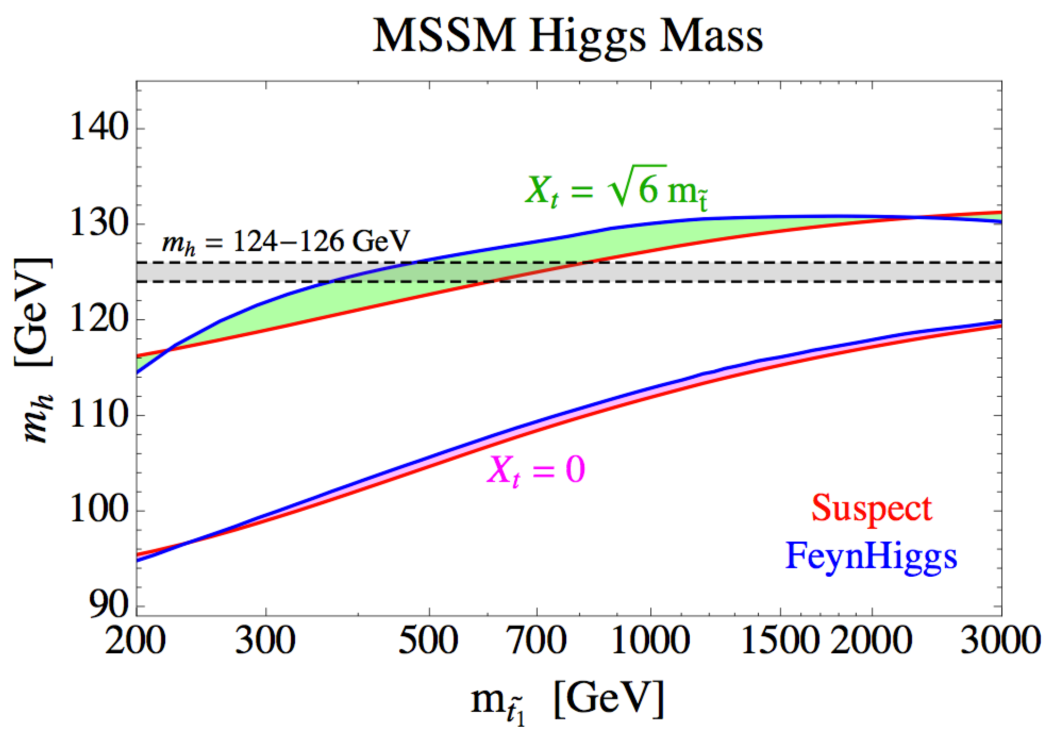




SUSY, Where are you?

- SUSY is a nice SM extension for many reasons
  - Potential unification of gauge couplings, explanation for the hierarchy problem, candidate for dark matter (the LSP)
- SUSY has one **major** problem: we haven't found it!
  - The bounds on light sparticles are getting quite high (left)
  - Still could be hiding in a compressed scenario, at high mass, with a light stop (right), or with R-parity violation



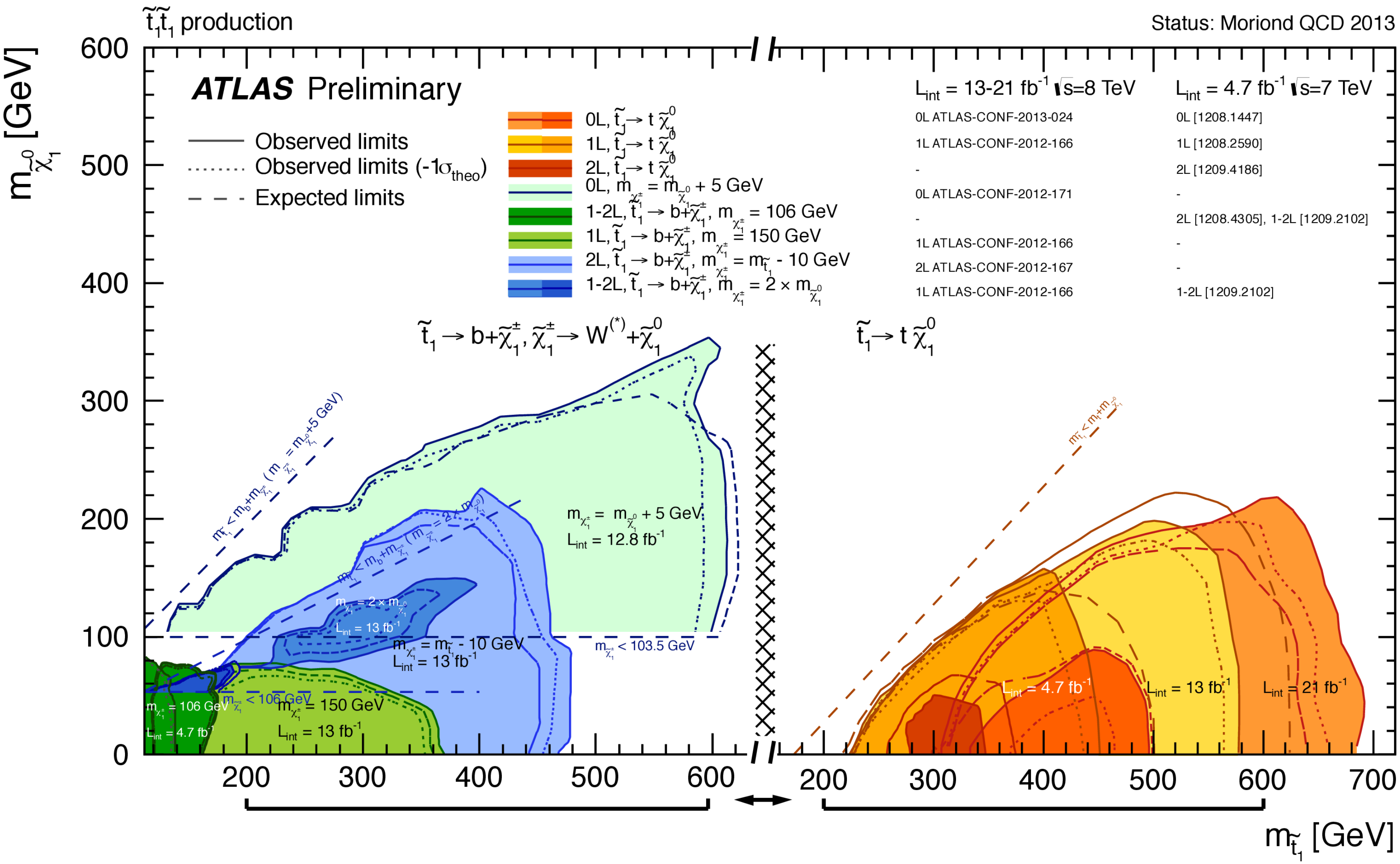


Warnings about our SUSY Limits

- We need *your help* to provide the *most useful* limits that we can
- An increasing number of searches are moving to
  - Binned signal regions
  - Simultaneous fits of multiple signal regions
- These have *important implications* that you should think about!
  - Signal contamination is always taken into account when setting a limit
  - If there is large signal contamination in control regions, then there is *no such thing* as a model-independent limit for these searches
  - The *only* model independent limits will be single-binned: using these, you will find weaker limits than we can get using the correlations
  - But these are the *best way* to set a *coherent* limit on SUSY using *all* information available to us! If you want a strong limit…

