Two Higgs Doublets Models

heavy Higgs $\longleftrightarrow$ modified Higgs couplings

$$m_h^2 \approx m_Z^2 + 16\delta_\lambda v^2$$

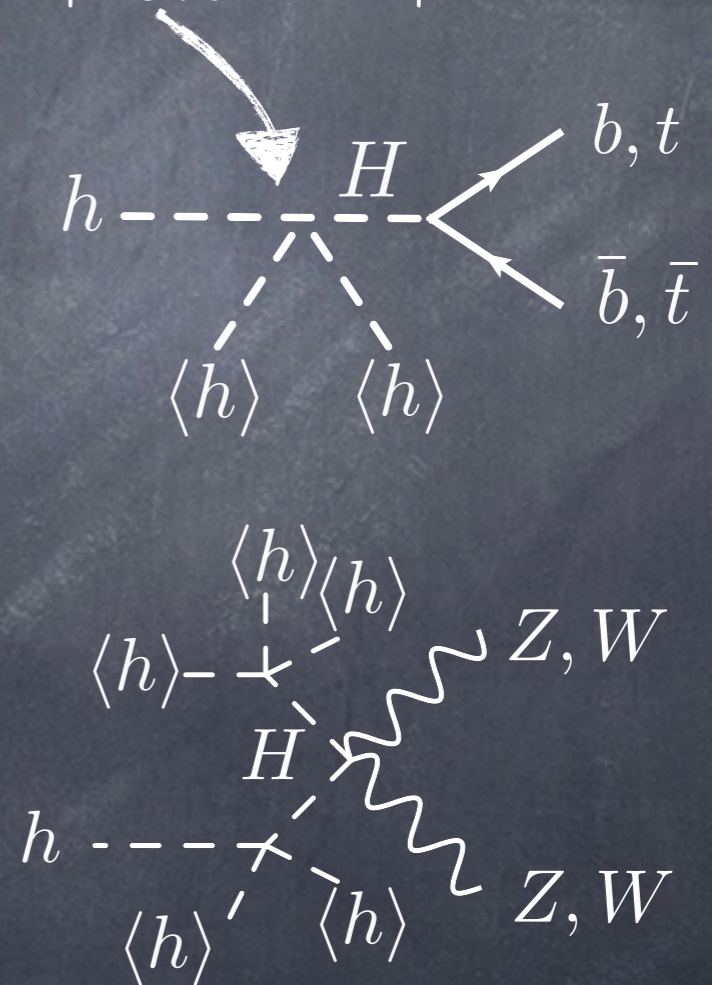$$125^2\text{GeV}^2 = 91^2\text{GeV}^2 + 86^2\text{GeV}^2$$

Need SUSY contributions to V(h,H)
(Heavy stops,D-terms,F-terms,...)

