

# More pMSSM SUSY Without Prejudice at LHC-7 and -8

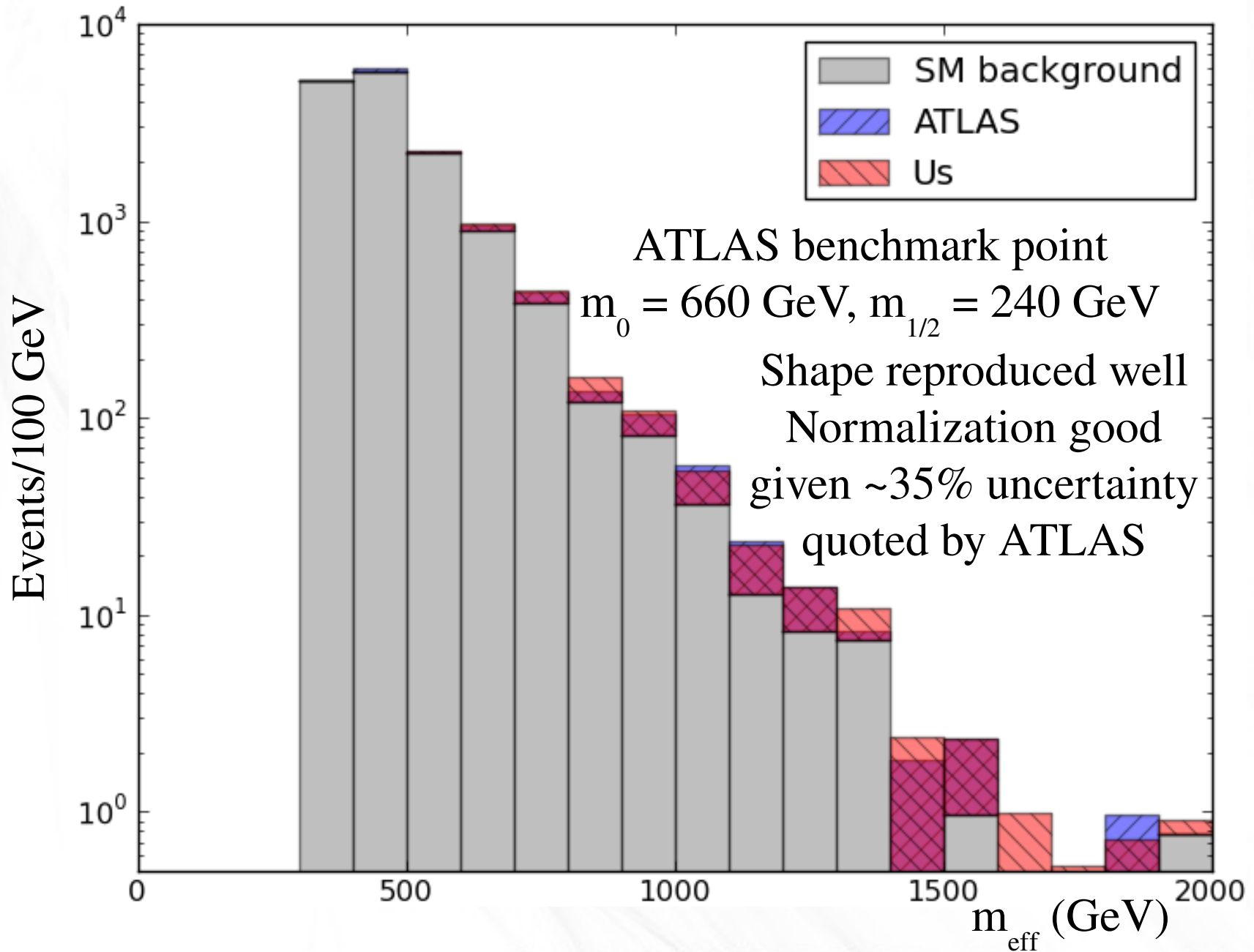
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Pheno 2012

Matthew Cahill-Rowley, JoAnne Hewett, Stefan  
Hoeche, AI, Tom Rizzo, to appear

# ATLAS MET searches

- Generate SUSY events for each of the 223256 neutralino LSP models with PYTHIA, scale with K-factors from Prospino, pass through PGS
- Analysis code based on 1009.2539, 1103.1697
- 1/fb: jets + MET, many jets, one/two leptons
- 5/fb: jets + MET, many jets, one lepton
- Models predicting more events than the limit in any search region are excluded



