WG2: missing energy signatures

Towards the report

Contents

- 125 GeV Higgs as transversal topic
- prospects for future machines in part transversal, in part in summary

Everything has to fit within 15 pages!

Motivation

The LHC has been built

- to discover the Higgs

  → mechanism of electroweak symmetry breaking

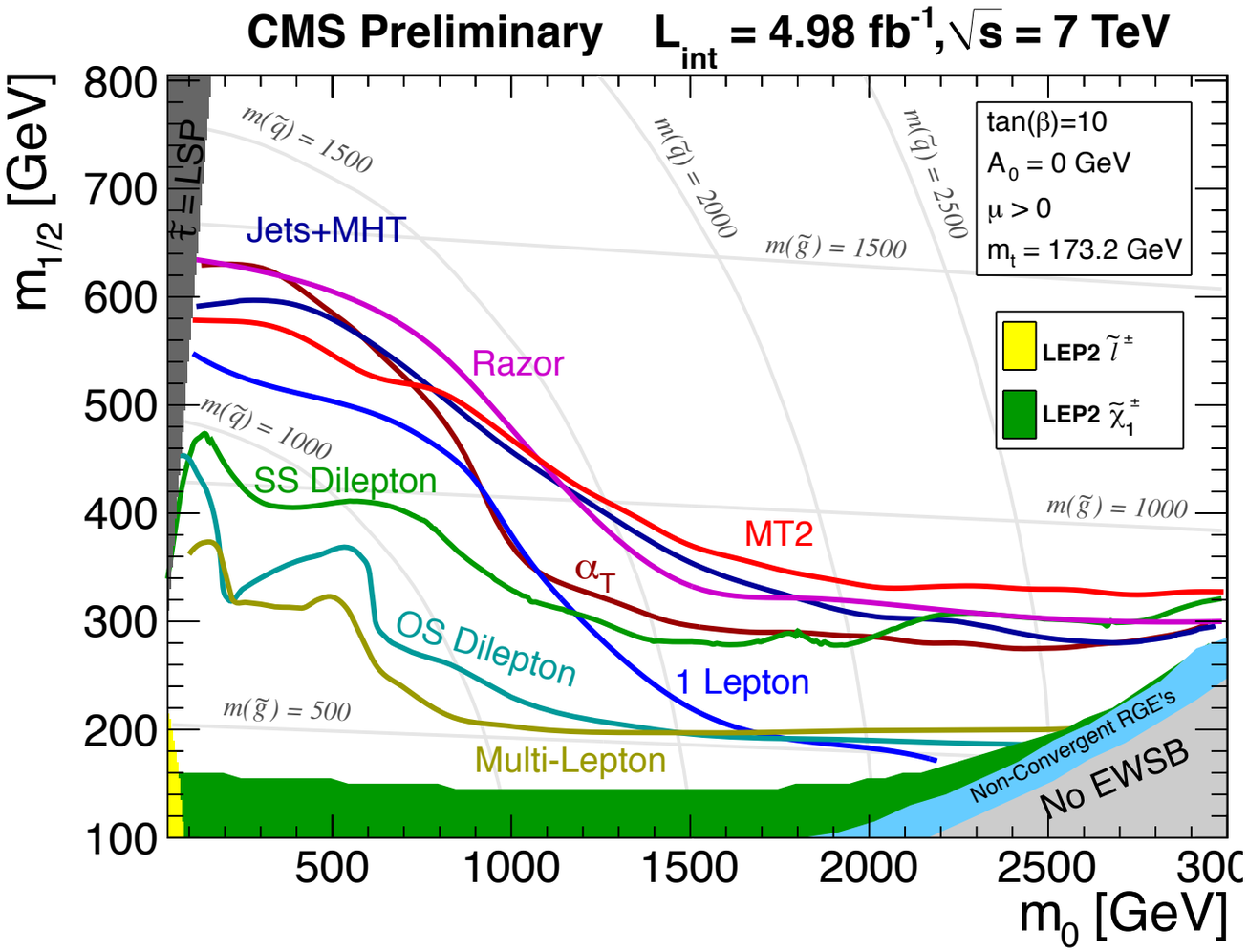
- to discover new physics BSM

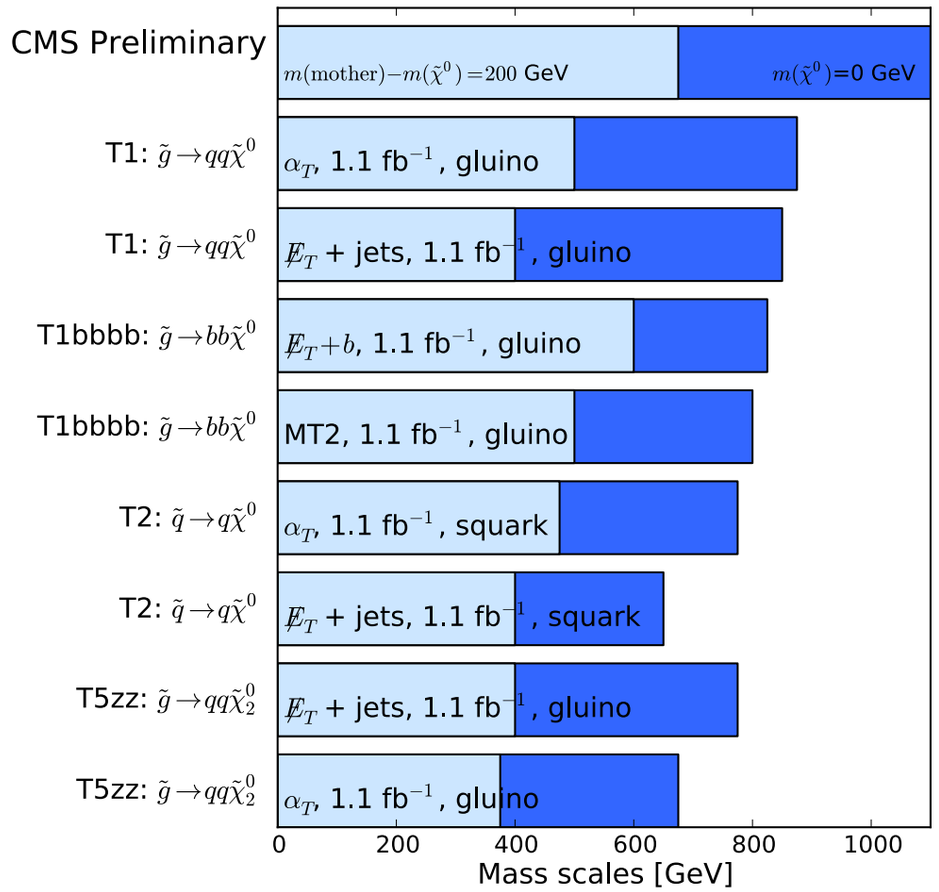
  → stabilization of the electroweak scale

[connection with dark matter make MET signatures specially interesting]

