The Higgs Sector of the pMSSM in the light of the Higgs Discovery at LHC

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Which are the constraints on SUSY parameter space from a ~125 GeV Higgs boson ?

Which are the SUSY scenarios most interesting for the LHC program ?

Which are the implications of measurements of the Higgs properties at the LHC ?

This talk is part of a study which attempts to answer these questions, at least in part:

Use pMSSM flat scans, apply flavour and DM constraints, verify observability of points in LHC MET and Higgs analyses, impose Higgs mass range and study fraction of viable pMSSM points as function of pMSSM parameters;

Implications of h BR measurements at LHC and LC discussed in the March plenary;

Today discuss some implications of results presented by ATLAS, CMS, CDF and D0.

This study presented in arXiv:1207:1348v2

For previous results see EPJ C72 (2012) 1906, PLB 708 (2012) 162.

pMSSM Scans

Flat scan of 19 pMSSM parameters:
60M pMSSM points generated

$$1 \leq \tan\beta \leq 60\,,$$
$$50\ \text{GeV} \leq M_A \leq 3\ \text{TeV}\,,$$
$$-10\ \text{TeV} \leq A_f \leq 10\ \text{TeV}\,,$$
$$50\ \text{GeV} \leq m_{\tilde{f}_L}, m_{\tilde{f}_R}, M_3 \leq 3.5\ \text{TeV}\,,$$
$$50\ \text{GeV} \leq M_1, M_2, |\mu| \leq 2.5\ \text{TeV}$$

$$m_t = (173 \pm 1)\ \text{GeV},\ \bar{m}_b(\bar{m}_b) = (4.19^{+0.18}_{-0.06})\ \text{GeV},$$
$$M_Z = (91.19 \pm 0.002)\ \text{GeV},\ M_W = (80.42 \pm 0.003)\ \text{GeV},$$
$$\alpha(M_Z^2) = 1/127.916 \pm 0.015,\ \alpha_s(M_Z^2) = 0.1184 \pm 0.0014\,.$$

Constraints

$$2.16 \times 10^{-4} < \text{BR}(B \to X_s\gamma) < 4.93 \times 10^{-4}$$

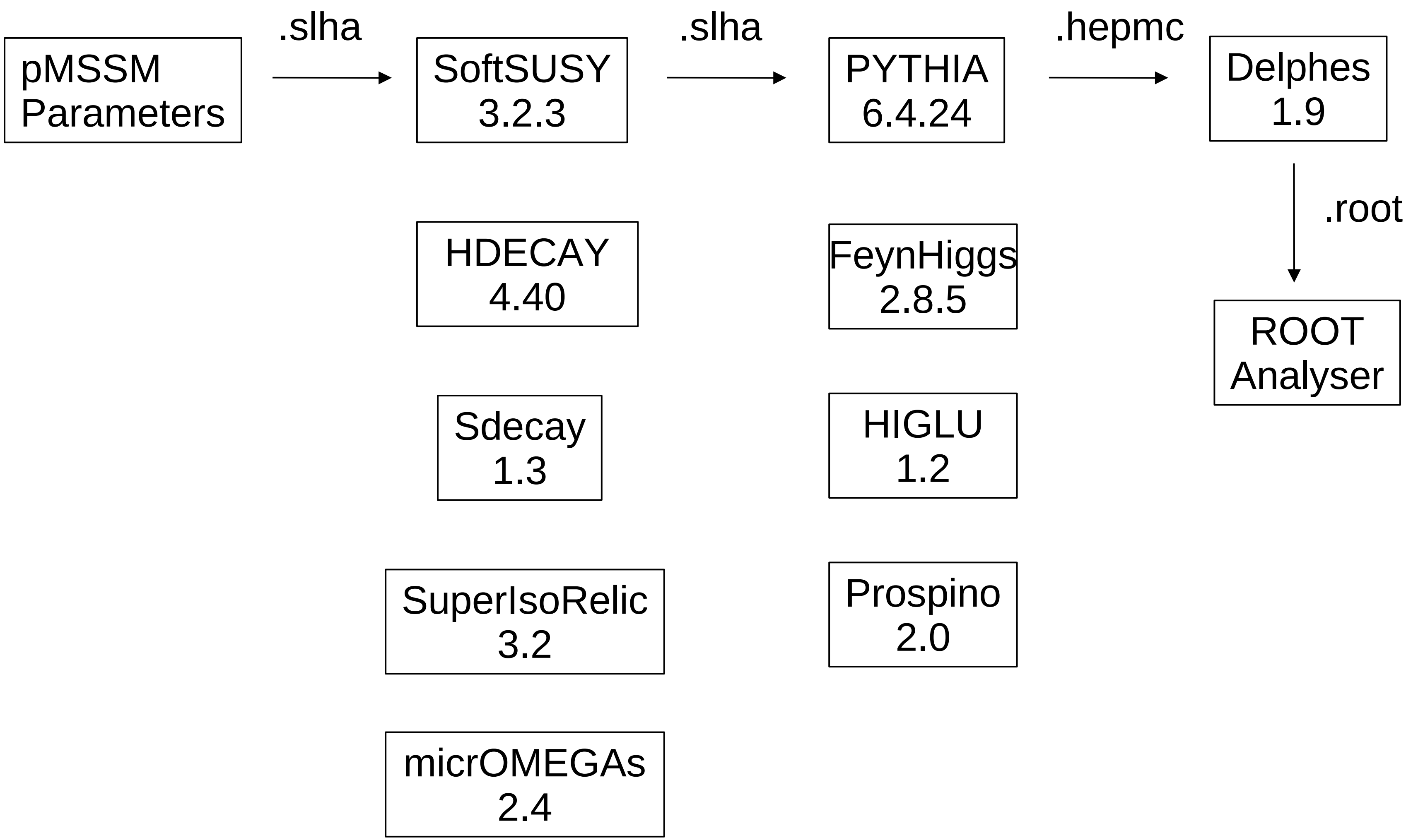
→ $$\text{BR}(B_s \to \mu^+\mu^-) < 5 \times 10^{-9}$$

