Search for supersymmetry in the multijet and missing transverse momentum final state: an analysis performed on 2.3 fb^{-1} of 13 TeV data collected with the CMS detector

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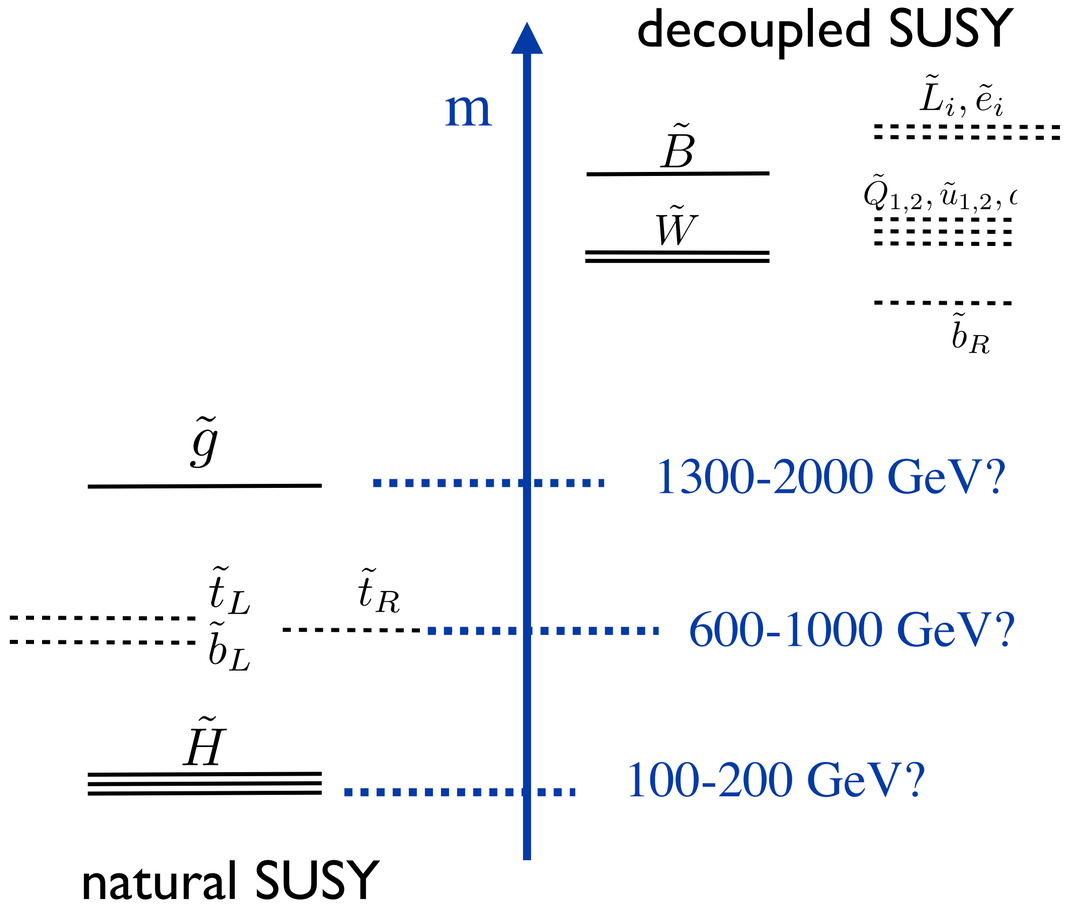
on behalf of the CMS collaboration

Young Scientists Forum
51er Rencontres de Moriond (EWK)
12-19 Mar 2016

Signal models and signatures

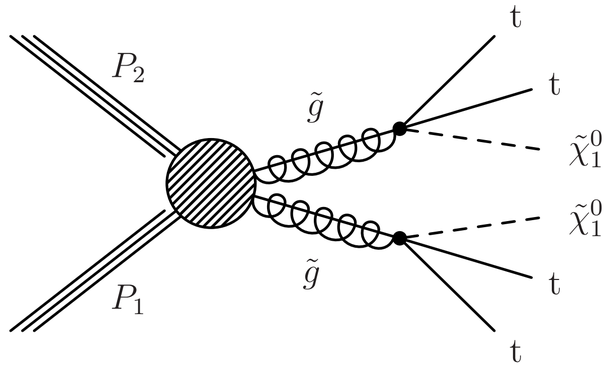
- SUSY great target for early Run II search:
  - ✓ Strongly-produced, high mass, spectacular final states
- "Natural" scenario: several particles accessible at EWK scale



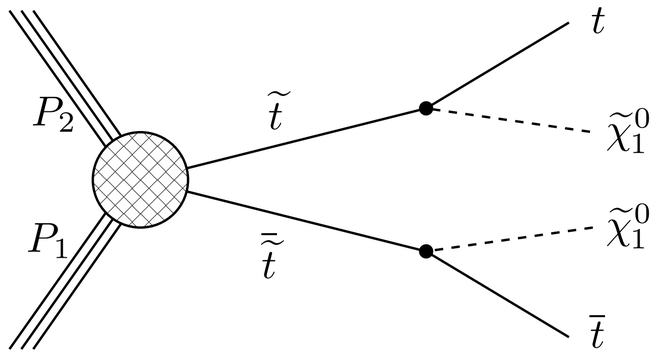
References: M. Papucci, et. al. (2011), N. Craig (2013), J. Feng (2013)
https://twiki.cern.ch/twiki/bin/view/AtlasPublic/SupersymmetryPublicResults
https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsSUS

Sample models

Direct gluino production



Direct stop production



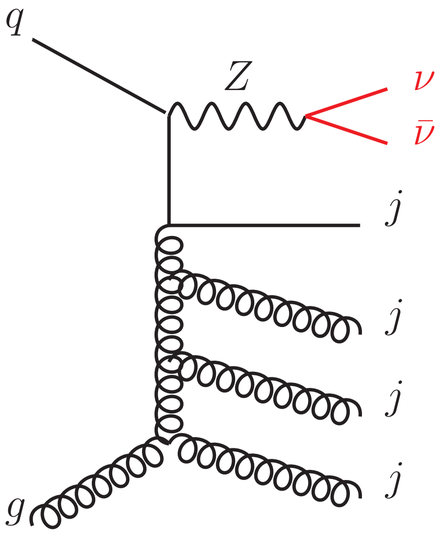
Search strategy: inclusive and generic

- Consider events with lots of jets (4+, p_T > 30 GeV), large H_T^{miss} (> 200 GeV) and H_T (>500 GeV), no leptons
- Characterize events by binning in simple variables:

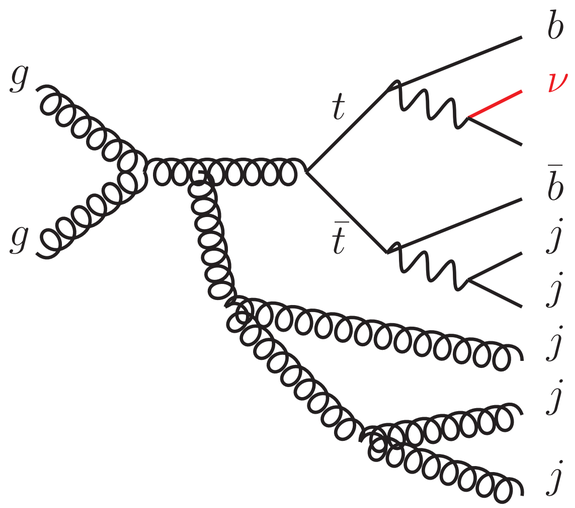
$$\left\{ \begin{array}{ll} & 3 \text{ bins of } N_{\text{jet}} \\ \times & 4 \text{ bins of } N_{\text{b-jet}} \\ \times & 6 \text{ bins of } H_T^{\text{miss}} \& \ H_T \end{array} \right\} = 72 \text{ search regions}$$

