pMSSM update for Snowmass

Ahmed Ismail
SLAC

April 22, 2013

Matthew Cahill-Rowley, JoAnne Hewett,
AI, Tom Rizzo

The phenomenological MSSM

- Start with the MSSM with R-parity

- Take minimal flavor violation, CP, diagonal sfermion masses with first two generations degenerate; motivated by experiment!

- Scan the resulting 19/20-dimensional space, up to 4 TeV sparticles, searching for points consistent with all existing constraints: precision electroweak, flavor, colliders (1206.4321)

- Choose models where lightest neutralino/gravitino is LSP, but do not require LSP to saturate relic density; 2.2×10^5 models with each LSP type before Higgs discovery, LHC through 09/2012 (1211.1981)

LHC simulation

- In final stages of implementing $8\ \text{TeV}\ 13\ \text{fb}^{-1}$ ATLAS SUSY searches

- Will eventually include most recent analyses with $21\ \text{fb}^{-1}$ of 8 TeV data

- Also simulating events at 14 TeV

- In contact with ATLAS to get more details about potential cuts for 14 TeV SUSY search signal regions

Linear colliders

- Showed search efficiencies for models with light uncolored sparticles in 1211.1981

- Several examples of interesting spectra for LC in benchmarks

| Sparticle	$\sqrt{s} = 250$ GeV	$\sqrt{s} = 500$ GeV	$\sqrt{s} = 1$ TeV	$\sqrt{s} = 2$ TeV
$\tilde{\chi}_1^0$	48.3%	54.5%	60.5%	67.3%
$\tilde{\chi}_2^0$	53.0%	58.7%	64.6%	69.5%
$\tilde{\chi}_3^0$		61.9%	66.5%	69.0%
$\tilde{\chi}_1^\pm$	47.6%	54.4%	60.4%	67.3%
$\tilde{\chi}_2^\pm$		54.0%	66.5%	68.3%
$\tilde{e}_L$		31.6%	56.5%	63.6%
$\tilde{e}_R$		48.6%	58.2%	62.8%
$\tilde{\nu}_e$		32.0%	56.7%	63.7%
$\tilde{\tau}_1$		48.0%	58.6%	64.3%
$\tilde{\nu}_\tau$		44.7%	58.7%	64.5%
$\tilde{t}_1$			27.8%	56.5%
$\tilde{b}_1$			27.9%	58.3%

LHC exclusion efficiencies
Table 10, 1211.1981

Complementarity

- How do LHC and direct detection, indirect detection, and neutrino experiments work together to discover SUSY?