$$0.56 < \frac{\text{BR}(B \to \tau\nu)}{\text{BR}_{SM}(B \to \tau\nu)} < 2.70\,,$$
$$4.7 \times 10^{-2} < \text{BR}(D_s \to \tau\nu) < 6.1 \times 10^{-2}\,,$$
$$2.9 \times 10^{-3} < \text{BR}(B \to D^0\tau\nu) < 14.2 \times 10^{-3}\,,$$
$$0.985 < \text{R}_{\ell 23}(K \to \mu\nu) < 1.013\,.$$

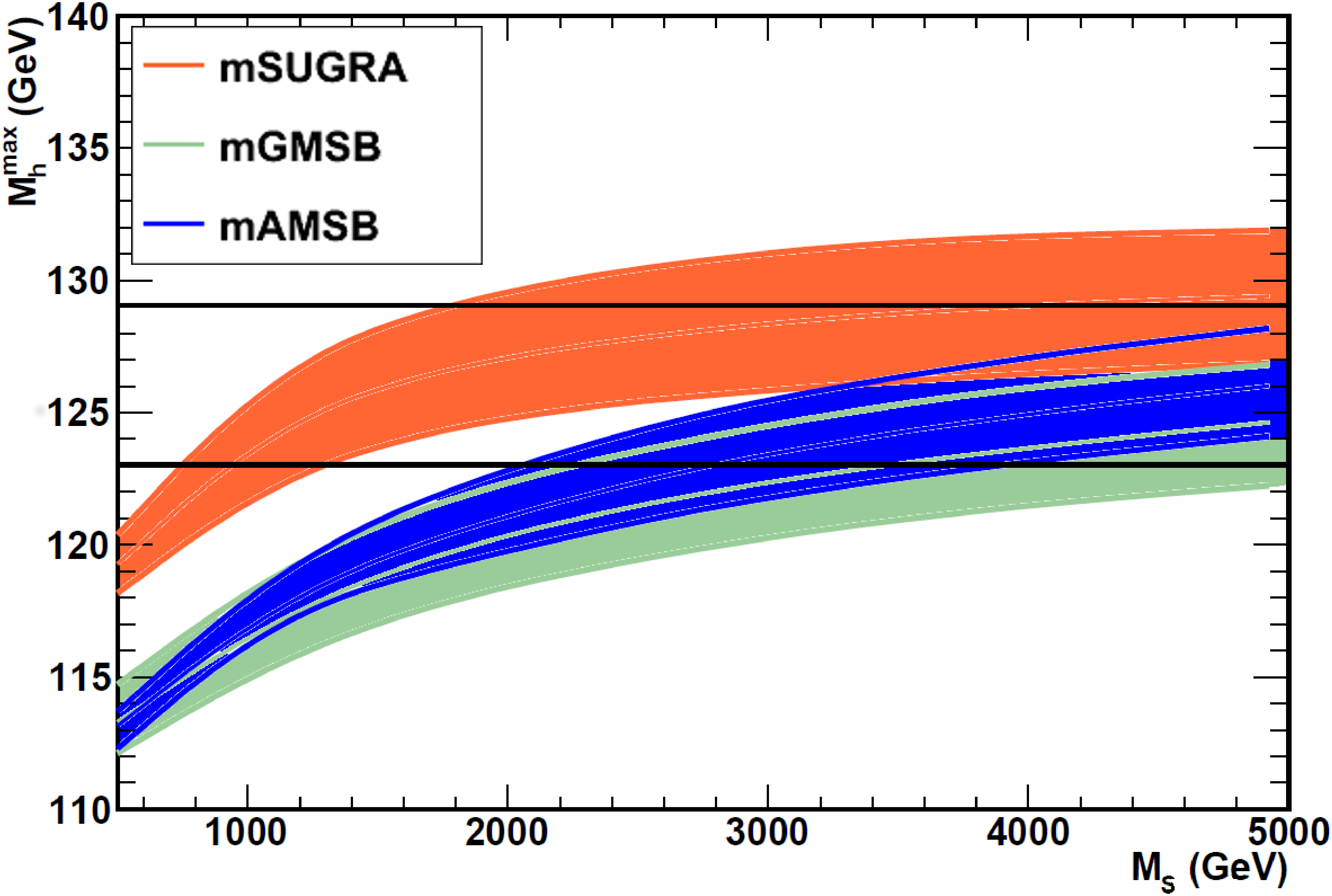
$$-2.4 \times 10^{-9} < \delta a_\mu < 4.5 \times 10^{-9}$$