SM background composition

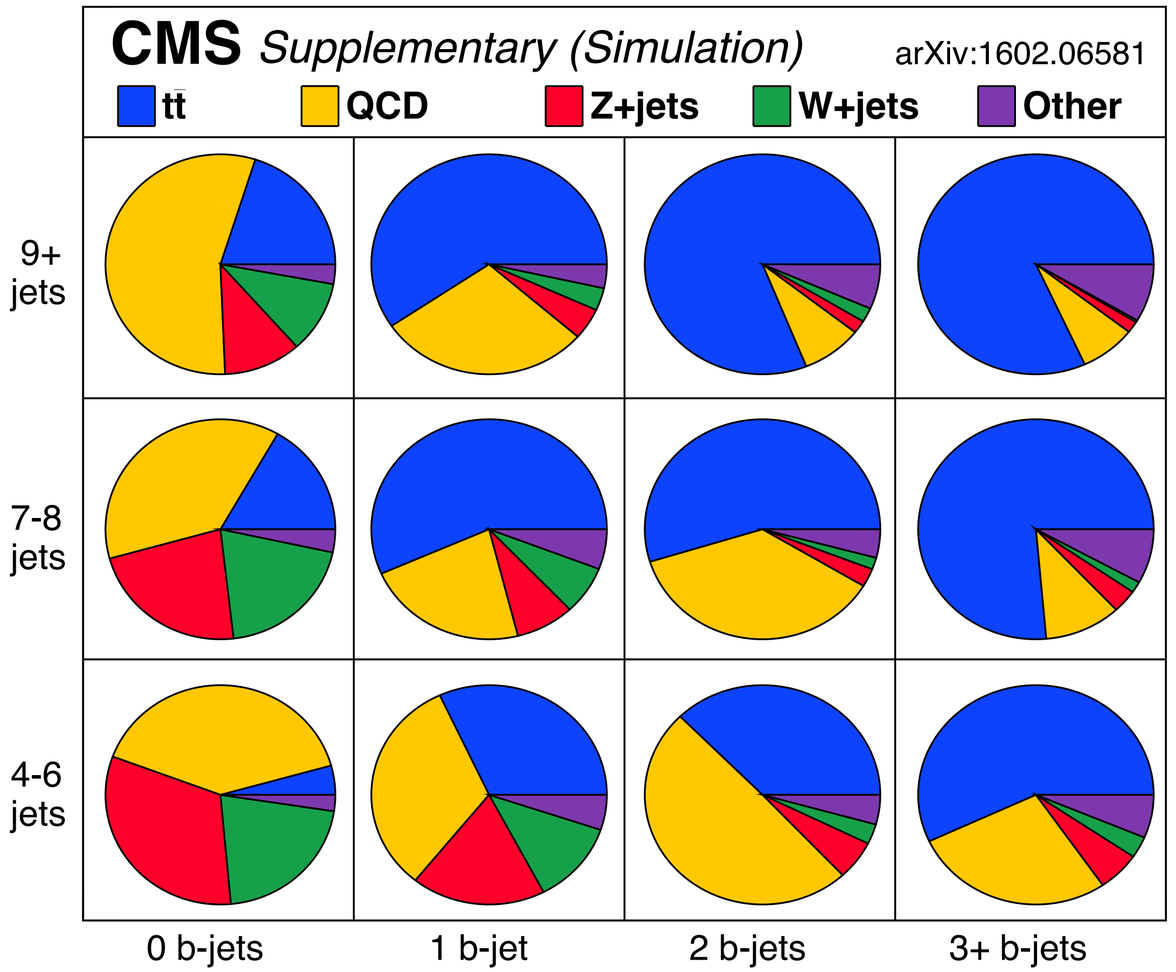
Z→νν + jets



top / *W* →ℓν+ jets



$H_T^{\text{miss}} > 200$ GeV, $H_T > 500$ GeV (13 TeV)



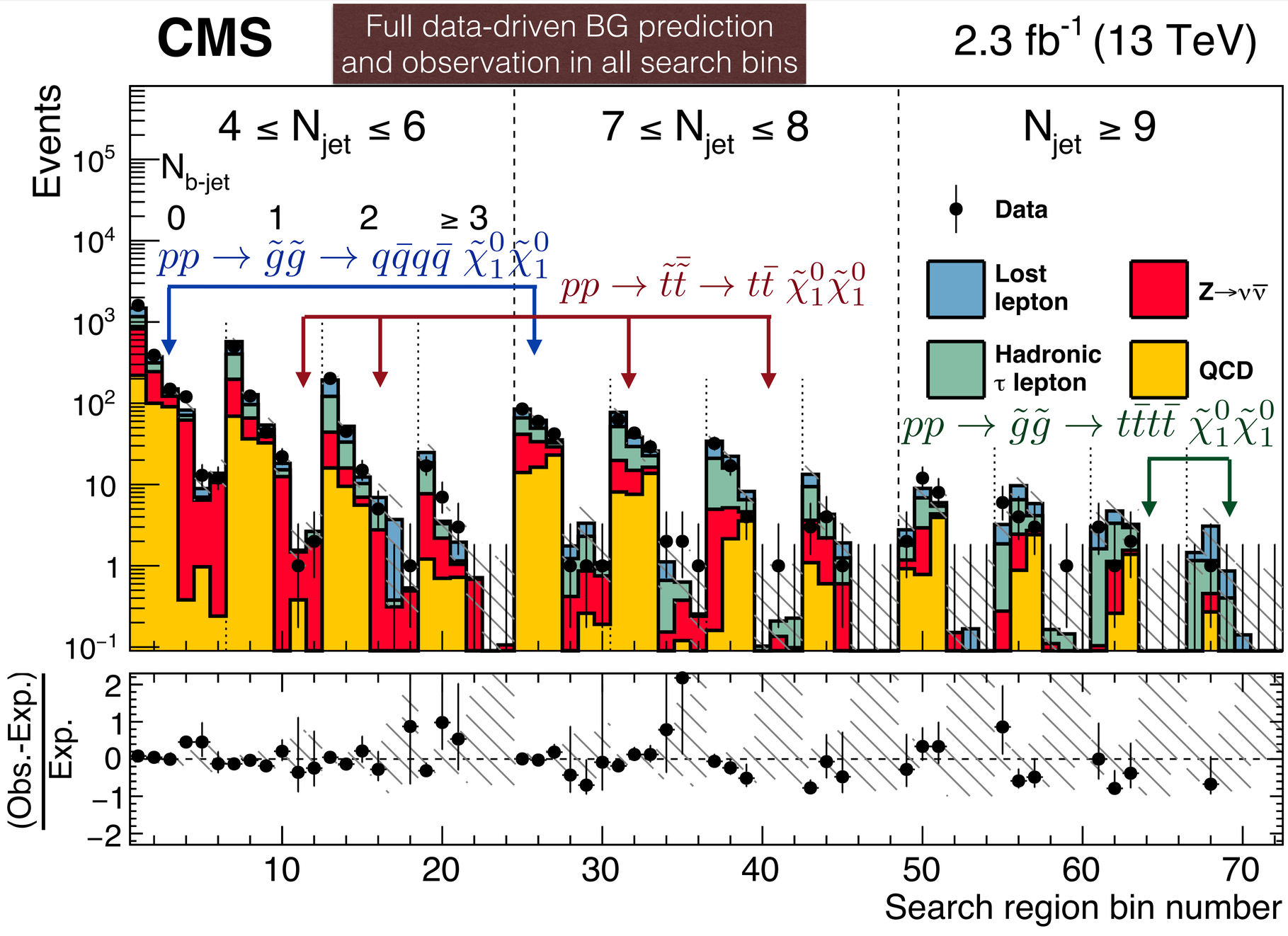
QCD multijet (fake-H_T^{miss})

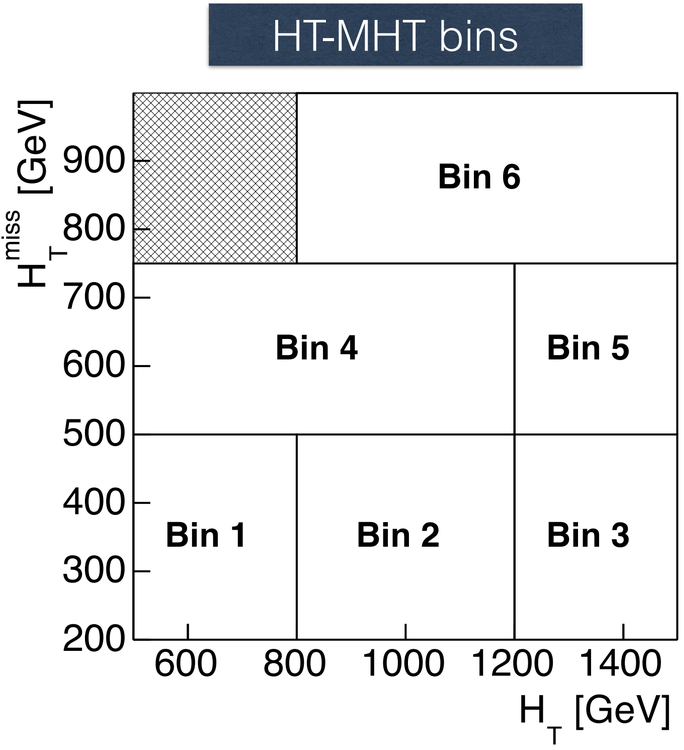
Grey: true jet p_T

Black: measured jet p_T

- SM backgrounds have xsecs orders-of-magnitude above SUSY
- Find sensitivity on **extreme kinematic tails**
- **Measure each SM background using control regions in data**

