# SUSY after LHC8

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LHCP
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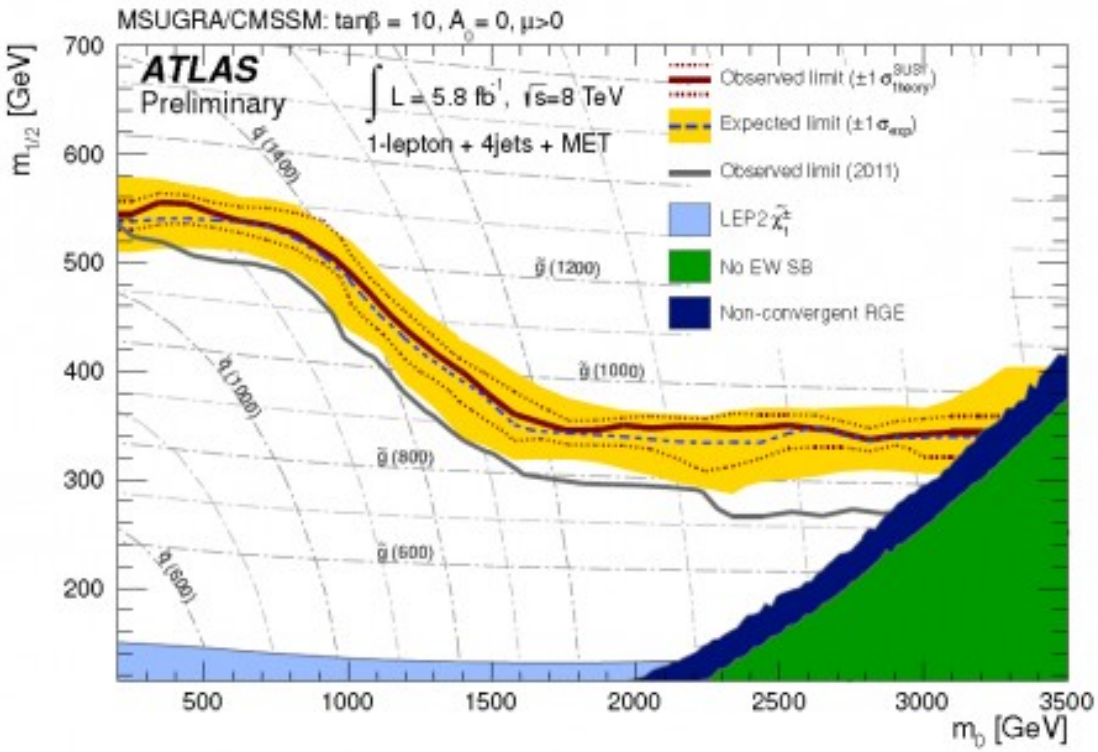
# LHC and CMSSM @ 8 TeV




CMSSM

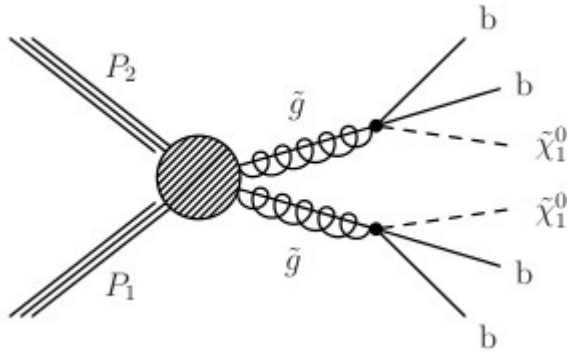
(mSUGRA)