Limits being pushed higher and deeper

into SUSY parameter space

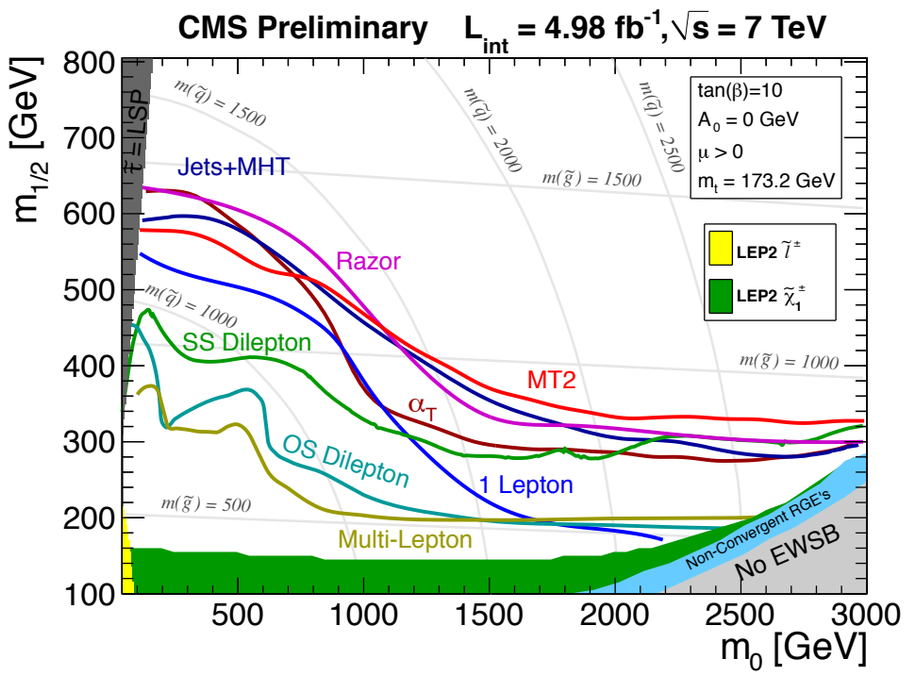




Simplest (constrained) models hard under pressure

Status of constrained models, CMSSM

- 1 page contribution by fitting groups
- CMSSM is being "punshed in the face"
  - Higgs mass, fine-tuning
  - Tension between low energy / EW fit and direct search limits
- Statements in the writeup still rather vague, need to be more quantitative



Plot by Nazila et al on max mh in constained SUSY models

Not plain vanilla: pMSSM

- The pMSSM is a 19-dimensional parametrization of the MSSM that captures most of its phenomenological features. It encompasses and goes beyond a broad range of more constrained SUSY models.

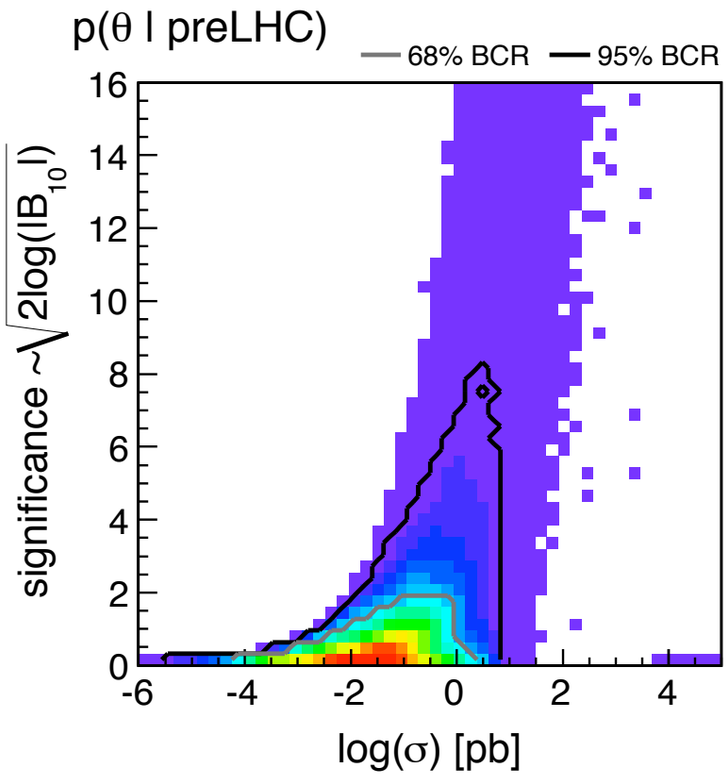
> "The pMSSM leads to a much broader set of predictions for the properties of the SUSY partners as well as for a number of experimental observables than those found in any of the conventional SUSY breaking scenarios such as mSUGRA [CMSSM]. This set of models can easily lead to atypical expectations for SUSY signals at the LHC."

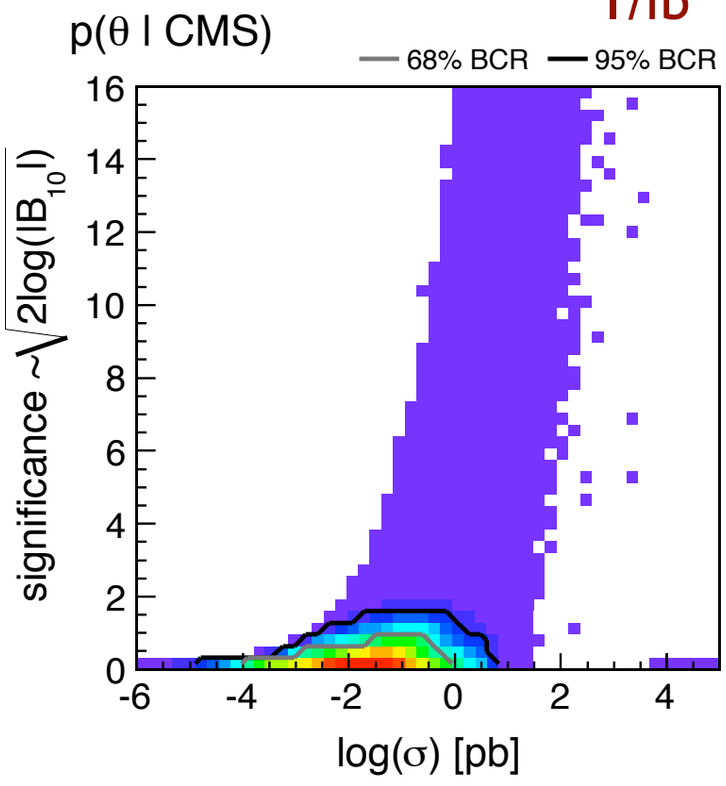
from the conclusions of arXiv:0812.0980
"SUSY without prejudice"

