Published for SISSA by Springer

Received: *October 12, 2015*
Accepted: *October 13, 2015*
Published: *October 28, 2015*

Erratum: Non-decoupling SUSY in LFV Higgs decays: a window to new physics at the LHC

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Erratum to: JHEP09(2013)160

ArXiv ePrint: 1304.3371

JHEP10(2015)192

In this short note we have reviewed the numerical results of the rates for the $h, H, A \to \tau\mu$ decay channels that are originated from slepton flavor mixings of LR and RL types after correcting a detected bug in our FORTRAN code used in [1]. We have found an unfortunate missing global $1/\sqrt{2}$ factor in the contribution to the LR and RL form factors from the vertex diagram with two sleptons and one neutralino in the triangular loop, which once introduced it turns out that produces a cancellation among the dominant non-decoupling contributions, i.e. constant with the large $m_{\rm SUSY}$ scale, from this diagram and the external leg loop diagram with one slepton and one neutralino in the loop. These two diagrams are the dominant ones in the LR and RL cases and when added and after correcting the mentioned mistake, it results in a total decoupling behavior with the large $m_{\rm SUSY}$ scale instead of the total non-decoupling behavior wrongly obtained before. There is consequently a considerable reduction of all the LFV ratios if $\tilde{\delta}_{23}^{LR}$ (or $\tilde{\delta}_{23}^{RL}$) is the responsible of the flavor slepton mixing. We have redone all the plots referred to these two parameters in [1] and we present them here. The plots for the predictions of the LHC rates due to these LR and RL parameters (figures 7 and 8) are then strongly affected. We conclude here that no measurable rates can be found at the LHC if the flavor mixing between the second and the third slepton generations is of LR (or RL) type. Therefore, the results of figures 9 and 10 would be equivalent to have only $\delta_{23}^{LL} = 0.9$ as in figure 6. All the results for mixings of LL and RR types in [1] remain valid and they are not affected at all by this mistake.

doi:10.1007/JHEP10(2015)192

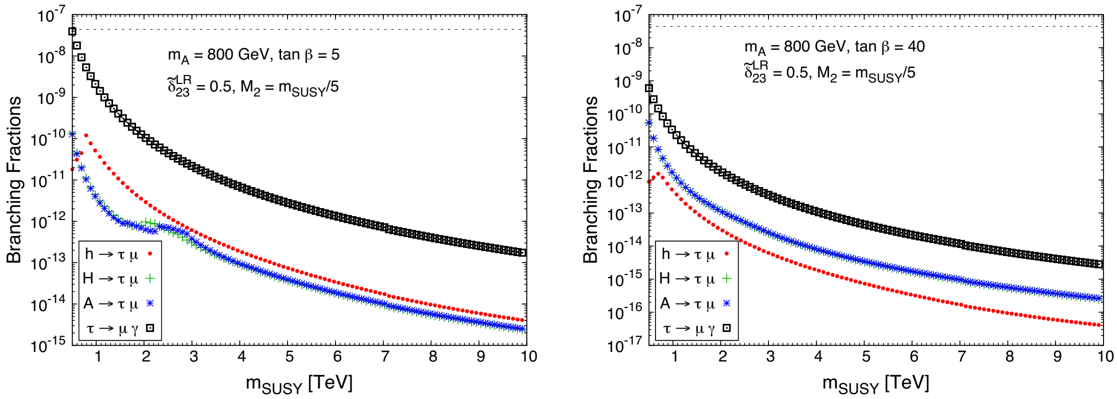

Figure 1. Large $m_{\rm SUSY}$ behavior of the LFV decay rates: BR($h \to \tau\mu$), BR($H \to \tau\mu$), BR($A \to \tau\mu$) and BR($\tau \to \mu\gamma$) as functions of $m_{\rm SUSY}$ for $\tan\beta = 5$ (left panel) and $\tan\beta = 40$ (right panel) with $\tilde{\delta}_{23}^{LR} = 0.5$. The results for $\tilde{\delta}_{23}^{RL} = 0.5$ (not shown) are identical to those of $\tilde{\delta}_{23}^{LR} = 0.5$. In each case, the other flavor changing deltas are set to zero. In all panels, $m_A = 800\,\mathrm{GeV}$ and the other MSSM parameters are set to the values reported in the text, with $M_2 = \frac{1}{5} m_{\rm SUSY}$. The horizontal dashed line denotes the current experimental upper bound for $\tau \to \mu\gamma$ channel, BR($\tau \to \mu\gamma$) $< 4.4 \times 10^{-8}$.

