LFV in MSSM based on the minimal SO(10) model

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Collaboration

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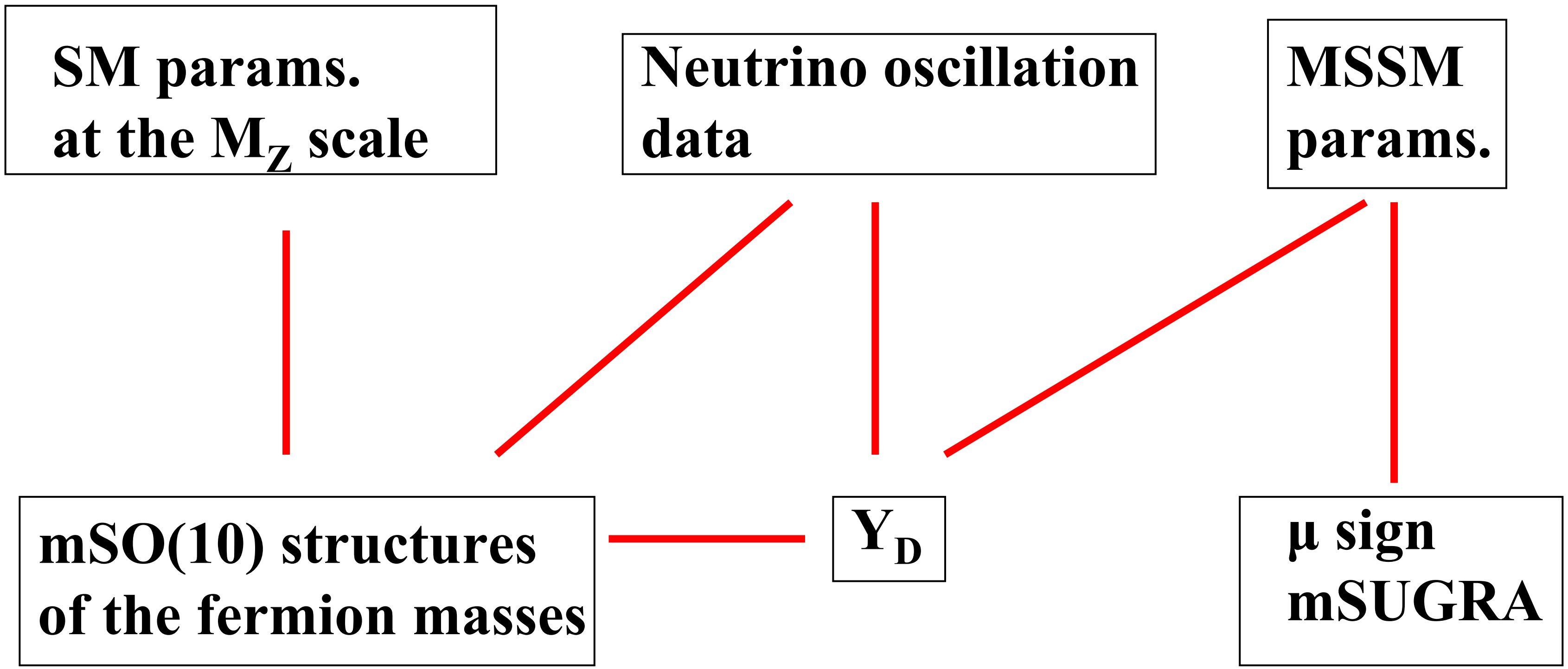
Process	E.u.b.	Reference
$\mu \to e\gamma$	1.2×10^{-11}	Eidelman [PDG] PLB, 592 (2004)
$\tau \to e\gamma$	1.1×10^{-7}	Aubert [BaBar], hep-ex/0508012
$\tau \to \mu\gamma$	6.8×10^{-8}	Aubert [Babar], PRL 92, 0401202 (2004)
$\tau \to e\pi^0$	1.9×10^{-7}	Enari [Belle], PLB 622, 218 (2005)
$\tau \to \mu\pi^0$	4.3×10^{-7}	Enari [Belle], PLB 622, 218 (2005)
$\tau \to e\eta$	2.3×10^{-7}	Enari [Belle], PLB 622, 218 (2005)
$\tau \to \mu\eta$	1.3×10^{-7}	Enari [Belle], PLB 622, 218 (2005)
$\tau \to e\eta'$	10×10^{-7}	Enari [Belle], PLB 622, 218 (2005)
$\tau \to \mu\eta'$	4.1×10^{-7}	Enari [Belle], PLB 622, 218 (2005)
$\tau \to e\rho^0$	2.0×10^{-6}	Eidelman [PDG] PLB, 592 (2004)
$\tau \to \mu\rho^0$	6.3×10^{-6}	Eidelman [PDG] PLB, 592 (2004)
$\tau \to e\phi$	6.9×10^{-6}	Eidelman [PDG] PLB, 592 (2004)
$\tau \to \mu\phi$	7.0×10^{-6}	Eidelman [PDG] PLB, 592 (2004)
$\tau \to e\pi^+\pi^-$	8.7×10^{-7}	Yusa [Belle], NPB(PS), 144 (2005)
$\tau \to \mu\pi^+\pi^-$	2.8×10^{-7}	Yusa [Belle], NPB(PS), 144 (2005)
$\tau \to eK^0\overline{K^0}$	2.2×10^{-6}	Eidelman [PDG] PLB, 592 (2004)
$\tau \to \mu K^0\overline{K^0}$	3.4×10^{-6}	Eidelman [PDG] PLB, 592 (2004)
$\tau \to eK^+K^-$	3.0×10^{-7}	Yusa [Belle], NPB(PS), 144 (2005)
$\tau \to \mu K^+K^-$	11.7×10^{-7}	Yusa [Belle], NPB(PS), 144 (2005)