$$\Delta V = \delta_\lambda h^4 + \delta h^3 H + ...$$

$$\frac{y_b}{y_b^{SM}} = 1 - 4\delta \tan\tilde{\beta}\frac{v^2}{m_H^2}$$

$$\frac{y_t}{y_t^{SM}} = 1 + 4\delta \cot\tilde{\beta}\frac{v^2}{m_H^2}$$

$$\Delta c_V \sim \frac{v^4}{m_H^4} \sim 0$$

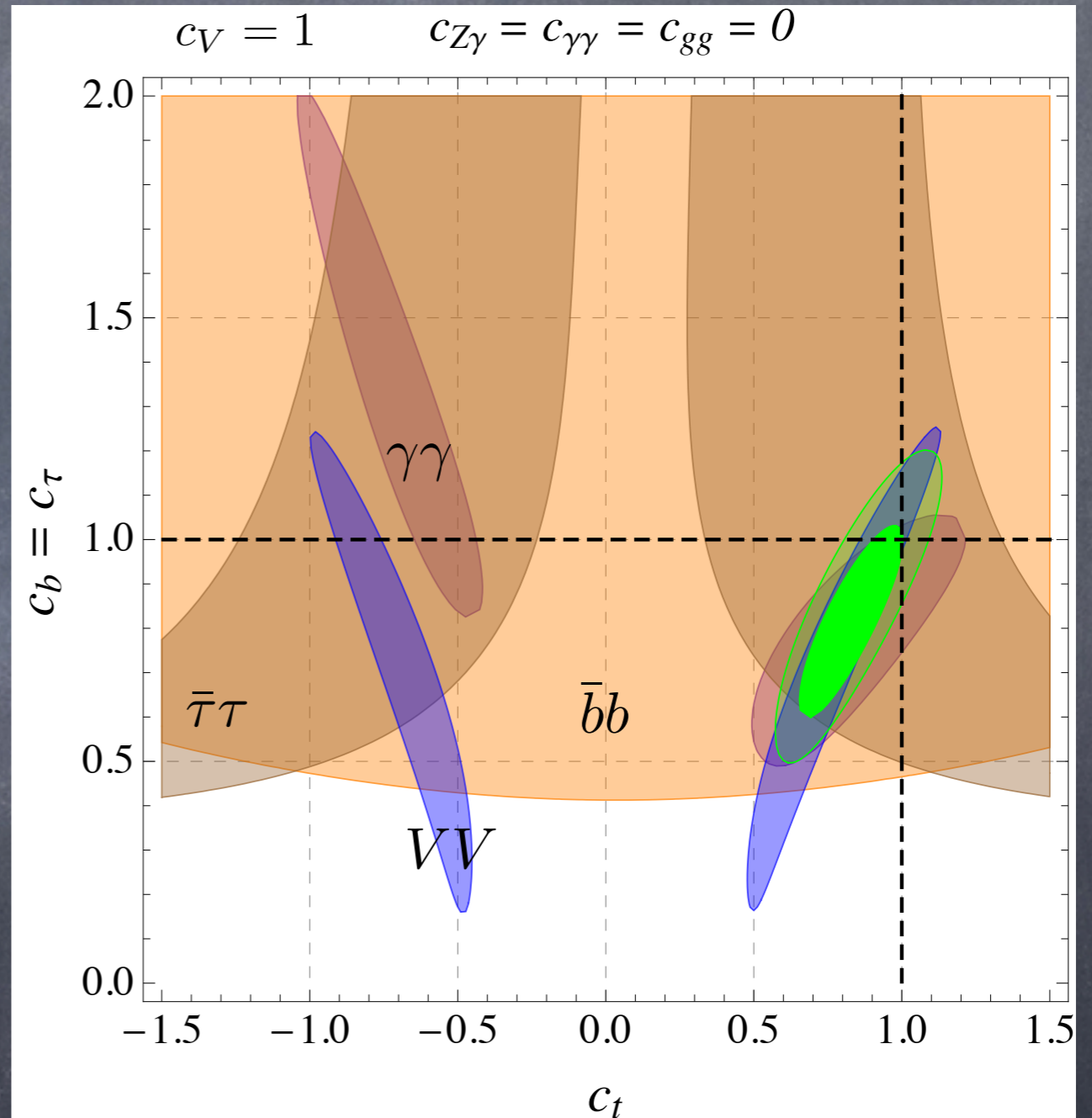Blum,D'Agnolo,Fan'12; Azatov,Chang,Craig,Galloway'12
Montull,Gupta, FR, '12

*Ignoring loop effects that couple b and Hu (Gupta,Rzehak,Wells'12)

