Quantum Corrections to the MSSM

$h^0 \to b\bar{b}$ vertex :

Decoupling Limit

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From work in collaboration with:

H.Haber, M.J.Herrero, H.Logan, S.P., S.Rigolin and D.Temes,
Phys.Rev.D63:055004, 2001, hep-ph/0007006

H.Haber, H.Logan, S.P. and D.Temes, In preparation, 2005

- Introduction
  - Motivations
  - Meaning of Decoupling
  - Minimal Supersymmetric Standard Model
- Decoupling limit in the MSSM
- Neutral Higgs boson decays: $h^0 \to b\bar{b}$
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  - Decoupling behaviour
- Conclusions

Introduction

Motivations/Goals

- Use radiative corrections from SUSY particles and extra Higgses in observables with external SM particles as indirect signals of new physics from MSSM

  (Same spirit of EW precision fits: indirect top signals before Tevatron direct searches)

- Interested in the decoupling behaviour of heavy SUSY particles at one loop

  - SUSY non-decoupling: clear signal at low energy observables, even if $M_{SUSY} \sim \mathcal{O}(TeV)$

- In particular, we concentrate in the Higgs decay $h^0 \to b\bar{b}$

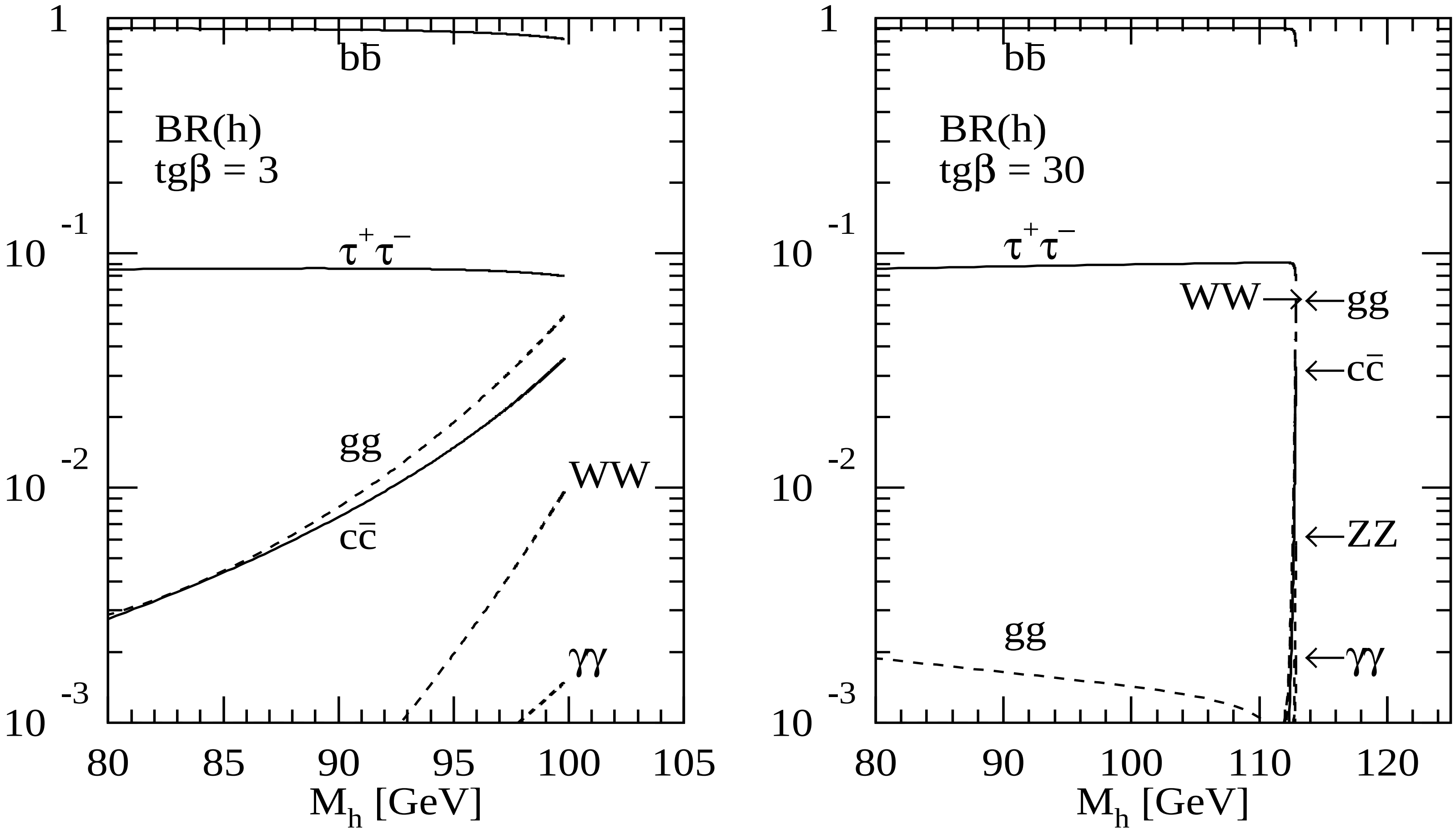
  - Higgs boson physics : optimal to look for these indirect signals

  - are significantly affected by radiative corrections from heavy SUSY particles and/or heavy Higgses

  - dominant decay and relevant for production
    (production processes $gg \to b\bar{b}h^0$ and $q\bar{q} \to b\bar{b}h^0$ relevant at large $\tan\beta$)

Branching Ratios of Higgs decays

MSSM



M.Spira, hep-ph/9705337, hep-ph/9810289

The meaning of decoupling

Decoupling Theorem (Appelquist and Carazzone '75)

Theorem

> When integrating out the heavy modes from a given underlying theory, if the remaining theory is renormalizable, then
> all the effects of the heavy particles appear in the effective theory either as renormalization of the parameters and wave function of the light fields or else they are suppressed by negative powers of the heavy particle mass M

If $M \to \infty$ the influence of the heavy particle disappears at low energies $\equiv$ Decoupling

Examples of (non) decoupling :

- Effective action formalism

  Decoupling of e^- in low energy QED ($k^2 \ll m_e^2$)

$$e^{i\Gamma_{eff}[A_\mu]} = \int [\mathrm{d}\psi][\mathrm{d}\tilde{\psi}]\, e^{iS_{\rm QED}[A_\mu,\psi,\tilde{\psi}]}$$

$$S_{\rm QED}[A_\mu,\psi,\tilde{\psi}] = \int \mathrm{d}^4x \left[-\frac{1}{4}F_{\mu\nu}F^{\mu\nu} + \tilde{\psi}(i\not{D} - m_e)\psi\right]$$

$$\Downarrow$$

$$\Gamma_{eff}[A_\mu] = \int \overbrace{\mathrm{d}^4x \left[-\frac{1}{4}F_{\mu\nu}F^{\mu\nu}\right]}^{\text{Renorm.LowEn.Th.}} \underbrace{- \frac{e^2}{15(4\pi)^2 m_e^2}\int \mathrm{d}^4x\, F_{\mu\nu}\Box F^{\mu\nu} + o\left(\frac{k^2}{m_e^2}\right)^2}_{\hookrightarrow\, 0 \text{ if } m_e \to \infty}$$

All large m_e effects can be absorbed in A_μ wave function renormalization.

