Flavor Mixing Phenomenoogy in Supersymmetric Models

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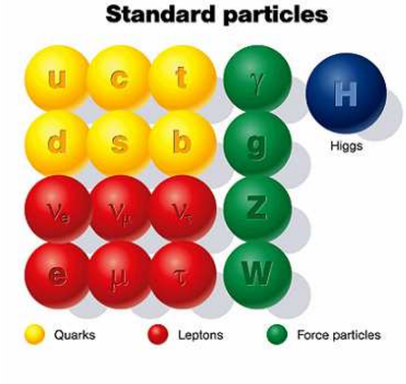
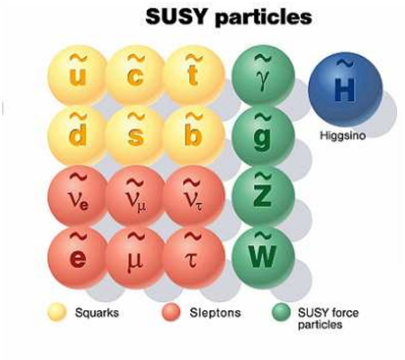
Overview

Overview

- After giving some motivation to study sfermion (scalar partener of the SM fermions) mixing, i will present the sfermion mixing effects in
  1. Model independent way.
  2. Minimal flavor violating CMSSM.
  3. Minimal flavor violating CMSSM-seesaw I.
- To the following observables
  1. Electroweak precision observables (EWPO).
  2. Higgs boson masses.
  3. B-Physics Observables (BPO).
  4. Quark flavor violating Higgs decay $h \to b\bar{s} + \bar{b}s$.

Why flavor mixing?





- Theoretically most favored extension but no direct experimental evidence. We can study indirect effects of SUSY and most of these effects involve flavor observables.

Why flavor mixing?

Flavor Changing Neutral Current processes (FCNC's).

In SM

- FCNC's are absent at tree level.
- Can only occur at one-loop level.
- CKM matrix is the only source for FCNC's.
- Highly suppressed due to GIM cancellation.

In SUSY

- Quark-squark misallignment is another source.
- Can dominate SM contribution by several orders of magnitude.
- Experimental deviation from SM could be a hint of SUSY.

Why flavor mixing?

Charged Lepton Flavor Violating decays (cLFV).

In SM

- Predictions for cLFV are zero.
- Even seesaw extension do not predict sizeable rates.
- SM seesaw prediction almost 40 orders of magnitude smaller than the present experimental bounds.

In SUSY (with seesaw extension)

- Lepton-slepton misallignment is another source.
- Higher rates possible (touching the present experimental bounds).
- Any experimental observation of cLFV could be a hint of SUSY.

Why flavor mixing?

Little hierarchy problem in MSSM.

- Discovery of a Higgs boson with mass $M_h \approx 125$ GeV $\Longrightarrow$ Large radiative corrections $\Longrightarrow$ heavy stop mass $m_{\tilde{t}} \geqslant \mathrm{TeV}$.
- Fine tuning of $\approx 1\%$ or more is required.

However

- Instead of heavy stop mass.
- If we assume large (left-right or flavor) mixing, we can get large radiative corrections.
- No or very little fine tuning required.

Flavor mixing in SUSY looks very promising but one needs to study it in detail to see if this is really true.

Squark Mixing

- Sfermion with different flavor can mix among each other

$$\begin{pmatrix} \tilde{u}_1 \\ \tilde{u}_2 \\ \tilde{u}_3 \\ \tilde{u}_4 \\ \tilde{u}_5 \\ \tilde{u}_6 \end{pmatrix} = R^{\tilde{u}} \begin{pmatrix} \tilde{u}_L \\ \tilde{c}_L \\ \tilde{t}_L \\ \tilde{u}_R \\ \tilde{c}_R \\ \tilde{t}_R \end{pmatrix}, \quad \begin{pmatrix} \tilde{d}_1 \\ \tilde{d}_2 \\ \tilde{d}_3 \\ \tilde{d}_4 \\ \tilde{d}_5 \\ \tilde{d}_6 \end{pmatrix} = R^{\tilde{d}} \begin{pmatrix} \tilde{d}_L \\ \tilde{s}_L \\ \tilde{b}_L \\ \tilde{d}_R \\ \tilde{s}_R \\ \tilde{b}_R \end{pmatrix} \tag{1}$$

$R^{\tilde{u}}$ and $R^{\tilde{d}}$ being the 6×6 rotation matrices.

$$\mathrm{diag}\{m^2_{\tilde{u}_1}, m^2_{\tilde{u}_2}, m^2_{\tilde{u}_3}, m^2_{\tilde{u}_4}, m^2_{\tilde{u}_5}, m^2_{\tilde{u}_6}\} = R^{\tilde{u}} \, \mathcal{M}^2_{\tilde{u}} \, R^{\tilde{u}\dagger} \tag{2}$$

$$\mathrm{diag}\{m^2_{\tilde{d}_1}, m^2_{\tilde{d}_2}, m^2_{\tilde{d}_3}, m^2_{\tilde{d}_4}, m^2_{\tilde{d}_5}, m^2_{\tilde{d}_6}\} = R^{\tilde{d}} \, \mathcal{M}^2_{\tilde{d}} \, R^{\tilde{d}\dagger} \tag{3}$$

Slepton Mixing

- Similarly charged sleptons and sneutrinos can mix.