# ATLAS MET searches

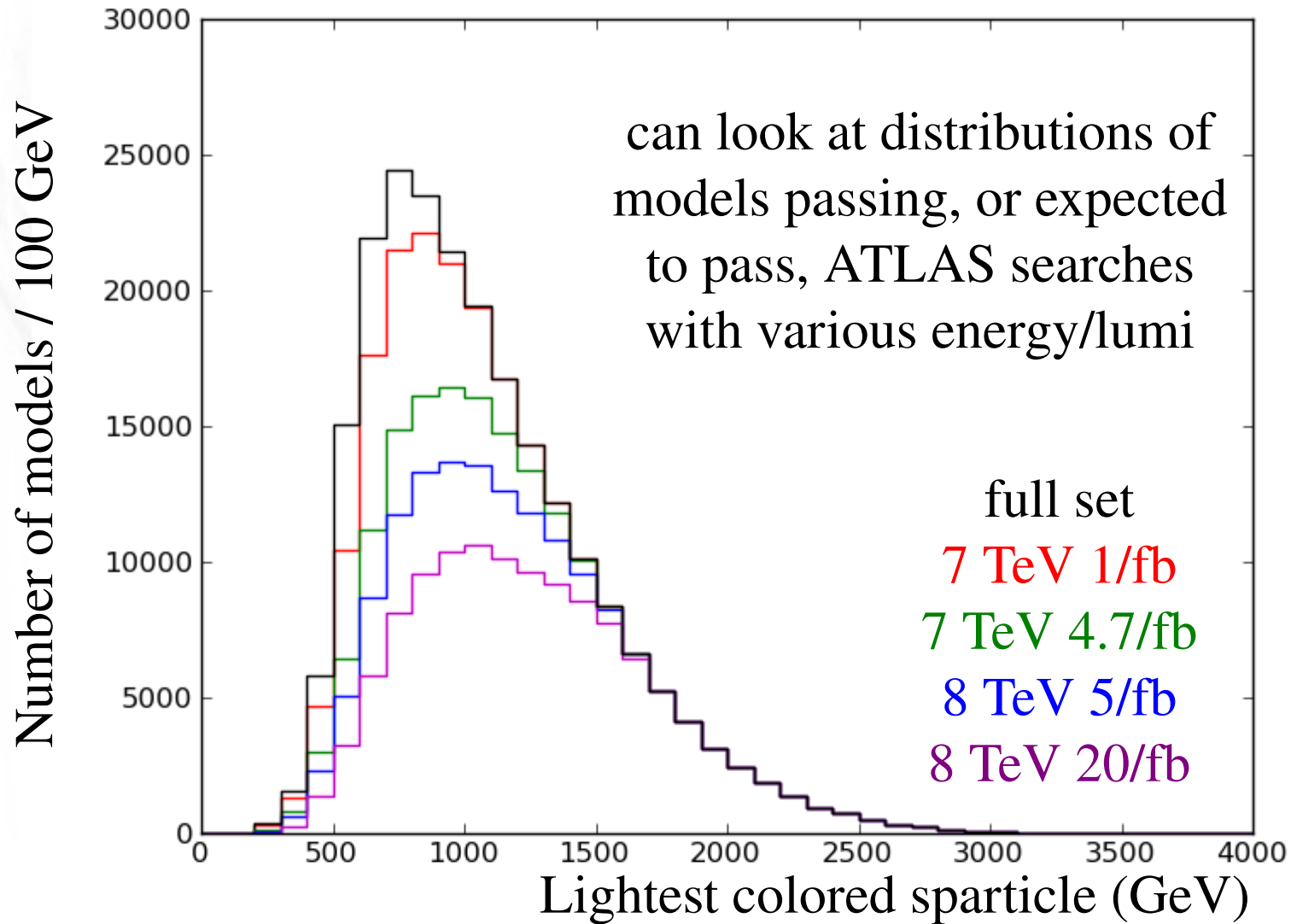
- Also: scale up 7 TeV backgrounds to 8 TeV in each search region, assuming cuts do not change, by “transfer factors” arrived at through simulating backgrounds at both energies with SHERPA 1.4.0, using ME+PS merging (0903.1219)
- Transfer factor =  $(8 \text{ TeV})_{\text{SHERPA}} / (7 \text{ TeV})_{\text{SHERPA}}$
- Take  $(8 \text{ TeV})_{\text{ATLAS}} = (7 \text{ TeV})_{\text{ATLAS}} \times \text{transfer factor}$
- Use  $CL_s$  to estimate limit in each search