Masiero, PRL 57, 961 (1986)
Hisano, PRD 53, 2442 (1996)

$$\left(\Delta m^2_{\tilde{\ell}}\right)_{ij} \sim -\frac{3m_0^2 + A_0^2}{8\pi^2} \left(Y_\nu^\dagger L Y_\nu\right)_{ij}$$

$$L_{ij} = \log\left(\frac{M_G}{M_{R_i}}\right)\delta_{ij}$$



SM params.
at the M_Z scale
Neutrino oscillation data
MSSM params.
mSO(10) structures of the fermion masses
Y_D
μ sign
mSUGRA

MSSM

Z-scale

$g_i,\ m_{u_i}, m_{d_i},\ m_{e_i}, (V_{CKM})_{ij}$ | $\leftarrow \tan\beta, \delta, m_s$

$g_i;\ M_u^\dagger M_u, M_d^\dagger M_d, M_e^\dagger M_e$ | choice of basis: $D_u,\ D_e\ :\ b_{1,Z}$

$g_i;\ Y_u^\dagger Y_u, Y_d^\dagger Y_d, Y_e^\dagger Y_e$

RGE without Y_D

GUT scale

$g_i = g_{GUT} \equiv g,\ Y_u^\dagger Y_u, Y_d^\dagger Y_d, Y_e^\dagger Y_e$ | $\rightarrow$ basis $b_{1,GUT}$

$g;\ D^2_{Y_u}, D^2_{Y_d}, D^2_{Y_e};$ | $U_u, U_d, U_e = 1 \rightarrow$ | $V; V^{GUT}_{CKM}, F, B$

$g;\ D_{Y_u}, D_{Y_d}, D_{Y_e}$ | $\leftarrow$ choice of phases: D_u: b_u

$g;\ D_u, M_d, D_e$ (u-dijag b.)