- Computing observables: two examples

- Non-decoupling of the Top quark in $\Gamma(Z \to \bar{b}b)$: $\Gamma(Z \to \bar{b}b) = \Gamma_0 \left(1 + a\frac{\alpha}{4\pi}\frac{m_t^2}{m_W^2}\right)$

- Decoupling of SUSY particles in $\Gamma(t \to W^+b)$: $\Gamma(t \to W^+b) = \Gamma_0 \left(1 + b\frac{\alpha_S}{4\pi}\frac{m_t^2}{M_{SUSY}^2}\right)$

Supersymmetry

Supersymmetry $N = 1$ (SUSY) :

fermion	f	1/2	$\Leftrightarrow$	sfermion	$\tilde{f}$	0
gauge boson	G	1	$\Leftrightarrow$	gaugino	$\tilde{g}$	1/2
Higgs boson	H	0	$\Leftrightarrow$	higgsino	$\tilde{h}$	1/2

Minimal Supersymmetric Standard Model (MSSM)

Standard Model (Enlarged Higgs sector)				
	$m_{A^0}, \tan\beta$			
$\begin{pmatrix} \nu_e \\ e^- \end{pmatrix}_L, e_R^+ \dots \begin{pmatrix} t \\ b \end{pmatrix}_L, t_R^c, b_R^c$	$\begin{pmatrix} H_1^+ \\ H_1^0 \end{pmatrix}, \begin{pmatrix} H_2^0 \\ H_2^- \end{pmatrix}$	B	$W^\pm, W^3$	g
$\nu_e, e^-, \dots, t, b$	$H^\pm, A^0, H^0, h^0$	$\gamma, Z, W^\pm$		g
SUSY particles				
$\begin{pmatrix} \tilde{\nu}_e \\ \tilde{e}^- \end{pmatrix}_L, \tilde{e}_R^+ \dots \begin{pmatrix} \tilde{t} \\ \tilde{b} \end{pmatrix}_L, \tilde{t}_R^*, \tilde{b}_R^*$	$\begin{pmatrix} \tilde{H}_1^+ \\ \tilde{H}_1^0 \end{pmatrix}, \begin{pmatrix} \tilde{H}_2^0 \\ \tilde{H}_2^- \end{pmatrix}$	$\tilde{B}$	$\tilde{W}^\pm, \tilde{W}^3$	$\tilde{g}$
$\tilde{\nu}_e, \tilde{e}_1^-, \tilde{e}_2^- \quad \dots \quad \tilde{t}_1, \tilde{t}_2, \tilde{b}_1, \tilde{b}_2$	$\tilde{\chi}^-_{\{1,2\}}, \tilde{\chi}^o_{\{1,\dots,4\}}$			$\tilde{g}$
$M^2_{\tilde{L}}, M^2_{\tilde{E}}, M^2_{\tilde{Q}}, M^2_{\tilde{U}}, M^2_{\tilde{D}}$ A_e, A_b, A_t		M_1	M_2	M_3
μ, $\tan\beta$				

renormalizable quantum field theory, precision calculations possible (predictions $\longleftrightarrow$ experiments)

Decoupling limit in the MSSM

DECOUPLING LIMIT IN THE HIGGS SECTOR : $M_A \gg M_Z$

Haber, Nir, 1990

Two Higgs Doublets Model with 5 physical particles : $h^0, H^0, A^0, H^\pm$

2HDM type II : H_1 couple to b and H_2 to t

$\longrightarrow$ Tree level: $M_{H^o} \simeq M_{H^\pm} \simeq M_A \gg M_Z$

$$M_{h^o} \simeq M_Z |cos 2\beta|$$

Higgs couplings in the MSSM normalized to SM couplings

ϕ		$g_{\phi \bar{t} t}$	$g_{\phi \bar{b} b}$	$g_{\phi VV}$
SM	H	1	1	1
MSSM	h^o	$\cos\alpha / \sin\beta$	$-\sin\alpha / \cos\beta$	$\sin(\beta - \alpha)$

$$\frac{\cos\alpha}{\sin\beta} \simeq 1 + \mathcal{O}(M_Z^2/M_A^2)\,, \quad -\frac{\sin\alpha}{\cos\beta} \simeq 1 + \mathcal{O}(M_Z^2/M_A^2)\,, \quad \sin(\beta-\alpha) \simeq 1 + \mathcal{O}(M_Z^4/M_A^4)$$

$\longrightarrow$ Beyond tree level: $M_{H^o} \simeq M_{H^\pm} \simeq M_A \gg M_Z$

$$M_{h^o} \leq 130 - 135\, GeV$$

DECOUPLING LIMIT IN THE SUSY SECTOR :

Stops and sbottoms :

$$\hat{M}^2_{\tilde{q}} \equiv \begin{pmatrix} M^2_{\tilde{L}_q} & m_q X_q \\ m_q X_q & M^2_{\tilde{R}_q} \end{pmatrix} \;, \quad q \equiv t, b$$

$$\begin{aligned} M^2_{\tilde{L}_q} &= M^2_{\tilde{Q}_q} + m_q^2 + \cos 2\beta\, M_Z^2 (T_3^q - Q_q s_W^2) \\ M^2_{\tilde{R}_q} &= M^2_{\tilde{U},\tilde{D}} + m_q^2 + \cos 2\beta\, M_Z^2 Q_q s_W^2 \qquad (q = t, b) \\ X_t &= A_t - \mu \cot\beta \,, \quad X_b = A_b - \mu \tan\beta \end{aligned}$$

We consider the limit: $M_{SUSY} \sim M_{\tilde{Q}} \sim M_{\tilde{D}} \sim M_{\tilde{U}} \sim M_{\tilde{g}} \sim \mu \sim A_b \sim A_t \gg M_Z$