$$\begin{pmatrix} \tilde{l}_1 \\ \tilde{l}_2 \\ \tilde{l}_3 \\ \tilde{l}_4 \\ \tilde{l}_5 \\ \tilde{l}_6 \end{pmatrix} = R^{\tilde{l}} \begin{pmatrix} \tilde{e}_L \\ \tilde{\mu}_L \\ \tilde{\tau}_L \\ \tilde{e}_R \\ \tilde{\mu}_R \\ \tilde{\tau}_R \end{pmatrix} , \quad \begin{pmatrix} \tilde{\nu}_1 \\ \tilde{\nu}_2 \\ \tilde{\nu}_3 \end{pmatrix} = R^{\tilde{\nu}} \begin{pmatrix} \tilde{\nu}_{eL} \\ \tilde{\nu}_{\mu L} \\ \tilde{\nu}_{\tau L} \end{pmatrix} , \qquad (4)$$

with $R^{\tilde{l}}$ and $R^{\tilde{\nu}}$ being the respective 6×6 and 3×3 unitary rotating matrices that yield the diagonal slepton mass-squared matrices,

$$\mathrm{diag}\{m^2_{\tilde{l}_1}, m^2_{\tilde{l}_2}, m^2_{\tilde{l}_3}, m^2_{\tilde{l}_4}, m^2_{\tilde{l}_5}, m^2_{\tilde{l}_6}\} = R^{\tilde{l}} \, \mathcal{M}^2_{\tilde{l}} \, R^{\tilde{l}\dagger} \qquad (5)$$

$$\mathrm{diag}\{m^2_{\tilde{\nu}_1}, m^2_{\tilde{\nu}_2}, m^2_{\tilde{\nu}_3}\} = R^{\tilde{\nu}} \, \mathcal{M}^2_{\tilde{\nu}} \, R^{\tilde{\nu}\dagger} \qquad (6)$$

- We have 6×6 non-diagonal mass matrix for squarks and charged sleptons and 3×3 mass matrix for sneutrinos.

$$\mathcal{M}^2_{\tilde{F}} = \begin{pmatrix} M^2_{\tilde{F}\,LL} & M^2_{\tilde{F}\,LR} \\ M^{2\,\dagger}_{\tilde{F}\,LR} & M^2_{\tilde{F}\,RR} \end{pmatrix}, \mathcal{M}^2_{\tilde{\nu}} = \begin{pmatrix} M^2_{\tilde{\nu}\,LL} \end{pmatrix} \tag{7}$$

where $F = U, D, L$ and $\mathcal{M}^2_{\tilde{U}}$, $\mathcal{M}^2_{\tilde{D}}$, $\mathcal{M}^2_{\tilde{L}}$ and $\mathcal{M}^2_{\tilde{\nu}}$ are up-squark, down-squark, charged slepton and sneutrino mass matrices.

- Off-diagonal entries are parametrized in terms of dimensionless parameters δ^{FAB}_{ij}.

$$M^2_{\tilde{U}\,LL} = \begin{pmatrix} m^2_{\tilde{U}_1} & \delta^{QLL}_{12} m_{\tilde{U}_1} m_{\tilde{U}_2} & \delta^{QLL}_{13} m_{\tilde{U}_1} m_{\tilde{U}_3} \\ \delta^{QLL}_{21} m_{\tilde{U}_2} m_{\tilde{U}_1} & m^2_{\tilde{U}_2} & \delta^{QLL}_{23} m_{\tilde{U}_2} m_{\tilde{U}_3} \\ \delta^{QLL}_{31} m_{\tilde{U}_3} m_{\tilde{U}_1} & \delta^{QLL}_{32} m_{\tilde{U}_3} m_{\tilde{U}_2} & m^2_{\tilde{U}_3} \end{pmatrix} \tag{8}$$

- In total, there are 21 flavor violating δ^{FAB}_{ij} in squarks sector and 12 δ^{FAB}_{ij} in slepton sector.

Model Independent and Minimal Flavor Violation approach

- Model Independent (MI) approach
  - Sfermion mixing (δ_{ij}^{FAB}) is introduced by hand.
  - No assumption is made on the origin of the flavor mixing.
- Minimal Flavor Violation (MFV) approach
  - Flavor mixing in the quark sector is controlled by the CKM matrix even in theories beyond the SM.
  - Flavor mixng in lepton sector is controlled by PMNS matrix (seesaw parameters more precisely).
  - Sfermion mixing (δ_{ij}^{FAB}) is induced by the RGE running due to presence of CKM and PMNS matrices in RGEs.

Constrained MSSM (CMSSM)

- Soft SUSY-breaking parameters are assumed to be universal at the Grand Unification scale $M_{\rm GUT} \sim 2 \times 10^{16}$ GeV.

$$
\begin{aligned}
(m^2_Q)_{ij} = (m^2_U)_{ij} = (m^2_D)_{ij} = (m^2_L)_{ij} = (m^2_E)_{ij} = m^2_0\ \delta_{ij}, \\
m^2_{H_1} = m^2_{H_2} = m^2_0, \\
m_{\tilde{g}} \ = \ m_{\tilde{W}} \ = \ m_{\tilde{B}} \ = \ m_{1/2}, \\
(A_U)_{ij} = A_0(Y_U)_{ij}, \quad (A_D)_{ij} = A_0(Y_D)_{ij}, \quad (A_E)_{ij} = A_0(Y_E)_{ij}.
\end{aligned} \tag{9}
$$

- Only four parameters $(m_0, m_{1/2}, A_0$ and $tan\beta)$ required.
- CKM (PMNS) matrix is the only sources of flavor violation in CMSSM (CMSSM-seesaw I).

Precision Observables

Electroweak ρ parameter

- ρ parameter is a measure of relative strength of neutral and charged-current interactions at zero momentum transfer. In SM at tree level

$$\rho = \frac{M_W^2}{Cos^2\theta_W M_Z^2} = 1 \tag{10}$$

- Higher order corrections modify this relation to

$$\rho = \frac{1}{1 - \Delta\rho} \tag{11}$$

- Here $\Delta\rho$ parametrizes the leading universal corrections to EWPO induced by the mass splitting between the fields in an isospin doublet

$$\Delta\rho = \frac{\Sigma_{ZZ}(0)}{M_Z} - \frac{\Sigma_{WW}(0)}{M_W} \tag{12}$$

Here $\Sigma_{ZZ}(0)$ and $\Sigma_{WW}(0)$ are unrenormalized Z and W boson self-energies (Transverse parts only).