Data and SM background prediction

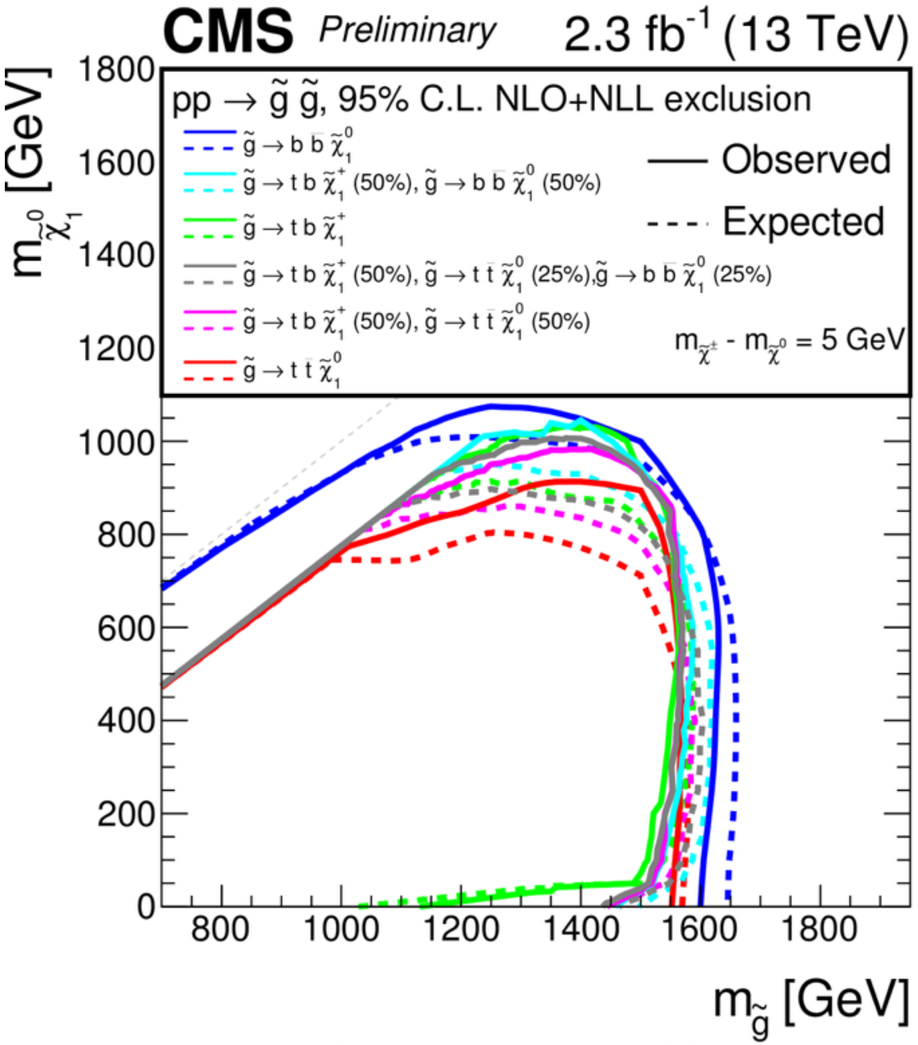




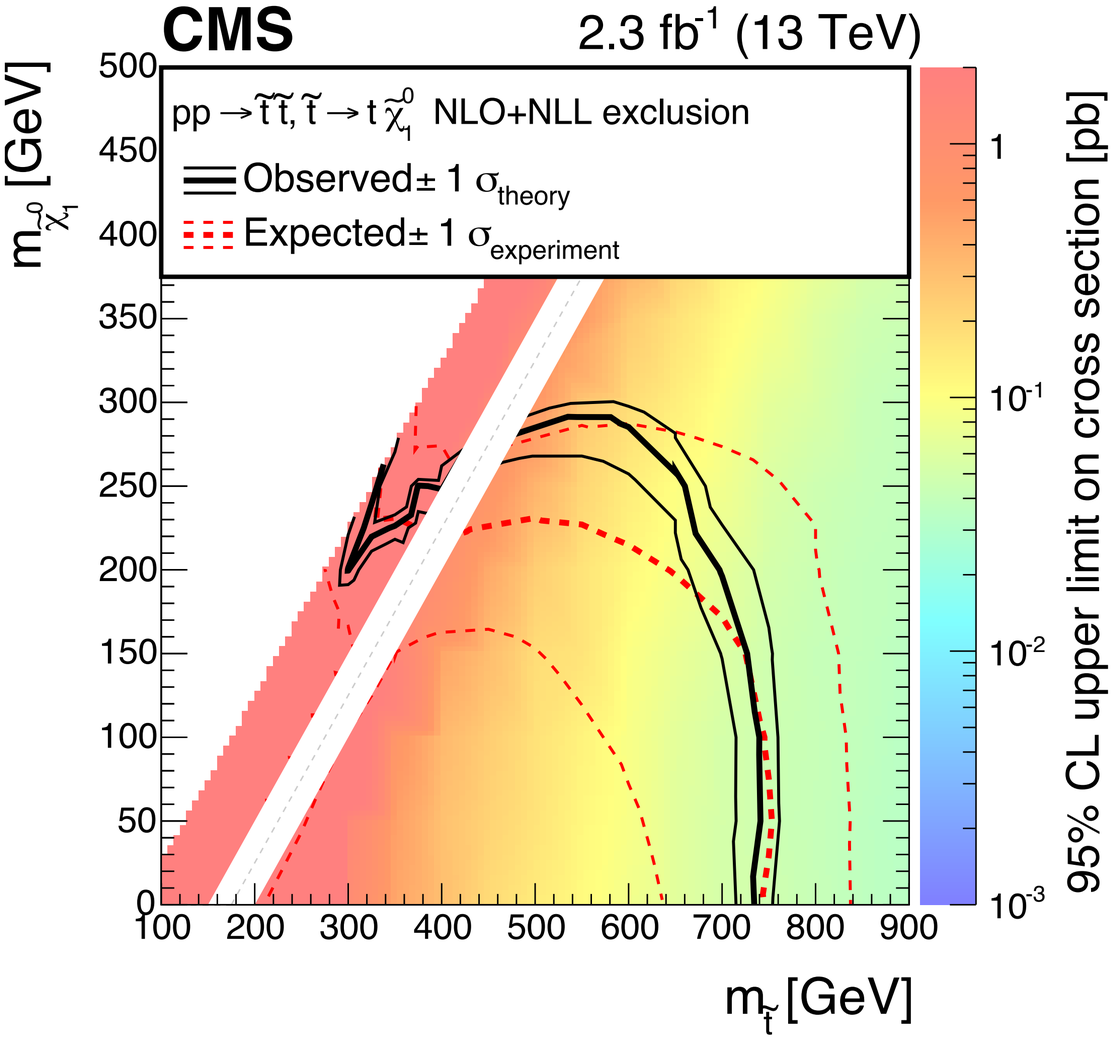
Data are well-described by SM background prediction