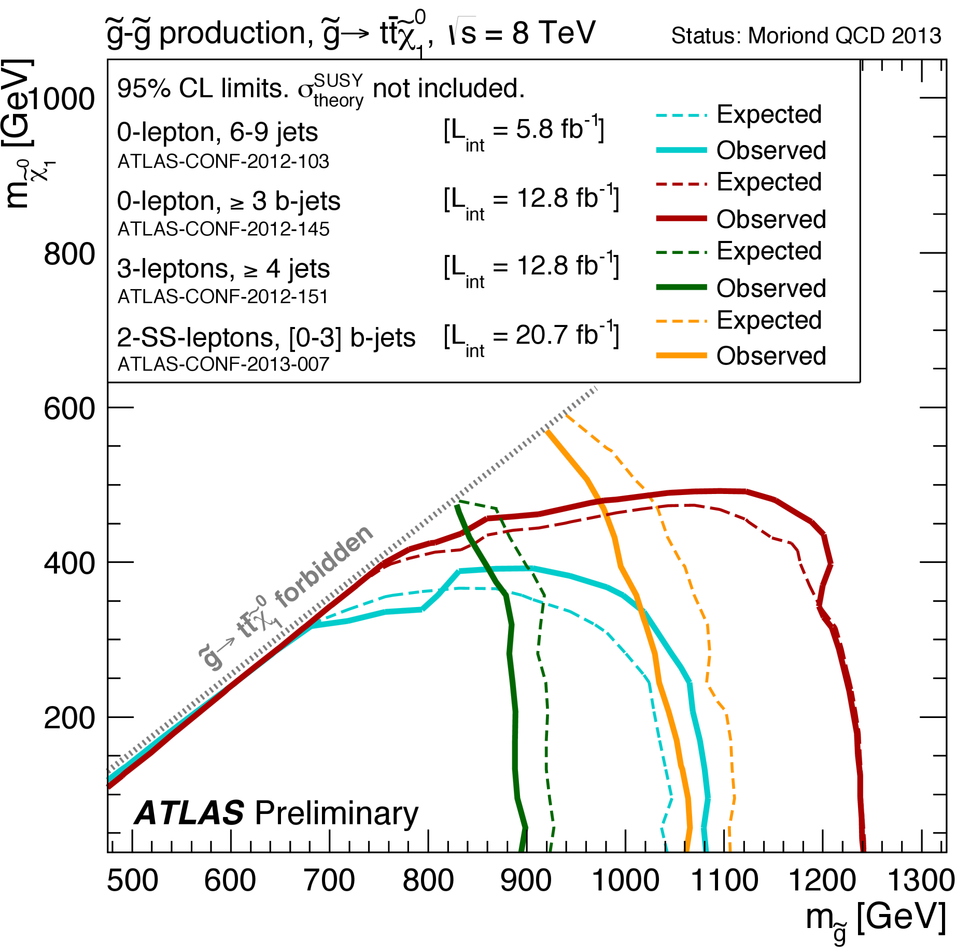
Nailing Down the Stop

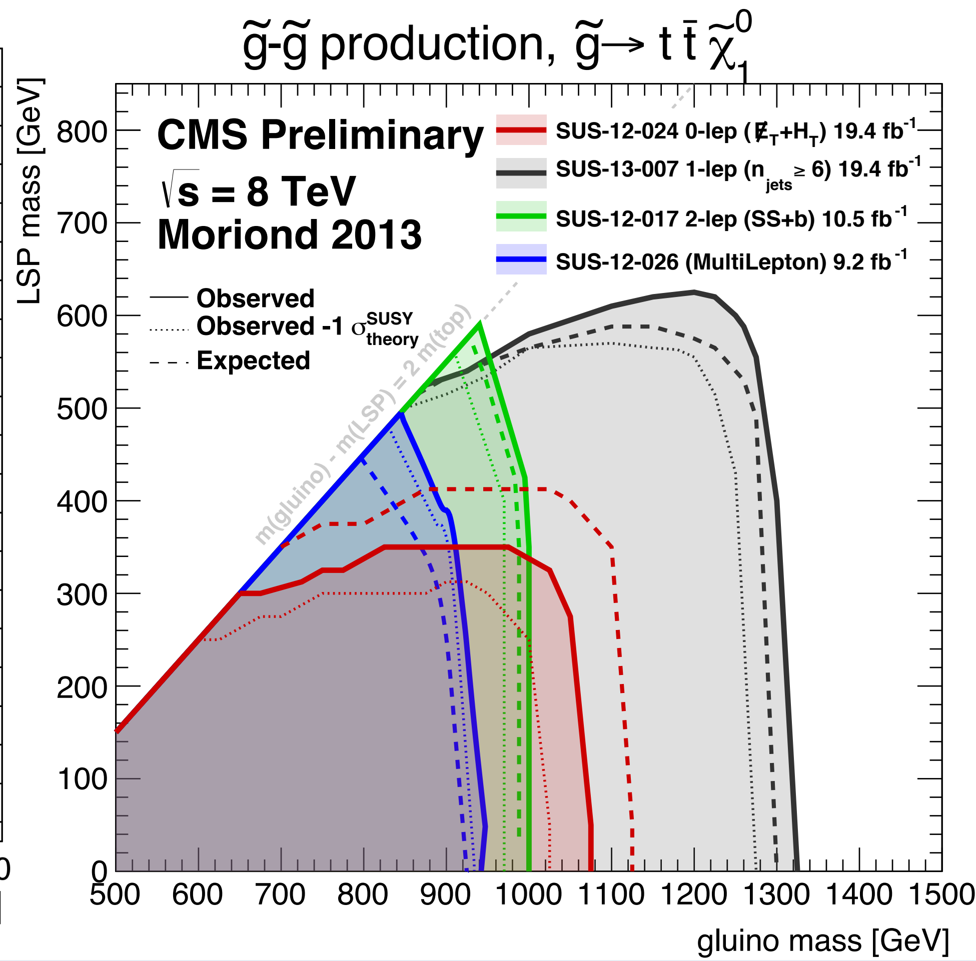
- If we will find "natural" SUSY, there is good news: we know where to look!
- Trying to cover various decay modes with dedicated searches now



Aside: Simplified Models

- Considerable effort has gone to limits on SUSY-inspired simplified models
- Below: gluino pair production with a decay through an off-shell stop
- The limits you saw on the previous slide were all simplified model results



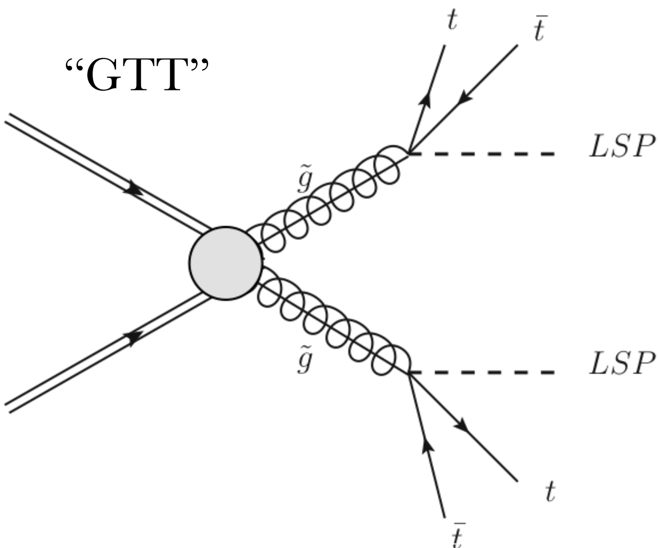


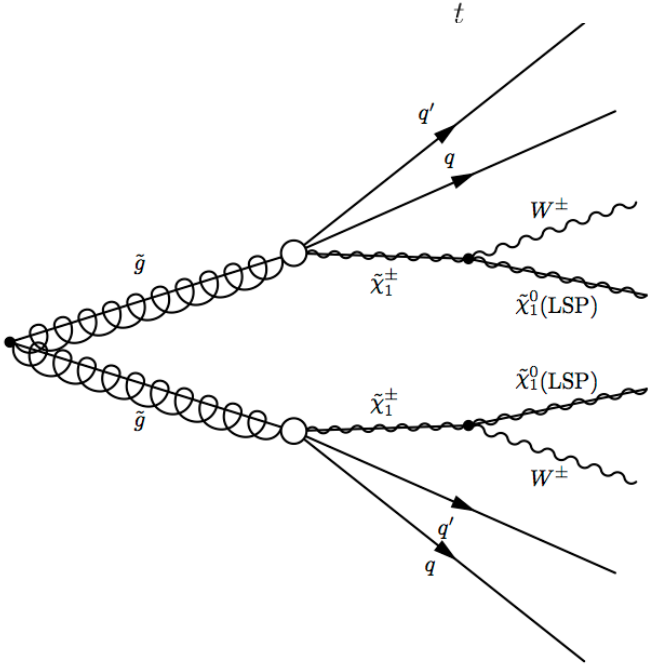
Simplified Models: **Pros** and **Cons**

- These models allow ***fair comparisons*** of searches
  - Except that we often generate the models differently, and subtle changes can be very important (e.g. the handedness of the stop in stop simplified models)
- These limits can be **ported** to other (non-SUSY) models
  - It is hard for us to get to all of your different models, so this is good!
  - You are likely going to see a large number of papers and notes interpreting our full 2012 results in the coming months
- When setting limits on shapes, these models ***do not include*** all the shape features of a full SUSY model
  - This goes beyond the old signal-contamination concerns!
  - This also harms the portability of these limits
- The limits are ***made independent*** of other particles in the model
  - Cross sections can depend *hugely* on the other particles (e.g. squark pair-production)
  - Means we are setting limits on $\sigma\times BR^2$, with some complex mapping to σ
- All this having been said, I still like simplified models
  - They are better in many ways than "complete" models, even given the drawbacks
  - To understand these limits, don't *just* look at the lines!! The lines are a guide; the numbers on the plots (which we endeavor to provide) are the most important part!

(Simple) SUSY with Many Jets

"GTT"

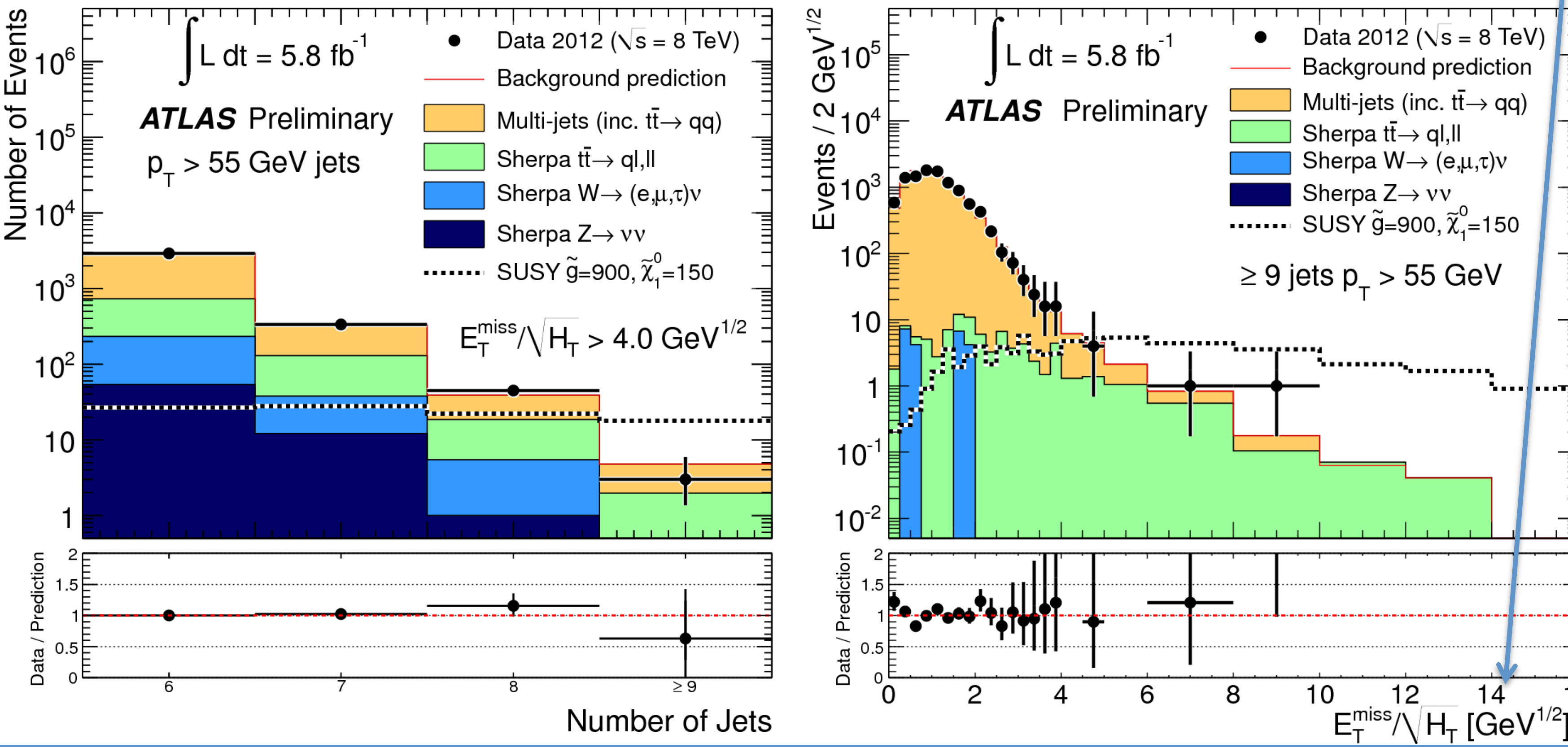




- A few of our favorite SUSY scenarios include many jets in the final state
  - Doesn't take much before we get quite long decay chains and high-multiplicity final states
  - N.B. that when this many W bosons are in the chain, leptons become very likely
- Top, gluino production resulting in a (potential) bbbb qqqq qqqq+MET final state
  - TWELVE jets for those who are counting!
- Bottom, gluino production resulting in a (potential) qqqq qqqq+MET final state
  - "Only" eight jets, maybe not as impressive?
- Add R-Parity violation to these and you get *many* scenarios with *many* jets in the final state
  - Some of these scenarios may not have much MET, but because the jet multiplicity is so high we have a nice way to reduce the backgrounds