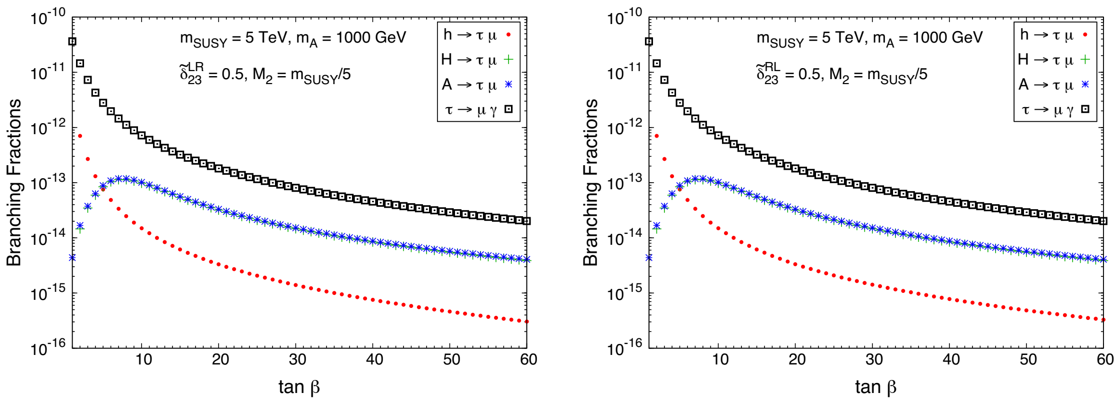

Figure 2. BR($h \to \tau\mu$), BR($H \to \tau\mu$), BR($A \to \tau\mu$) and BR($\tau \to \mu\gamma$) as functions of $\tan\beta$ for $\tilde{\delta}_{23}^{LR} = 0.5$ (left panel) and $\tilde{\delta}_{23}^{RL} = 0.5$ (right panel). In each case, the other flavor changing deltas are set to zero. In all panels, $m_A = 1000\,\mathrm{GeV}$, $m_{\rm SUSY} = 5\,\mathrm{TeV}$ and the other MSSM parameters are set to the values reported in the text, with $M_2 = m_{\rm SUSY}/5$.

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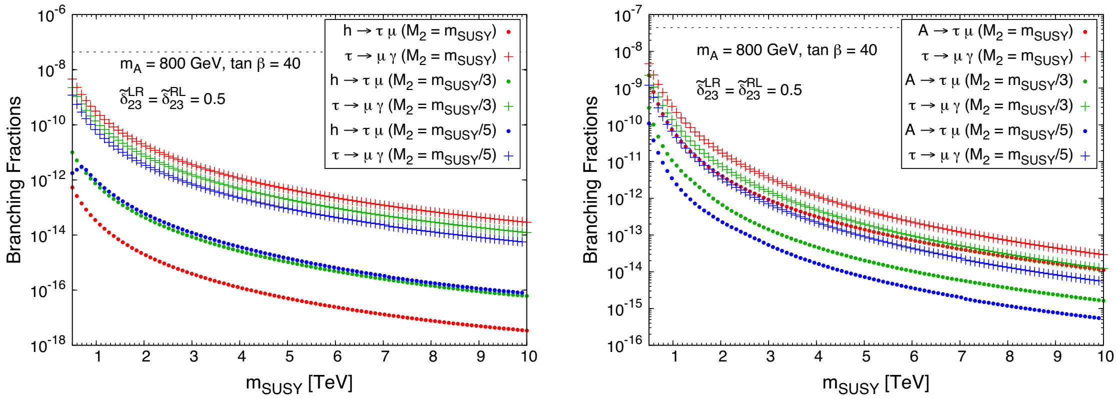