$SO(10)$

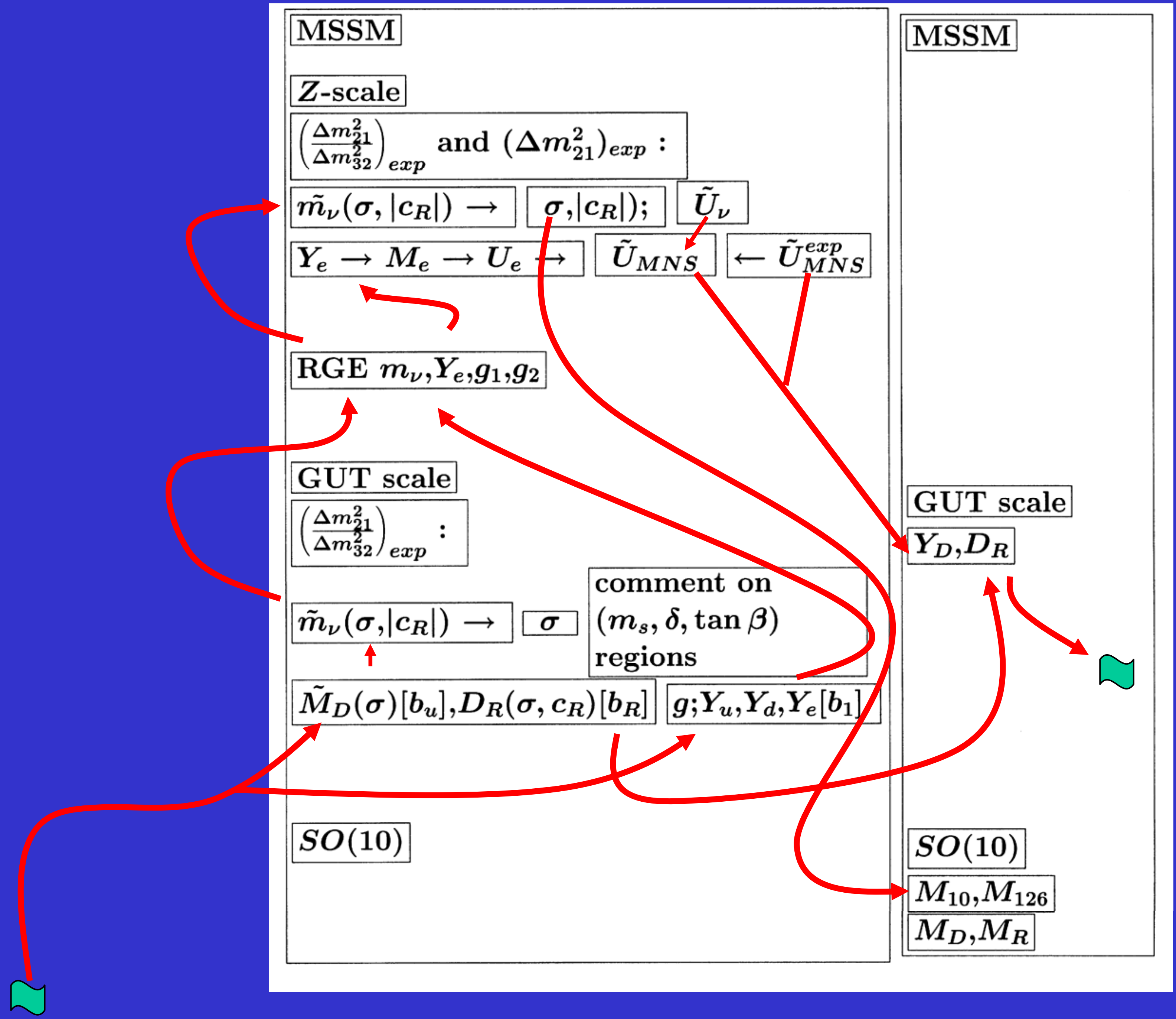
$g;\ D_u, M_d, D_e$

$(M_u, M_d, M_e, M_D, M_R)(c_{10}, c_{126}, M_{10}, M_{126})$
$M_e = c_d(M_d + \kappa M_u)$
invariants : LHS=RHS