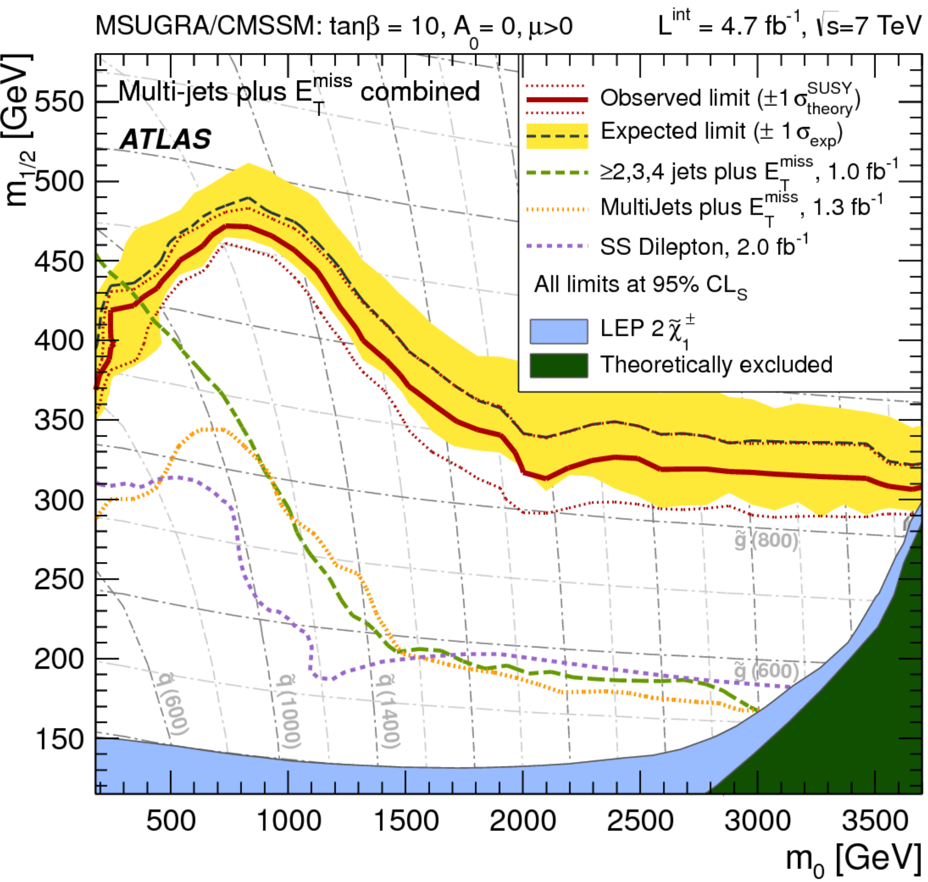
Multijet Searches on the Market

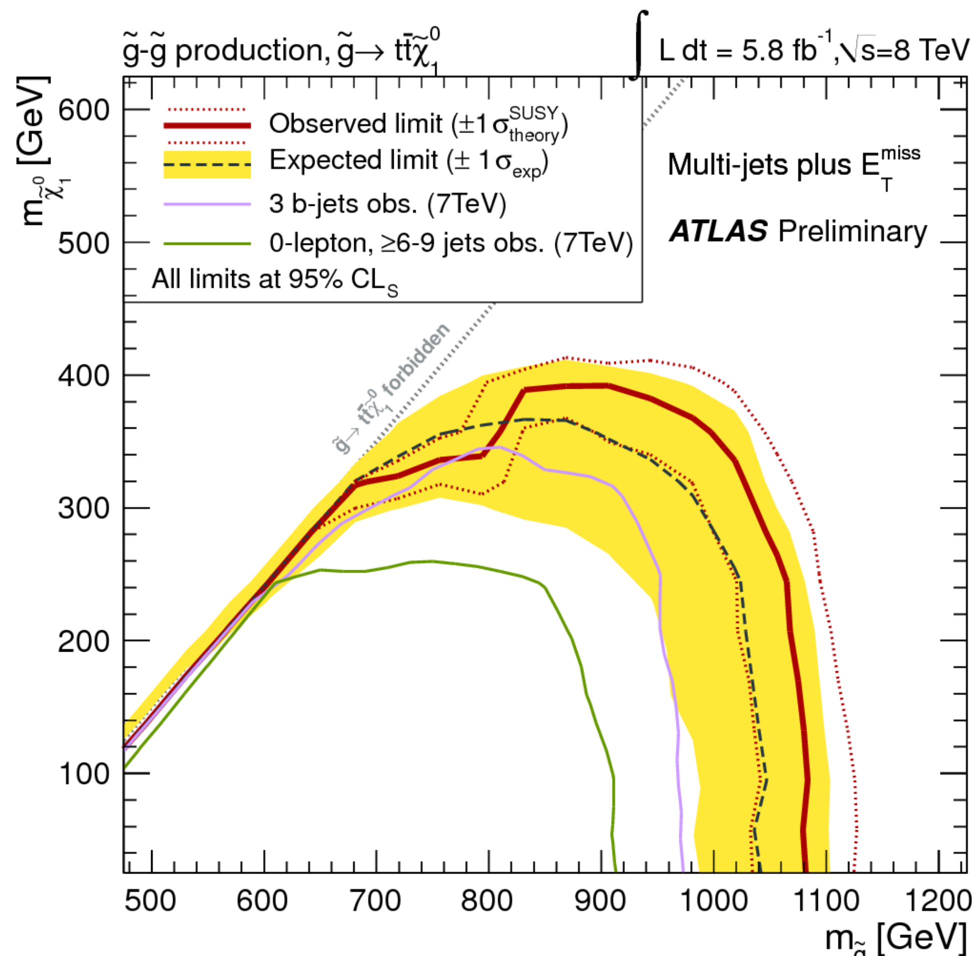
- ATLAS and CMS are getting into *many-jet* (high-p_T, even) searches
- One of the major backgrounds here is QCD multijets
- The "variable of interest" used is missing transverse energy *significance*
  - Cannot trust MC generators to do 2->9 parton production (maybe next-gen?)
  - But the distributions in this variable are ~consistent against jet multiplicity



The Agony of Setting Limits

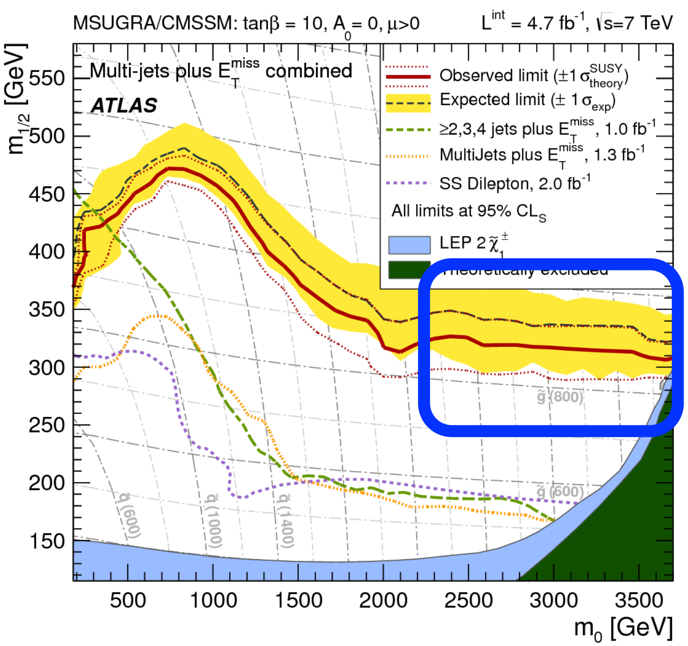
- Some of the strongest limits on the market for MSUGRA and GTT models
- Strong enough that ATLAS is also working on a 1-lepton many-jet search
- Small excess in 2011 is now a deficit in 2012



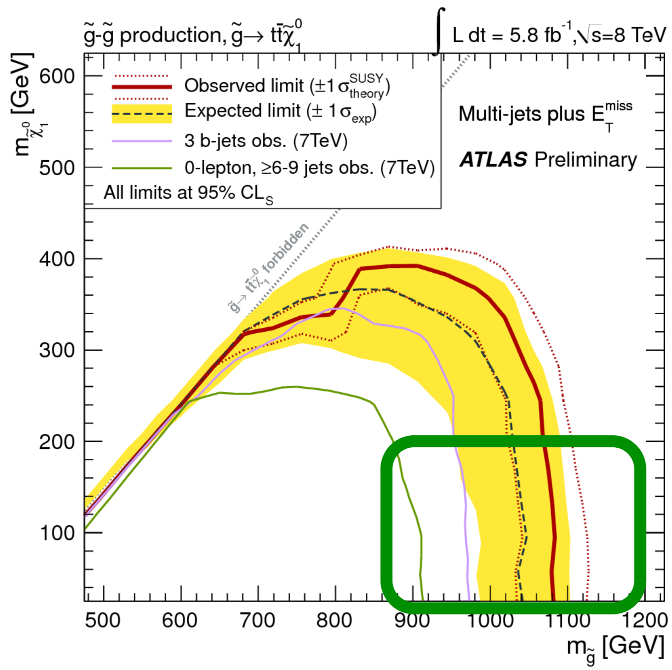


Note on the Higgs

- In fact, in our MSSM models, adding the constraint of a Higgs at 125 GeV and floating some of the parameters (A_0) that were previously fixed,