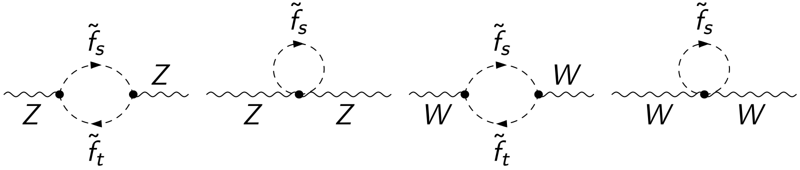
- $\Delta\rho$ enters in δM_W and $\delta Sin^2\theta_{eff}$ through the equation

$$\delta M_W = \frac{M_W}{2}\frac{Cos^2\theta_W}{Cos^2\theta_W - Sin^2\theta_W}\Delta\rho \tag{13}$$

$$\delta Sin^2\theta_{eff} = -\frac{Cos^2\theta_W Sin^2\theta_W}{Cos^2\theta_W - Sin^2\theta_W}\Delta\rho \tag{14}$$

$$\tag{15}$$

Generic Feynman diagrams for the W or Z boson self-energies.



Mass of the W-boson M_W is very precisely measured.

- $M_W^{exp,current} = 80.385 \pm 0.015 GeV$
- $\delta M_W^{\text{exp,future}} \sim 4\ \mathrm{MeV}$.
- $\delta M_W^{\text{MSSM}} \sim (5-10)\ \mathrm{MeV}$ (depending on SUSY mass scale).

Similarly effective leptonic weak mixing angle $Sin^2\theta_{eff}$ is very precisely measured.

- $Sin^2\theta_{eff}^{exp,current} = 0.23146$
- $\delta Sin^2\theta_{eff}^{exp,current} = 15 \times 10^{-5}$
- $\delta Sin^2\theta_{eff}^{\text{exp,future}} \sim 1.3 \times 10^{-5}$

Higgs Masses

- There are two higgs doublets in MSSM resulting in five physical (h, H, A, H^+, H^-) Higgs Bosons.
- Neutral CP-even Higgs boson masses are derived by solving the equation

$$\left[p^2 - m^2_{h,tree} + \hat{\Sigma}_{hh}(p^2)\right]\left[p^2 - m^2_{H,tree} + \hat{\Sigma}_{HH}(p^2)\right] - \left[\hat{\Sigma}_{hH}(p^2)\right]^2 = 0\,. \tag{16}$$

- Charged Higgs mass is derived by the position of the pole in the charged Higgs propagator,

$$p^2 - m^2_{H^\pm,\mathrm{tree}} + \hat{\Sigma}_{H^-H^+}\left(p^2\right) = 0. \tag{17}$$

Higgs Masses

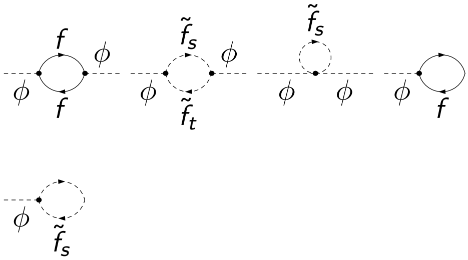
Experimental status of M_h

- $M_h = 125.09 \pm 0.24$ GeV (PDG 2015 update) with $\delta M_h \approx 150$ MeV possible at LHC.
- $\delta M_h \approx 50$ MeV at ILC.

Theoretical calculations are already at very advanced level however.

- $\delta M_h^{th} = 2$ GeV.

Generic Feynman diagrams for the Higgs self-energies and tadpoles are shown below where ϕ denotes Higgs boson.



BPO

1. For $\mathrm{BR}(B \to X_s\gamma)$, loop contributions to the Wilson coefficients come from
   1. Loops with Higgs bosons.
   2. Loops with charginos.
   3. Loops with gluinos.
2. For $\mathrm{BR}(B_s \to \mu^+\mu^-)$, loop contributions to the Wilson coefficients come from
   1. Box diagrams.
   2. Z-penguin diagrams and
   3. Neutral Higgs boson ϕ-penguin diagrams.
3. For ΔM_{B_s}, loop contributions to the Wilson coefficients come from
   1. Box diagrams.
   2. Z-penguin diagrams.
   3. double Higgs-penguin diagrams

BPO

Observable	Experimental Value	SM Prediction
$\mathrm{BR}(B \to X_s \gamma)$	$3.43 \pm 0.22 \times 10^{-4}$	$3.15 \pm 0.23 \times 10^{-4}$
$\mathrm{BR}(B_s \to \mu^+ \mu^-)$	$(3.0)^{+1.0}_{-0.9} \times 10^{-9}$	$3.23 \pm 0.27 \times 10^{-9}$
ΔM_{B_s}	$116.4 \pm 0.5 \times 10^{-10}$	$(117.1)^{+17.2}_{-16.4} \times 10^{-10}$

Table: Experimental status of BPO with their SM prediction. ΔM_{B_s} given in MeV. The most up to date value of $\mathrm{BR}(B_s \to \mu^+\mu^-) = 2.9 \pm 0.7 \times 10^{-9}$ would have had a minor impact on our analysis.

