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No.

Date

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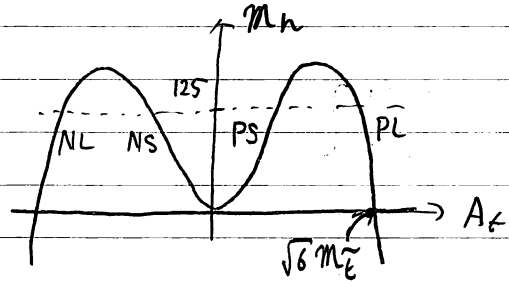
SUSY "search" at the LHC
by Higgs decay BR.

□ Higgs mass

$$m_h^2 = m_Z^2 \cos^2 2\beta + \frac{3 m_t^4}{2\pi^2 v^2}\left[\log\frac{m_{\tilde{t}}^2}{m_t^2} + \alpha\left(1 - \frac{1}{12}\alpha\right)\right]$$

$$\alpha = \frac{(A_t - \mu\cot\beta)^2}{m_{\tilde{t}}^2}$$



□ quark mass

$$-\mathcal{L} = y_b\, \bar{b}_R H_d Q_L + y_t\, \bar{t}_R H_u Q_L$$

Non-holomorphic terms forbidden by SUSY.

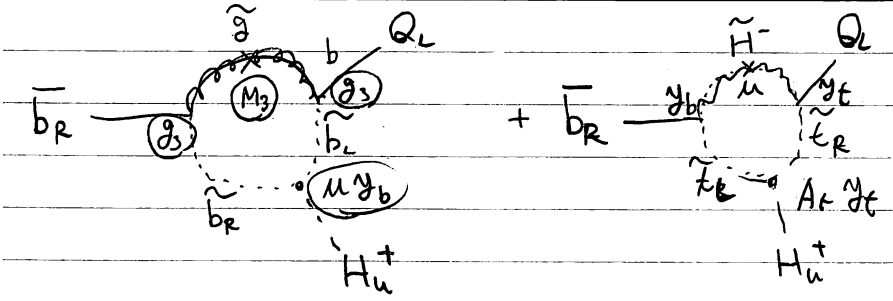
↓ Radiative corrections

$$-\mathcal{L} = (\quad) + \Delta y_b \cdot \bar{b}_R Q_L H_u^\dagger + \Delta y_t\, \bar{t}_R Q_L H_d^\dagger$$

$v = 246\,\mathrm{GeV} = \sqrt{2}\left(\sqrt{v_u^2 + v_d^2}\right)$

$$\begin{cases} m_b = y_b v_d + \Delta y_b \cdot v_u = y_b v_d \left(1 + \dfrac{\Delta y_b}{y_b}\tan\beta\right) \\ m_t = y_t v_u + \Delta y_t \cdot v_d = y_t v_u \left(1 + \dfrac{\Delta y_t}{y_t}\cot\beta\right) \end{cases}$$

$$\sim 1 + \left(\frac{2\alpha_s}{3\pi}\frac{M_3 \mu}{\text{loop func.}} + \frac{y_t^2}{16\pi^2}\frac{A_t \mu}{\text{loop}\cdots}\right)\tan\beta$$



• Hbb coupling

$$-\mathcal{L} \supset y_b \bar{b}_R H_d Q + \Delta y_b \bar{b}_R H_u^\dagger Q + y_t \bar{t}_R H_u Q + \Delta y_t \bar{t}_R H_d^\dagger Q$$

$$\downarrow \quad -\frac{1}{\sqrt{2}} h \sin\alpha \qquad \downarrow \quad \frac{1}{\sqrt{2}} h \cos\alpha$$

Higgs mass R.C.