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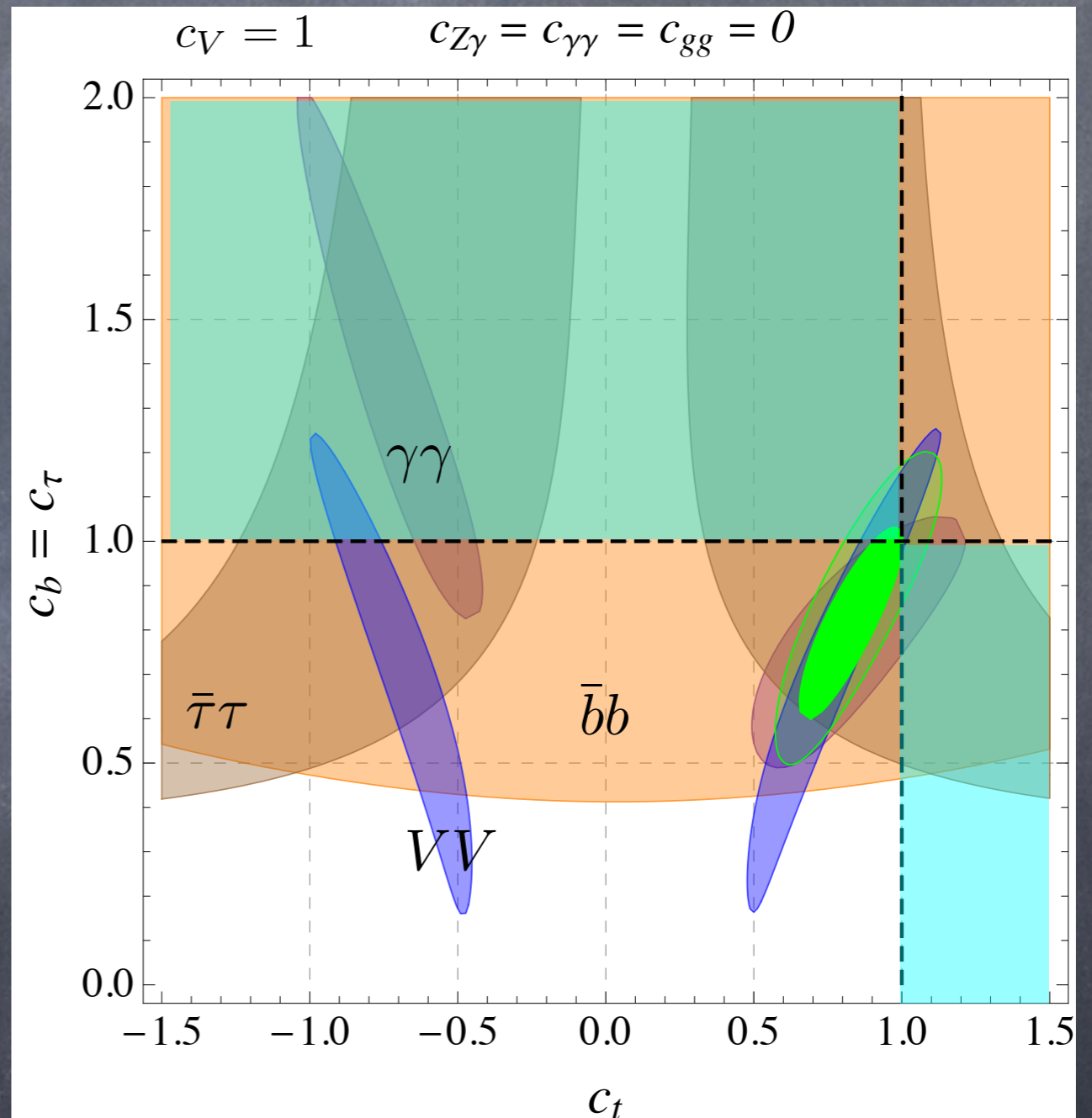$$\frac{y_t}{y_t^{SM}} = 1 + 4\delta \cot\tilde{\beta}\, \frac{v^2}{m_H^2}$$