Figure 3. Sensitivity to M_2: LFV Higgs decay rates (dots) and $\mathrm{BR}(\tau \to \mu\gamma)$ (crosses) as functions of m_{SUSY} with $\tilde{\delta}_{23}^{LR} = \tilde{\delta}_{23}^{RL} = 0.5$ for different choices of M_2: $M_2 = m_{\mathrm{SUSY}}$ (in red), $M_2 = \frac{1}{3} m_{\mathrm{SUSY}}$ (in green) and $M_2 = \frac{1}{5} m_{\mathrm{SUSY}}$ (in blue). The results for H (not shown) are nearly identical to those of A. In each case, the other flavor changing deltas are set to zero. In all panels, $m_A = 800\,\mathrm{GeV}$, $\tan\beta = 40$ and the other MSSM parameters are set to the values reported in the text. The horizontal dashed line denotes the current experimental upper bound for $\tau \to \mu\gamma$ channel, $\mathrm{BR}(\tau \to \mu\gamma) < 4.4 \times 10^{-8}$.

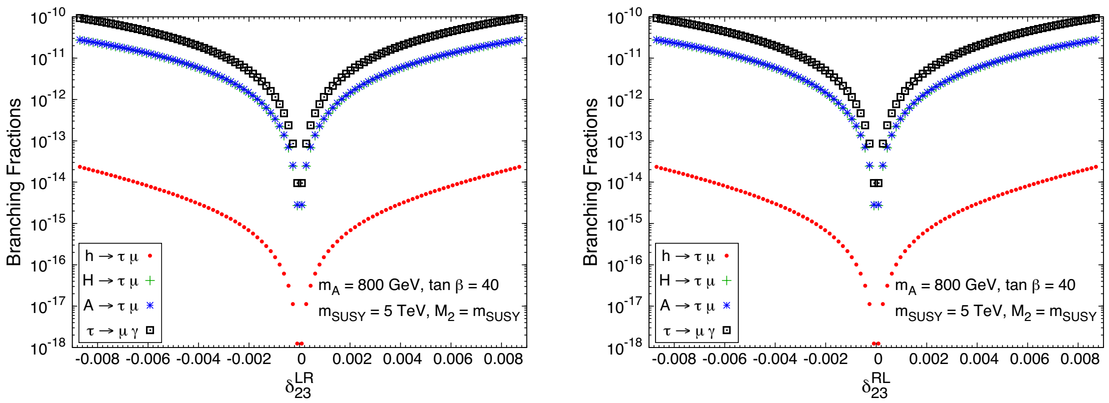

Figure 4. $\mathrm{BR}(h \to \tau\mu)$, $\mathrm{BR}(H \to \tau\mu)$, $\mathrm{BR}(A \to \tau\mu)$ and $\mathrm{BR}(\tau \to \mu\gamma)$ as functions of δ_{23}^{LR} (left panel) and δ_{23}^{RL} (right panel). In each case, the other flavor changing deltas are set to zero. In all panels, $m_A = 800\,\mathrm{GeV}$, $\tan\beta = 40$, $m_{\mathrm{SUSY}} = 5\,\mathrm{TeV}$ and the other MSSM parameters are set to the values reported in the text, with $M_2 = m_{\mathrm{SUSY}}$.