$\Longleftrightarrow$ heavy squarks, heavy gluino

Two extreme cases:

- Close to maximal mixing: $\theta_{\tilde{q}} \sim 45^\circ$

$$|M_L^2 - M_R^2| \ll m_q X_q \Rightarrow |M^2_{\tilde{q}_1} - M^2_{\tilde{q}_2}| \ll |M^2_{\tilde{q}_1} + M^2_{\tilde{q}_2}|$$

- Close to minimal mixing: $\theta_{\tilde{q}} \sim 0^\circ$

$$|M_L^2 - M_R^2| \gg m_q X_q \Rightarrow |M^2_{\tilde{q}_1} - M^2_{\tilde{q}_2}| \sim \mathcal{O}|M^2_{\tilde{q}_1} + M^2_{\tilde{q}_2}|$$

Charginos :

$$\hat{M}_{\tilde{\chi}^\pm} = \begin{pmatrix} M_2 & \sqrt{2} m_W \sin\beta \\ \sqrt{2} m_W \cos\beta & \mu \end{pmatrix} ,$$

$$U^* \hat{M}_{\tilde{\chi}^\pm} V^{-1} = \text{ diag } (m^2_{\tilde{\chi}^\pm_1}, m^2_{\tilde{\chi}^\pm_2})$$

$U, V \equiv$ unitary chargino mixing matrices obtained from the diagonalization of $\hat{M}_{\tilde{\chi}^\pm}$

We consider the limit: $M_{SUSY} \sim \mu \sim M_2 \gg M_Z$

$\Longleftrightarrow$ heavy charginos

$\Longrightarrow$ Focus on:

- Loops of squarks and gluinos : These $\mathcal{O}(\alpha_S)$ are the dominant SUSY corrections
- Loops of squarks and charginos : $\mathcal{O}(Y_t)$ Yukawa corrections $(Y_t = \frac{g^2 m_t^2}{8\pi m_W^2 \sin^2\beta})$
- Decoupling/Non-decoupling behaviour of SUSY particles

Neutral Higgs boson decays : $h^0 \to b\bar{b}$

- Tree-level $h^0 \to b\bar{b}$ coupling: $g_{hbb} = \frac{g\, m_b \sin\alpha}{2\, m_W \cos\beta}$

  $\to$ At tree level, the mixing angle α is determined by fixing $\tan\beta$ and m_A

- $\Gamma(h^o \to b\bar{b})$ decay rate to one loop:

$$\Gamma_1(h^o \to b\bar{b}) \equiv \Gamma_0(h^o \to b\bar{b})\,(1 + 2\,\Delta_{\text{Rad.Corr.}})$$

$$\Delta_{\text{Rad.Corr.}} = \Delta^{\text{Loops}} + \Delta^{\text{CT}}$$

- Counterterms:

$$\Delta^{\text{CT}} = \left(\frac{\delta m_b}{m_b} + \frac{\delta v}{v} + \delta Z_V^b\right) + \frac{\cos\alpha}{\sin\alpha} \underbrace{\frac{\hat{\Sigma}_{h^0 H^0}}{m_{h^0}^2 - m_{H^0}^2}}_{\hookrightarrow\, \tan\Delta\alpha}$$

- The radiatively corrected $h^0 b\bar{b}$ coupling depends on the CP-even Higgs mixing angle α

  $\to$ SUSY-QCD corrections: There are no $\mathcal{O}(\alpha_s)$ corrections to α

  $\to$ SUSY-Electroweak corrections: Radiative corrections to α must be included

SUSY-QCD corrections to $h^0 \to \bar{b}b$

- $\Gamma(h^0 \to b\bar{b})$ decay rate to one loop and $\mathcal{O}(\alpha_S)$:

$$\Gamma_1(h^o \to b\bar{b}) \equiv \Gamma_0(h^o \to b\bar{b})(1 + 2\Delta_{QCD} + 2\Delta_{SQCD})$$

- Both contributions are large:

  Δ_{QCD}: gives $\sim$ 50% reduction in $\Gamma(h^o \to b\bar{b})$ for M_{h^0} in its MSSM range.

  QCD correction has the same form in MSSM as in SM .

  Braaten & Leveille 1980, Sakai 1980, Inami & Kubota 1981

  Δ_{SQCD} : SUSY-QCD correction is comparable to QCD correction for a wide window of the parameter space.

  Numerical computations seem to reveal decoupling of SUSY-QCD corrections in the heavy sparticles limit.

  Dabeltein 1995, Corasa, Jimenez & Sola 1995

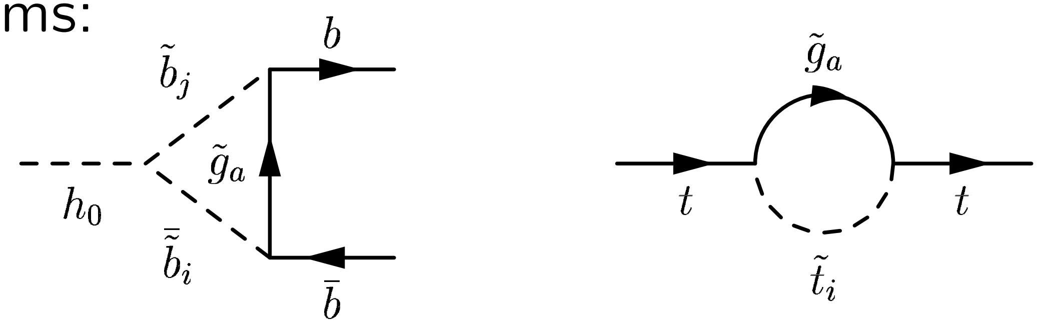
- Delayed decoupling at large $\tan\beta$
  - Squarks and gluino loops with $M_{SUSY}, m_A \gg m_Z$ in $h^0 \to b\bar{b}$

    H.Haber, M.J.Herrero, H.Logan, S.P., S.Rigolin, D.Temes, hep-ph/0007006

We explored decoupling behaviour both numerically and analytically

H.Haber, M.J.Herrero, H.Logan, S.P., S.Rigolin, D.Temes, '01

- One-loop diagrams:



- On-shell renormalization scheme assumed

- Counterterms of $\mathcal{O}(\alpha_s)$:

$$\Delta^{CT} = \frac{\delta m_b}{m_b} + \frac{\delta Z_L^b + \delta Z_R^b}{2}$$
$$= \Sigma_S^b(m_b^2) - 2m_b^2(\Sigma_S^{b\prime}(m_b^2) + \Sigma_V^{b\prime}(m_b^2))$$