- Parameters defined at the weak scale; minimal assumptions: no new CP phases, flavor-diagonal sfermion mass matrices and trilinear couplings, 1st/2nd generation degenerate and A-terms negligible, lightest neutralino is the LSP.

pMSSM

Large cross section ⇔ high signal significance?





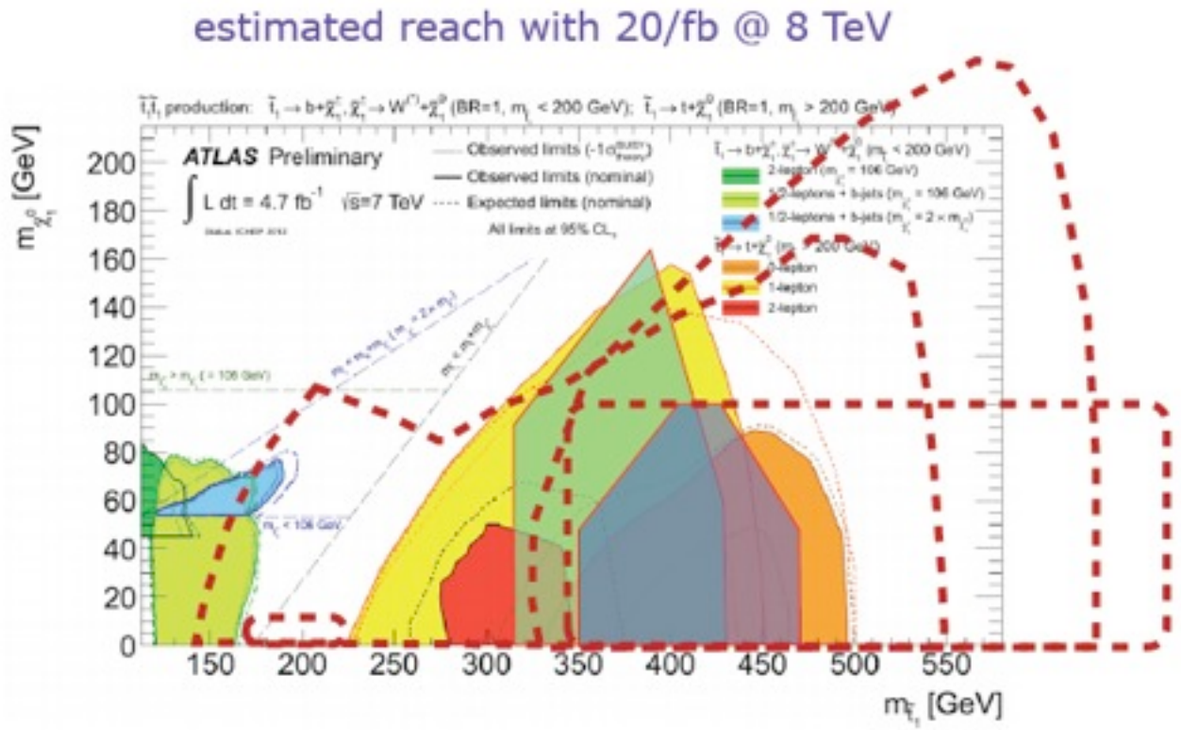
Signal of order 1 pb cross section
can have escaped detection!

characteristics of such scenarii: small mass splittings, soft jets, low MET

Natural SUSY, light stops

$$-\frac{m_Z^2}{2} = |\mu|^2 + m_{H_u}^2$$

- Motivation: naturalness, importance for understanding Higgs sector
- Limitations of current analyses
- Overview of new techniques
- Outlook: future machines