Interpretation

Direct gluino production, gluino decays to heavy flavor squarks

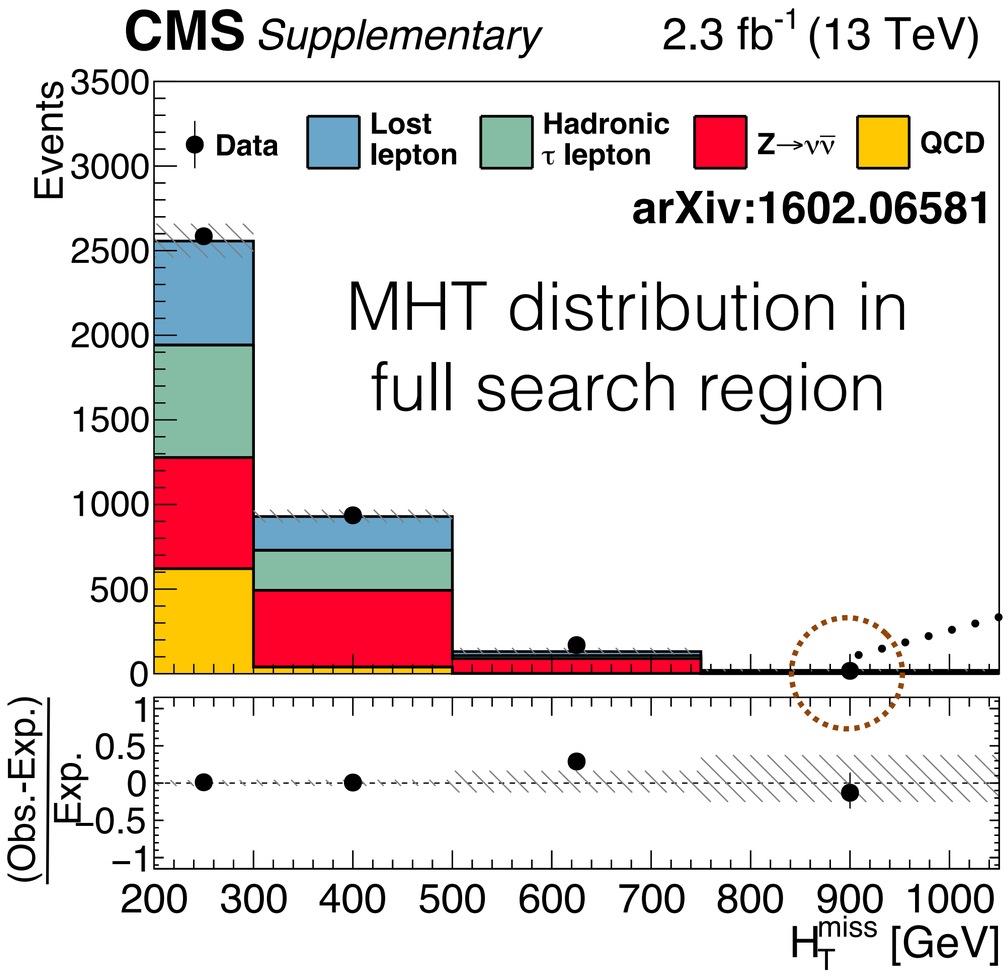


Direct stop production

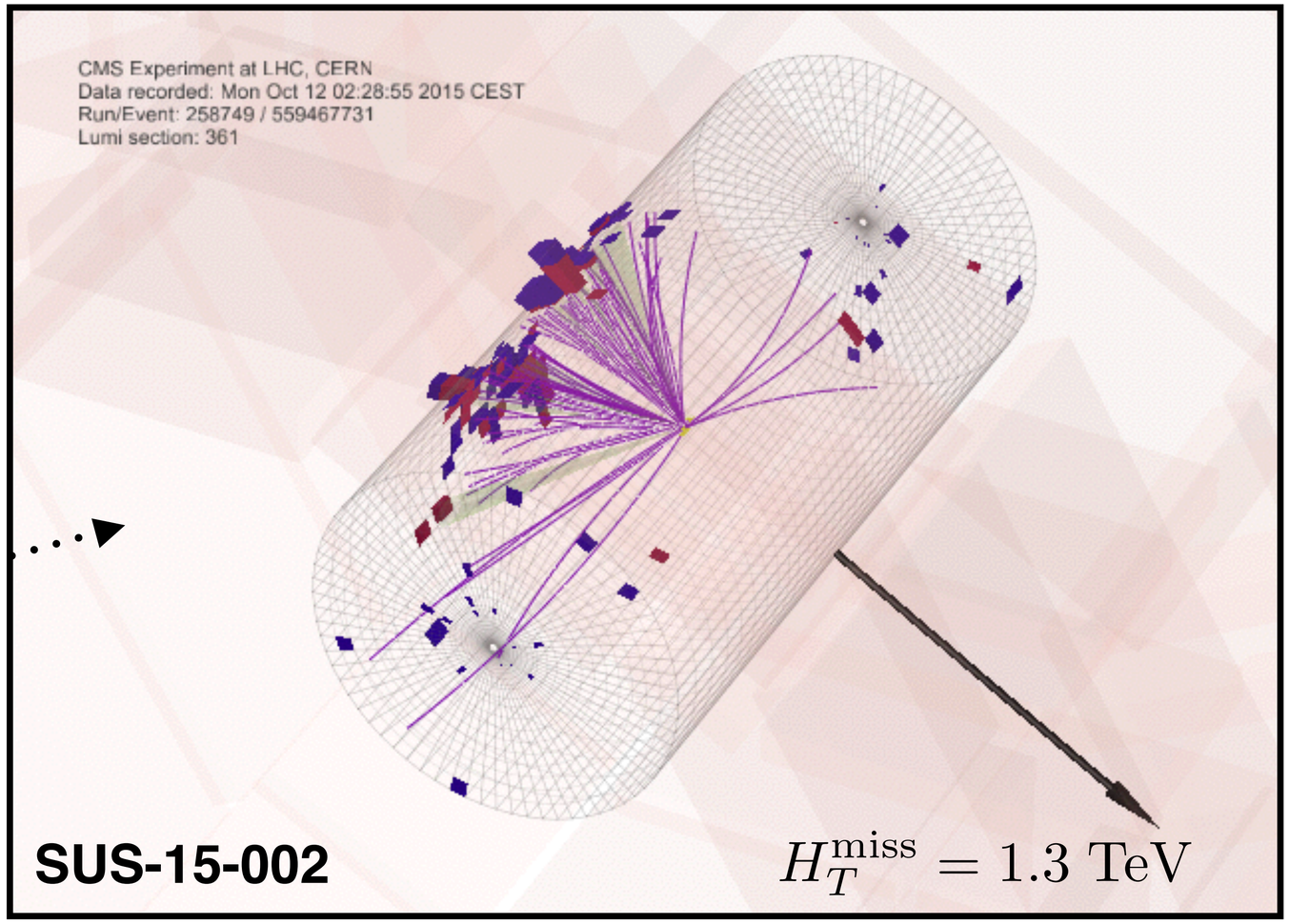


- No excess → set limits on simplified models → significantly surpassing many 2012 limits
- For additional interpretations, see backup slides and SUS-16-004

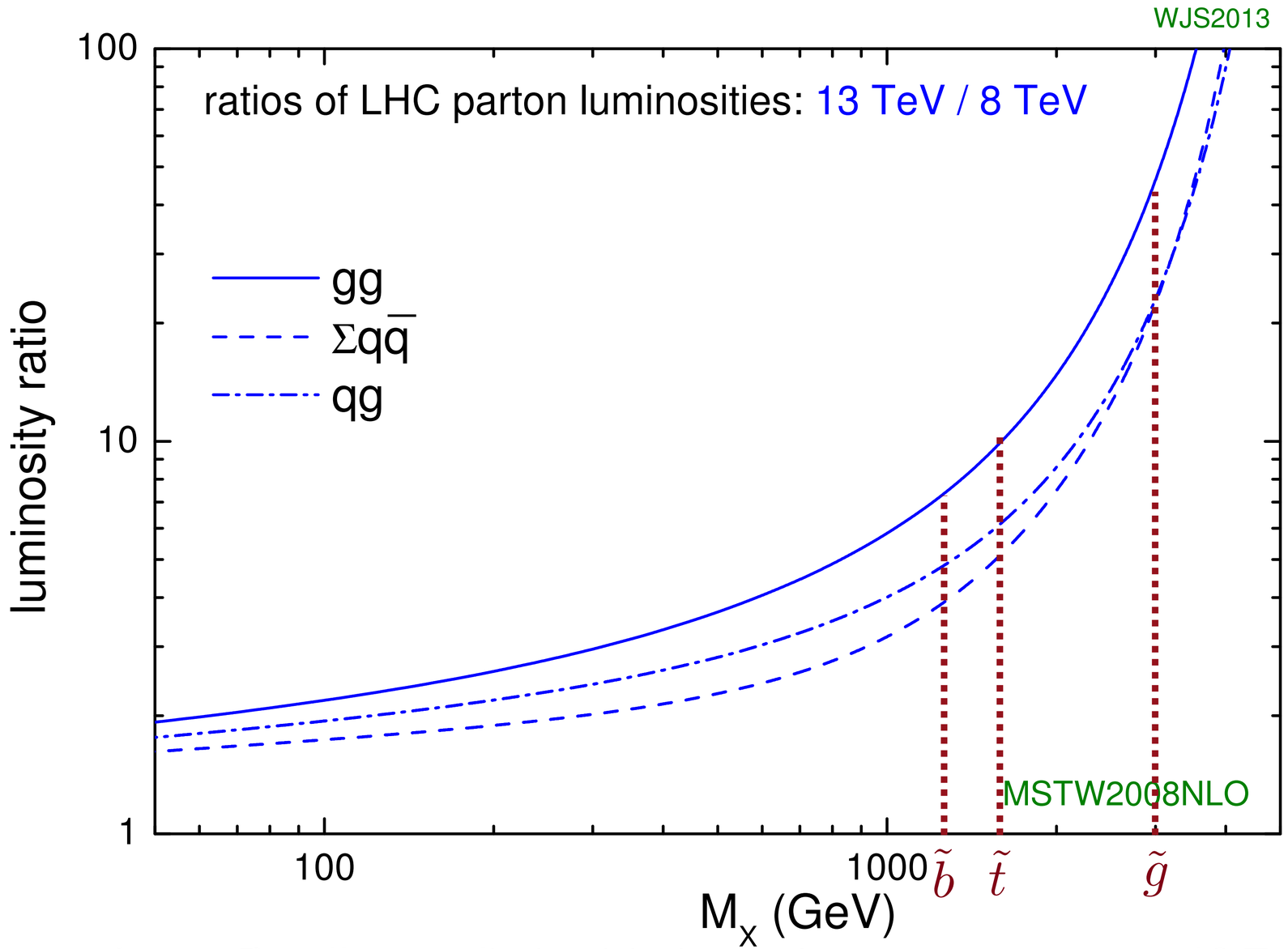
To end on a more exciting note…



Largest-H_T^{miss} event



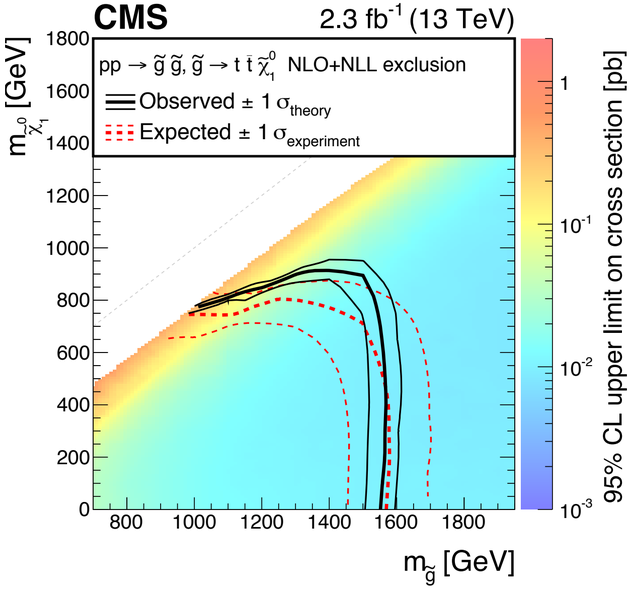
Backup: 13 TeV / 8 TeV parton lumi ratio scales with mass!