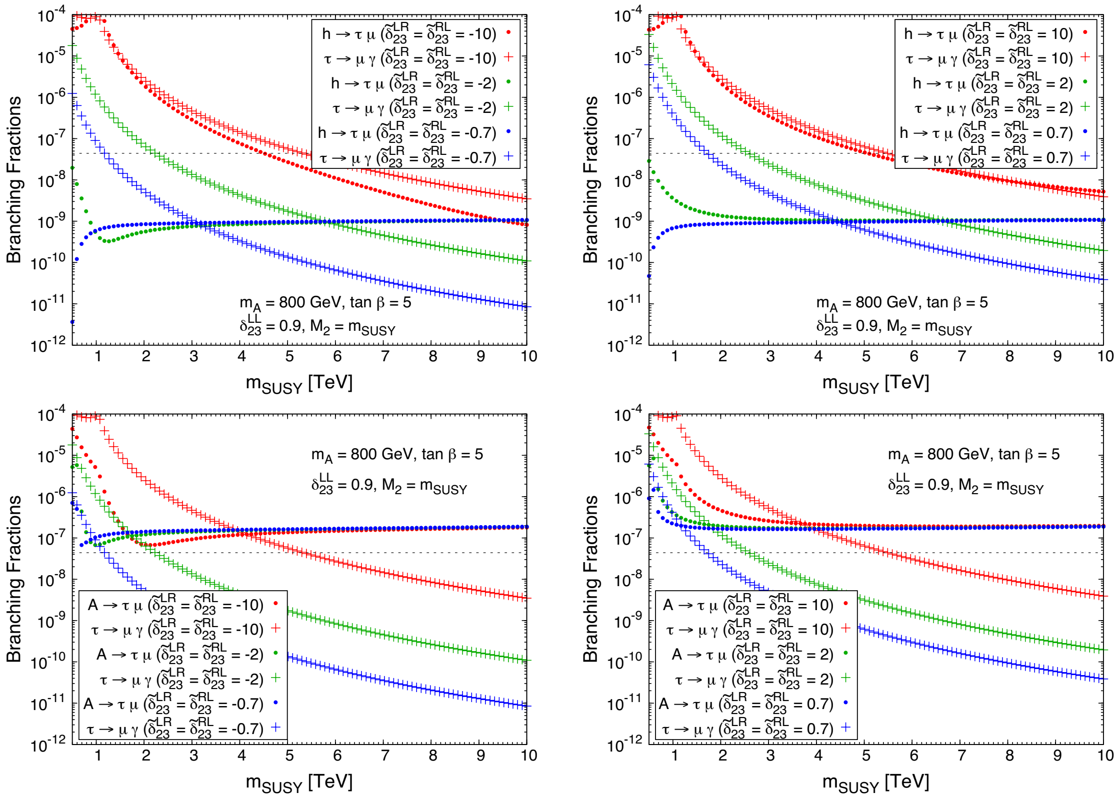

Figure 5. Sensitivity to double LL and LR mixing deltas: LFV Higgs decay rates (dots) and $\mathrm{BR}(\tau \to \mu\gamma)$ (crosses) as functions of m_{SUSY} with $\delta_{23}^{LL} = 0.9$ for different choices of negative LR mixing (left panels), $\tilde{\delta}_{23}^{LR} = \tilde{\delta}_{23}^{RL}$: -0.7 (in blue), -2 (in green) and -10 (in red), and of positive LR mixing (right panels), $\tilde{\delta}_{23}^{LR} = \tilde{\delta}_{23}^{RL}$: $+0.7$ (in blue), $+2$ (in green) and $+10$ (in red). The results for H (not shown) are nearly identical to those of A. In each case, the other flavor changing deltas are set to zero. In both panels, $m_A = 800\,\mathrm{GeV}$, $\tan\beta = 5$, $M_2 = m_{\mathrm{SUSY}}$ and the other MSSM parameters are set to the values reported in the text. The horizontal dashed line denotes the current experimental upper bound for $\tau \to \mu\gamma$ channel, $\mathrm{BR}(\tau \to \mu\gamma) < 4.4 \times 10^{-8}$.

Acknowledgments

We wish to thank Andreas Crivellin for his several remarks and discussions on our first (wrong) results for these LR and RL cases which were not showing the decoupling behavior that he was expecting. Our corrected results included here manifest clearly this expected decoupling behavior with the SUSY mass scale m_{SUSY}.

References

[1] M. Arana-Catania, E. Arganda and M.J. Herrero, *Non-decoupling SUSY in LFV Higgs decays: a window to new physics at the LHC*, *JHEP* **09** (2013) 160 [arXiv:1304.3371] [INSPIRE].

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