QFV Higgs decay $h \to b\bar{s} + \bar{b}s$

- In SM $\mathrm{BR}(h \to b\bar{s} + \bar{b}s)$ can be atmost $\mathcal{O}(10^{-7})$.
- In MSSM SUSY-QCD loops can enhance the BR by several orders of magnitude.
- We (re-)calculate full one-loop contributions from SUSY-QCD and SUSY-EW loops.
- We take into account LL,LR,RL, RR mixing (prior to this only LL mixing was analyzed). For our calculation define

$$\mathrm{BR}(h \to b\bar{s} + \bar{b}s) = \frac{\Gamma(h \to b\bar{s} + \bar{b}s)}{\Gamma_{h,\mathrm{tot}}^{\mathrm{MSSM}}} \tag{18}$$

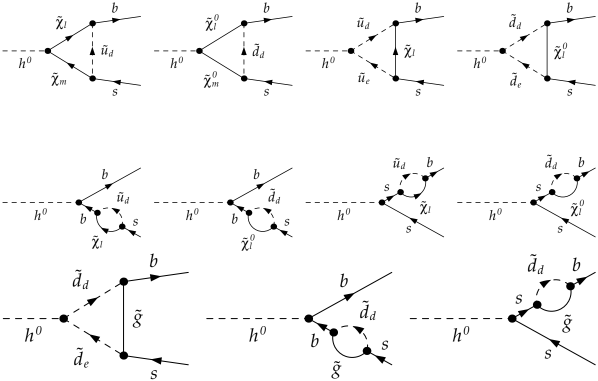
where $\Gamma_{h,\mathrm{tot}}^{\mathrm{MSSM}}$ is the total decay width of the light Higgs boson h of the MSSM, as evaluated with FeynHiggs.

QFV Higgs decay $h \to b\bar{s} + \bar{b}s$

Major SUSY contributions to these processes come from

1. Diagrams with squarks and gluinos in loop (SUSY-QCD).
2. Diagrams with squarks and neutralino-chargino in loop (SUSY-EW).

Feynman diagrams are shown below.



Computational Setup

1. For EWPO and Higgs masses
   1. We modified FeynArts/Formcalc setup to include LFV Feynman rules (squarks mixing was already there).
   2. Calculated Feyman diagrams for gauge boson self energies, Higgs bosons self energies and tadpoles.
   3. Checked UV divergences.
   4. After making sure that we get finite results we added the analytical results to FeynHiggs for EWPO and Higgs masses.
2. For BPO
   1. We used B-physics subroutine from the SuFla code (added in a private version of FeynHiggs).
3. For $h \to b\bar{s} + \bar{b}s$
   1. We used FeynArts/FormCalc setup.

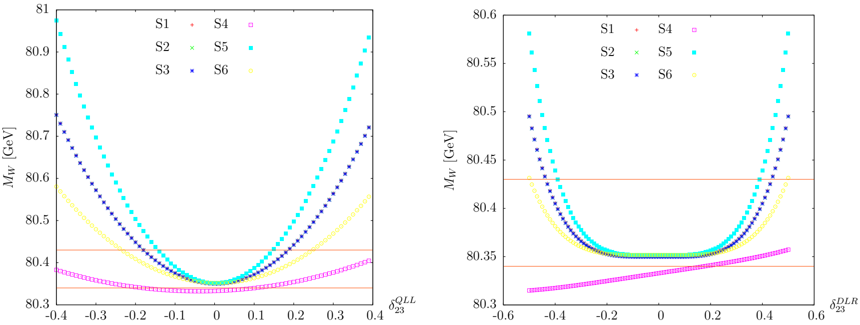
Model independent analysis

Input parameters

	S1	S2	S3	S4	S5	S6
$m_{\tilde{L}_{1,2}}$	500	750	1000	800	500	1500
$m_{\tilde{L}_3}$	500	750	1000	500	500	1500
M_2	500	500	500	500	750	300
A_τ	500	750	1000	500	0	1500
μ	400	400	400	400	800	300
$tan\beta$	20	30	50	40	10	40
M_A	500	1000	1000	1000	1000	1500
$m_{\tilde{Q}_{1,2}}$	2000	2000	2000	2000	2500	1500
$m_{\tilde{Q}_3}$	2000	2000	2000	500	2500	1500
$A_{t,b}$	2300	2300	2300	1000	2500	1500

Table: Selected points in MSSM parameter space. All Masses and trilinear couplings are in GeV. We have used GUT relation. Trilinear couplings not mentioned in the table are zero.

M_W with squark mixing

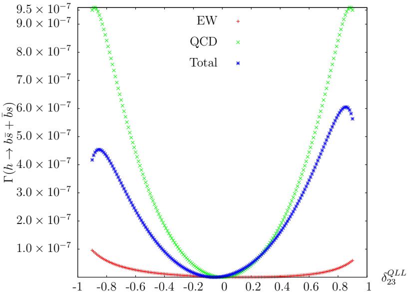


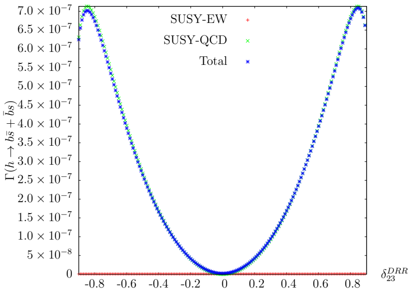
- M_W as a function of δ_{23}^{QLL} and δ_{23}^{DLR} for the MSSM points defined in Table 2.
- The area between the orange lines shows the allowed values of M_W with 3σ uncertainty.

$\Gamma(h \to b\bar{s} + \bar{b}s)$

For input parameters

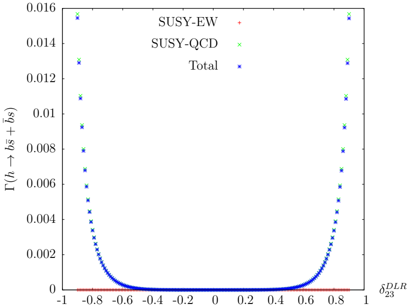
$$\mu = 800 \text{ GeV}, \; m_{susy} = 800 \text{ GeV}, \; A_f = 500 \text{ GeV}, \\ M_A = 400 \text{ GeV}, \; M_2 = 300 \text{ GeV}, \; tan\beta = 35 \,, \qquad (19)$$

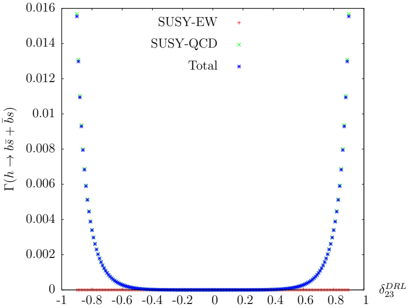




- $\Gamma(h \to b\bar{s} + \bar{b}s)$ as a function of δ_{23}^{QLL} and δ_{23}^{DRR}.