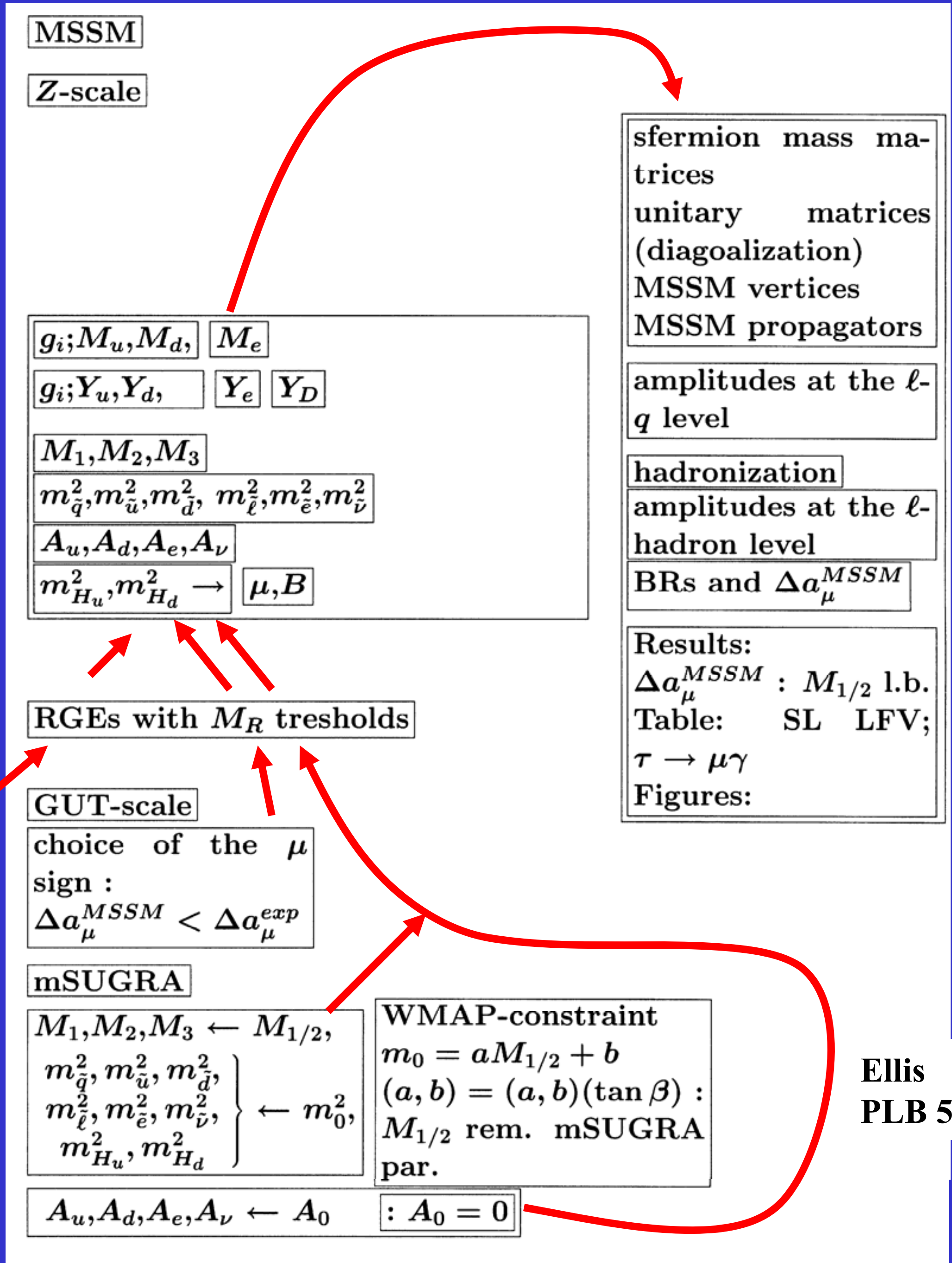
$\kappa, |c_d|;\ \sigma$ | comment on $SO(10)$ solutions : (m_s, δ)