- with R. Cotta, A. Drlica-Wagner, S. Funk, M. Wood
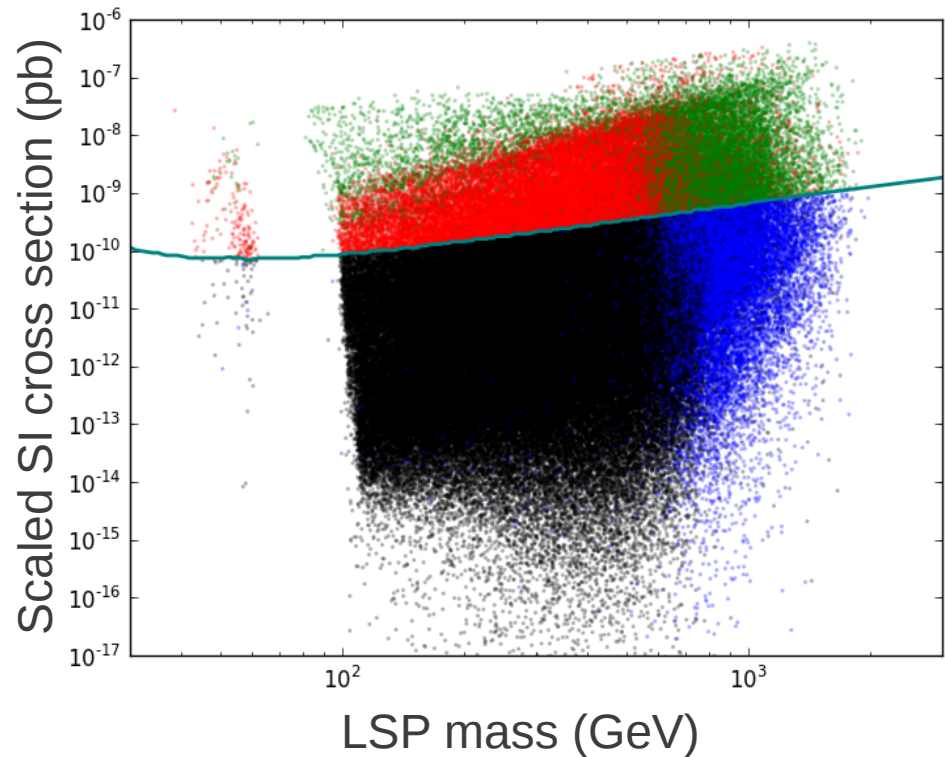
Excluded by DD only
Excluded by ID only
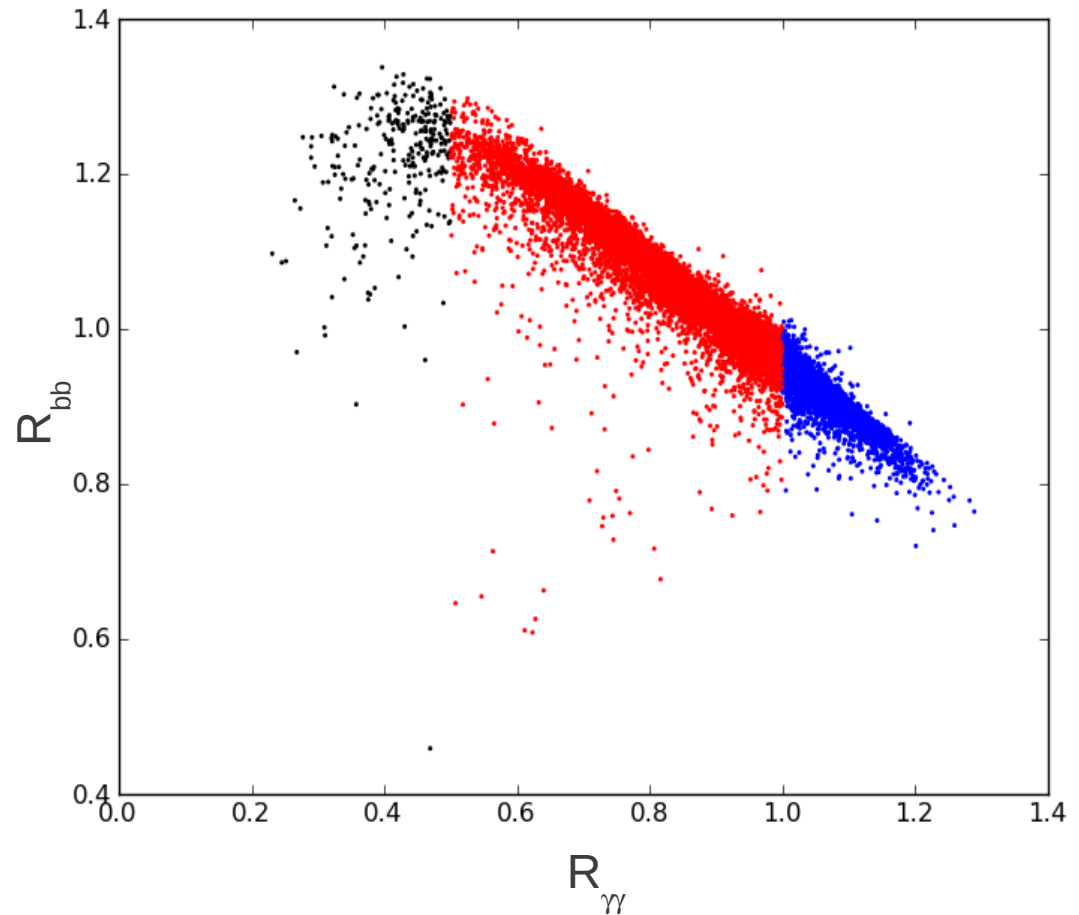Excluded by DD and ID
Survives DD and ID