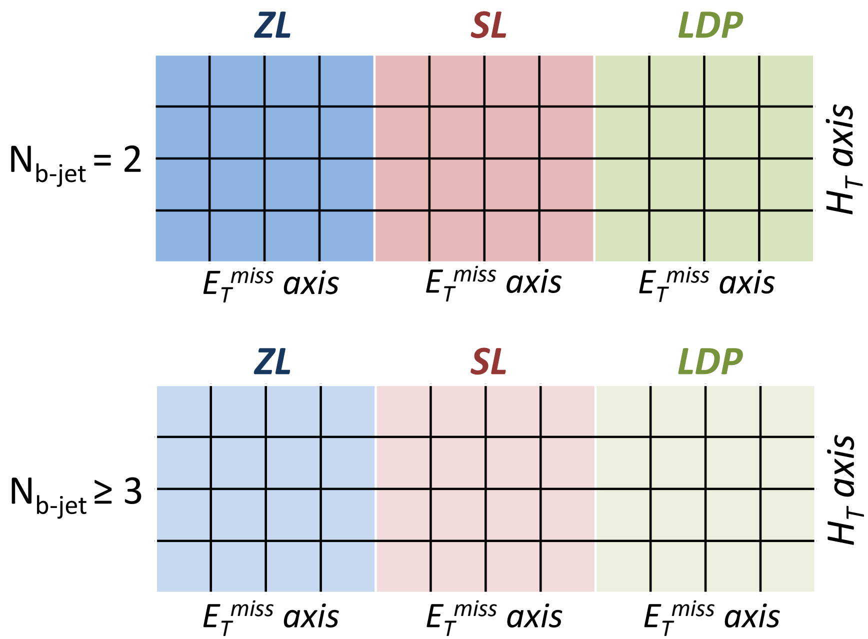


This **becomes** **This**



CMS Multi-b-jet Search

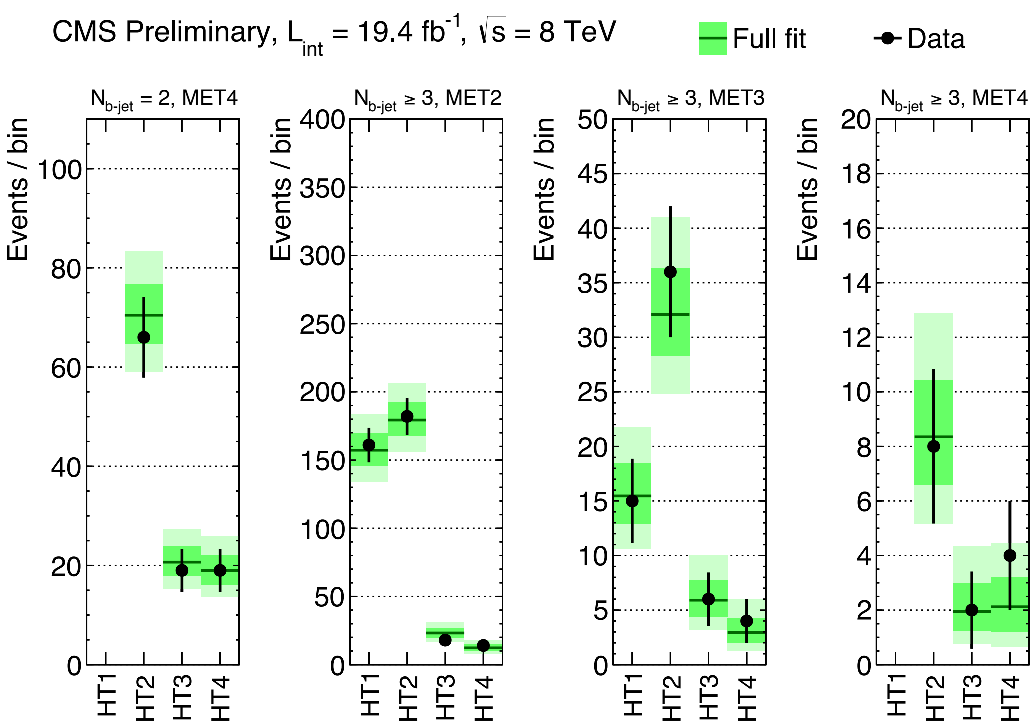
- Events divided into *many* bins
  - 1, 2, 3+ b-tagged jets; four bins of H_T, four bins of MET
- Conceptually, control, validation, and signal regions are in this set
- Actually, they are not really treated differently in the fit
- The question is rephrased: in the most sensitive bins of the analysis, how does the data-MC agreement look?

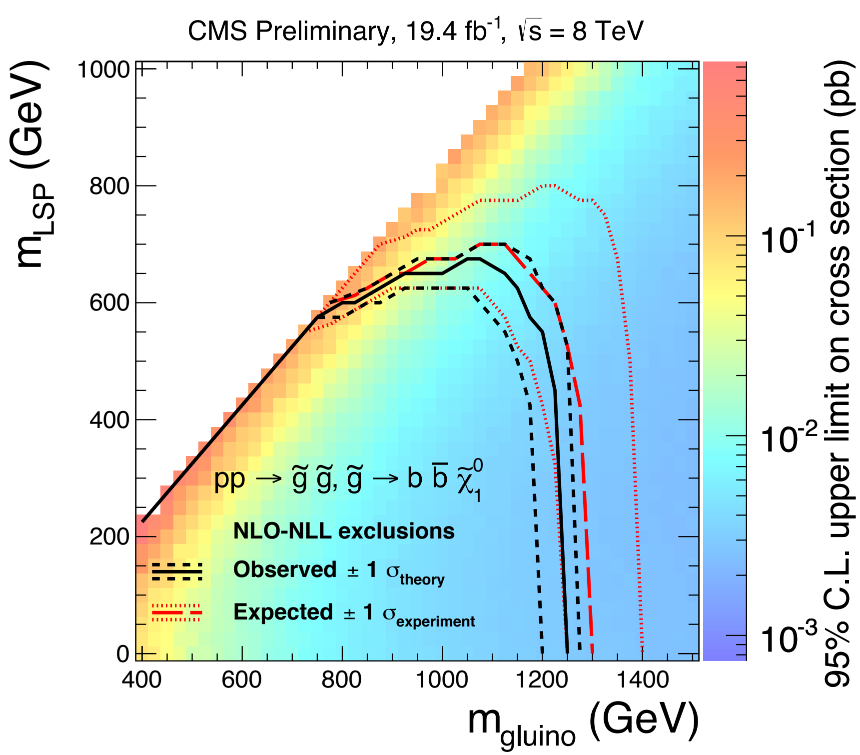


Bin	H_T (GeV)	E_T^{miss} (GeV)
1	400 – 500 (HT1)	125 – 150 (MET1)
2	500 – 800 (HT2)	150 – 250 (MET2)
3	800 – 1000 (HT3)	250 – 350 (MET3)
4	> 1000 (HT4)	> 350 (MET4)

Fit / Exclusion Results

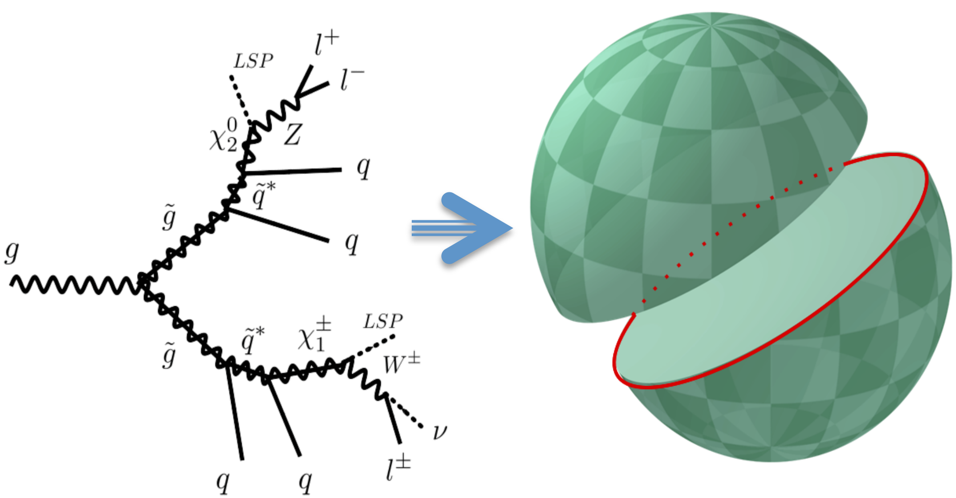
- In the 14 most sensitive regions, no significant excess found
  - Note: most sensitive regions will vary by signal model (!!), but they almost always will include the regions with the highest number of b-tagged jets!
- Limits are set in a number of different simplified models

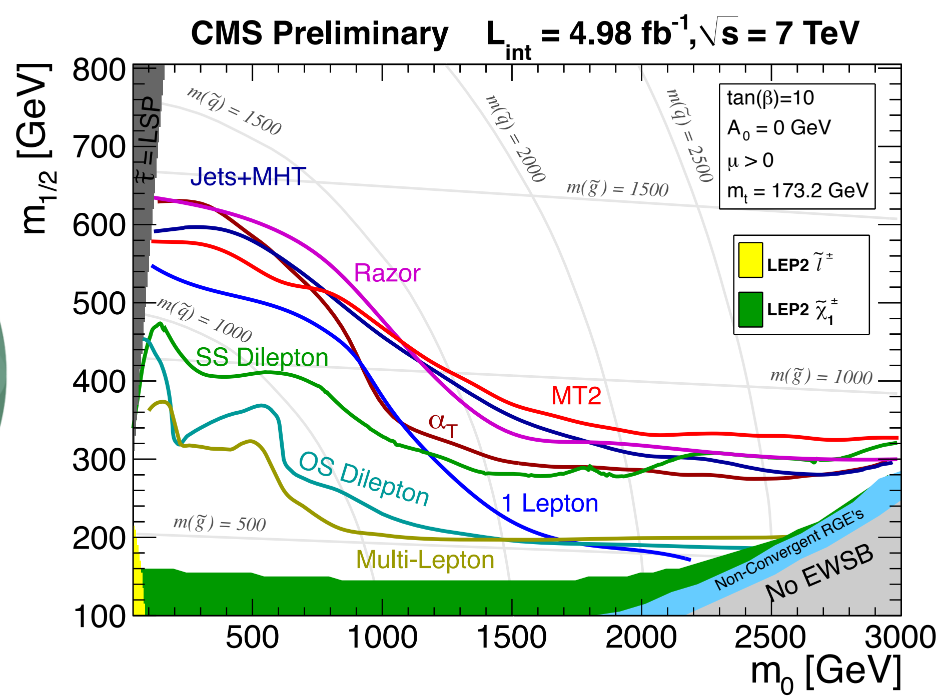




Structure from Chaos

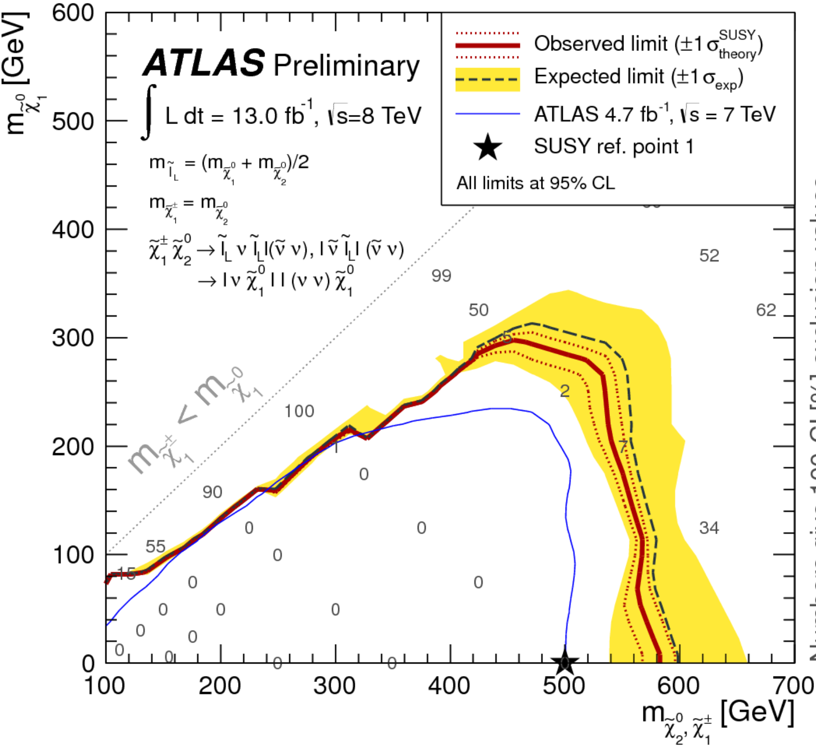
- With all those final state objects, can we do better than just counting them?
  - Enter mega-jets and the variables like α_T, MT2, and Razor
- Try to re-construct a decay topology by assuming SUSY is pair produced and that the pairs tend to be ~symmetric in mass
  - Build two four-vectors, one for each side of the SUSY diagram
  - NB: don't have to be covering opposite hemispheres (picture is a bit misleading)
  - Limits *can* be strong – depends on the topology which approach really wins