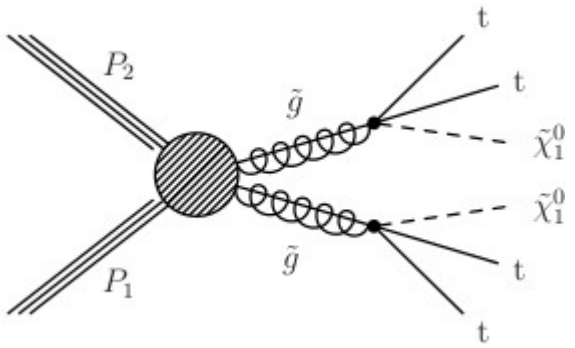
degenerate squark masses

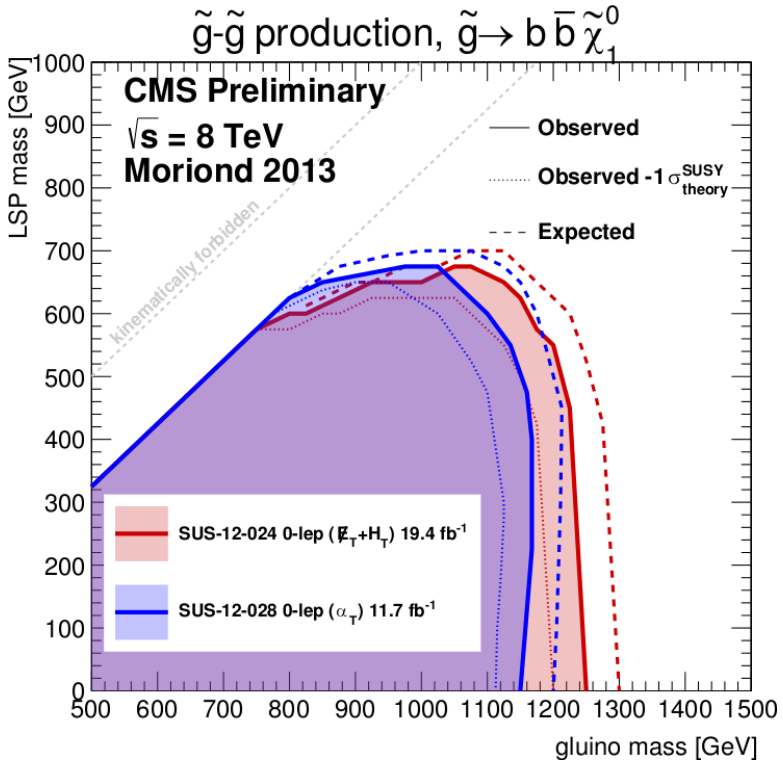
squarks > 1.5 TeV

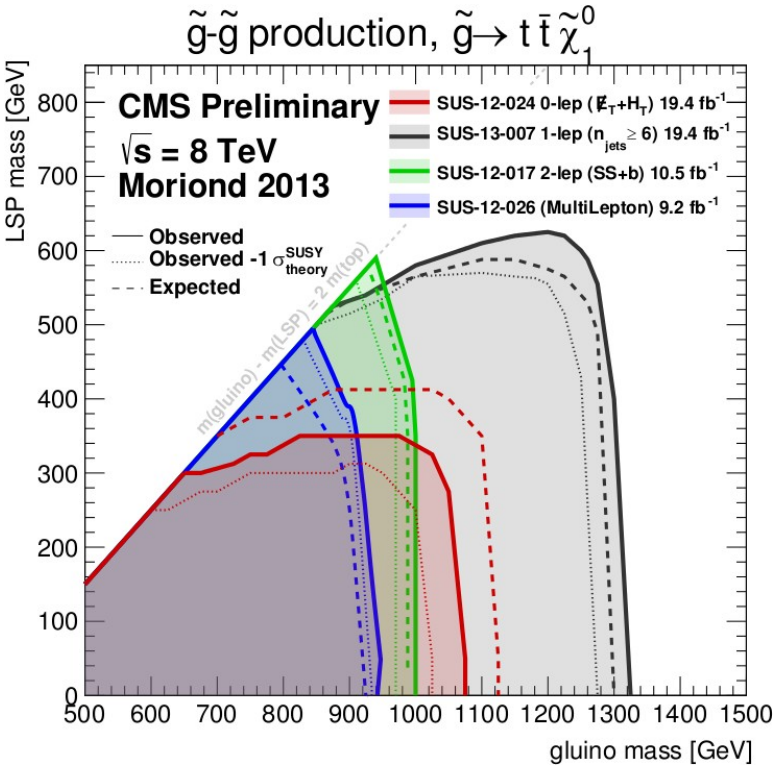
gluino > 1.2 TeV

# LHC and simplified models

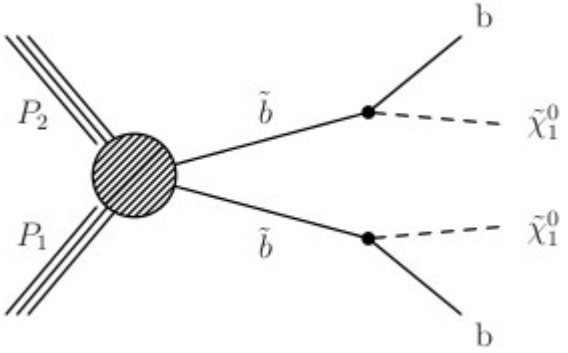


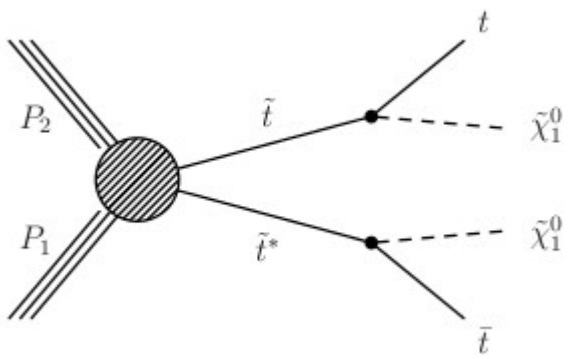



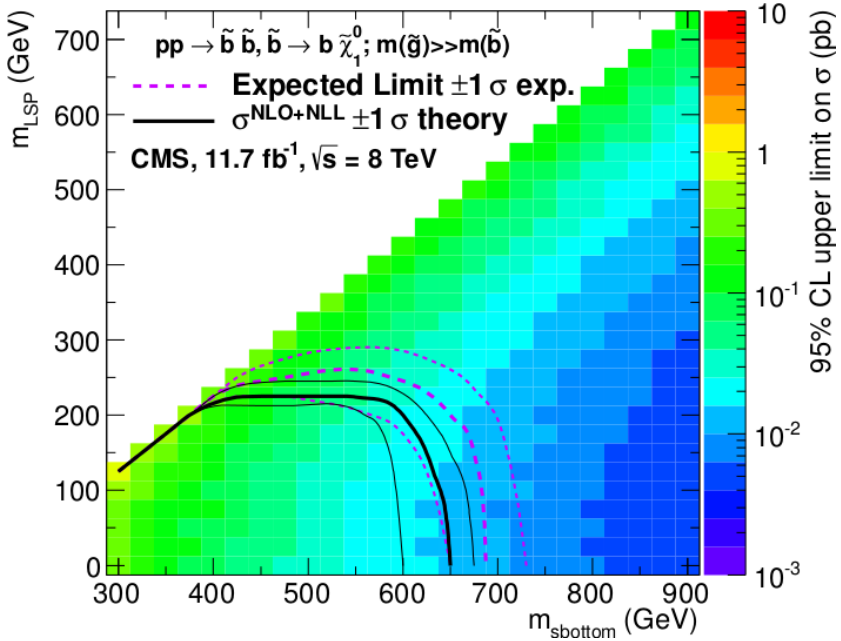



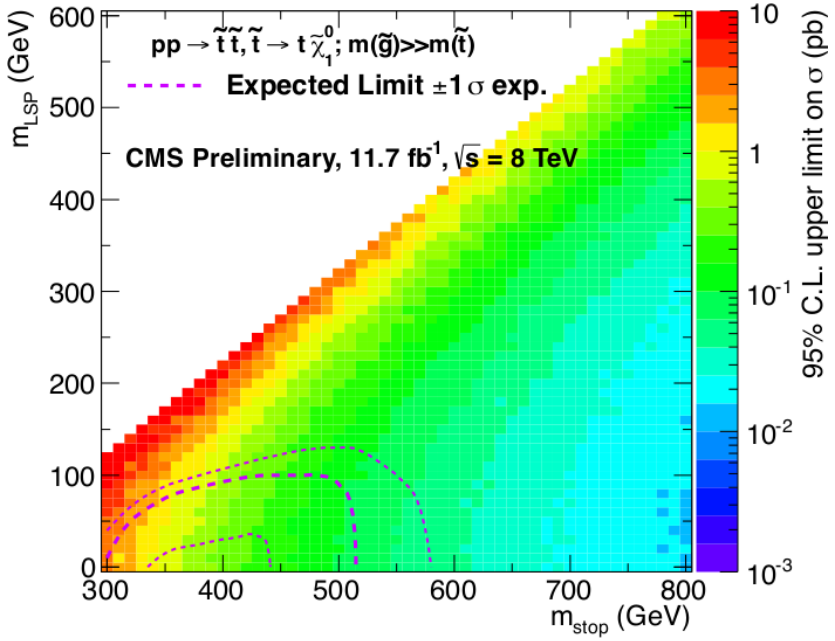



# LHC and simplified models



# The problem of NATURALNESS

$$\frac{dm^2_{H_u}}{d\log\mu} \simeq \frac{3y_t^2}{8\pi^2}\left(m^2_{\tilde{Q}_3} + m^2_{\tilde{u}_3} + |A_t|^2\right)$$

$$\Rightarrow m_{\tilde{t}} \lesssim (500-600)\,\text{GeV}\sqrt{\frac{\Delta}{10}}$$

On the other hand

$$\left(m_h^2\right)_{phys} = v^2\left(\lambda_{tree} + \delta\lambda_{loop}\right)$$