$$10^{-4} < \Omega_\chi h^2 < 0.155$$

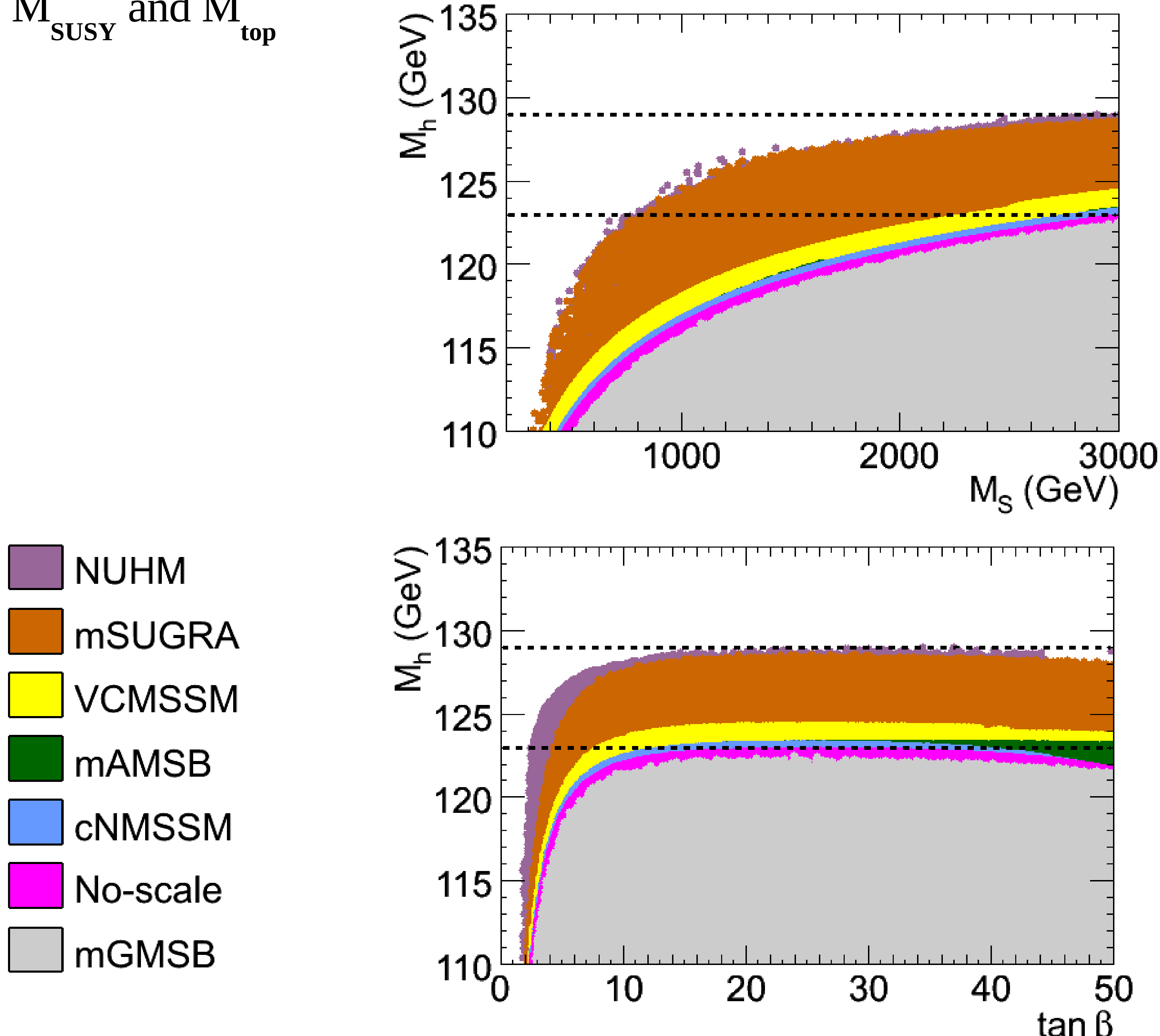
Software Tools



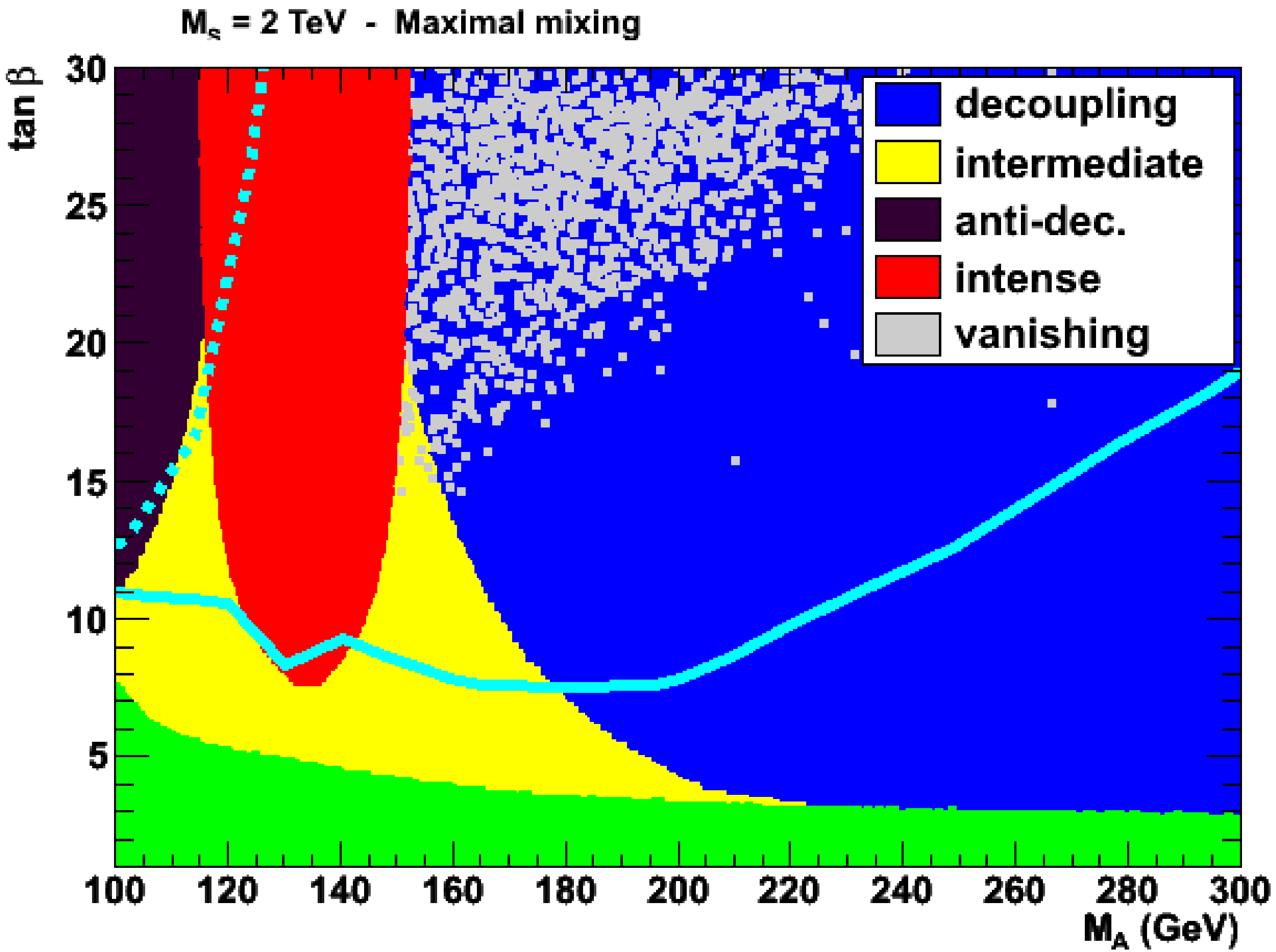
M_h^{max} vs M_{SUSY} and M_{top}



M_h^{max} vs M_{SUSY} and M_{top}