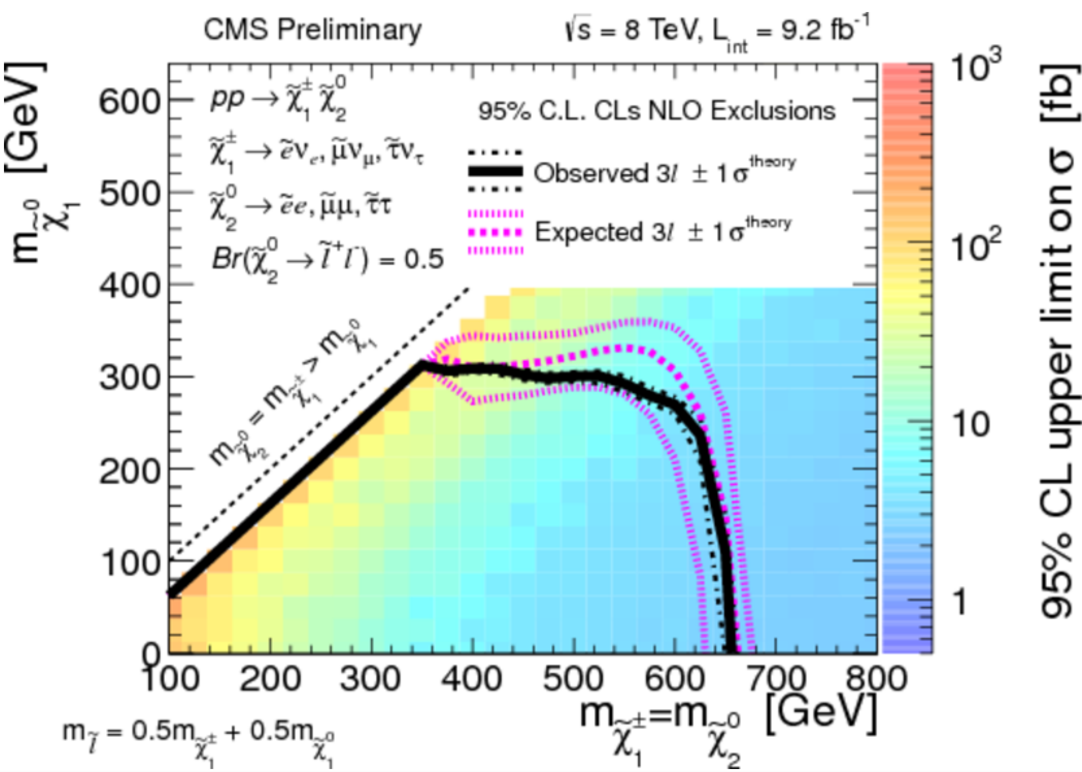




Weakinos and Sleptons

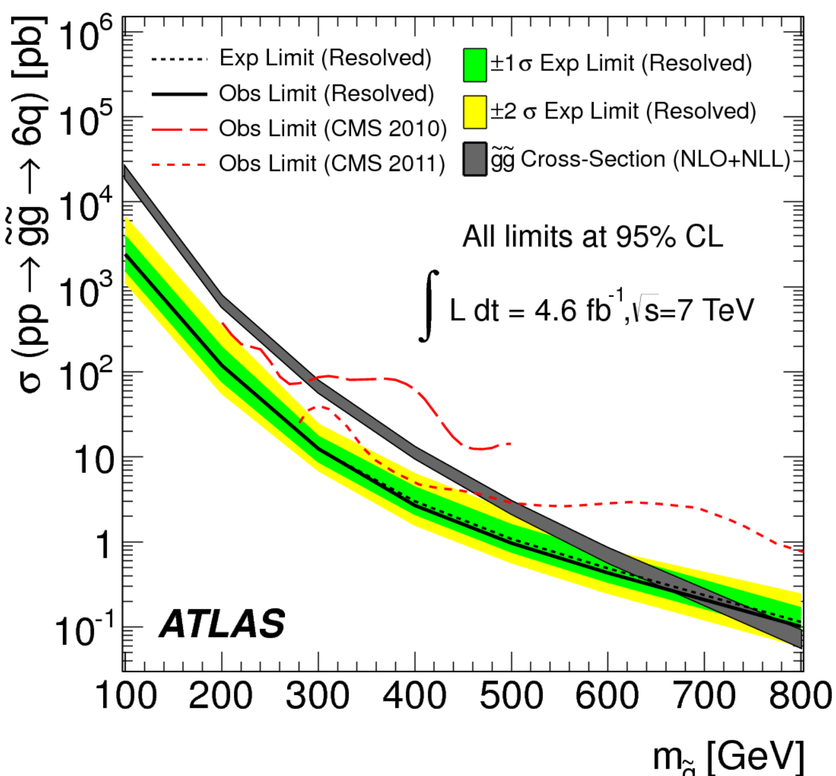
- We have some nice searches for weakino production
  - Generally much lighter, so need leptonic final states
  - Many options for (non-)degeneracy, decay modes, etc
  - Even worse when sleptons enter the game, but we still provide limits on some specific light stau models
  - It eventually pays to use our model-independent multi-lepton production limits

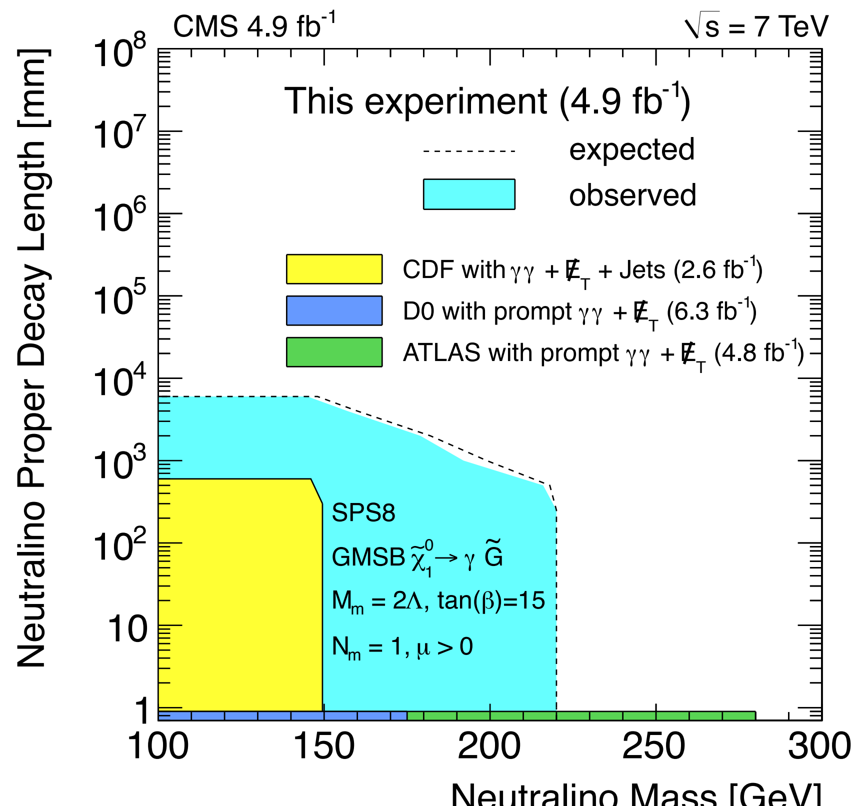




R-Parity Violation

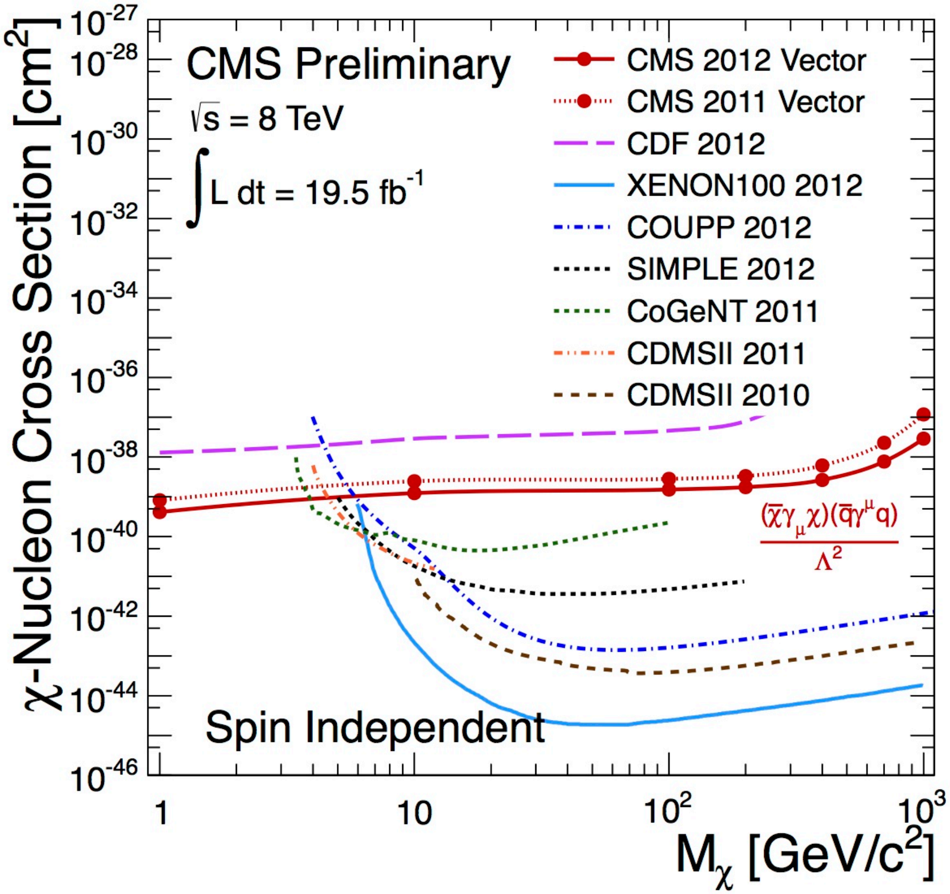
- R-Parity violating models come in three basic flavors
  - Short lived (resonance searches)
  - "Magic" lifetimes (displaced vertices, displaced jets
  - Long lived (heavy charged particles)
- Large number of searches for these because of the variety of signatures