– In the one-loop counterterm contribution: Z_{h^0}, VEV's ($\tan\beta$) and $g\,,m_W$ parameters receive no $\mathcal{O}(\alpha_s)$ corrections

- At one-loop order, there are no $\mathcal{O}(\alpha_s)$ corrections to α

  $\Rightarrow$ we use tree level relations for α

- We perform expansions of integrals and mixing angles for $M_{SUSY} \gg m_{EW}$ and get terms $\mathcal{O}(\frac{m_{EW}^2}{M_{SUSY}^2})^n$, $n = 0, 1$
- Δ_{SQCD} in the on-shell scheme
  - $A_b\,, \mu \sim M_{SUSY}$ enter in couplings and in $L - R$ squark mixing
  - $M_{\tilde{g}}$ enters in explicit factor and in arguments of one-loop integrals
  - $\tan\beta$ enters in $L - R$ squark mixing.
- Leading term, $n = 0$ ($\theta_{\tilde{b}} \sim 45^\circ$):

$$\Delta_{SQCD} = \frac{\alpha_s}{3\pi} \left\{ \frac{-\mu M_{\tilde{g}}}{\tilde{M}_S^2} (\tan\beta + \cot\alpha)\, f_1(R) + \mathcal{O}\left(\frac{m_{EW}^2}{M_{SUSY}^2}\right) \right\}$$

$$\tilde{M}_S^2 \equiv \frac{1}{2}(M_{\tilde{b}_1}^2 + M_{\tilde{b}_2}^2)\,,\ R \equiv M_{\tilde{g}}/\tilde{M}_S\,,\ f_1(1) = 1$$

⇒ Non-decoupling with M_{SUSY}

⇒ Enhanced at large $\tan\beta$

It agrees with effective coupling result in the zero ext. mom. approx.

Carena, Mrenna & Wagner '99, etc.

How can we interpretate these results?

$\Rightarrow$ In terms of effective Higgs-quark-quark interactions

Tree-level Potential:

$$V = \epsilon_{ij}\left[h_b\, H_1^i\, Q^j\, b_R + h_t\, H_2^j\, Q^i\, t_R\right] + h.c. \quad , \quad Q = \begin{pmatrix} t_L \\ b_L \end{pmatrix}.$$

By taking M_{SUSY} large, the low-energy effective theory is a generic 2HDM type II.

The radiative corrections generate new terms

Effective Lagrangian approach:

Carena *et al.* hep-ph/9402253, hep-ph/9808312, hep-ph/9907422; Pierce *et al.* hep-ph/9606211

$$V^{1-loop} = V + \epsilon_{ij}\left[h_b\, \Delta_b\, H_2^j\, Q^i\, b_R + h_t\, \Delta_t\, H_1^i\, Q^j\, t_R\right] + h.c.$$

- New $Hq\bar{q}$ couplings emerge of 2HDMIII type
  $\longrightarrow$ not vanish if M_{SUSY} is taken to infinity.
  $\Rightarrow$ Non-decoupling of SUSY (squark-gluino and squark-chargino) loops
- SUSY indirect effects at low energies

Recovering decoupling if all MSSM spectra heavy

If, in addition to heavy sbottoms and gluino, we have also heavy extra Higgses, $M_A \gg M_Z$, then:

$$\cot\alpha = -\tan\beta - 2\frac{M_Z^2}{M_A^2}\tan\beta\cos 2\beta + \mathcal{O}\left(\frac{M_Z^4}{M_A^4}\right)$$

$$\Longrightarrow \Delta_{SQCD} = \frac{\alpha_s}{3\pi}\left\{\frac{-2\mu M_{\tilde{g}}}{\tilde{M}_S^2} f_1(R)\tan\beta\cos 2\beta\frac{m_Z^2}{m_A^2} + \mathcal{O}\left(\frac{m_{EW}^2}{M_{SUSY}^2}\right)\right\}$$

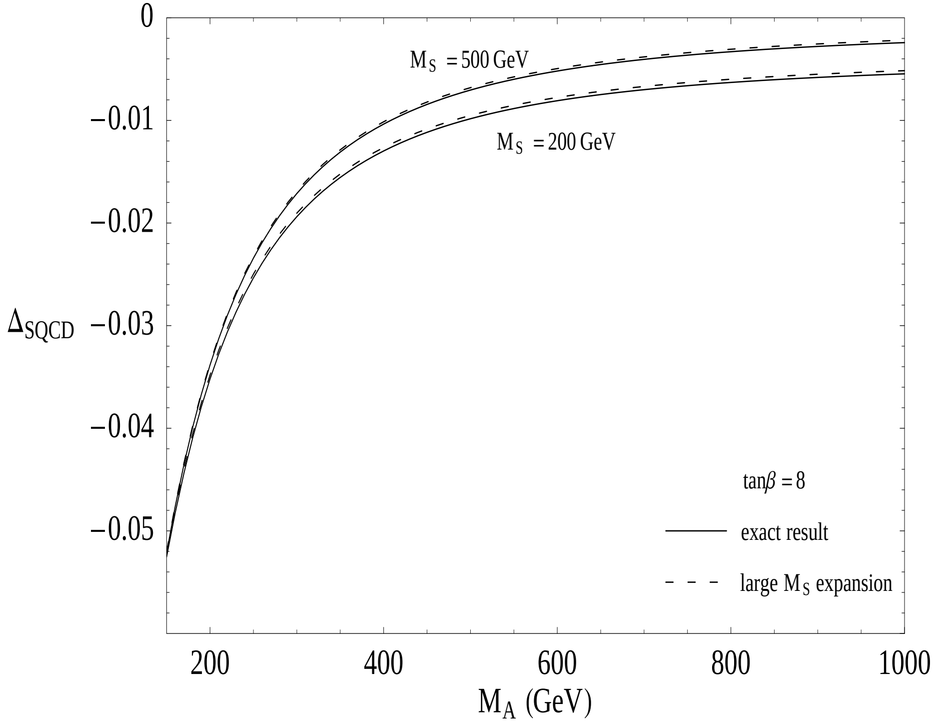
Decoupling if and only if M_{SUSY} and $M_A \to \infty$

Comments:

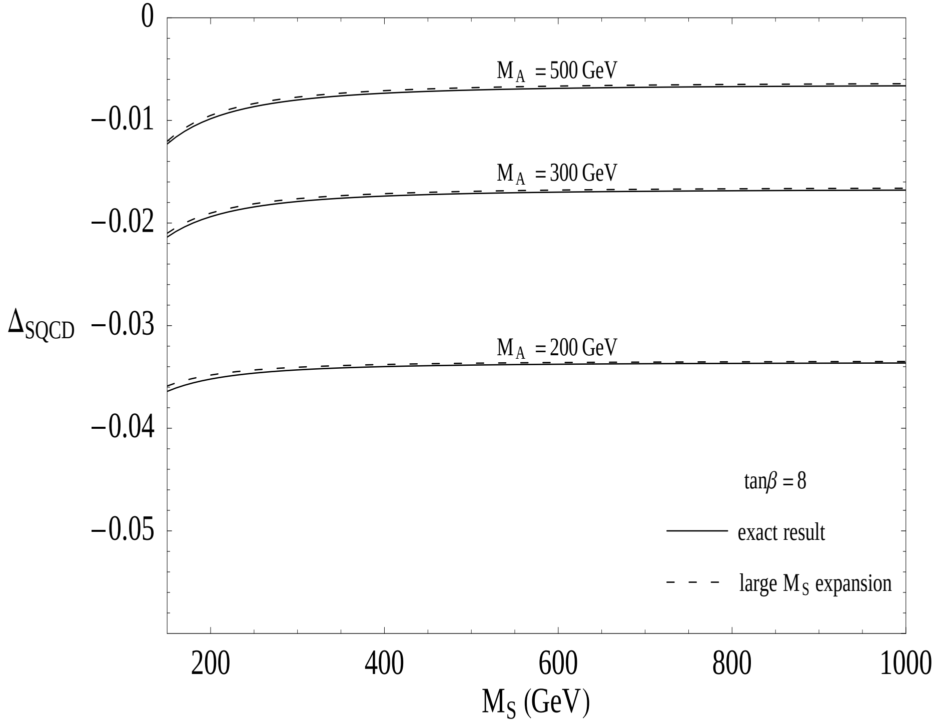
- Dominant terms go as $\Delta_{SQCD} \sim C_1\frac{M_Z^2}{M_A^2} + C_2\frac{M_{Z,h^0}^2}{M_{SUSY}^2}$
- In the limit $\tan\beta \gg 1$:
  - Δ_{SQCD} grows linearly with $\tan\beta$ and is proportional to $\mu\, M_{\tilde{g}}$
  - the sign of Δ_{SQCD} governed by sign of μ and $M_{\tilde{g}}$
- Similar results for $\theta_{\tilde{b}} \sim 0^\circ$

Two different scales $M_A \neq M_S$

For fixed M_S and large M_A



For fixed M_A and large M_S



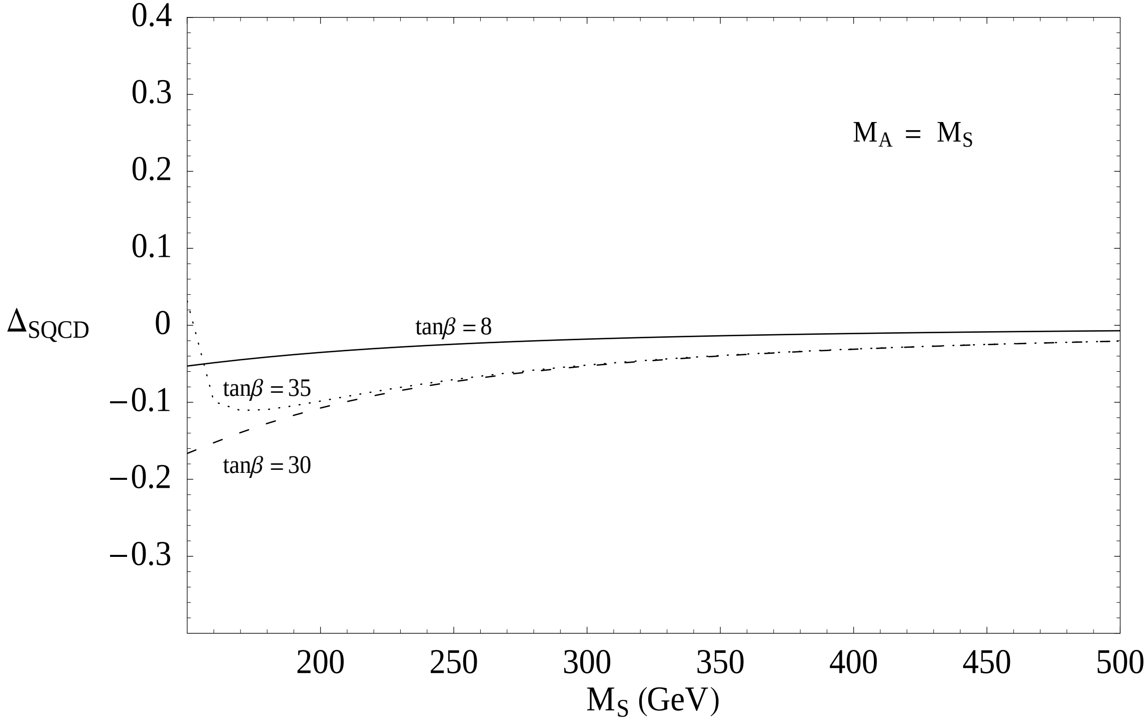
No independent decoupling with M_A No independent decoupling with M_S

Δ_{SQCD} tends to a non vanishing constant: SUSY non-decoupling

An example with Maximal Mixing $(\theta_{\tilde{b}} \sim 45^\circ)$

Take just one scale M_S :

$A_b = \mu = M_{\tilde{Q}} = M_{\tilde{D}} = M_{\tilde{g}} = M_S$ and $M_A = M_S$, with $M_S \gg M_Z$



- In agreement with numerical behaviour of exact result
- Decoupling with M_S : recovering SM result
- Typical size for $M_S \geq 250\, GeV$: $\Delta_{SQCD} \leq -10\%$