$\Gamma(h \to b\bar{s} + \bar{b}s)$

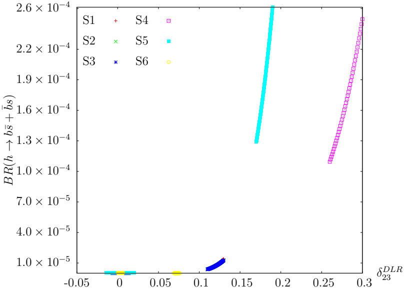




- $\Gamma(h \to b\bar{s} + \bar{b}s)$ as a function of δ_{23}^{DLR} and δ_{23}^{DRL}.

$\mathrm{BR}(h \to b\bar{s} + \bar{b}s)$ for one squark $\delta_{ij}^{FAB} \neq 0$

For realistic MSSM points defined in Table 2 with EWPO and BPO constraints.



- $\mathrm{BR}(h \to b\bar{s} + \bar{b}s)$ as a function of δ_{23}^{DLR}.
- $\mathrm{BR}(h \to b\bar{s} + \bar{b}s) \approx 2 \times 10^{-4}$ can be found, possibly in the reach of future e^+e^- colliders.

$\mathrm{BR}(h \to b\bar{s} + \bar{b}s)$ for two squark $\delta_{ij}^{FAB} \neq 0$

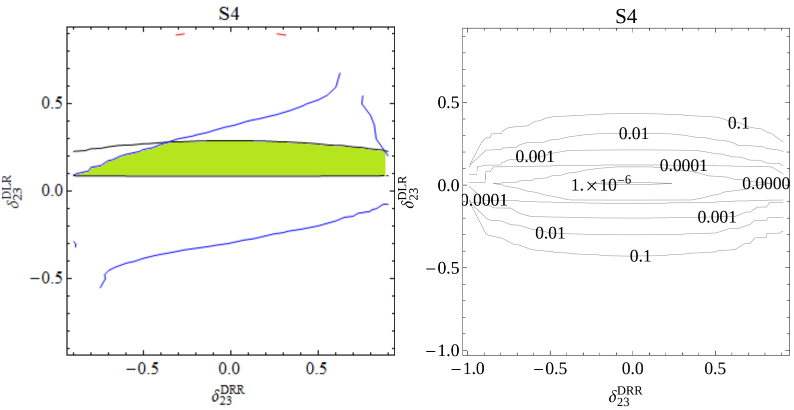


Figure: Left: Contours of $\mathrm{BR}(B \to X_s\gamma)$ (Black), $\mathrm{BR}(B_s \to \mu^+\mu^-)$ (Green), ΔM_{B_s}(Blue) and M_W (Red) in $(\delta_{23}^{QLL}, \delta_{23}^{DLR})$ plane for point S4. The shaded area shows the range of values allowed by all constraints. Right: corresponding contours for $\mathrm{BR}(h \to b\bar{s} + \bar{b}s)$.

$\mathrm{BR}(h \to b\bar{s} + \bar{b}s)$ for two squark $\delta_{ij}^{FAB} \neq 0$

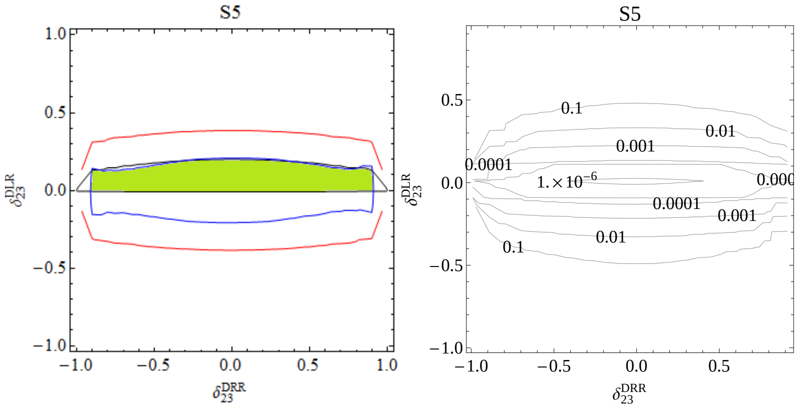
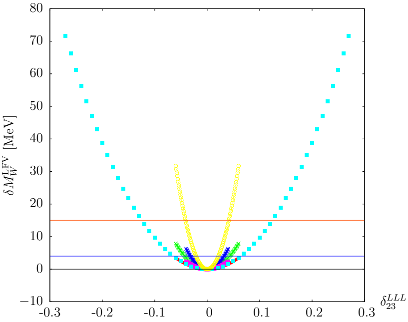
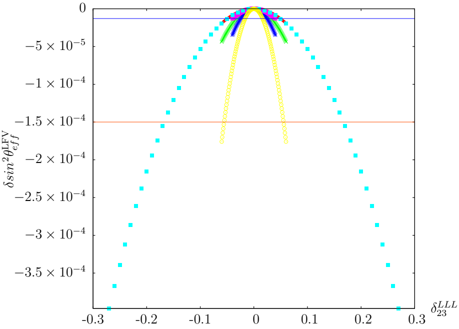


Figure: Left: Contours of $\mathrm{BR}(B \to X_s\gamma)$ (Black), $\mathrm{BR}(B_s \to \mu^+\mu^-)$ (Green), ΔM_{B_s}(Blue) and M_W (Red) in $(\delta_{23}^{QLL}, \delta_{23}^{DLR})$ plane for point S5. The shaded area shows the range of values allowed by all constraints. Right: corresponding contours for $\mathrm{BR}(h \to b\bar{s} + \bar{b}s)$.