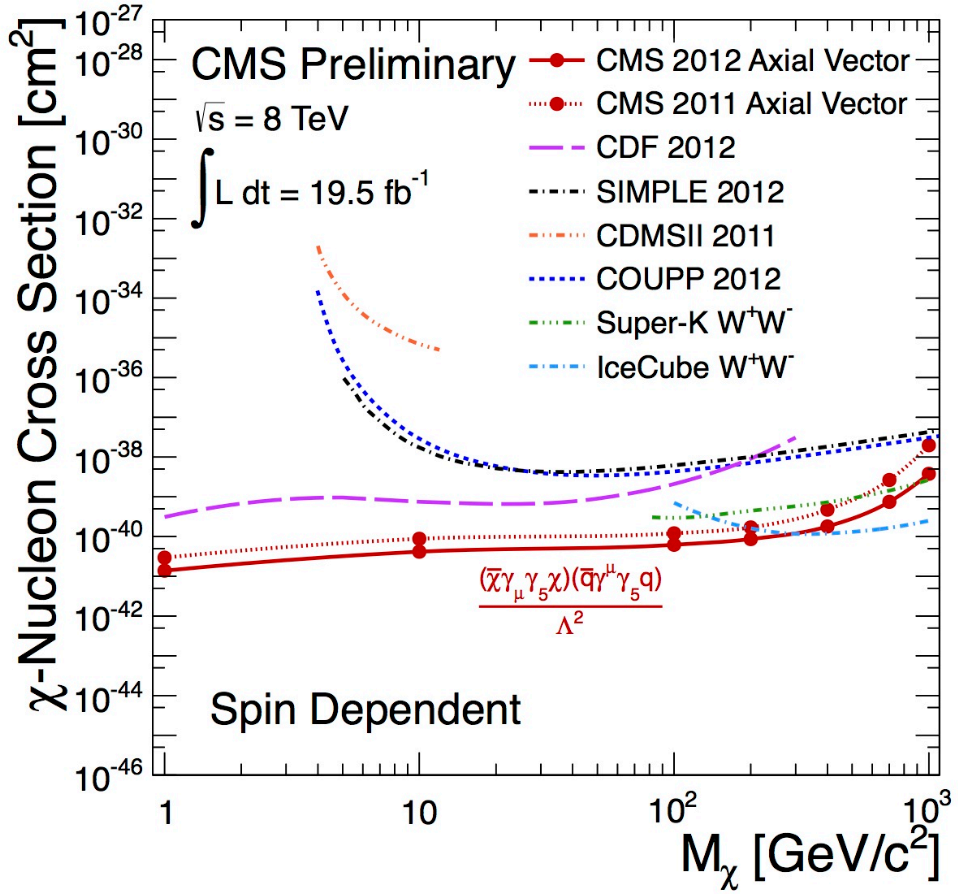




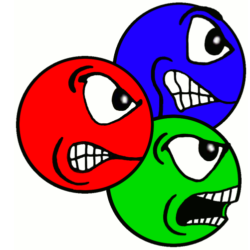
Phenomenology

- Remember that our limits on non-traditional SUSY phenomena may also limit SUSY – exotic searches can exclude SUSY too!
- Monojets are right on the boundary
  - Some of the strongest CMS limits come from SUSY searches as well

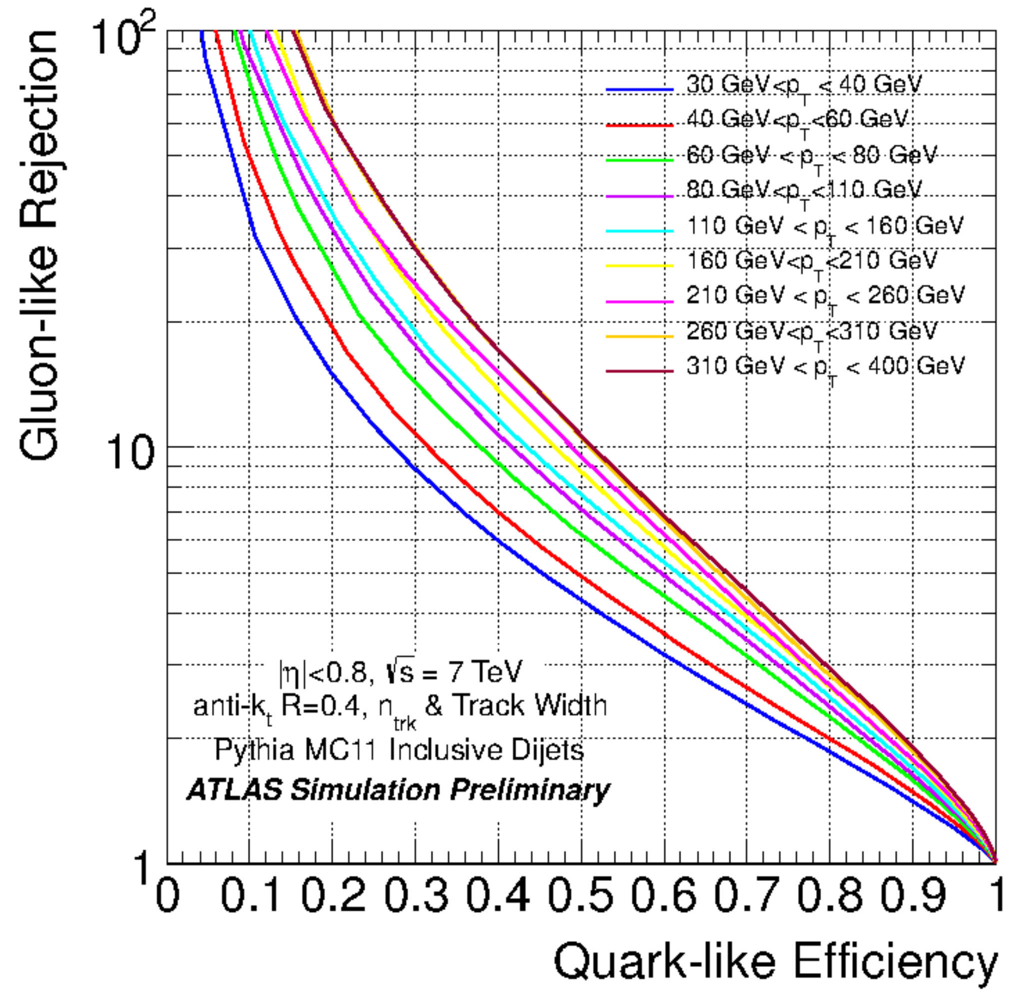




Quark Jet Tagging?

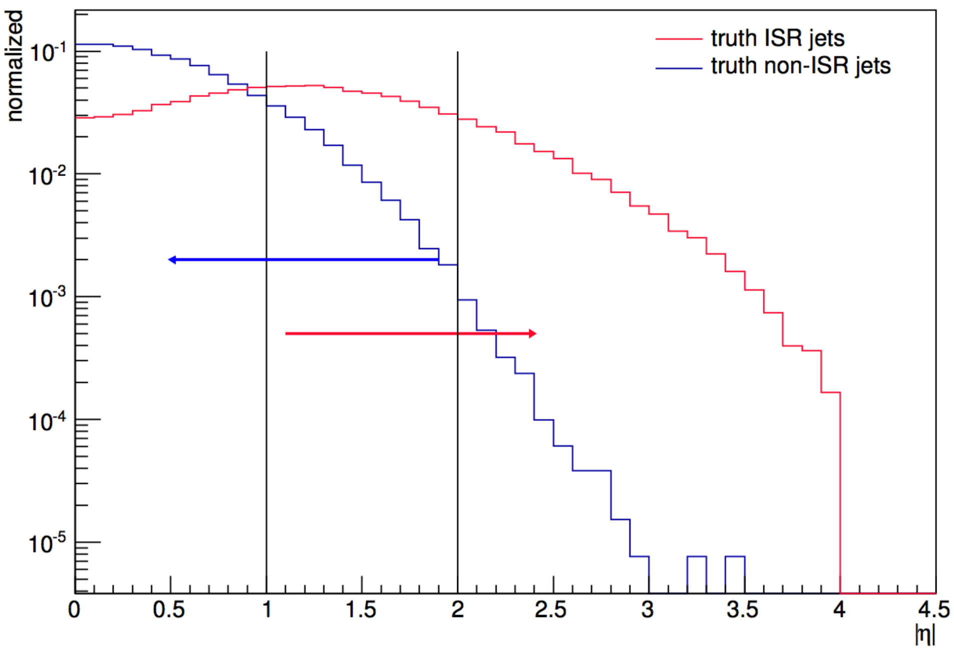


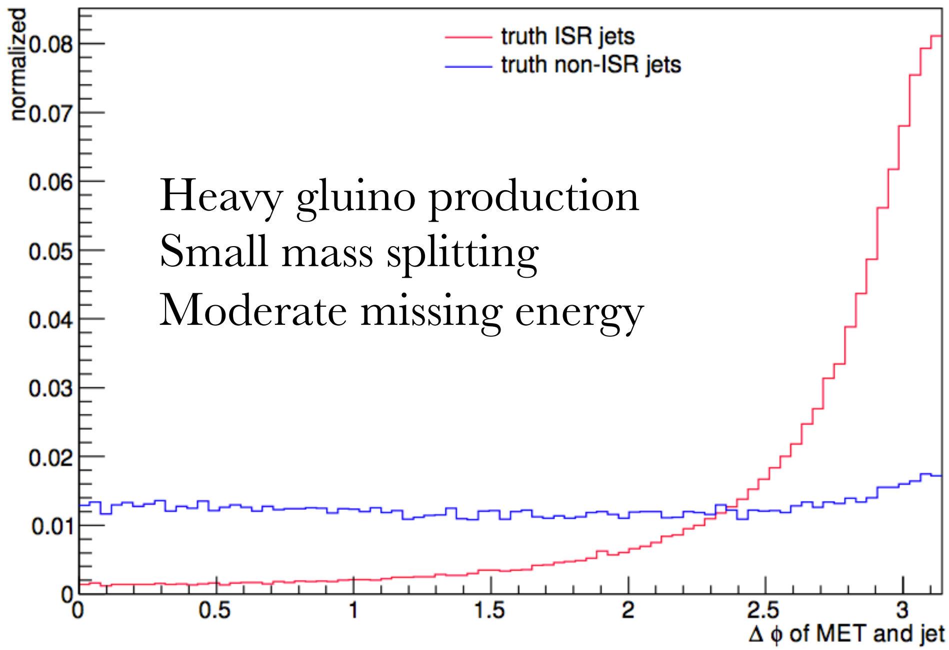
- Quite a bit of interest in quark/ gluon jet discrimination lately
  - Pheno in arXiv:1106.3076
  - Jets are **colorless**, so "quark-jet" is a misnomer
  - Quark-like jet and gluon-like jet are still useful for physics…
- This Pythia MC significantly *overestimates* the differences in the observable properties
  - Means that our quark/gluon discrimination is not this good (worse by a factor of two)
  - You shouldn't take q/g discriminators too seriously *yet*
  - We *are* working on the problems, so expect that soon we will get reasonable performance out