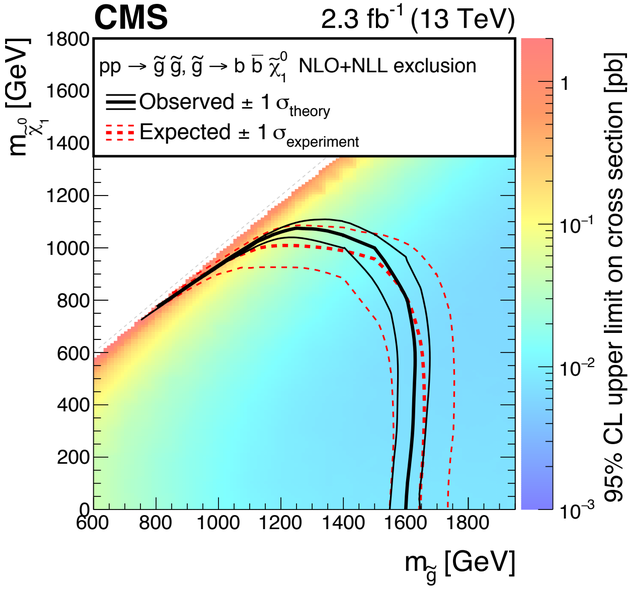
- At pre-Run II mass limits, big boost in xsec as we go to 13 TeV
- Easy to break new ground with early dataset

Backup: additional interpretations—direct gluino production

$\tilde{g} \to t\bar{t}\tilde{\chi}_1^0$

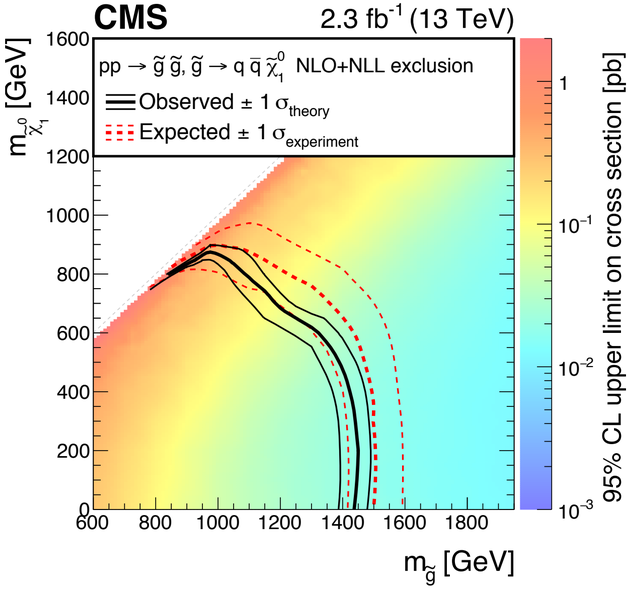


$\tilde{g} \to b\bar{b}\tilde{\chi}_1^0$



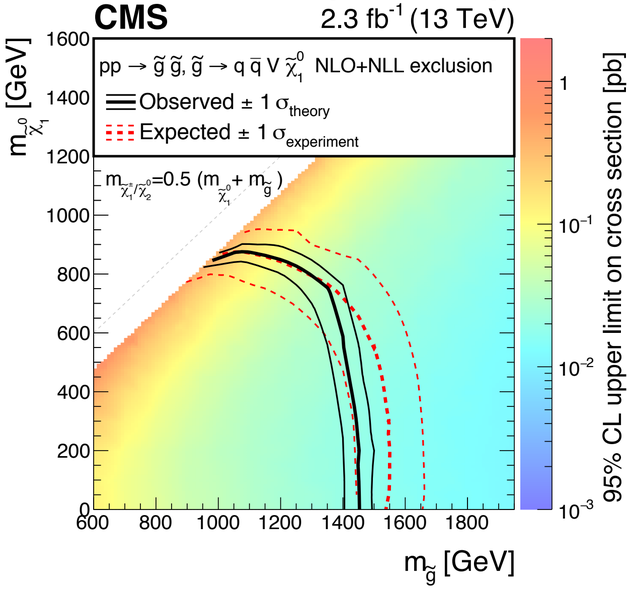
$\tilde{g} \to q\bar{q}\tilde{\chi}_1^0$

(q = u, d, s, c)

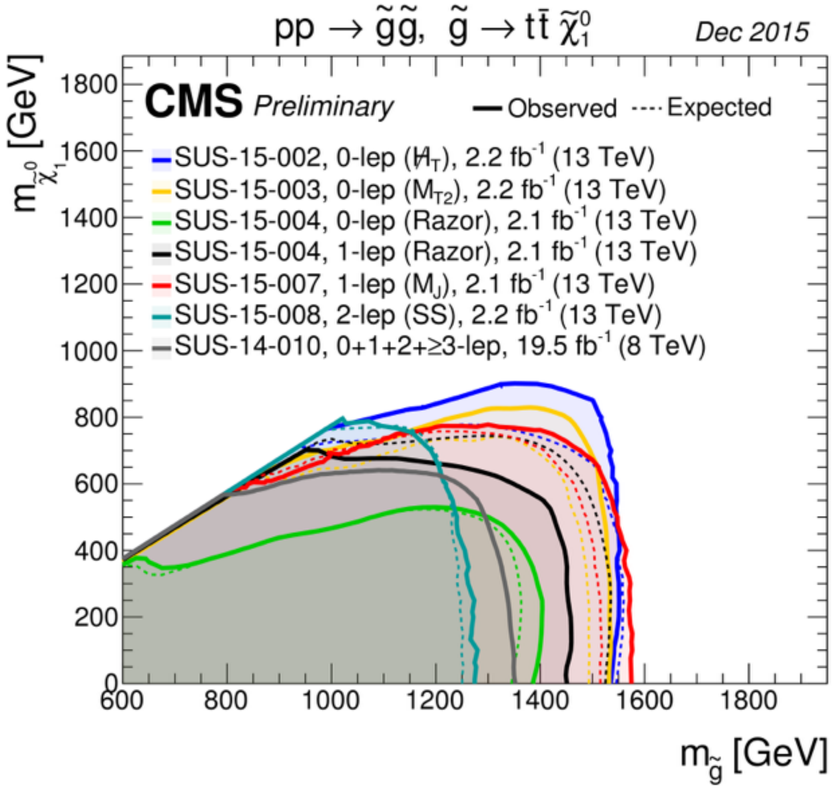


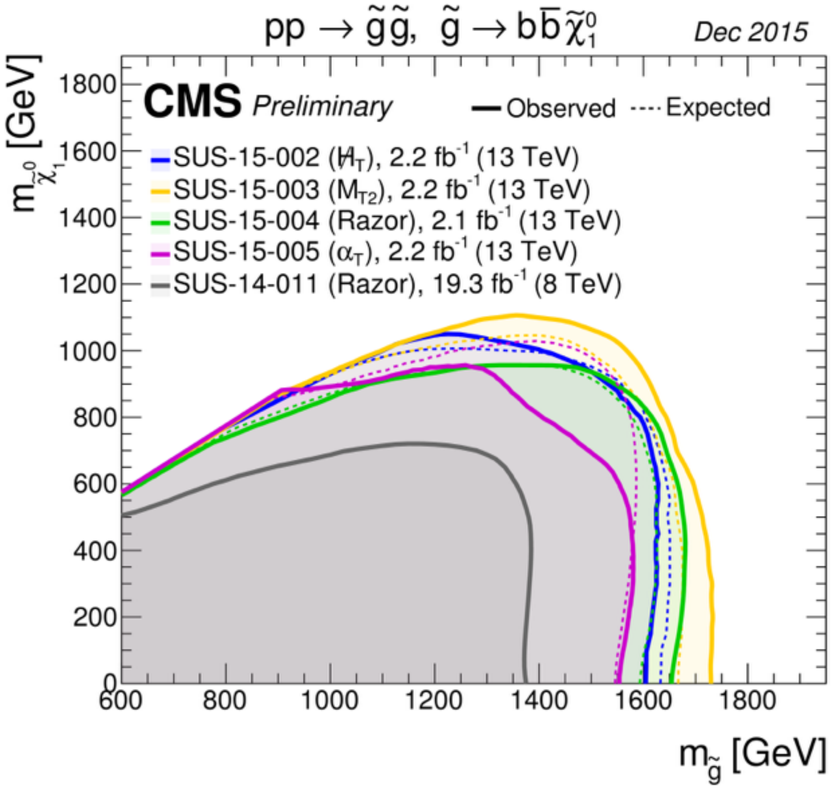
$\tilde{g} \to q\bar{q}V\tilde{\chi}_1^0$

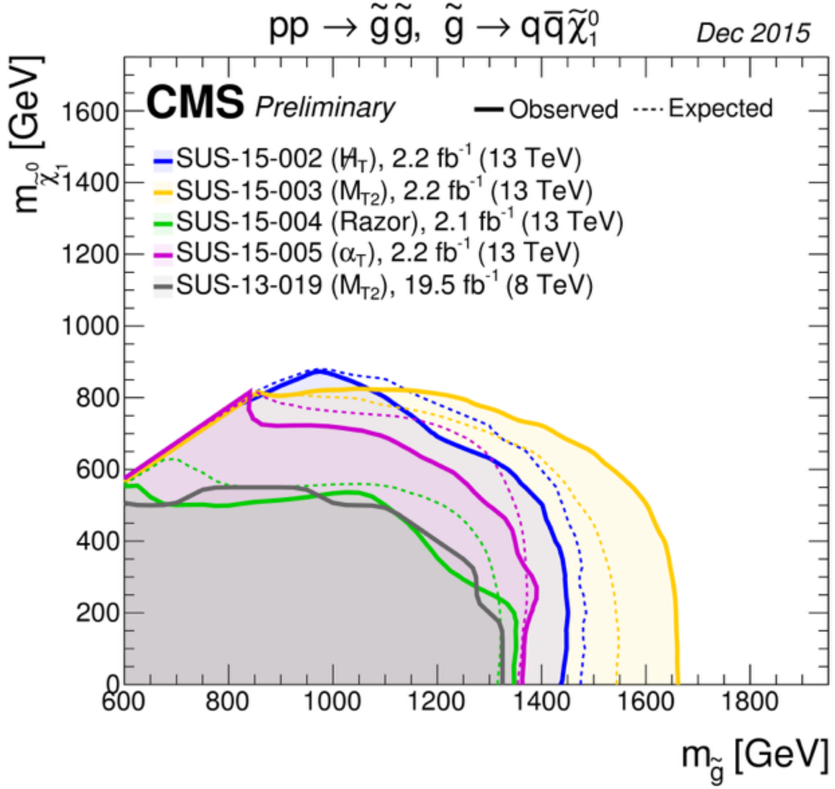
(q = u, d, s, c)
(V = W, Z)