δM_W^{LFV} and $\delta Sin^2\theta_{eff}^{LFV}$

- $\delta M_W^{LFV} = M_W - M_W^{MSSM}, \quad \delta Sin^2\theta_{eff}^{LFV} = Sin^2\theta_{eff} - Sin^2\theta_{eff}^{MSSM}$

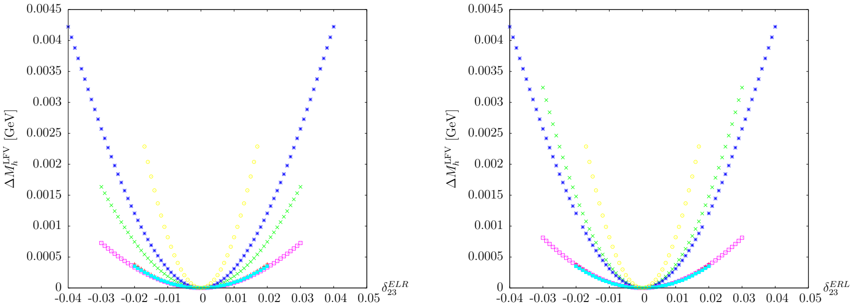




- $\delta M_W^{LFV} \approx 0.07\,GeV > \delta M_W^{exp} = 0.015\,GeV$.
- $\delta Sin^2\theta_{eff}^{LFV} \approx 4 \times 10^{-4} > \delta Sin^2\theta_{eff}^{exp} = 15 \times 10^{-5}$.

ΔM_h^{LFV}

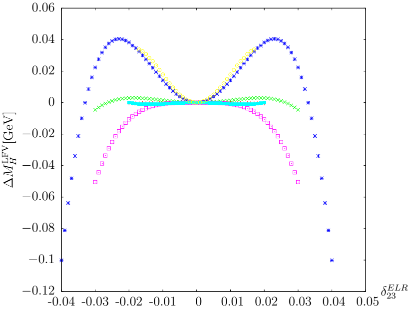
- $\Delta M_h^{LFV} = M_h - M_h^{MSSM}$

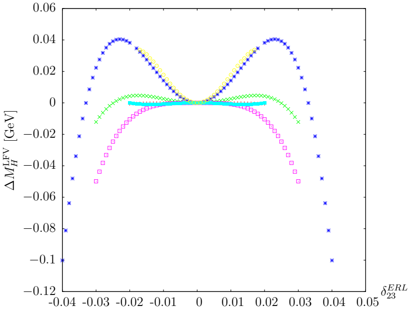


- Slepton mixing effects are negligible for M_h.

ΔM_H^{LFV}

- $\Delta M_H^{LFV} = M_H - M_H^{MSSM}$

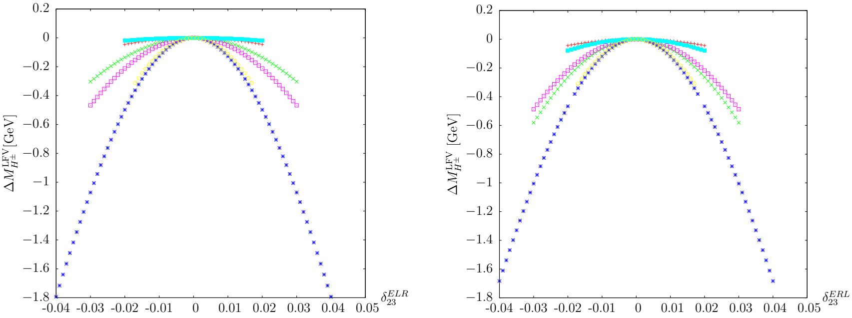




- $\Delta M_H^{LFV} = 0.1 GeV$ still not significant.

$\Delta M_{H^\pm}^{LFV}$

- $\Delta M_{H^\pm}^{LFV} = M_{H^\pm} - M_{H^\pm}^{MSSM}$



- Sizable corrections, $\Delta M_{H^\pm}^{LFV} \approx 2GeV$.

CMSSM analysis

Input parameters

- MSSM particle spectrum obtained by running RGEs using Spheno.
- Output from spheno in the form of SLHA handed over to Feynhiggs.
- We have scanned all combinations of

$$m_0 = 500 - 5000 \text{ GeV} , \quad (20)$$
$$m_{1/2} = 1000 - 3000 \text{ GeV} , \quad (21)$$
$$A_0 = -3000, -2000, -1000, 0 \quad \text{GeV} \quad (22)$$
$$tan\beta = 10, 20, 30, 45 \quad (23)$$

with $\mu > 0$.

- Here we show only representative results in the m_0–$m_{1/2}$ plane for different values of $tan\beta$ and A_0.