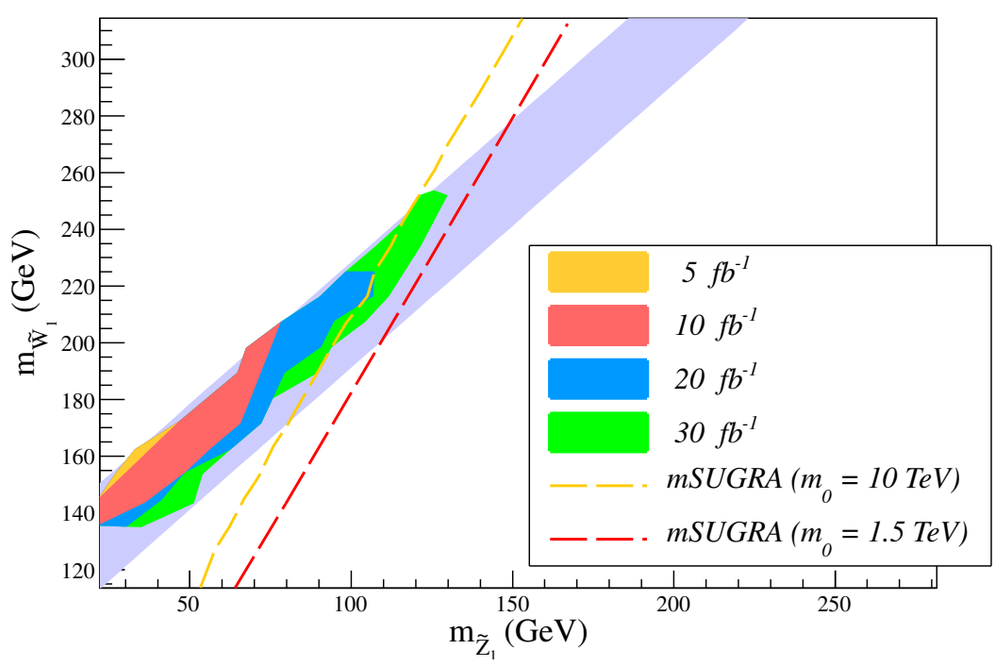
Light higgsinos

$$-\frac{m_Z^2}{2} = |\mu|^2 + m_{H_u}^2$$

- Same naturalness issue as for stops
- Intrinsically difficult at LHC (H. Baer: hidden SUSY)
- Short contribution by Howie exists but needs to be extended a bit (theoretical motivation etc)
- Mono-jet, mono-photon + MET might give some handle on these scenarios
- Stop to higgsino decays? Rest of the spectrum decoupled or not?