SUSY-Electroweak corrections to $h^0 \to \bar{b}b$

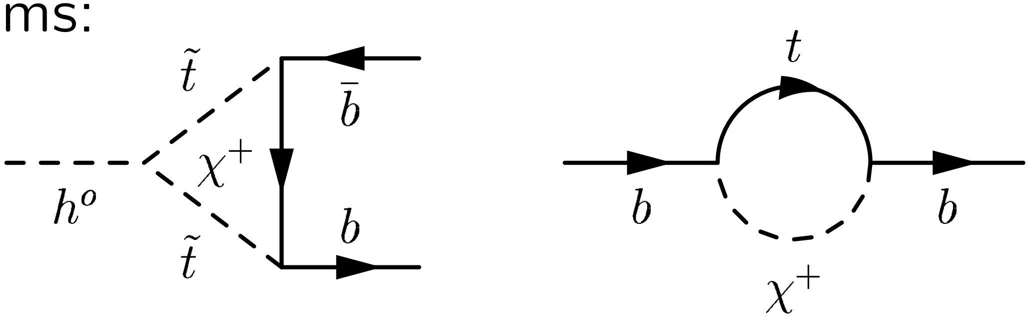
H.Haber, H.Logan, S.P., D.Temes, '05

- We consider $\mathcal{O}(m_t^2)$ leading Yukawa corrections
- $\Gamma(h^o \to b\bar{b})$ decay rate to one loop:

$$\Gamma_1(h^o \to b\bar{b}) \equiv \Gamma_0(h^o \to b\bar{b})(1 + 2\,\Delta_{SEW})$$

$$\Delta_{SEW} = \Delta_{m_t}^{loops} + \Delta_{m_t}^{CT}$$

- One-loop diagrams:



- Neutralino-squarks loops are subleadings contributions
- Δ_{SEW} : Exact results in agreement with Dabeltein 1995
- Expansions of integrals and mixing angles as before

- On-shell renormalization scheme: Radiative corrections to α included

- α_{eff}-approximation considered : the dominant contributions for Higgs boson self-energies are obtained by setting $q^2 = 0$ and, therefore, $\hat{\Sigma}(q^2) \longrightarrow \hat{\Sigma}(0)$

  $\Rightarrow$ To 1st order: $\tan \Delta\alpha = \frac{\hat{\Sigma}_{h^0 H^0}}{m^2_{h^0} - m^2_{H^0}} = \frac{\Sigma_{h^0 H^0}(0) - \delta m_{h^0 H^0}}{m^2_{h^0} - m^2_{H^0}}$

- Counterterm: $\Delta^{CT}_{m_t} = \frac{\delta m_b}{m_b} + \delta Z^b_V = \Sigma^b_s(m^2_b)$

  - There are no corrections to Z_{h^0}, VEV's ($\tan\beta$) and $g\,, m_W$ parameters

- Leading term ($\theta_{\tilde{b}} \sim 45^\circ$):

$$\Delta_{SEW} = \frac{g^2}{64\pi^2 m^2_W} \frac{1}{\sin^2\beta} m^2_t \left\{ \frac{-\mu\, A_t}{\tilde{M}^2_S} (\tan\beta + \cot\alpha)\, f_1(R) + \mathcal{O}\left(\frac{m^2_{EW}}{M^2_{SUSY}}\right) \right\}$$

$$\tilde{M}^2_S \equiv \frac{1}{2}(M^2_{\tilde{t}_1} + M^2_{\tilde{t}_2})\,,\;\; R \equiv m_{\tilde{\chi}^\pm_2}/\tilde{M}_S\,,\;\; f_1(1) = 1\,,\;\; \mu = m_{\tilde{\chi}^\pm_2}$$

$\Rightarrow$ Non-decoupling with M_{SUSY}

$\Rightarrow$ Enhanced at large $\tan\beta$

Recovering decoupling if all MSSM spectra heavy

If, in addition to heavy stops and charginos, we have also heavy extra Higgses, $M_A \gg M_Z$, then:

$$\cot\alpha = -\tan\beta - 2\frac{M_Z^2}{M_A^2}\tan\beta\cos 2\beta + \mathcal{O}\left(\frac{M_Z^4}{M_A^4}\right)$$

$$\rightarrow\ \Delta_{SEW} = \frac{g^2}{32\pi^2 m_W^2}\frac{1}{\sin^2\beta}\, m_t^2 \left\{\frac{-\mu\, A_t}{\tilde{M}_S^2} f_1(R)\tan\beta\cos 2\beta\,\frac{m_Z^2}{m_A^2} + \mathcal{O}\left(\frac{m_{EW}^2}{M_{SUSY}^2}\right)\right\}$$

Decoupling if and only if M_{SUSY} and $M_A \to \infty$

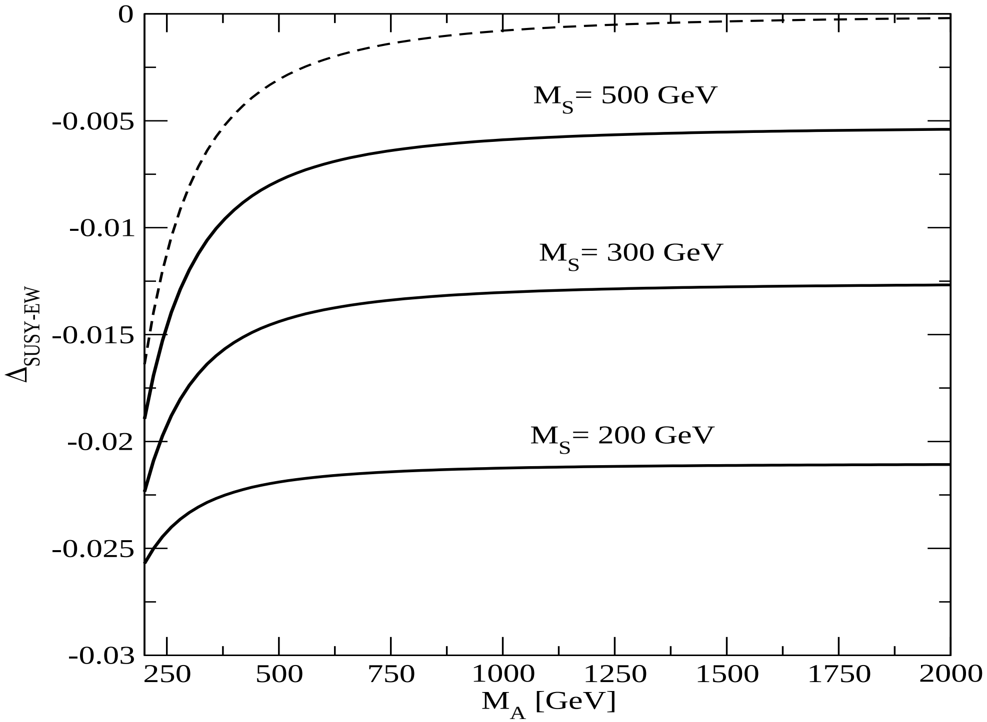
Comments:

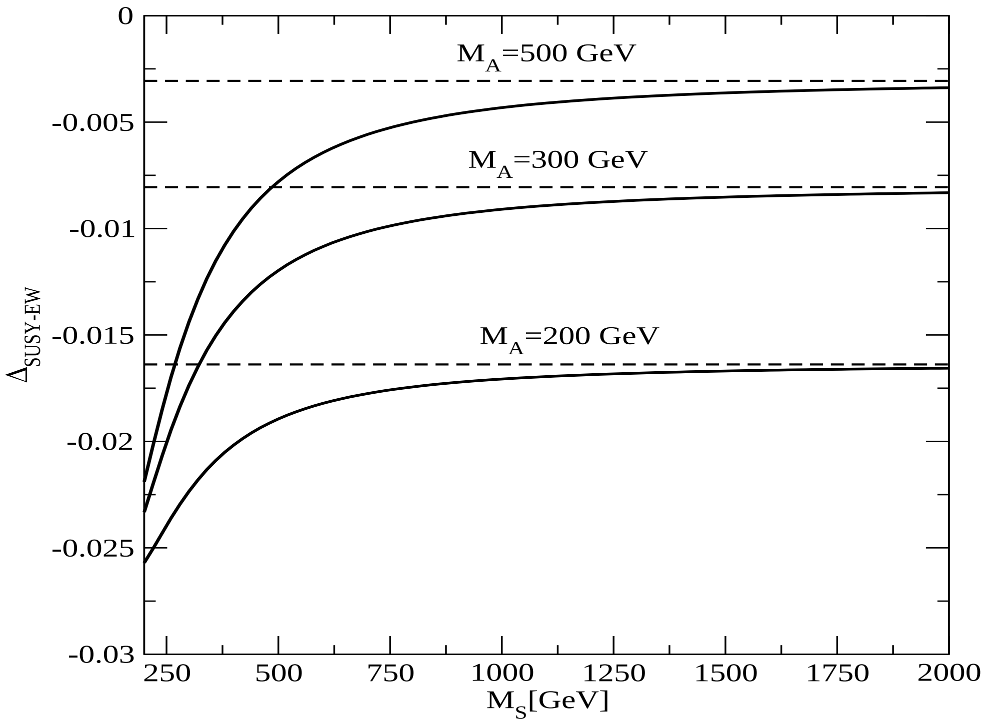
- Δ_{SEW} grows linearly with $\tan\beta$ and is proportional to $\mu\, A_t$
- the sign of Δ_{SEW} governed by sign of μ and A_t
- Similar results for $\theta_{\tilde{b}} \sim 0^\circ$

Two different scales $M_A \neq M_S$ Preliminary

For fixed M_S and large M_A

For fixed M_A and large M_S





No independent decoupling with M_A

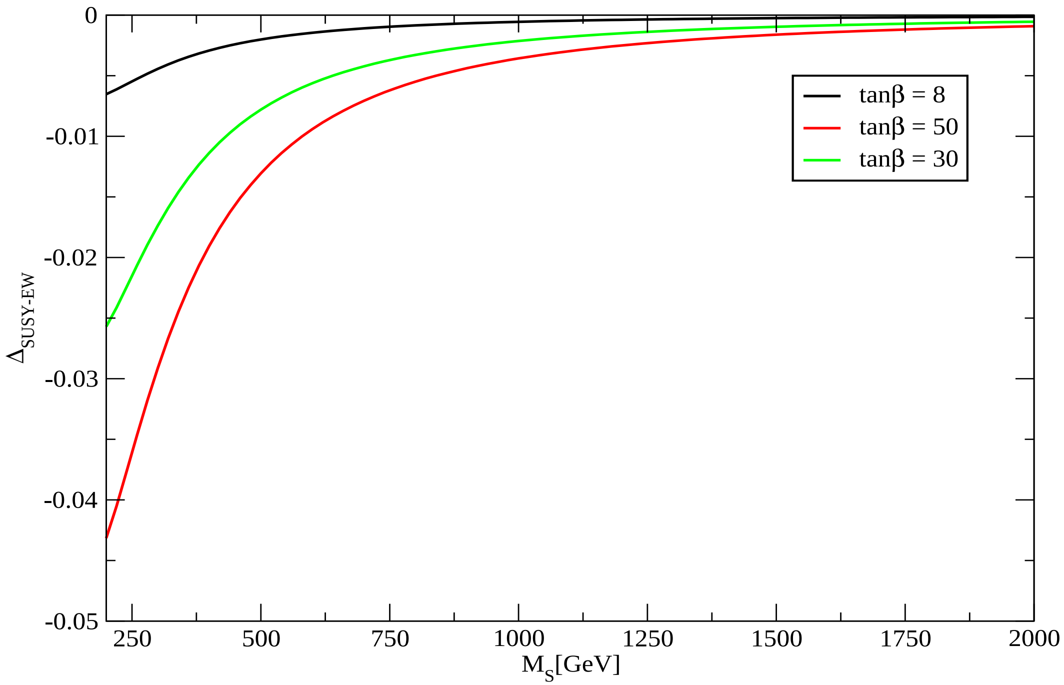
No independent decoupling with M_S

Δ_{SEW} tends to a non vanishing constant: SUSY non-decoupling

An example with Maximal Mixing $(\theta_{\tilde{b}} \sim 45^\circ)$

Take just one scale M_S :

$A_b = \mu = M_{\tilde{Q}} = M_{\tilde{D}} = M_S$ and $M_A = M_S$, with $M_S \gg M_Z$