Complementarity
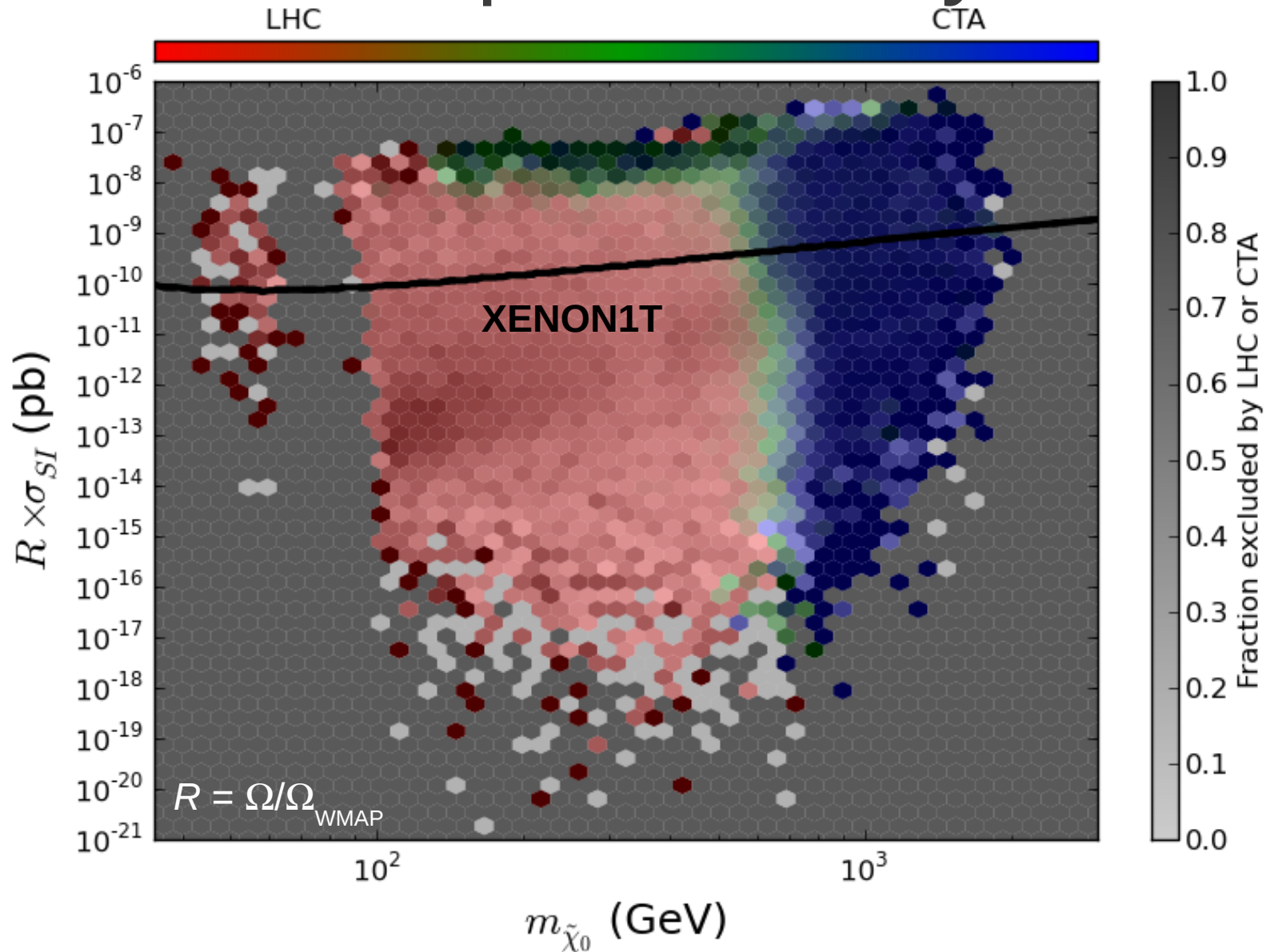
LHC, CTA, and XENON1T act orthogonally and exclude many models

Higgs and SUSY

- **What do SUSY searches tell us about the Higgs?** Use LHC to constrain Higgs properties from SM expectations

- **What do Higgs measurements say about SUSY?** Use LHC/ILC precision to constrain sparticle properties

1206.5800

New pMSSM scan

- Include recent Higgs discovery by requiring $m_h = 126 +/- 3$ GeV

- Demand that neutralino LSP relic density be in agreement with WMAP measurement

- Naturalness: only scan over points with less than 1% fine-tuning

- Expect many mixed bino-higgsino LSPs, multiple light gauginos

- Have models, need to pass through LHC simulation