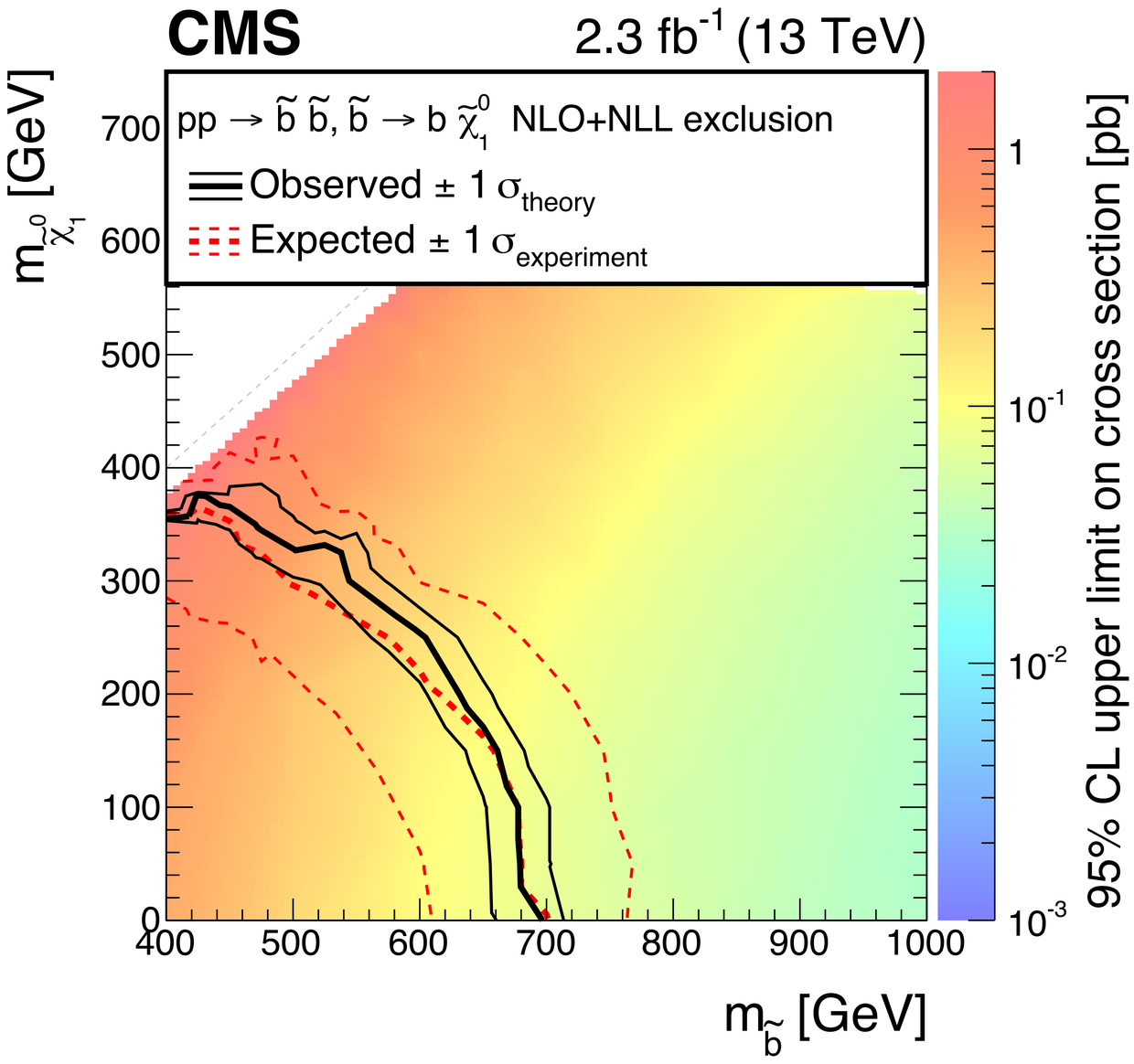
$\tilde{g} \to t\bar{t}\tilde{\chi}_1^0$ $\tilde{g} \to b\bar{b}\tilde{\chi}_1^0$ $\tilde{g} \to q\bar{q}\tilde{\chi}_1^0$