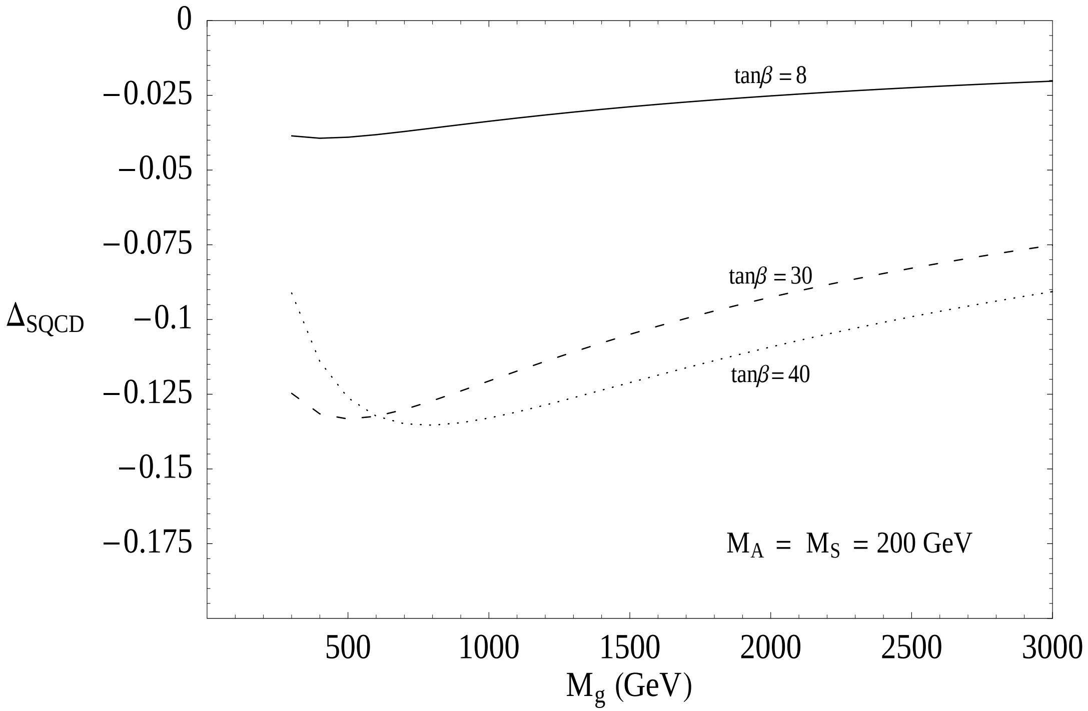
Preliminary

- Decoupling with M_S : recovering SM result
- Typical size for $M_S \geq 1\,TeV$: $\Delta_{SEW} \leq -0.5\%$
- For $M_S \sim 250\,TeV$ and $\tan\beta = 30$: $\Delta_{SEW} \simeq -2\%$

Independent decoupling of SUSY particles

- Independent decoupling of gluino

We expand the correction in the heavy gluino limit: $M_{\tilde{g}} \gg \tilde{M}_S \sim \mu \sim A_b \gg M_Z$

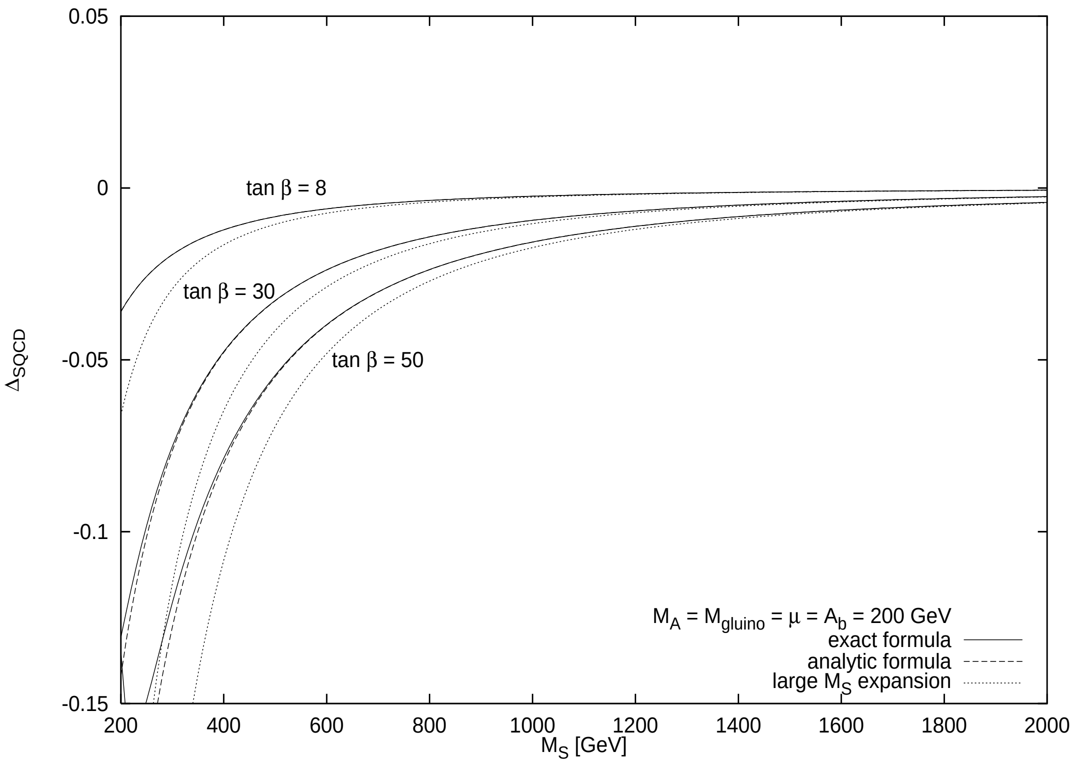


- Very slow decoupling with $M_{\tilde{g}}$
- Sizeable correction even for large $M_{\tilde{g}}$:

  For $\tan\beta = 30$ and $M_{\tilde{g}} = 1 TeV$, $\Delta_{SQCD} = -12\%$

- Independent decoupling of sbottoms

We expand the correction in the heavy sbottoms limit: $\tilde{M}_S \gg M_{\tilde{g}} \sim \mu \sim A_b \gg M_Z$



- Fast decoupling with $\tilde{M}_S$
- Similar results for stops (by considering stops-chargino loops)

CONCLUSIONS

- We consider $\mathcal{O}(\alpha_S)$ SUSY corrections and $\mathcal{O}(Y_t)$ Yukawa corrections to $\Gamma(h^o \to \bar{b}b)$ in the decoupling limit
- The one-loop SUSY corrections to $\Gamma(h^o \to \bar{b}b)$:
  - Decouple if and only if all SUSY masses and M_A are very large
  - Do not decouple if internal gluinos/squarks and chargino/squarks are very heavy and fixed M_A!!

    $\Rightarrow$ Indirect SUSY breaking signals at low energy Higgs physics?
  - The corrections grow with $\tan\beta$ $\Rrightarrow$ Sizeable for large $\tan\beta$
  - Corrections can be negative $\Longrightarrow$ Reduction in the partial decay width $\Gamma(h^0 \to \bar{b}b)$
  - Decouple independently and very slowly with the gluino mass
  - Decouple independently and fast with the sbottom and stop masses