# ATLAS MET searches

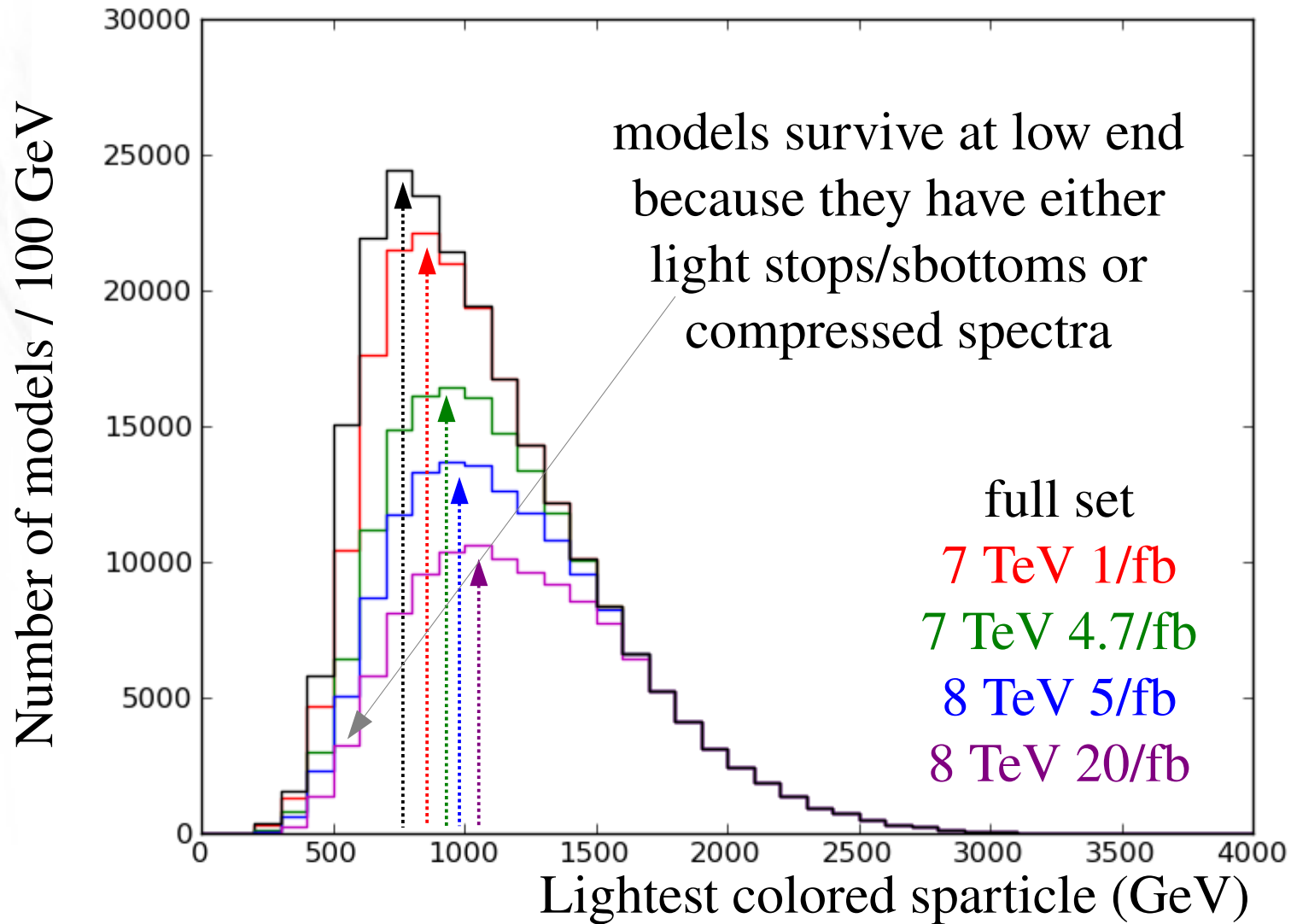
Analysis	7 TeV 1 fb <sup>-1</sup>	7 TeV 4.7 fb <sup>-1</sup>	8 TeV 5 fb <sup>-1</sup>	8 TeV 20 fb <sup>-1</sup>
Jets + MET	6.68%	23.23%	32.70%	45.11%
Many jets + MET	0.36%	1.61%	6.26%	7.35%
1 $\ell$ + jets + MET	0.81%	2.64%	1.41%	1.53%
2 $\ell$ + jets + MET	0.16%	0.22%	0.35%	0.38%
Remaining models	93.27%	76.72%	67.25%	54.87%

- Zero leptons + jets + MET is most effective search
- 2011 data excludes some models already, but increased energy and luminosity will probe model sets even further