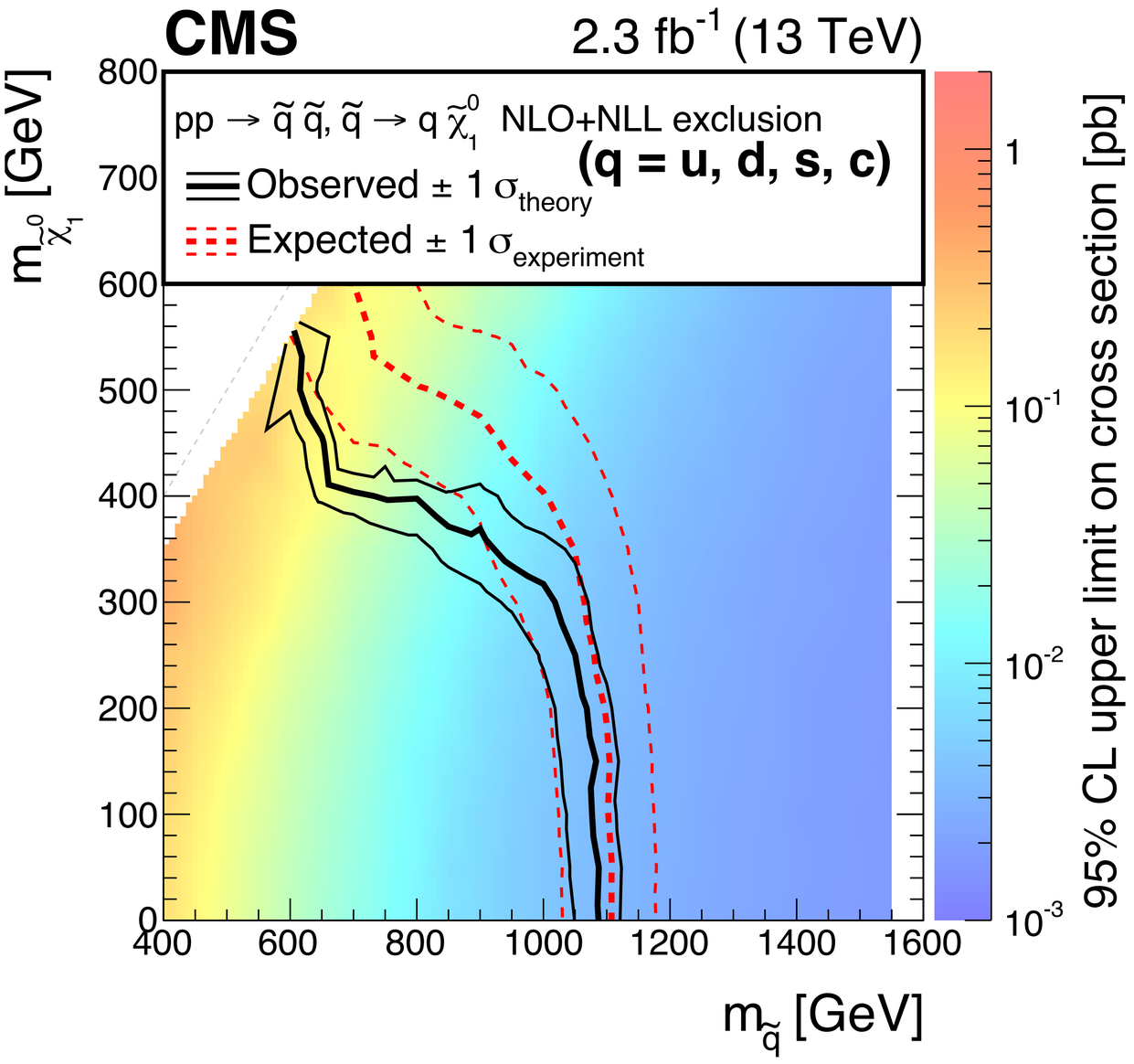




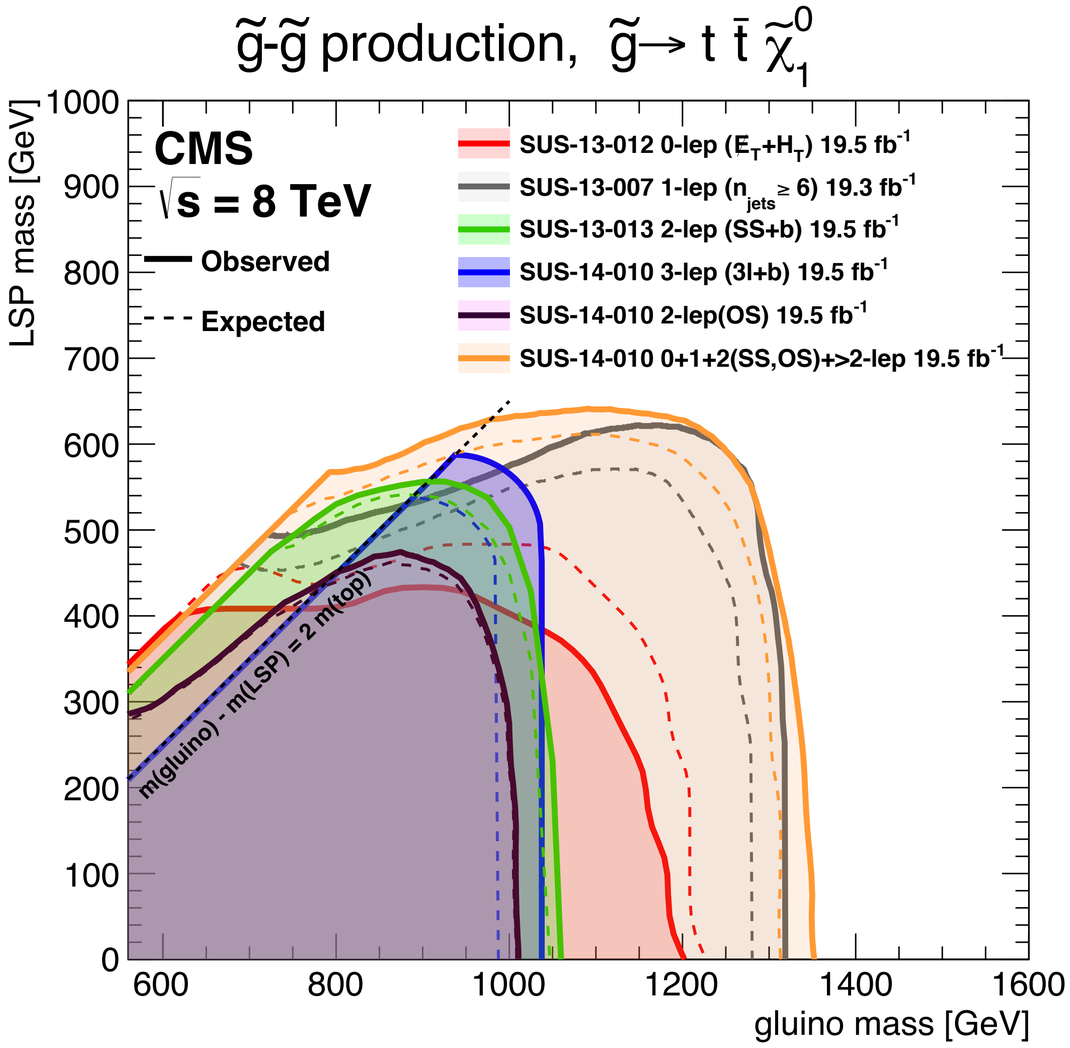


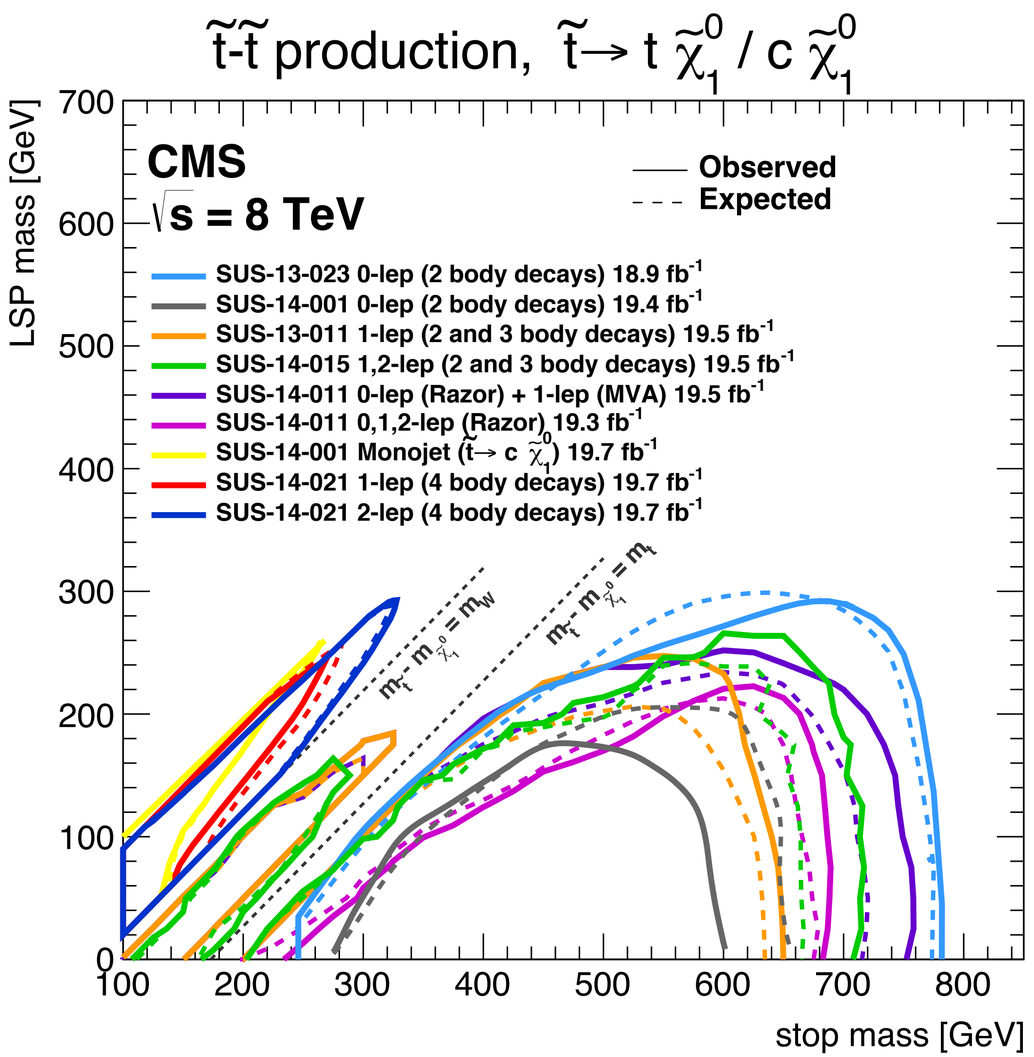
Backup: additional interpretations—direct squark production