The Not-Too-Distant Future

- Some interesting literature recently about the possibility of ISR tagging
  - For some theoretical discussion, see e.g. arXiv:0905.1201 and arXiv:1101.0810
  - Claims include that we could get at the production mass scale (this seems untrue) and that we could more easily find new physics (seems *more* true)
- This is experimentally not too painful, but one has to be very careful about the interpretation of what exactly is being tagged
  - There are a few variables we can look at that appear "safe" and well-modeled

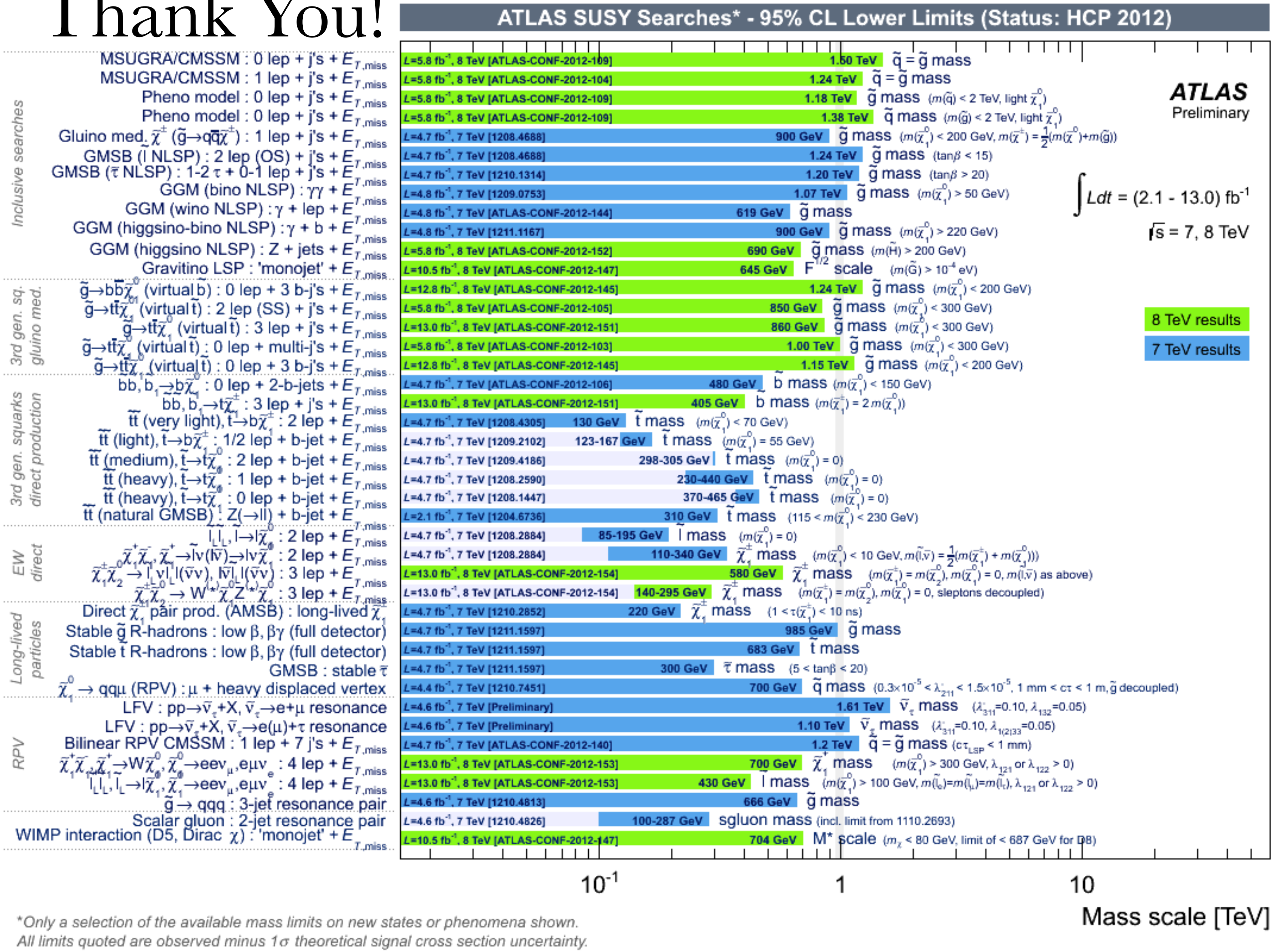




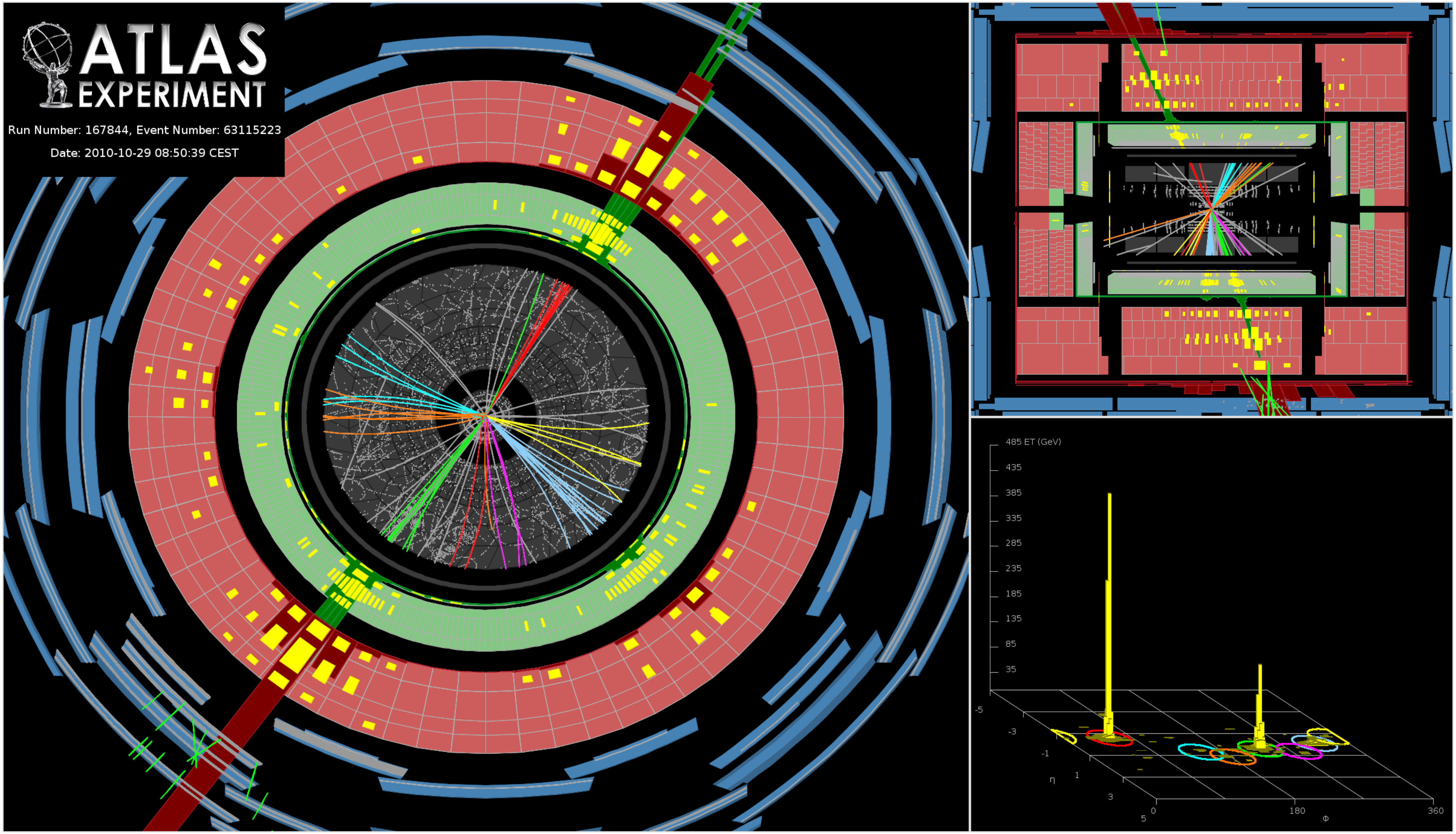
Summary

- The LHC measurement program is progressing nicely
  - NLO QCD and MCs (Pythia) are holding up surprisingly well
  - We are doing better precision physics than many anticipated we could
- We have a new particle to study
  - Right now really appears to be the SM Higgs
  - Any theory of new physics *must* take this thing into account
- Limits on Z' and SUSY are strong for simple scenarios and cover a wide range of possibilities
  - If there are areas that you think we have missed, please don't be shy!
- SUSY may (really!!!) not have long to live, in a natural way
  - We'll keep looking in those other key hiding places, compressed and R-parity violating scenarios, and for all the other possibilities out there…
  - There are some nice tools coming to improve our search reach
  - Some limits are becoming more model-dependent in order to provide limits that are as strong as possible; others are staying fairly model independent (but, of course, provide weaker limits on specific models!)
  - But, of course, there are a lot of places to look…

Thank You!