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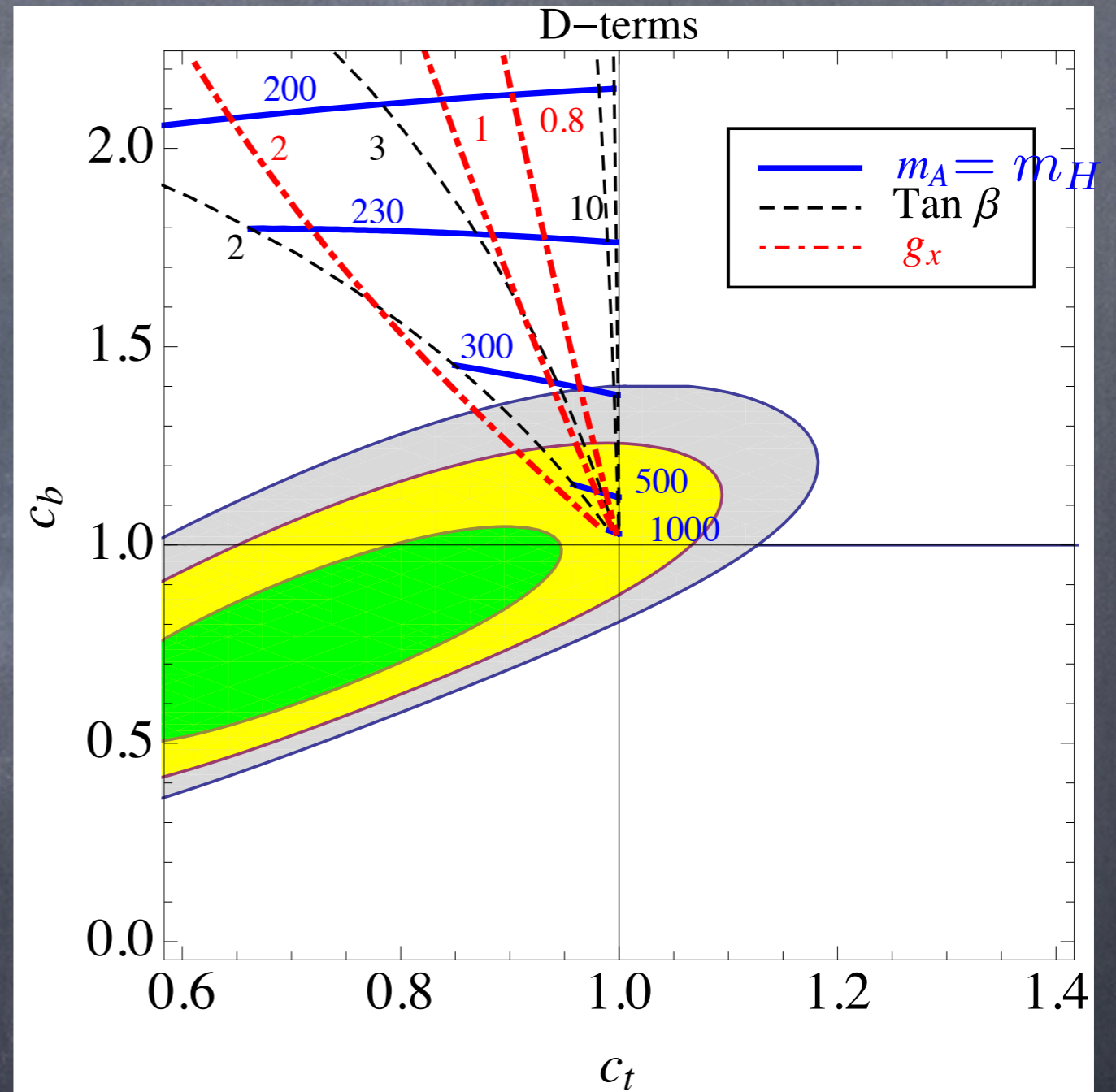Montull,Gupta, FR, '12

Two Higgs Doublets Models, SUSY

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D-Terms: $\Delta V = \kappa \left(|H_1^0|^2 - |H_2^0|^2 \right)^2$