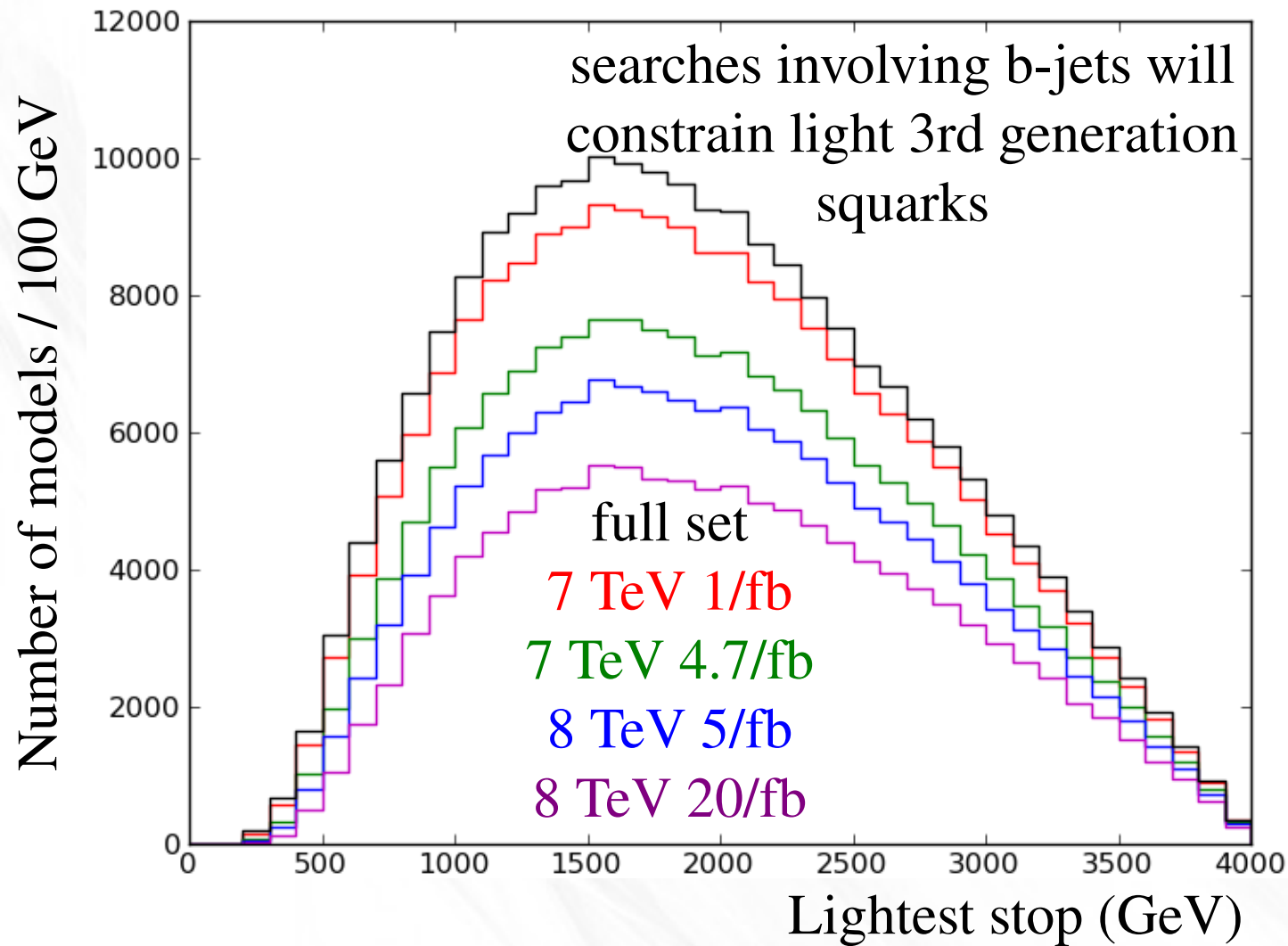
# ATLAS MET searches



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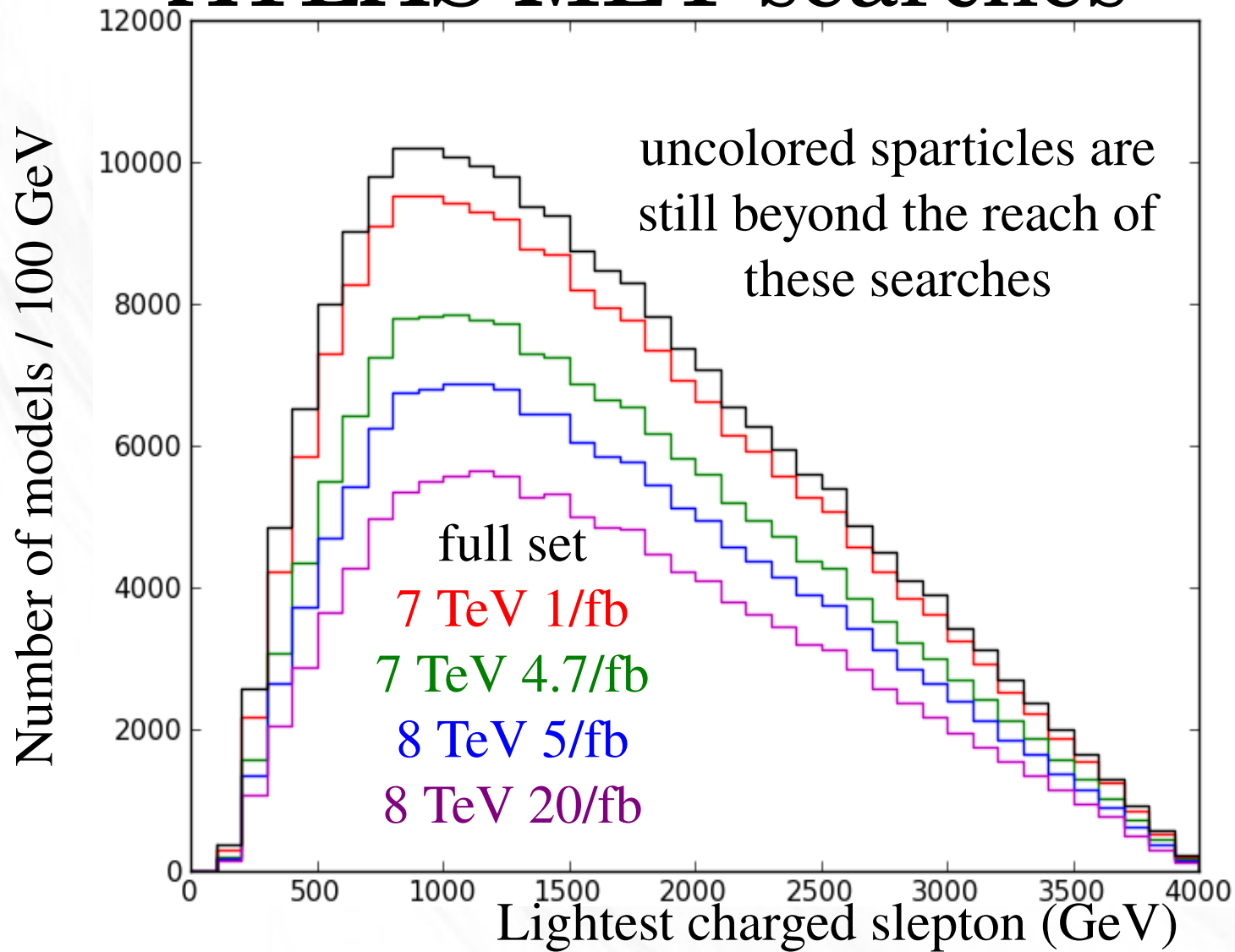