ATLAS SUSY Searches* - 95% CL Lower Limits (Status: HCP 2012)
ATLAS
Preliminary
∫Ldt = (2.1 - 13.0) fb⁻¹
√s = 7, 8 TeV
8 TeV results
7 TeV results
Inclusive searches
MSUGRA/CMSSM : 0 lep + j's + E_T,miss — L=5.8 fb-1, 8 TeV [ATLAS-CONF-2012-109] — 1.50 TeV q̃ = g̃ mass
MSUGRA/CMSSM : 1 lep + j's + E_T,miss — L=5.8 fb-1, 8 TeV [ATLAS-CONF-2012-104] — 1.24 TeV q̃ = g̃ mass
Pheno model : 0 lep + j's + E_T,miss — L=5.8 fb-1, 8 TeV [ATLAS-CONF-2012-109] — 1.18 TeV g̃ mass (m(q̃) < 2 TeV, light χ̃⁰₁)
Pheno model : 0 lep + j's + E_T,miss — L=5.8 fb-1, 8 TeV [ATLAS-CONF-2012-109] — 1.38 TeV q̃ mass (m(g̃) < 2 TeV, light χ̃⁰₁)
Gluino med. χ̃± (g̃→qq̄χ̃±) : 1 lep + j's + E_T,miss — L=4.7 fb-1, 7 TeV [1208.4688] — 900 GeV g̃ mass (m(χ̃⁰₁) < 200 GeV, m(χ̃±) = ½(m(χ̃⁰)+m(g̃)))
GMSB (l̃ NLSP) : 2 lep (OS) + j's + E_T,miss — L=4.7 fb-1, 7 TeV [1208.4688] — 1.24 TeV g̃ mass (tanβ < 15)
GMSB (τ̃ NLSP) : 1-2 τ + 0-1 lep + j's + E_T,miss — L=4.7 fb-1, 7 TeV [1210.1314] — 1.20 TeV g̃ mass (tanβ > 20)
GGM (bino NLSP) : γγ + E_T,miss — L=4.8 fb-1, 7 TeV [1209.0753] — 1.07 TeV g̃ mass (m(χ̃⁰₁) > 50 GeV)
GGM (wino NLSP) : γ + lep + E_T,miss — L=4.8 fb-1, 7 TeV [ATLAS-CONF-2012-144] — 619 GeV g̃ mass
GGM (higgsino-bino NLSP) : γ + b + E_T,miss — L=4.8 fb-1, 7 TeV [1211.1167] — 900 GeV g̃ mass (m(χ̃⁰₁) > 220 GeV)
GGM (higgsino NLSP) : Z + jets + E_T,miss — L=5.8 fb-1, 8 TeV [ATLAS-CONF-2012-152] — 690 GeV g̃ mass (m(H̃) > 200 GeV)
Gravitino LSP : 'monojet' + E_T,miss — L=10.5 fb-1, 8 TeV [ATLAS-CONF-2012-147] — 645 GeV F^1/2 scale (m(G̃) > 10⁻⁴ eV)
3rd gen. sq. gluino med.
g̃→bb̄χ̃⁰₁ (virtual b̃) : 0 lep + 3 b-j's + E_T,miss — L=12.8 fb-1, 8 TeV [ATLAS-CONF-2012-145] — 1.24 TeV g̃ mass (m(χ̃⁰₁) < 200 GeV)
g̃→tt̄χ̃⁰₁ (virtual t̃) : 2 lep (SS) + j's + E_T,miss — L=5.8 fb-1, 8 TeV [ATLAS-CONF-2012-105] — 850 GeV g̃ mass (m(χ̃⁰₁) < 300 GeV)
g̃→tt̄χ̃⁰₁ (virtual t̃) : 3 lep + j's + E_T,miss — L=13.0 fb-1, 8 TeV [ATLAS-CONF-2012-151] — 860 GeV g̃ mass (m(χ̃⁰₁) < 300 GeV)
g̃→tt̄χ̃⁰₁ (virtual t̃) : 0 lep + multi-j's + E_T,miss — L=5.8 fb-1, 8 TeV [ATLAS-CONF-2012-103] — 1.00 TeV g̃ mass (m(χ̃⁰₁) < 300 GeV)
g̃→tt̄χ̃⁰₁ (virtual t̃) : 0 lep + 3 b-j's + E_T,miss — L=12.8 fb-1, 8 TeV [ATLAS-CONF-2012-145] — 1.15 TeV g̃ mass (m(χ̃⁰₁) < 200 GeV)
3rd gen. squarks direct production
b̃b̃, b̃₁→bχ̃⁰₁ : 0 lep + 2-b-jets + E_T,miss — L=4.7 fb-1, 7 TeV [ATLAS-CONF-2012-106] — 480 GeV b̃ mass (m(χ̃⁰₁) < 150 GeV)
b̃b̃, b̃₁→tχ̃±₁ : 3 lep + j's + E_T,miss — L=13.0 fb-1, 8 TeV [ATLAS-CONF-2012-151] — 405 GeV b̃ mass (m(χ̃±₁) = 2 m(χ̃⁰₁))
t̃t̃ (very light), t̃→bχ̃±₁ : 2 lep + E_T,miss — L=4.7 fb-1, 7 TeV [1208.4305] — 130 GeV t̃ mass (m(χ̃⁰₁) < 70 GeV)
t̃t̃ (light), t̃→bχ̃±₁ : 1/2 lep + b-jet + E_T,miss — L=4.7 fb-1, 7 TeV [1209.2102] — 123-167 GeV t̃ mass (m(χ̃⁰₁) = 55 GeV)
t̃t̃ (medium), t̃→tχ̃⁰₁ : 2 lep + b-jet + E_T,miss — L=4.7 fb-1, 7 TeV [1209.4186] — 298-305 GeV t̃ mass (m(χ̃⁰₁) = 0)
t̃t̃ (heavy), t̃→tχ̃⁰₁ : 1 lep + b-jet + E_T,miss — L=4.7 fb-1, 7 TeV [1208.2590] — 230-440 GeV t̃ mass (m(χ̃⁰₁) = 0)
t̃t̃ (heavy), t̃→tχ̃⁰₁ : 0 lep + b-jet + E_T,miss — L=4.7 fb-1, 7 TeV [1208.1447] — 370-465 GeV t̃ mass (m(χ̃⁰₁) = 0)
t̃t̃ (natural GMSB) : Z(→ll) + b-jet + E_T,miss — L=2.1 fb-1, 7 TeV [1204.6736] — 310 GeV t̃ mass (115 < m(χ̃⁰₁) < 230 GeV)
EW direct
l̃_L l̃_L, l̃→lχ̃⁰₁ : 2 lep + E_T,miss — L=4.7 fb-1, 7 TeV [1208.2884] — 85-195 GeV l̃ mass (m(χ̃⁰₁) = 0)
χ̃⁺₁χ̃⁻₁, χ̃⁺₁→l̃ν(lν̃)→lνχ̃⁰₁ : 2 lep + E_T,miss — L=4.7 fb-1, 7 TeV [1208.2884] — 110-340 GeV χ̃±₁ mass (m(χ̃⁰₁) < 10 GeV, m(l̃,ν̃) = ½(m(χ̃±₁) + m(χ̃⁰₁)))
χ̃±₁χ̃⁰₂→l̃_Lνl̃_Ll(ν̃ν), l̃νl̃_Ll(ν̃ν) : 3 lep + E_T,miss — L=13.0 fb-1, 8 TeV [ATLAS-CONF-2012-154] — 580 GeV χ̃±₁ mass (m(χ̃±₁) = m(χ̃⁰₂), m(χ̃⁰₁) = 0, m(l̃,ν̃) as above)
χ̃±₁χ̃⁰₂ → W(*)χ̃⁰₁Z(*)χ̃⁰₁ : 3 lep + E_T,miss — L=13.0 fb-1, 8 TeV [ATLAS-CONF-2012-154] — 140-295 GeV χ̃±₁ mass (m(χ̃±₁) = m(χ̃⁰₂), m(χ̃⁰₁) = 0, sleptons decoupled)
Long-lived particles
Direct χ̃±₁ pair prod. (AMSB) : long-lived χ̃±₁ — L=4.7 fb-1, 7 TeV [1210.2852] — 220 GeV χ̃±₁ mass (1 < τ(χ̃±₁) < 10 ns)
Stable g̃ R-hadrons : low β, βγ (full detector) — L=4.7 fb-1, 7 TeV [1211.1597] — 985 GeV g̃ mass
Stable t̃ R-hadrons : low β, βγ (full detector) — L=4.7 fb-1, 7 TeV [1211.1597] — 683 GeV t̃ mass
GMSB : stable τ̃ — L=4.7 fb-1, 7 TeV [1211.1597] — 300 GeV τ̃ mass (5 < tanβ < 20)
χ̃⁰₁ → qqμ (RPV) : μ + heavy displaced vertex — L=4.4 fb-1, 7 TeV [1210.7451] — 700 GeV q̃ mass (0.3×10⁻⁵ < λ′₂₁₁ < 1.5×10⁻⁵, 1 mm < cτ < 1 m, g̃ decoupled)
RPV
LFV : pp→ν̃τ+X, ν̃τ→e+μ resonance — L=4.6 fb-1, 7 TeV [Preliminary] — 1.61 TeV ν̃τ mass (λ′₃₁₁=0.10, λ₁₃₂=0.05)
LFV : pp→ν̃τ+X, ν̃τ→e(μ)+τ resonance — L=4.6 fb-1, 7 TeV [Preliminary] — 1.10 TeV ν̃τ mass (λ′₃₁₁=0.10, λ₁(2)33=0.05)
Bilinear RPV CMSSM : 1 lep + 7 j's + E_T,miss — L=4.7 fb-1, 7 TeV [ATLAS-CONF-2012-140] — 1.2 TeV q̃ = g̃ mass (cτ_LSP < 1 mm)
χ̃⁺₁χ̃⁻₁, χ̃⁺₁→Wχ̃⁰₁, χ̃⁰₁→eeν_μ, eμν_e : 4 lep + E_T,miss — L=13.0 fb-1, 8 TeV [ATLAS-CONF-2012-153] — 700 GeV χ̃±₁ mass (m(χ̃⁰₁) > 300 GeV, λ₁₂₁ or λ₁₂₂ > 0)
l̃_L l̃_L, l̃_L→lχ̃⁰₁, χ̃⁰₁→eeν_μ, eμν_e : 4 lep + E_T,miss — L=13.0 fb-1, 8 TeV [ATLAS-CONF-2012-153] — 430 GeV l̃ mass (m(χ̃⁰₁) > 100 GeV, m(l̃_e)=m(l̃_μ)=m(l̃_τ), λ₁₂₁ or λ₁₂₂ > 0)
g̃ → qqq : 3-jet resonance pair — L=4.6 fb-1, 7 TeV [1210.4813] — 666 GeV g̃ mass
Scalar gluon : 2-jet resonance pair — L=4.6 fb-1, 7 TeV [1210.4826] — 100-287 GeV sgluon mass (incl. limit from 1110.2693)
WIMP interaction (D5, Dirac χ) : 'monojet' + E_T,miss — L=10.5 fb-1, 8 TeV [ATLAS-CONF-2012-147] — 704 GeV M* scale (m_χ < 80 GeV, limit of < 687 GeV for D8)
10⁻¹
1
10
Mass scale [TeV]
*Only a selection of the available mass limits on new states or phenomena shown.
All limits quoted are observed minus 1σ theoretical signal cross section uncertainty.

Backup Slides



More R-Parity Violating Limits

- Long-lived photons (left) and squark-like R-hadrons (right)