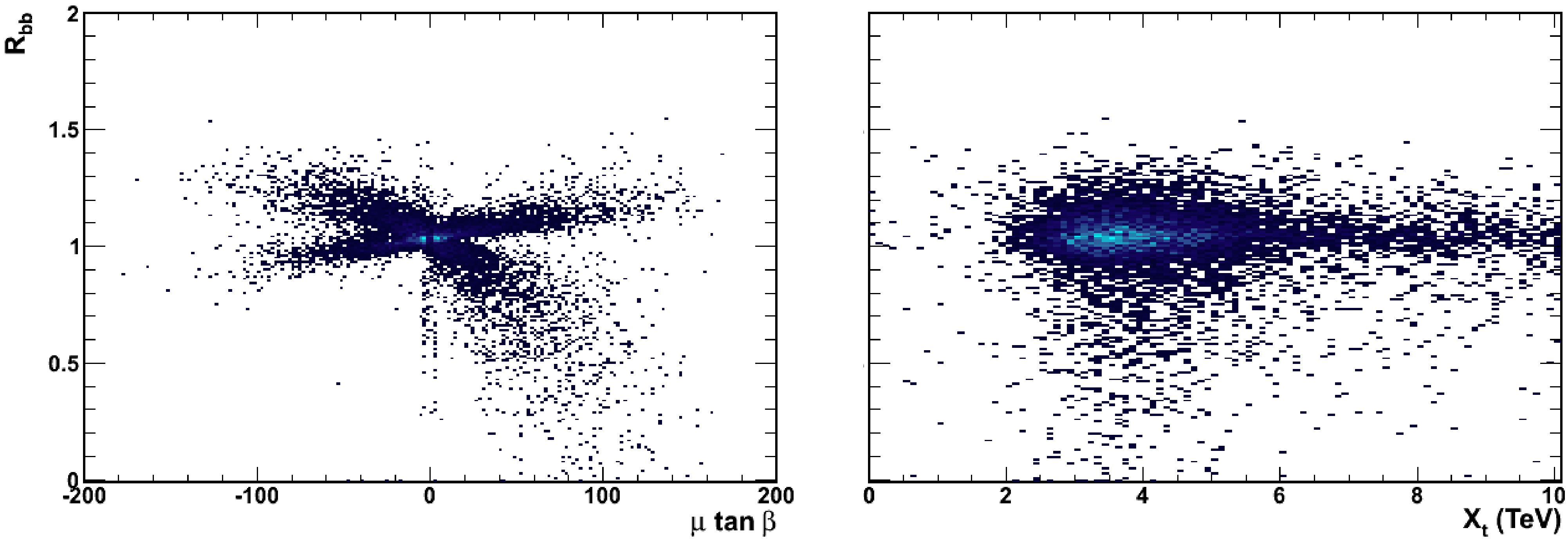
SUSY Regimes



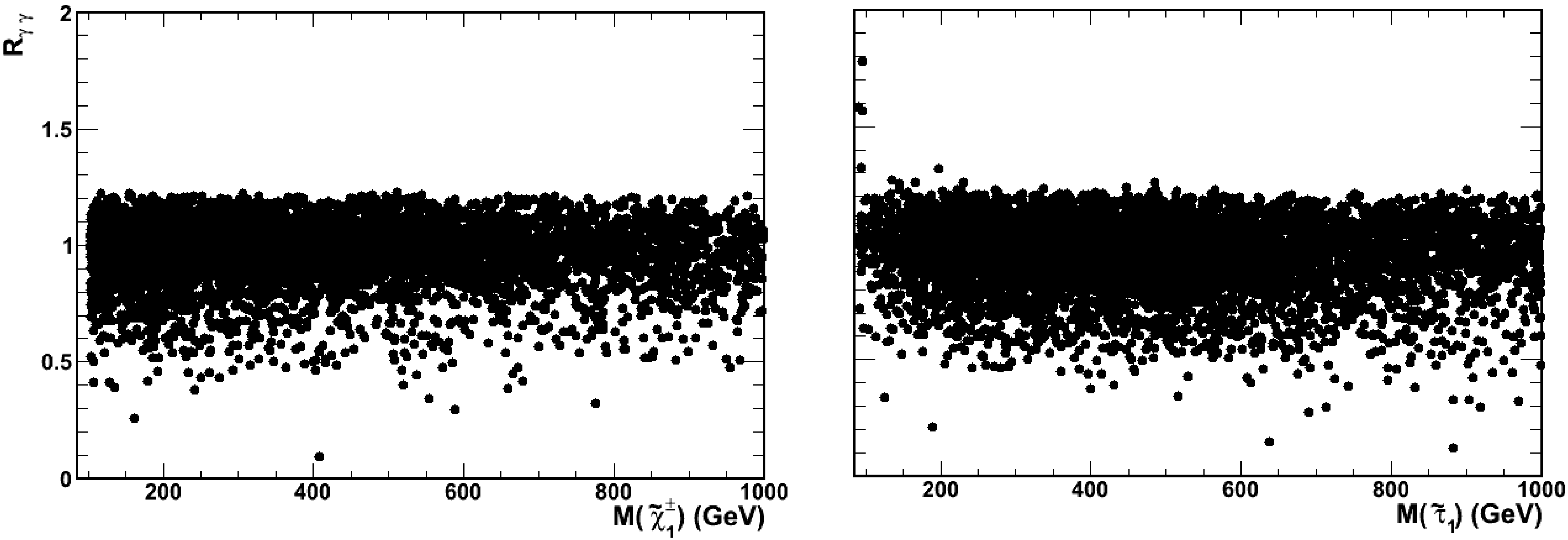
SUSY Particle Effects

Hbb and Higgs width

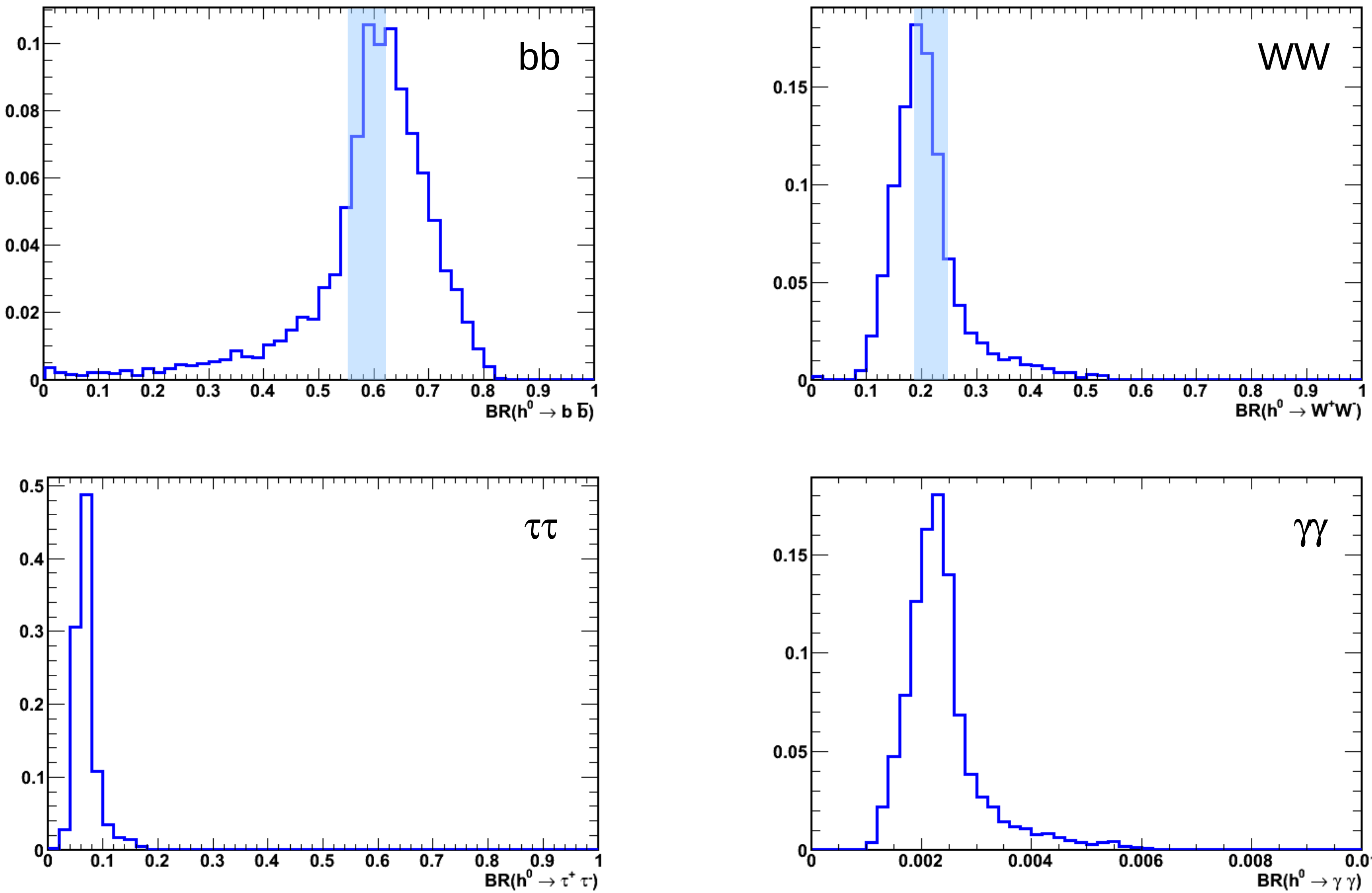
$$\Delta_b \approx \frac{2\alpha_s}{3\pi}\frac{m_{\tilde{g}}\mu\tan\beta}{\max(m_{\tilde{g}}^2, m_{\tilde{b}_1}^2, m_{\tilde{b}_2}^2)} + \frac{m_t^2}{8\pi^2 v^2\sin^2\beta}\frac{A_t\mu\tan\beta}{\max(\mu^2, m_{\tilde{t}_1}^2, m_{\tilde{t}_2}^2)}$$