$(M_{10}(\sigma), M_{126}(\sigma))\quad (\kappa, |c_d|, M_u, M_d)$

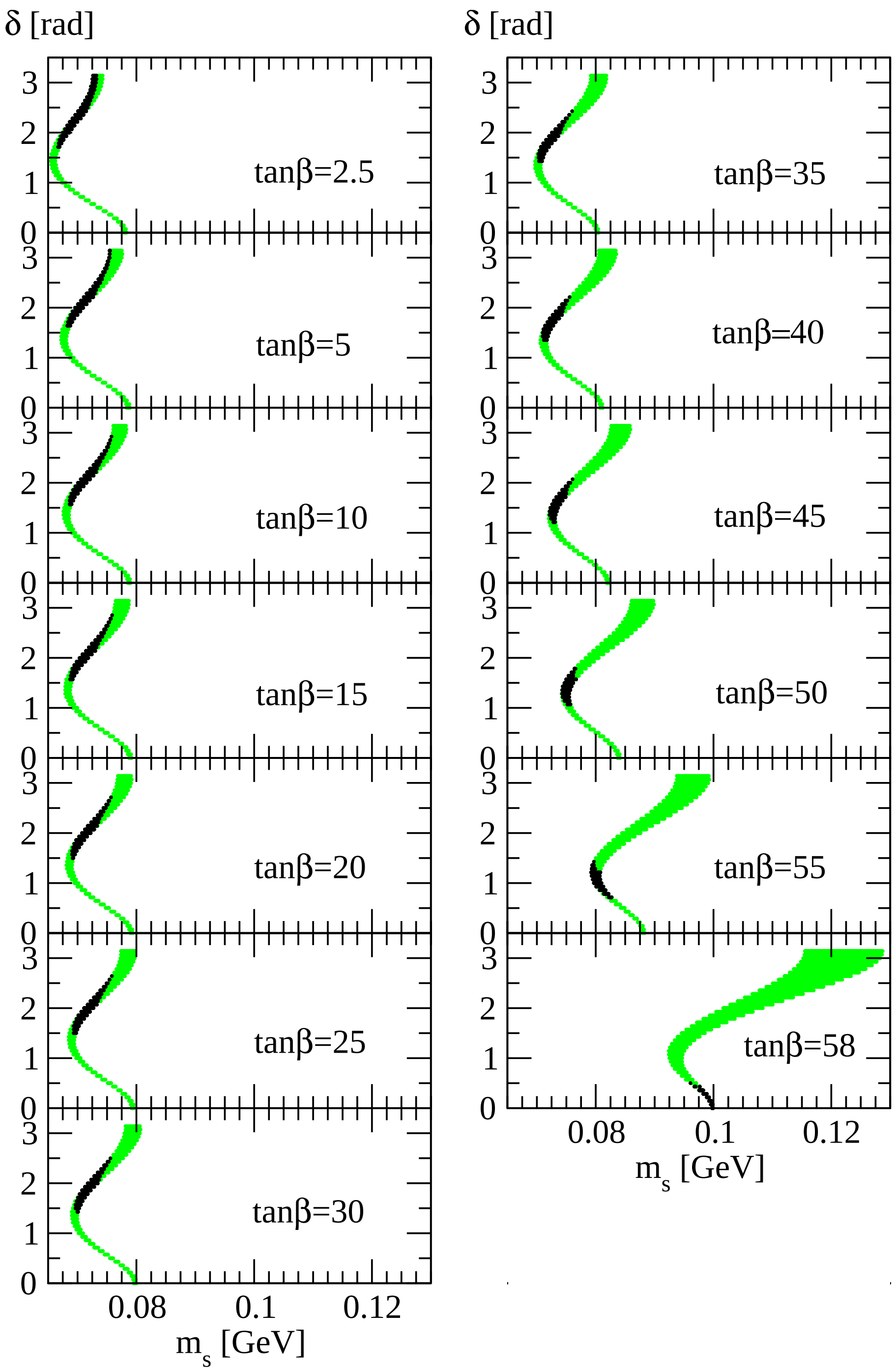
$(M_D(\sigma), M_R(\sigma, c_R))\quad (\kappa, |c_d|, M_u, M_d)$