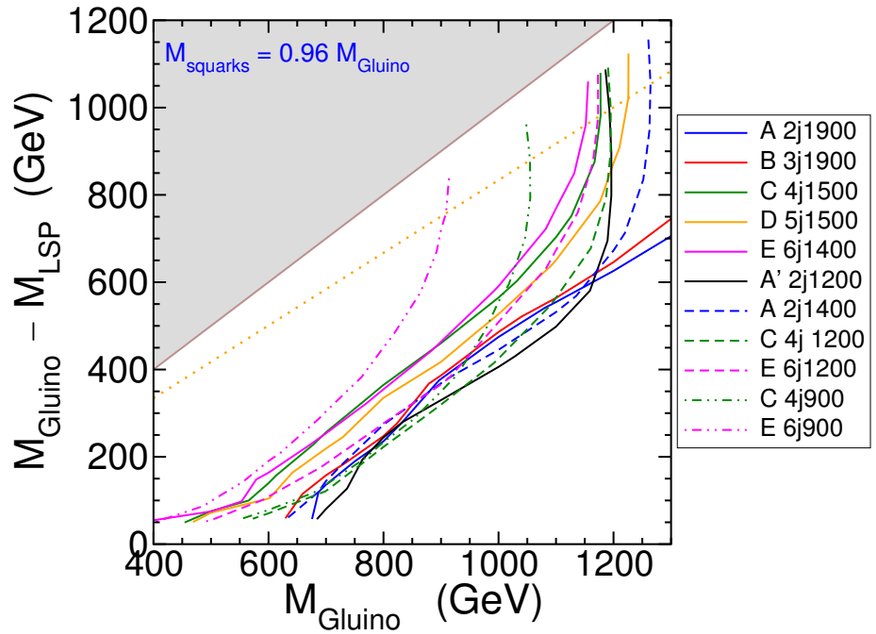
Electroweak gauginos

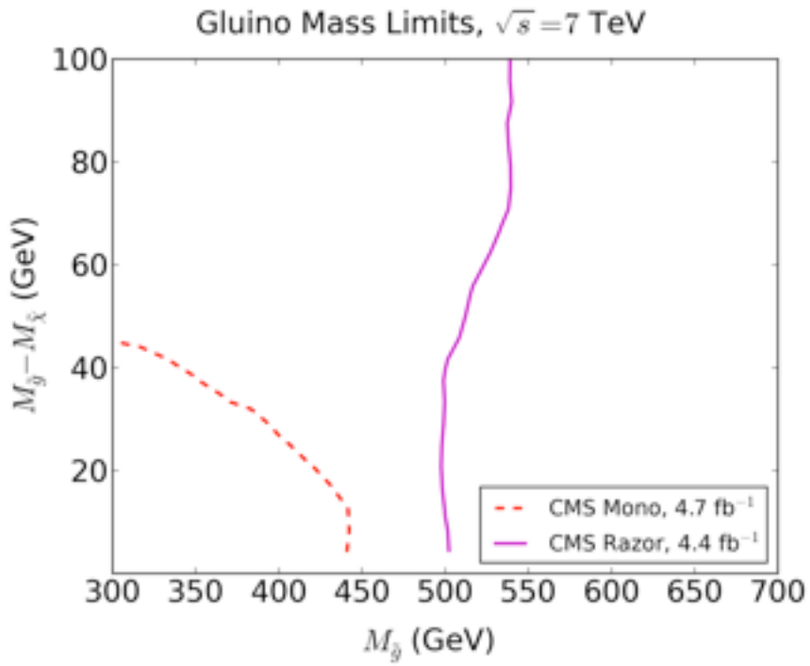
- ATLAS / CMS analyses not really sensitive so far
- Studies so far rely on intermediate sleptons
- Short section exists on potential for WZ+MET @ 8 TeV
- At 14 TeV also Wh + MET



Compressed spectra

- Contribution by Steve Martin
- Some new material by Jamie Tattersall on monojet+MET, c.f. his talk yesterday
- Can probably much improve with higher luminosity