SUSY Particle Effects
χ^+_1 and τ_1

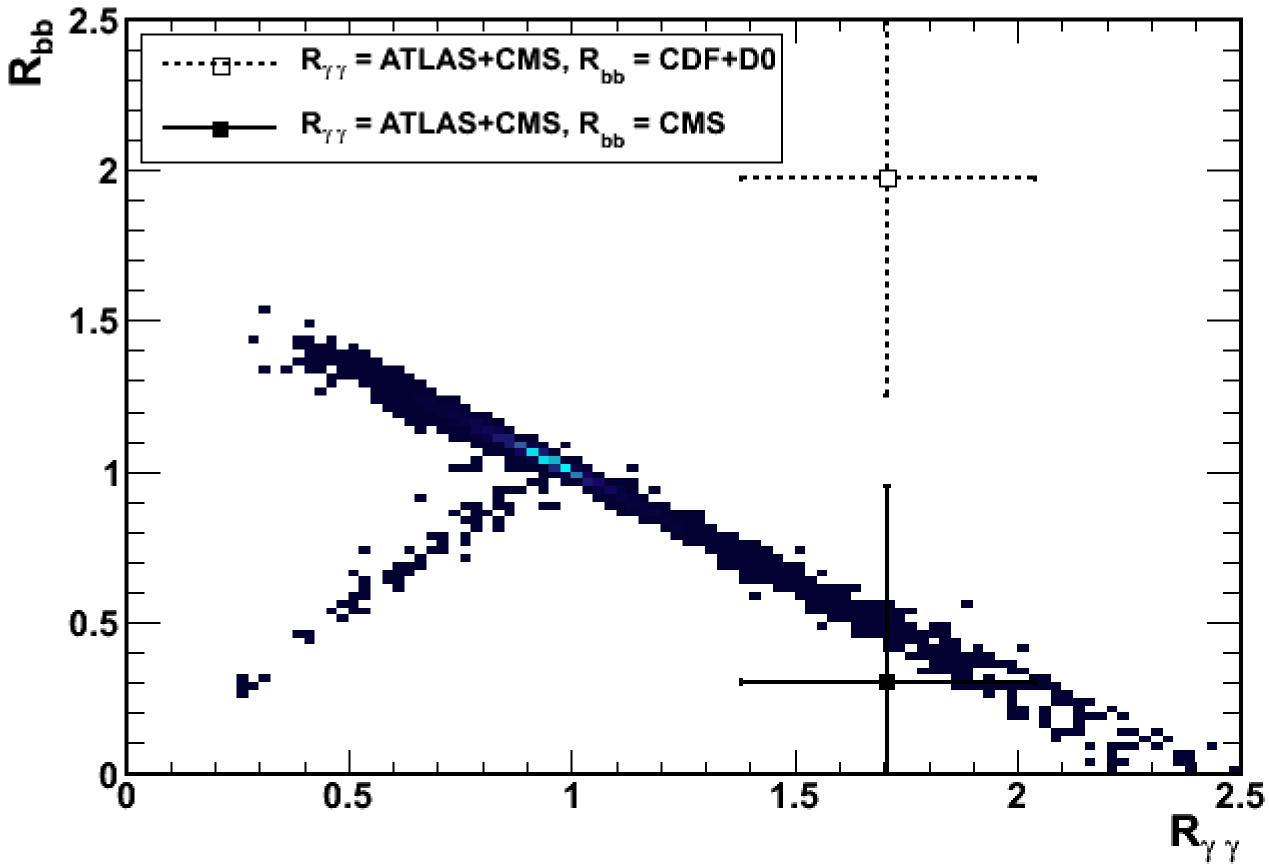


Higgs Branching Fractions
pMSSM points: $123 < M_h < 127$ GeV



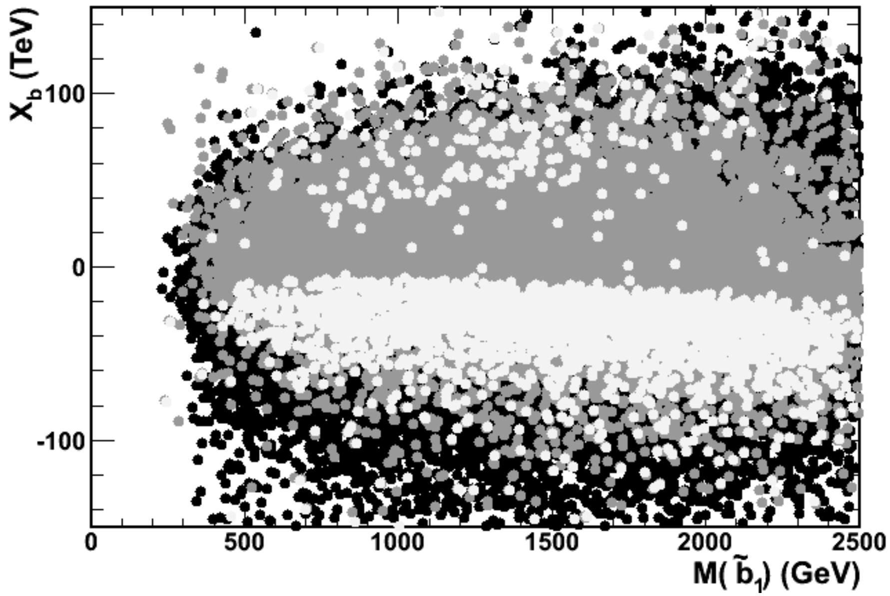
Fits to Data

Parameter	Value	Experiment
M_H	125.9±2.1 GeV	ATLAS [1] + CMS [2]
$\mu_{\gamma\gamma}$	1.71±0.33	ATLAS [50] + CMS [51]
μ_{ZZ}	0.95±0.40	ATLAS [52] + CMS [53]
$\mu_{b\bar{b}}$	<1.64 (95% C.L.)	CMS [54]
$\mu_{\tau\tau}$	<1.06 (95% C.L.)	CMS [55]