# ATLAS MET searches





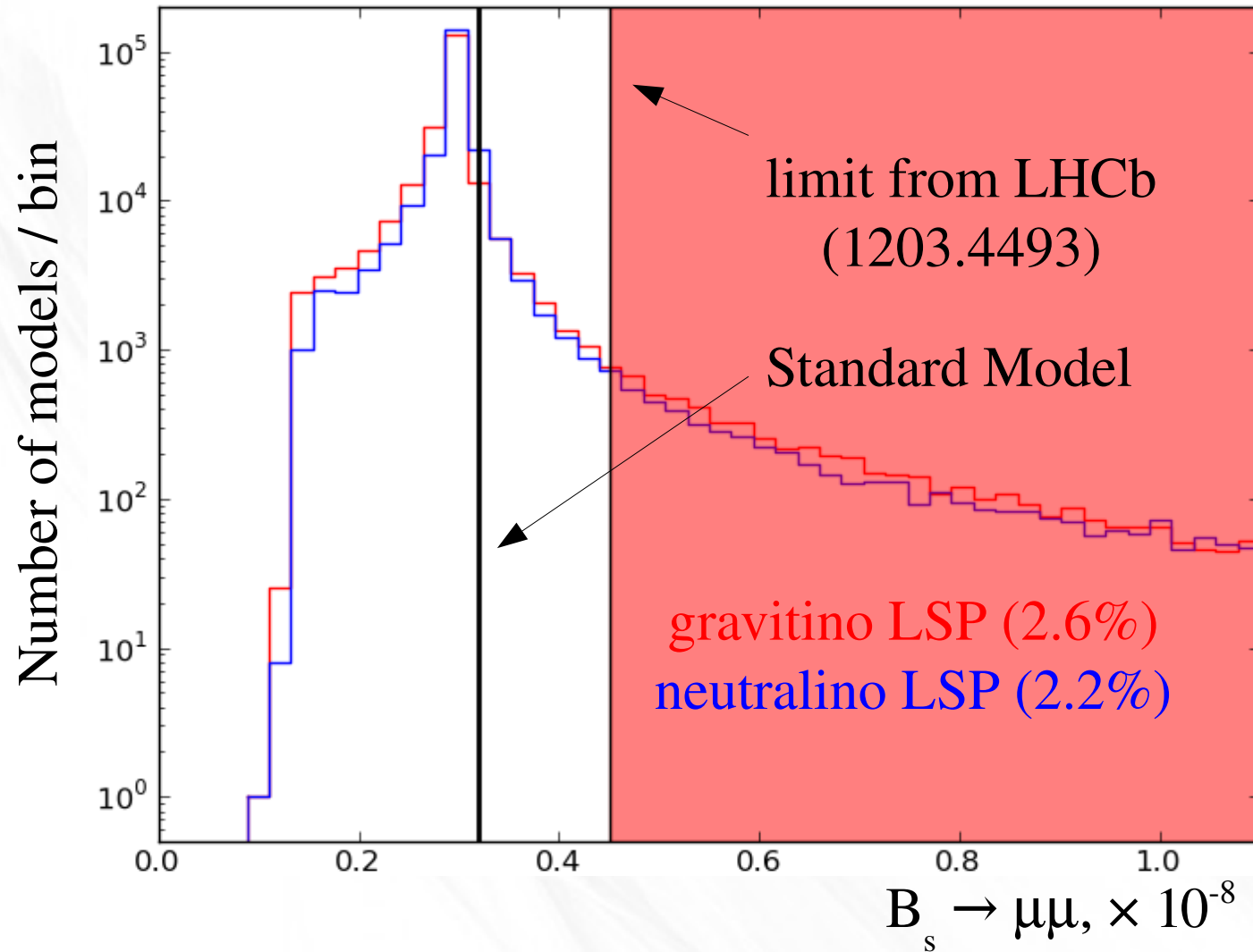
# ATLAS MET searches



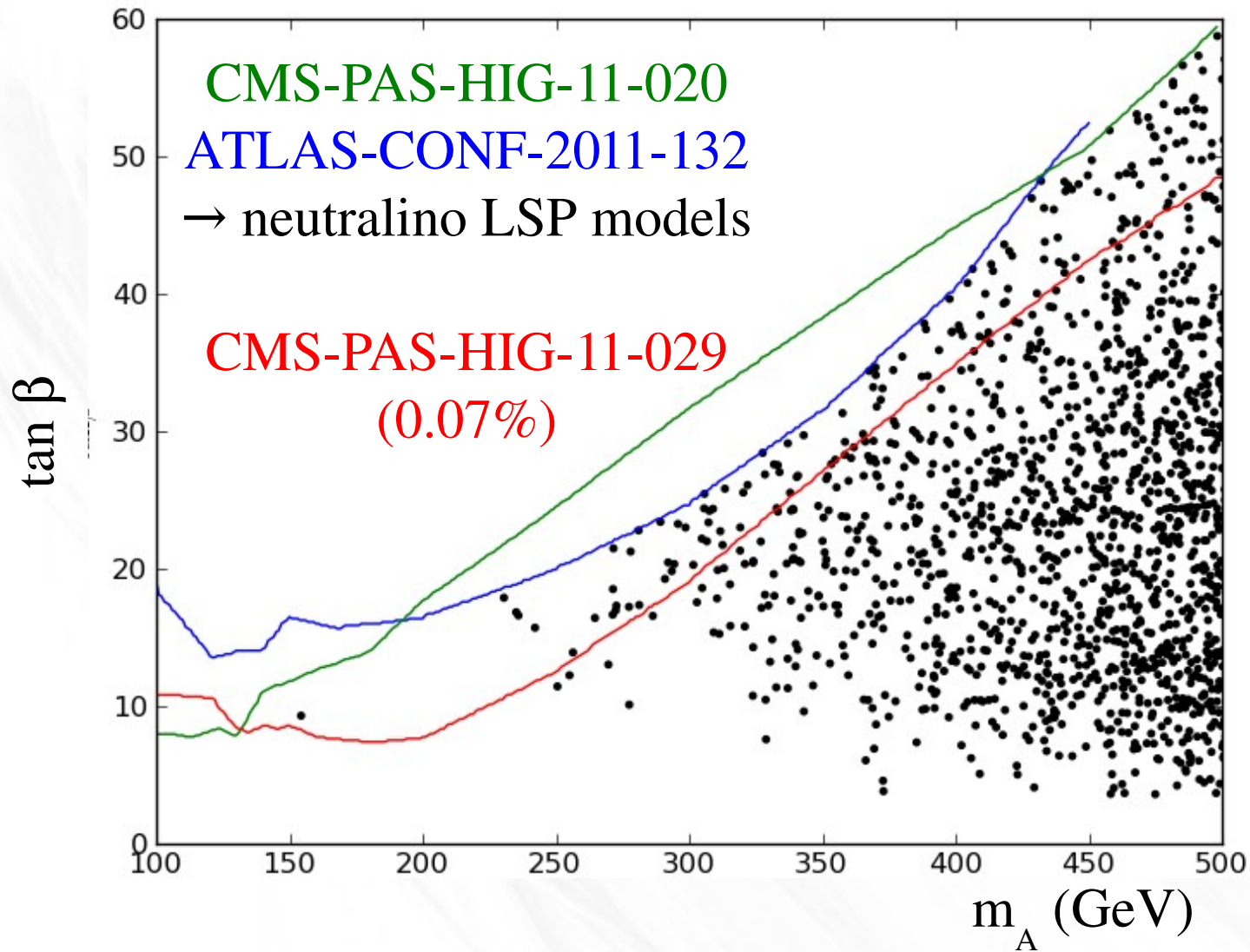
# Non-MET searches

- $B_s \rightarrow \mu\mu$  is sensitive to MSSM particles, particularly new Higgs bosons when  $\tan \beta$  is large
- $\phi \rightarrow \tau\tau$  searches also constrain the Higgs sector, providing limits in the  $m_A$  vs.  $\tan \beta$  plane
- Wino and higgsino LSPs often have associated charginos with small mass splittings, which may be detector stable