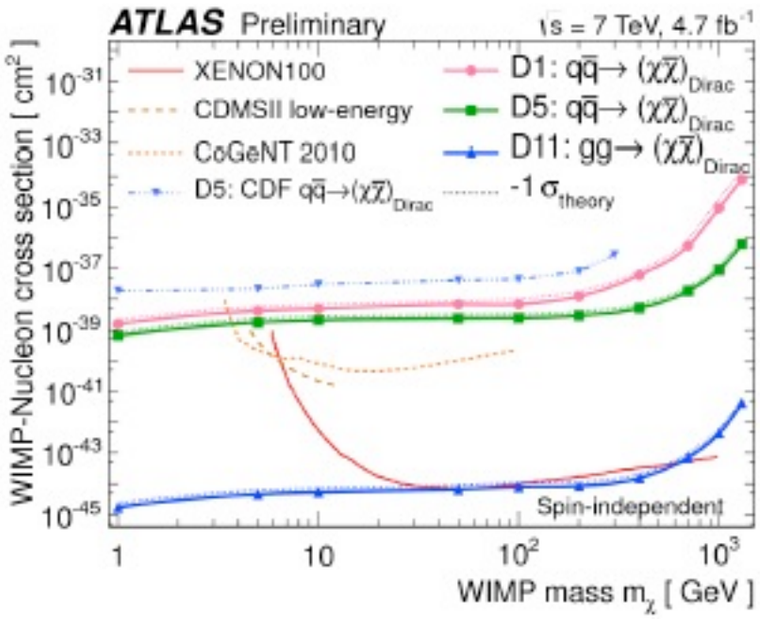


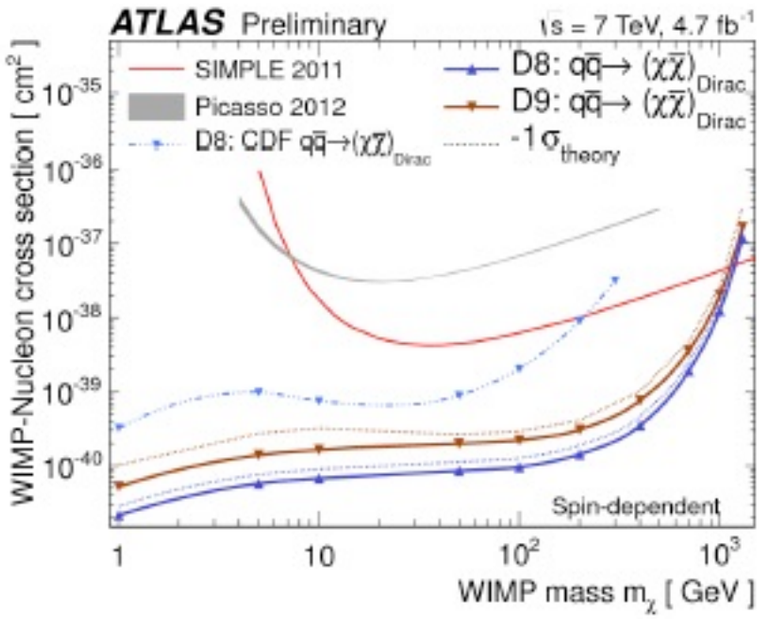
MSSM extensions

- NMSSM → Ulrich Ellwanger, Jack Gunion
  - Interesting implications from 125 GeV Higgs and light stops
- Extra gauge groups → Werner Porod

Dark Matter

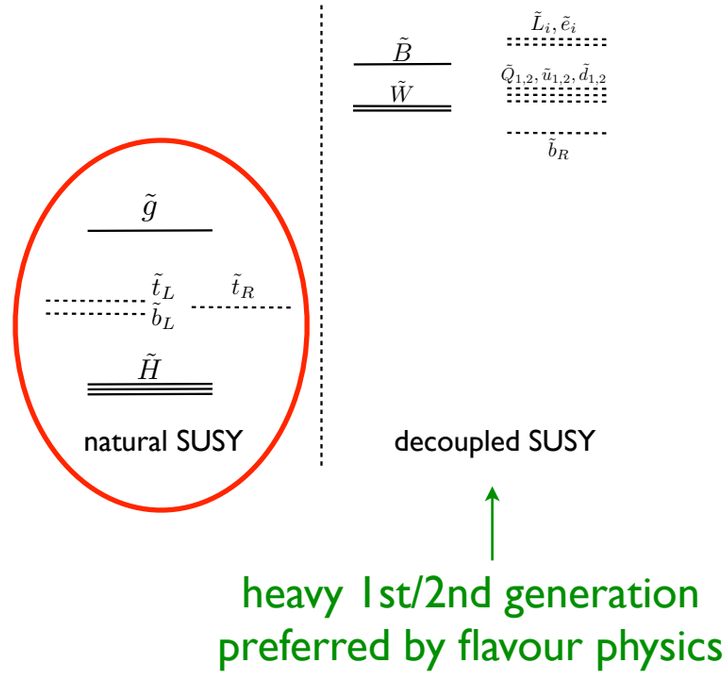
- Intriguing interplay between collider physics and astrophysics
- Very interesting experimental talks on direct DM yesterday
- Need theorists' interpretation





Summary

- Vanilla toy models (CMSSM!) very much under tension
- Searches not yet sensitive to EW production, small mass splittings, ...
- Also not yet sensitive to theoretically most interesting issues
  - Light Stops
  - Light Higgsinos
- Dark Matter connection:
  interplay with astrophysics/cosmology



Contents

1. Introduction max. 1 page ✓
2. Strategy and results of ATLAS and CMS searches 2-3 pages coming
3. Interpretation of results and implications for specific models/scenarios
   a. Status of constrained models (mostly CMSSM) 1 page ✓
   b. pMSSM max. 1 page ✓
   c. Natural SUSY, light stops <1 page ✓
   d. Light Higgsinos 1/2 page ✓
   e. Electroweak gauginos 1/2 page ✓
   f. Compressed spectra 1/2 page ✓
   g. NMSSM 1 page ✓
   h. SUSY with extra gauge groups max. 1 page ✓
   i. Monojets, monophotons + MET, non-SUSY max. 1 page ✓
4. Dark matter connection 2 pages still missing
5. Executive summary