Squark δ_{ij}^{FAB}

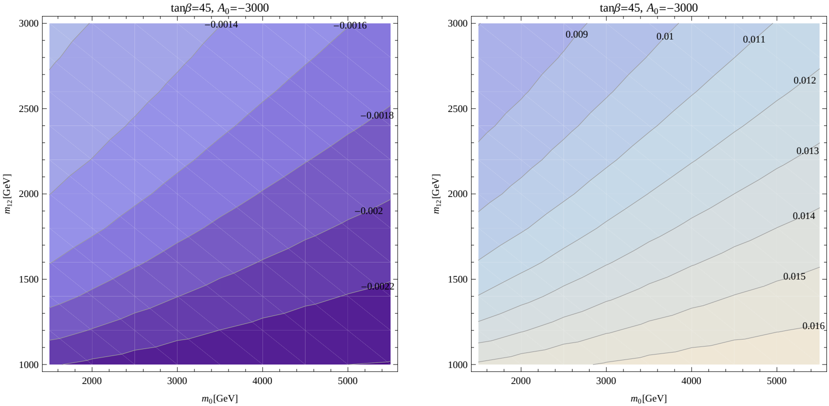
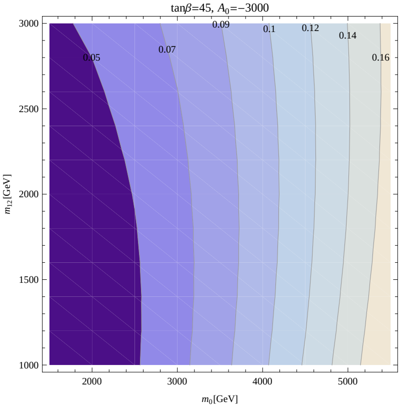
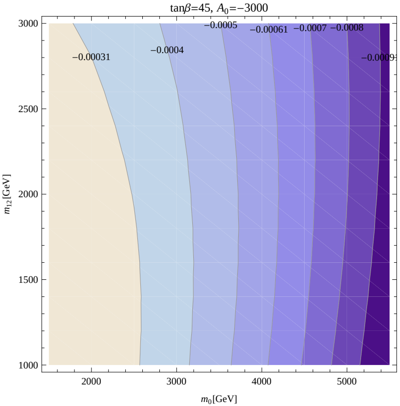


Figure: Contours of δ_{13}^{QLL}, δ_{23}^{QLL} in the m_0–$m_{1/2}$ plane.

EWPO

- $\delta M_W^{MFV} = M_W - M_W^{MSSM}, \quad \delta Sin^2\theta_{eff}^{MFV} = Sin^2\theta_{eff} - Sin^2\theta_{eff}^{MSSM}$

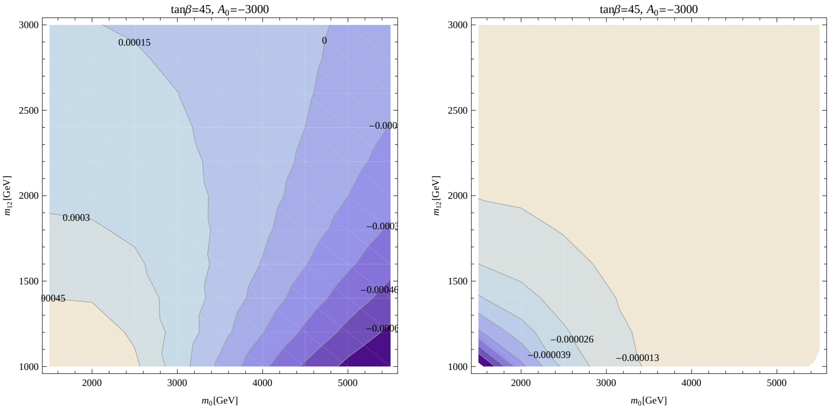




Significant effects specially for $m_0 \geq 3\mathrm{TeV}$

Higgs Masses

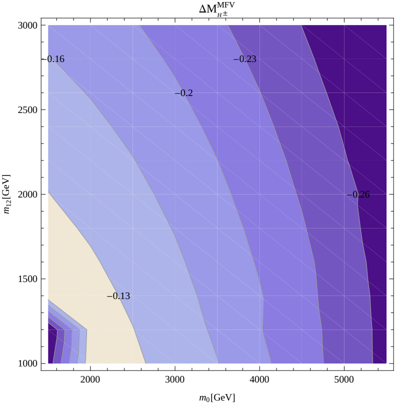
- $\Delta M_h^{MFV} = M_h - M_h^{MSSM}, \quad \Delta M_H^{MFV} = M_H - M_H^{MSSM}$



Effects are negligible

Higgs Masses

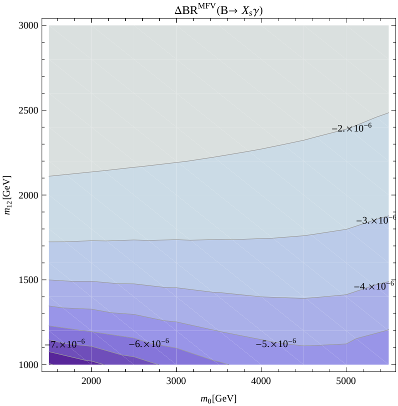
- $\Delta M_{H^\pm}^{MFV} = M_{H^\pm} - M_{H^\pm}^{MSSM}$

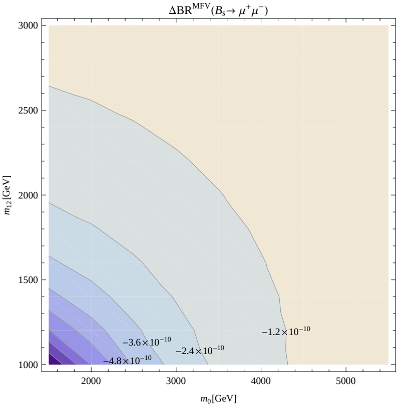


Effects are negligible

BPO

- $\Delta\mathrm{BR}^{\mathrm{MFV}}(B \to X_s\gamma) = \mathrm{BR}(B \to X_s\gamma) - \mathrm{BR}^{\mathrm{MSSM}}(B \to X_s\gamma)$
- $\Delta\mathrm{BR}^{\mathrm{MFV}}(B_s \to \mu^+\mu^-) = \mathrm{BR}(B_s \to \mu^+\mu^-) - \mathrm{BR}^{\mathrm{MSSM}}(B_s \to \mu^+\mu^-)$