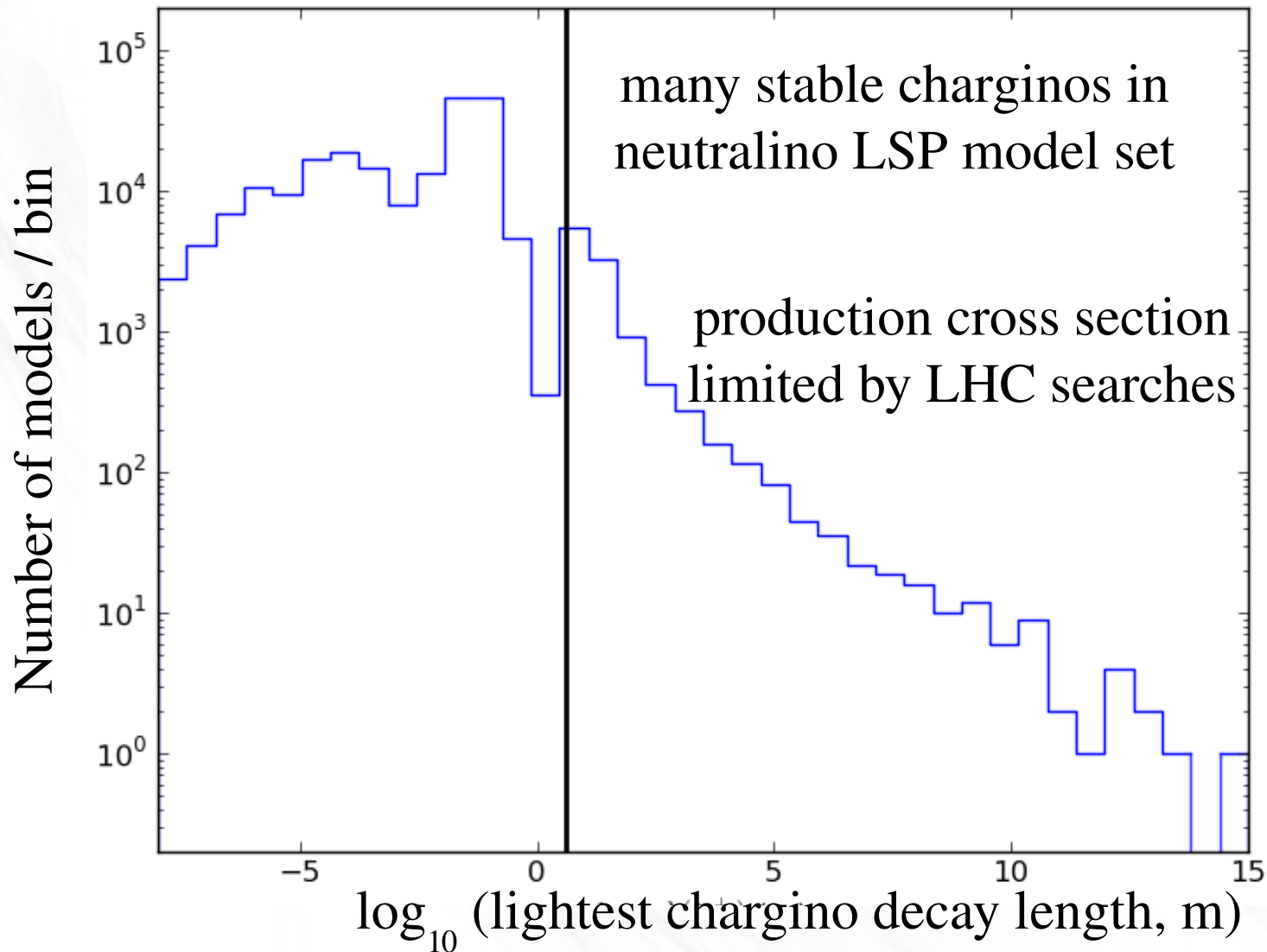
# Non-MET searches



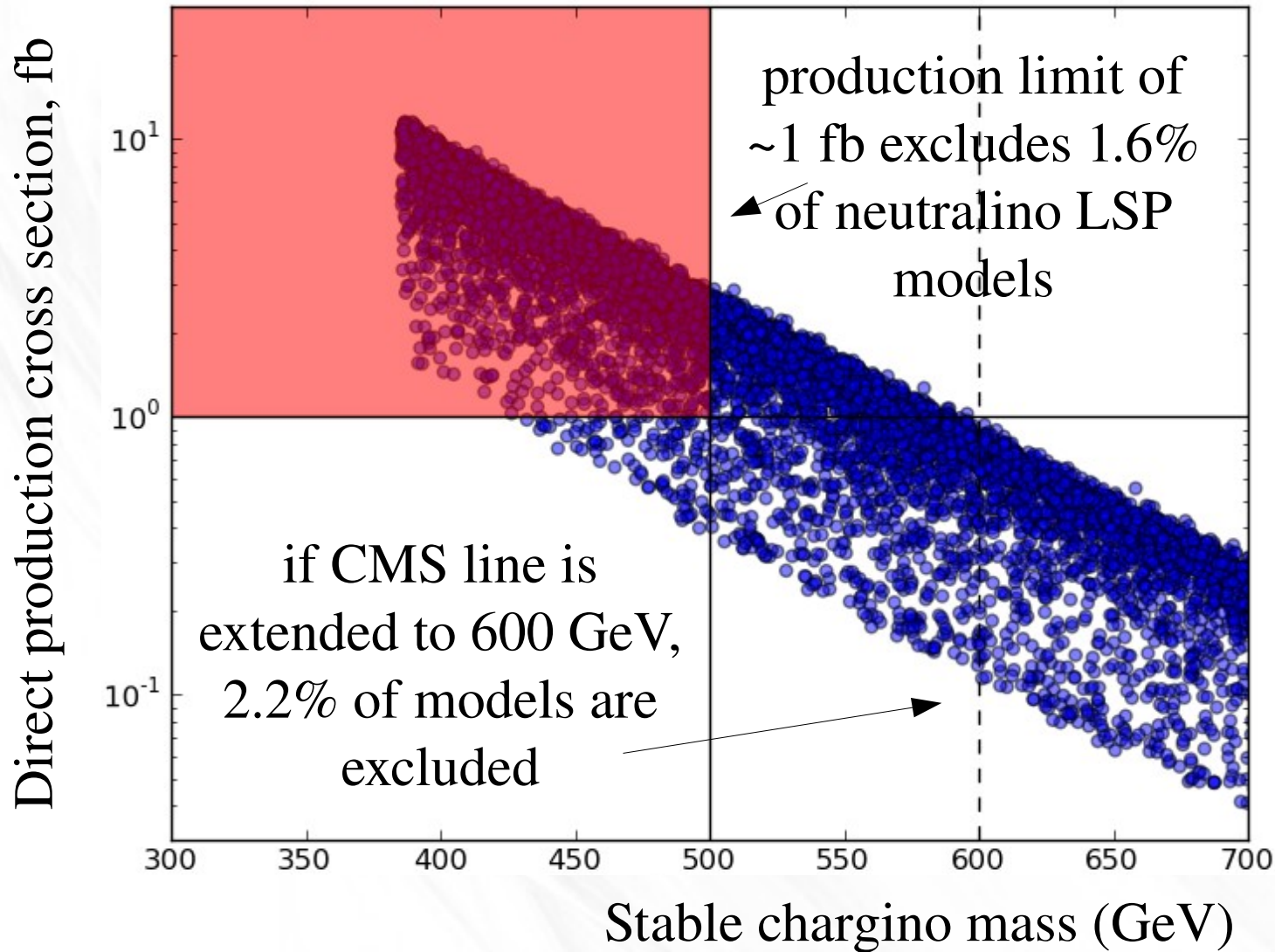
# Non-MET searches



# Non-MET searches



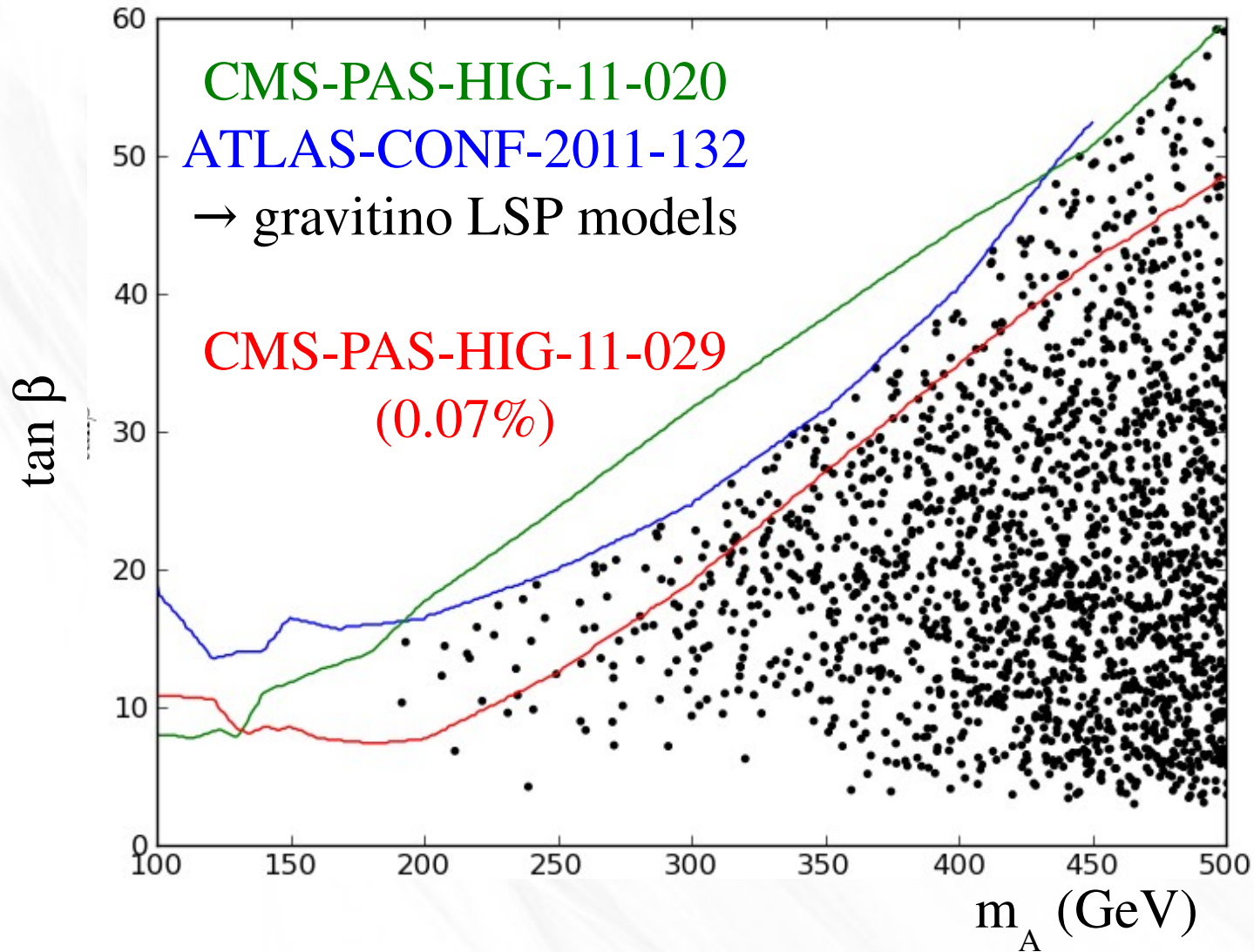
# Non-MET searches



# Outlook

- The pMSSM is a much more general framework than mSUGRA for studying the MSSM at the LHC
- Generally, the ATLAS searches do well at excluding pMSSM models with neutralino LSP
- After all searches shown here, 164683 / 223256 neutralino LSP models remain (73.8%)
- Stay tuned for further analysis of gravitino LSP models, including detailed stable particle treatment, and more LHC SUSY searches

# Non-MET searches





# Fine-tuning in the pMSSM

- Measure sensitivity of electroweak symmetry breaking scale to each pMSSM parameter  $p_i$
- $A_i = \partial(\log M_Z^2) / \partial(\log p_i)$ ,  $1 \leq i \leq 19$
- Most sensitive to  $\mu$  and stop mass parameters, but gluino mass enters at higher order
- Smaller contributions from all pMSSM parameters in principle
- Take maximum of all  $A_i$  to get fine-tuning  $\Delta$

# Fine-tuning in the pMSSM