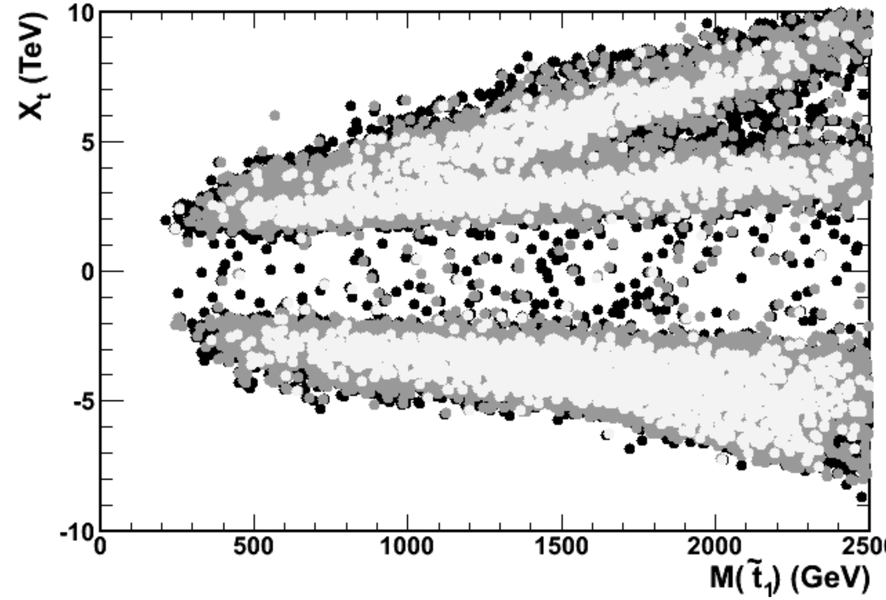


Fits to Data:
68 and 90% C.L. Contours

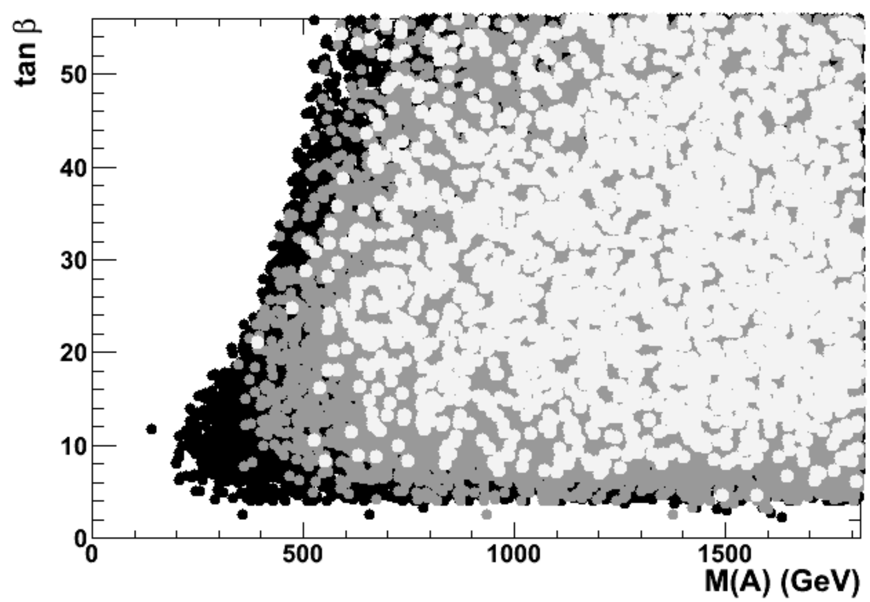
X_b - $M(b_1)$



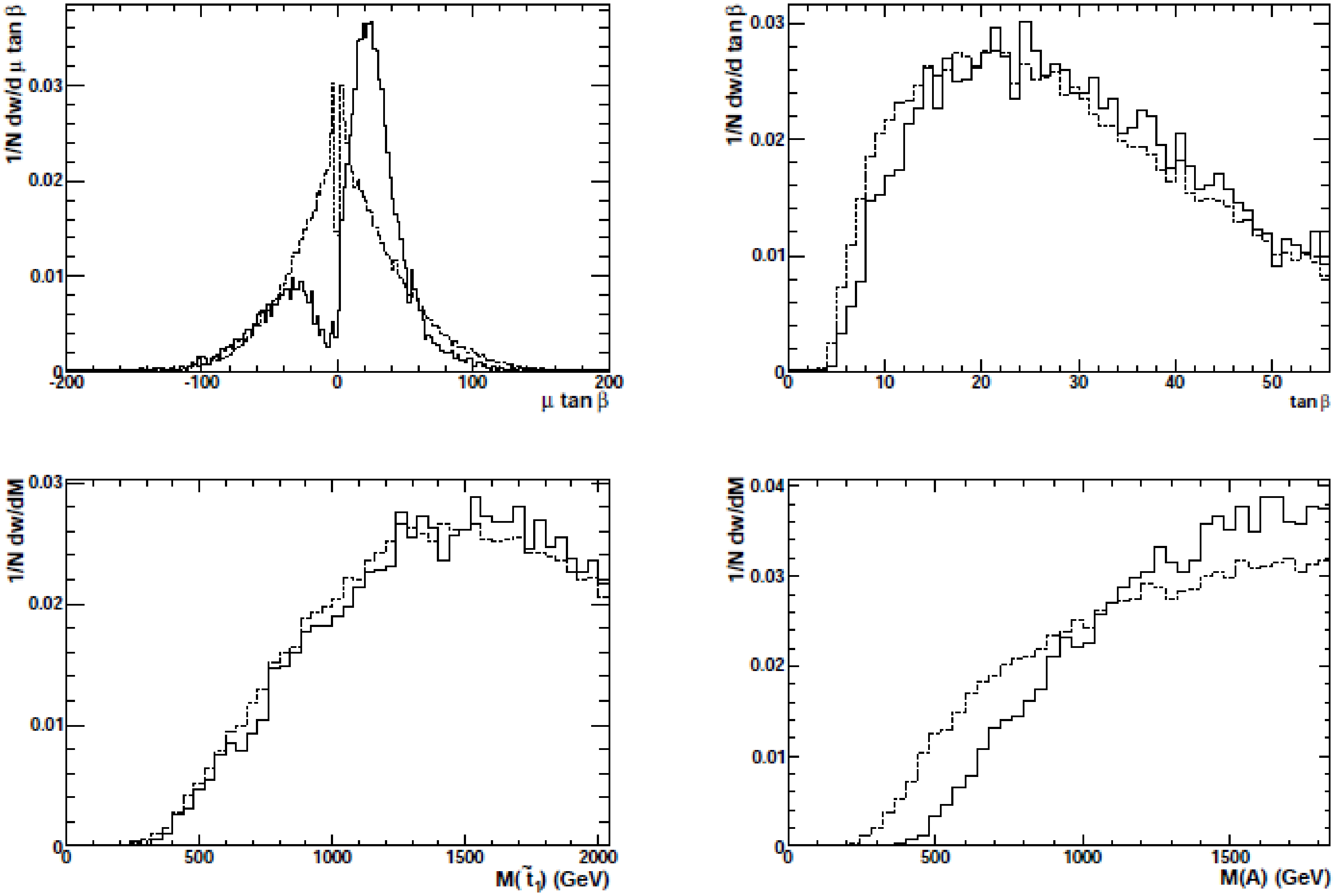
X_t - $M(t_1)$



M(A) – tan β



Fits to Data



0.06 (0.50) of selected pMSSM points compatible with LHC constraints at 68% (90%) C.L.

Conclusions

Study implications of Higgs mass and branching fraction measurements on SUSY Higgs parameters through pMSSM flat scans;

Mh hints to large values of M_{SUSY} and/or X_t, effect of M_{top} is important;

LHC data tends to exclude SUSY regimes of the Higgs sector realised at low M_A

Sizeable contributions to SUSY particles to h decay widths are possible and LHC rate measurements already provide important information which restricts the parameter space;

Study offers us an interesting platform to evaluate precision needs and value of LC data complementing LHC results in a realistic scenario;

Improved precision in Higgs mass and rates and enhanced sensitivity to A/H and SUSY particles at LHC to provide basis for clarifying the relation of discovered particle to physics beyond the SM and the role of future collider projects.