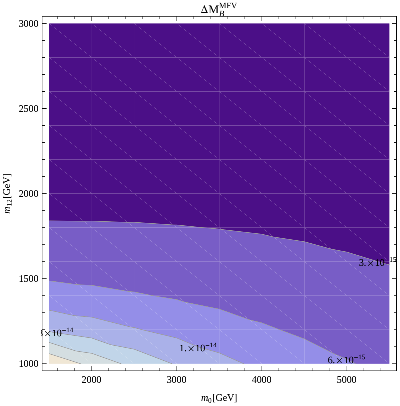




Effects are negligible

BPO

- $\Delta M_{B_s}^{\text{MFV}} = \Delta M_{B_s} - \Delta M_{B_s}^{\text{MSSM}}$



Effects are negligible

CMSSM-seesaw I analysis

Slepton δ_{ij}^{FAB}

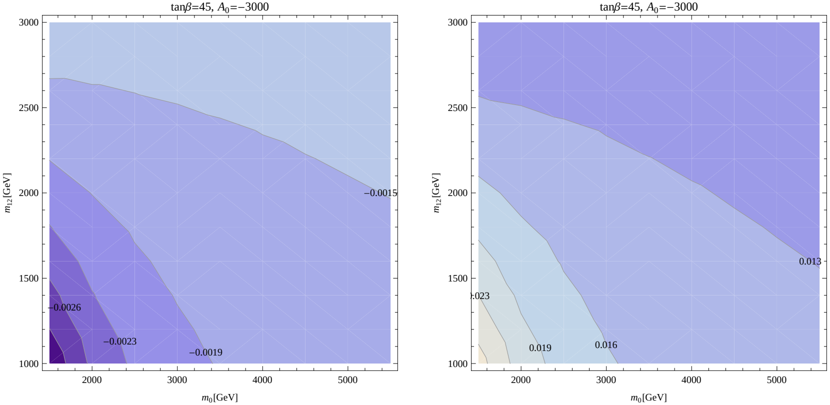
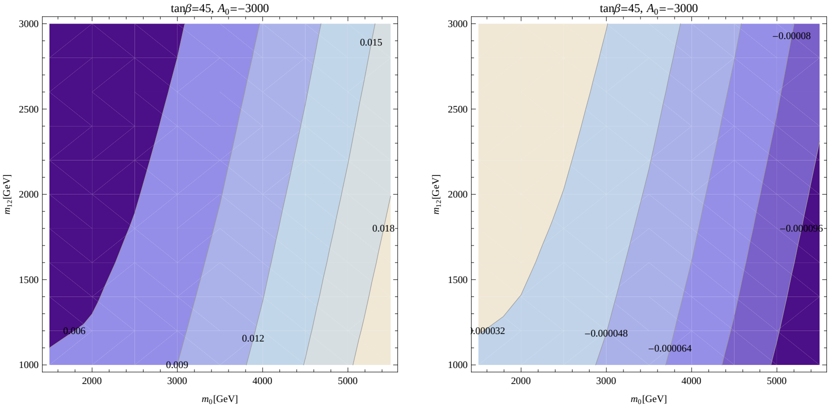


Figure: Contours of δ_{13}^{LLL}, δ_{23}^{LLL} in the m_0–$m_{1/2}$ plane.

EWPO

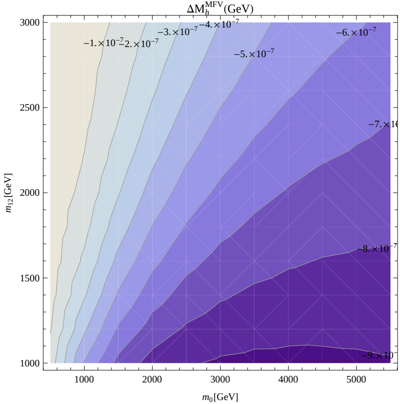
- $\delta M_W^{MFV} = M_W - M_W^{MSSM}, \quad \delta Sin^2\theta_{eff}^{MFV} = Sin^2\theta_{eff} - Sin^2\theta_{eff}^{MSSM}$

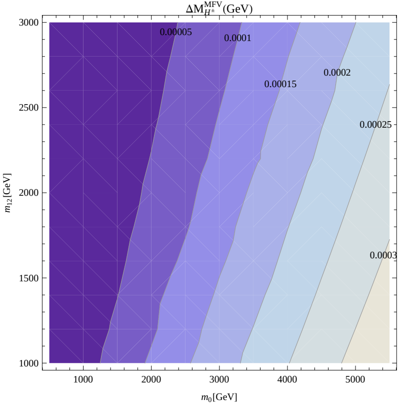


Effects are sizable

Higgs Masses

- $\Delta M_h^{MFV} = M_h - M_h^{MSSM}, \quad \Delta M_{H^\pm}^{MFV} = M_{H^\pm} - M_{H^\pm}^{MSSM}$





Effects are negligible

Conclusions

Conclusion

1. Model independent analysis.
   - New constraints on squarks δ_{ij}^{FAB}'s from EWPO.
   - $\mathrm{BR}(h \to b\bar{s} + \bar{b}s) \approx \mathrm{O}(10^{-3})$.
   - No new constraints on slepton δ_{ij}^{FAB}'s however sizeable corrections $\rangle$ the present experimental uncertainty from EWPO.
   - Slepton mixing mixing effects are negligible for M_h and M_H
   - Sizable corrections to $M_{H_\pm} \approx 2\ \mathrm{GeV}$ close to 1 % anticipated experimental uncertainty from slepton mixing.
2. CMSSM analysis.
   - Squark mixing effects are negligible for Higgs masses and BPO.
   - Sizable corrections to EWPO.
   - m_0 can be constrained from above if squark mixing is correctly taken into account for EWPO.
3. CMSSM-Seesaw I analysis.
   - Slepton mixing effects are negligible for Higgs masses.
   - However they are sizeable for EWPO.

Thanks