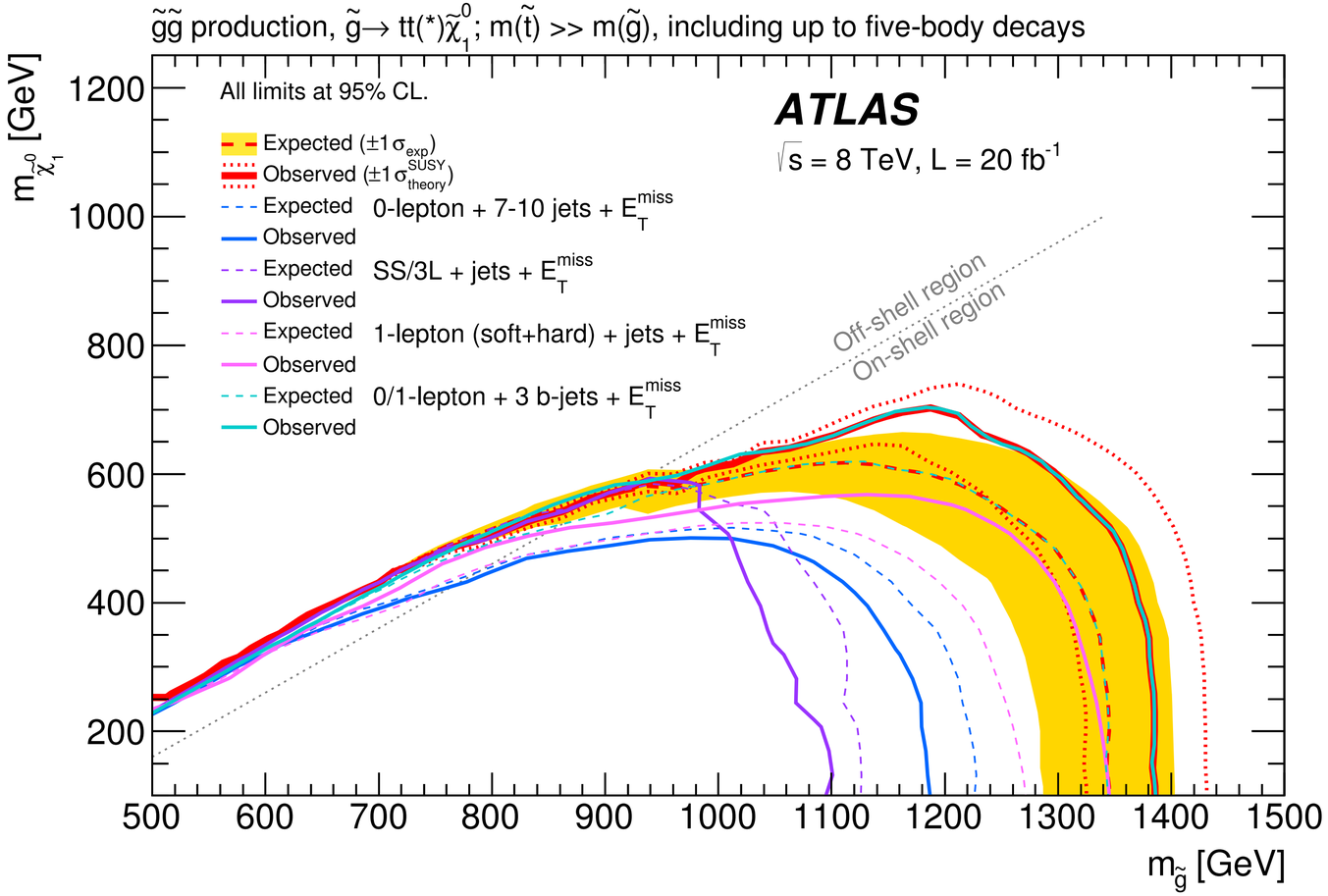


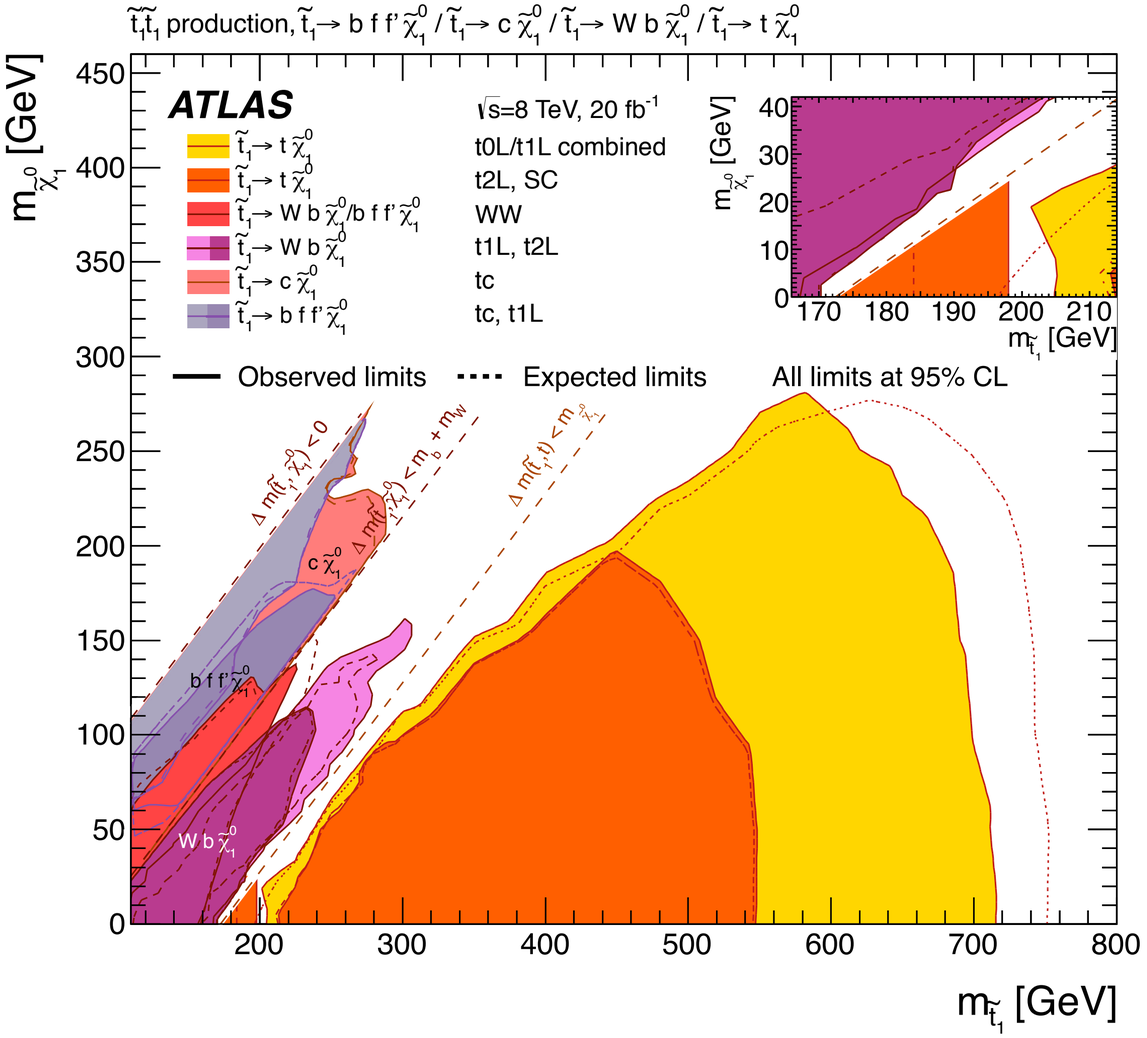
Backup: previous CMS limits on gluino and stop production



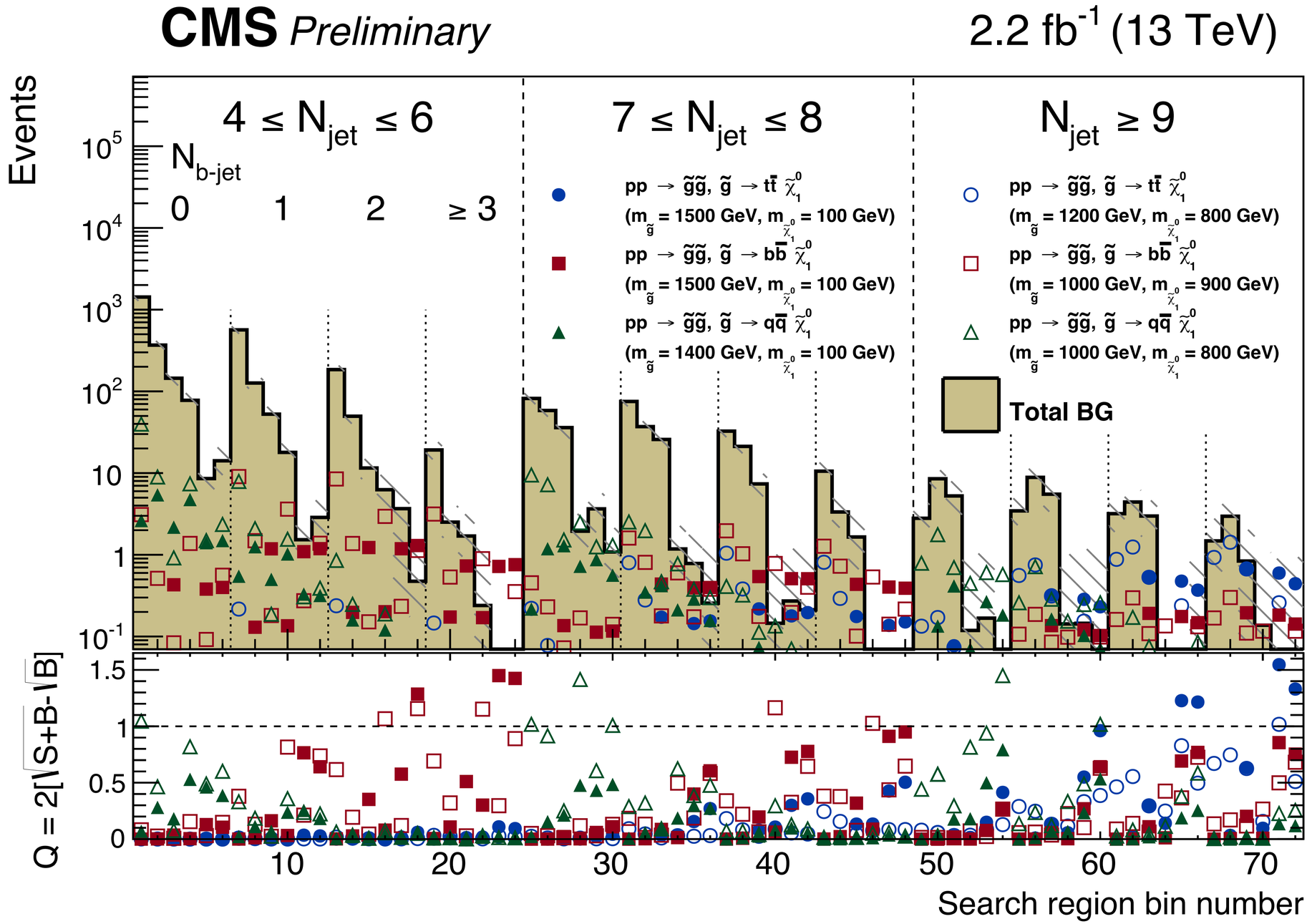


Backup: previous ATLAS limits on gluino and stop production





Backup: bin-by-bin signal sensitivity for gluino models



Backup: pull distribution for SM-only hypothesis