$$\cos(\beta-\alpha) = \frac{m_Z^2 \sin 4\beta}{2 m_A^2}\left(1 + \frac{\delta M_{11}^2 - \delta M_{22}^2}{2 m_Z^2 \cos 2\beta} - \frac{\delta M_{12}^2}{m_Z^2 \sin 2\beta}\right) + O\left(\frac{m_Z}{m_A}\right)^4$$

$$\left(\sim O(10^{-(2-4)})\right)$$

$h b\bar{b}$ coupling

$$g_{hb\bar{b}} = \cdots = -\frac{\sin\alpha}{\cos\beta} \frac{1 - \Delta_b \cot\alpha \cot\beta}{1+\Delta_b} g^{SM} \quad \Leftarrow \frac{m_b}{v}$$

$$= \left(\sin(\beta-\alpha) - \frac{\tan\beta - \Delta_b \cot\beta}{1+\Delta_b} \cos(\beta-\alpha)\right) g^{SM}$$

$$g_{ht\bar{t}} = \left(\sin(\beta-\alpha) - \frac{\cot\beta - \Delta_t \tan\beta}{1+\Delta_t} \cos(\beta-\alpha)\right) g^{SM}$$

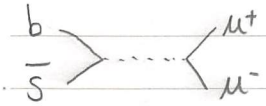
similar for τ

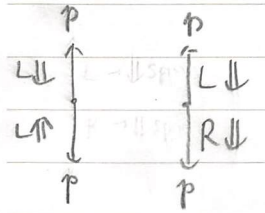
$\Delta_\tau \simeq \frac{-3\alpha_2}{8\pi} \frac{M_2 \mu \tan\beta}{\text{loop}}$

($\tilde{\tau}$. $\tilde{H}$ $\tilde{W}$ loop)

$$\frac{g_{hgg}}{g_{hgg}^{SM}} \simeq \frac{g_{ht\bar{t}}}{g_{ht\bar{t}}^{SM}} + \sum_{\text{quark}} \frac{m_f^2}{4(1+\Delta_f)^2}\left(\frac{m_{\tilde{f}_1}^2 + m_{\tilde{f}_2}^2 - X_f^2}{m_{\tilde{f}_1}^2 \cdot m_{\tilde{f}_2}^2}\right)$$

B_s $0(0^-)$

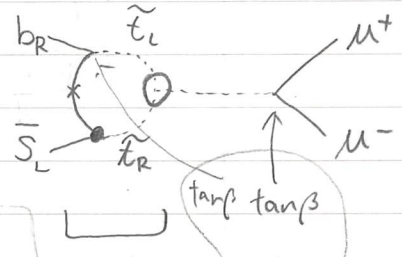




- Constraints

  - $B_s \to \mu^+\mu^-$

    SM: helicity suppressed ⟷ MSSM H($\tilde{H}$) contribution



$$Br(B_s \to \mu\mu) \begin{cases} \text{SM: } 3.65(23)\times 10^{-9} \\ \text{HC}_b\text{: } 2.8^{+0.7}_{-0.6}\times 10^{-9} \end{cases} \sim y_t^2 \mu A_t \tan\beta \text{ / loop}$$

$\tan^3\beta$ enhancement

  - $b \to s\gamma$

cf. stau/sbottom

$$\begin{pmatrix} m_S^2 & m_f(\mu\tan\beta) \\ & m_{S^2} \end{pmatrix}$$

  - Vacuum stability (stop)

$$\begin{pmatrix} m^2_{\tilde{t}_L} & A_t - \mu\cot\beta \\ & m^2_{\tilde{t}_R} \end{pmatrix}$$

numerical fit

$\rightsquigarrow A_t^2 + 3\mu^2 < 7.5\,(m^2_{\tilde{t}_L} + m^2_{t_R})$

Or with semiclassical approx with bounce solution.

- y_b flow-up

Numerical evaluation

- FeynHiggs (properly modified)

- $M_3 = 3M_2 = 6M_1 = m_A = -\mu = m_{\tilde{f}}$ ⓐ $\sqrt{m_{\tilde{Q}} m_{\tilde{u}}}$

not "BR".

$$R_F = \frac{\Gamma(h \to F)}{\Gamma_{SM}(h \to F)}$$

(A_t tuned) $= A_0$

- $M_3 = 3M_2 = 6M_1 = m_{Q,U}$

  $A_t = A_b = A_t$ tuned.

  $m_{D,L,E} = \max(M_3, |\mu|)$ s.t. avoid large mixing in $m_D \ll \mu$

  m_A, $\tan\beta$, μ varied. $\left(0.5 < \frac{|\mu|}{m_3} < 5.\right)$