$$\delta = -\frac{m_h^2}{2v^2} \frac{t_\beta}{t_\beta^2 - 1}$$

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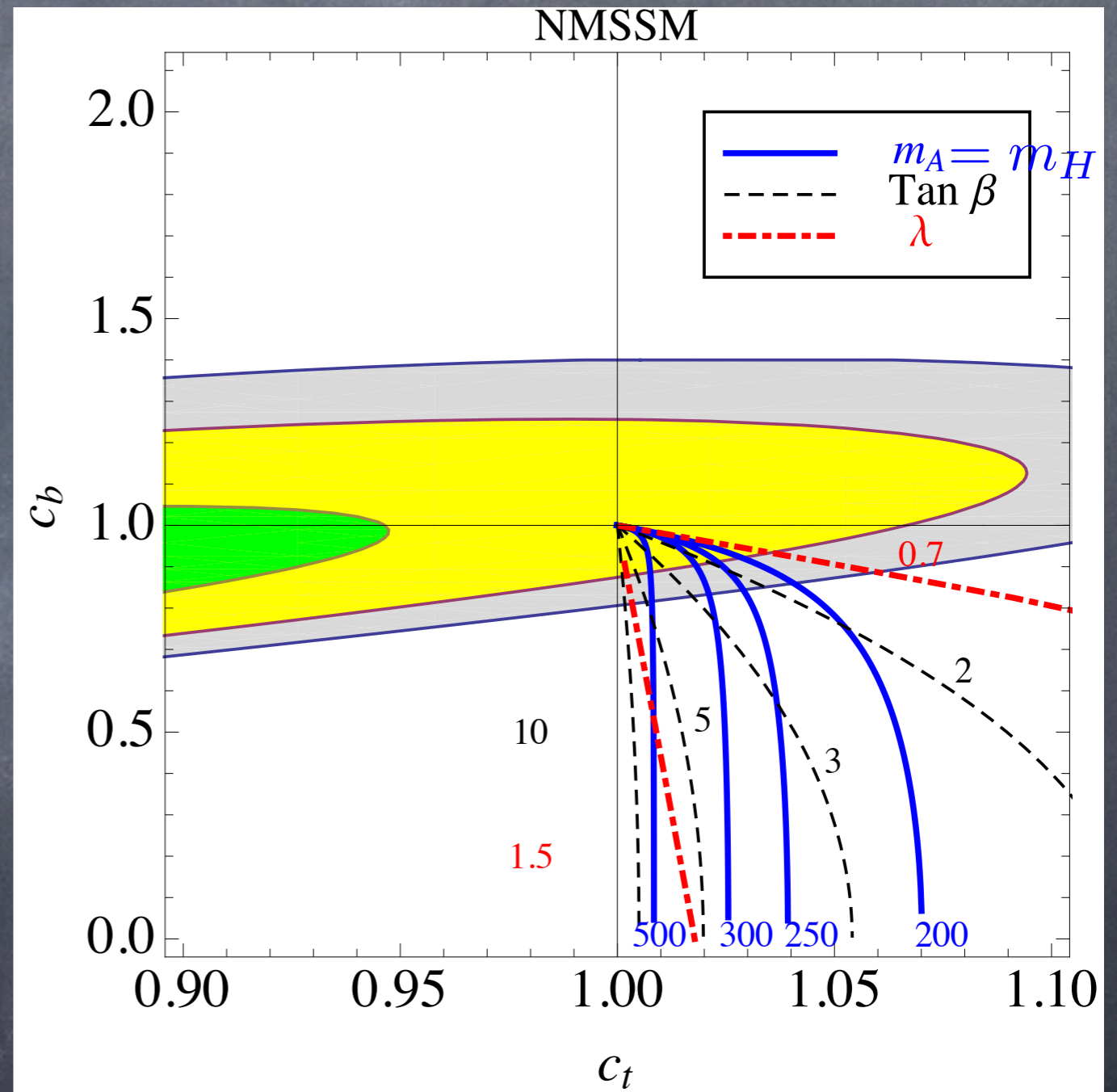$$\frac{y_b}{y_b^{SM}} = 1 - 4\delta \tan\tilde{\beta} \frac{v^2}{m_H^2}$$

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F-Terms (no mixing):

$$\Delta V = -\lambda_S^2 (H_1 H_2)^2 \frac{m_S}{M_S}$$

$$\Delta c_b \approx -t_\beta^2 (60\text{GeV}/m_H)^2$$

$$\Delta c_t \approx (60\text{GeV}/m_H)^2$$

NMSSM

Blum,D'Agnolo,Fan'12; Azatov,Chang,Craig,Galloway'12
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