$$m_h \simeq 125\text{GeV} \Rightarrow \text{ Heavy stops}$$

$$\Delta \gtrsim 100$$

# Ways out (non exhaustive list)

(1) Hiding stops

(2) Increase mh @ tree level

(3) Mixing stops ("charming stops")

(4) Adding "stops"

# 1) Hiding stops

SUSY is there, is natural but stops are hidden in kinematically difficult regions (i.e. compressed spectrum), or the bounds change because other decays are open (2nd neutralino, lightest chargino)

Problem: how to accommodate mh?

# 2) Increase mh @ tree level

(1) NMSSM/λSUSY (F-term)

(2) New gauge group (D-term)

(3) Low energy strong sector for SUSY breaking Gherghetta, Pomarol 11

Problem (?): have a phenomenology sufficiently close to the SM Higgs

# 3) Mixing stops ("charming")

Blanke, Giudice, Paradisi, Perez, Zupan 13

Agrawal, Frugiuele 13

(See Monika Blake's talk)

Idea: mixing RH stop with RH charm

(1) Flavor OK

(2) Naturalness mildly improved

(3) LHC bounds improved

# 4) New "stops"

Idea:

have additional $\delta\lambda_{loop}$ comparable to $\delta\lambda_{stops}$

(1) Present in models with approximate R-symmetry

(2) Naturalness improved from multiple loop contributions?

B., Frugiuele, Gregoire, Ponton (work in progress)

See also Francesco Riva's talk on a related model

# Conclusions

(1) LHC is constraining more and more SUSY parameter space (direct searches + Higgs discovery)

(2) Insisting on low FT O(10%), minimal paradigms are in bad shape (but ok if a FT of O(1%) is accepted)

(3) Non minimal models are compatible with low FT+data and usually give testable predictions for LHC13