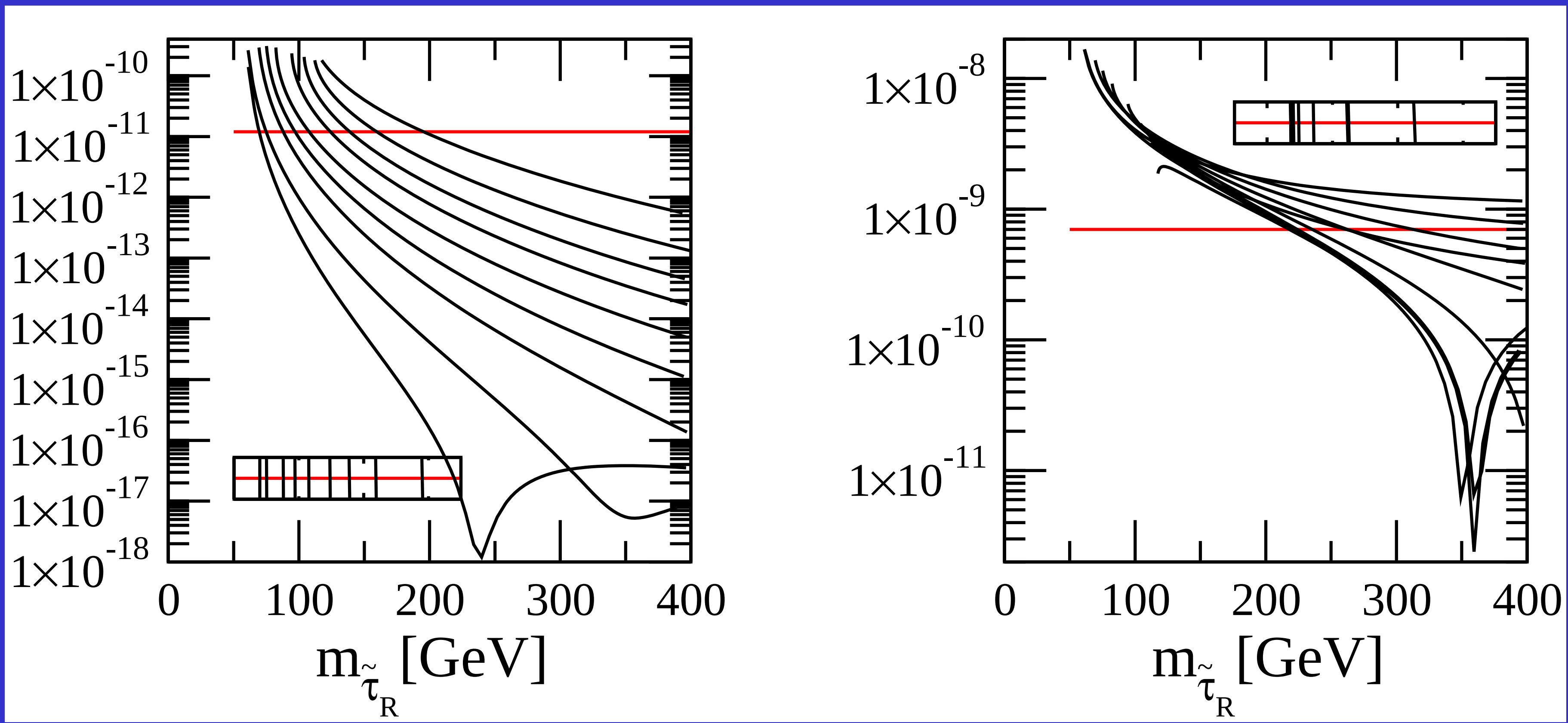
MSSM
Z-scale
$\left(\frac{\Delta m^2_{21}}{\Delta m^2_{32}}\right)_{exp}$ and $(\Delta m^2_{21})_{exp}$:
$\tilde{m}_\nu(\sigma, |c_R|) \longrightarrow$
$\sigma, |c_R|)$;
$\tilde{U}_\nu$
$Y_e \longrightarrow M_e \longrightarrow U_e \longrightarrow$
$\tilde{U}_{MNS}$
$\longleftarrow \tilde{U}^{exp}_{MNS}$
RGE m_ν, Y_e, g_1, g_2
GUT scale
$\left(\frac{\Delta m^2_{21}}{\Delta m^2_{32}}\right)_{exp}$:
$\tilde{m}_\nu(\sigma, |c_R|) \longrightarrow$
σ
comment on
$(m_s, \delta, \tan\beta)$
regions
$\tilde{M}_D(\sigma)[b_u], D_R(\sigma, c_R)[b_R]$
$g; Y_u, Y_d, Y_e[b_1]$
$SO(10)$
MSSM
GUT scale
Y_D, D_R
$SO(10)$
M_{10}, M_{126}
M_D, M_R

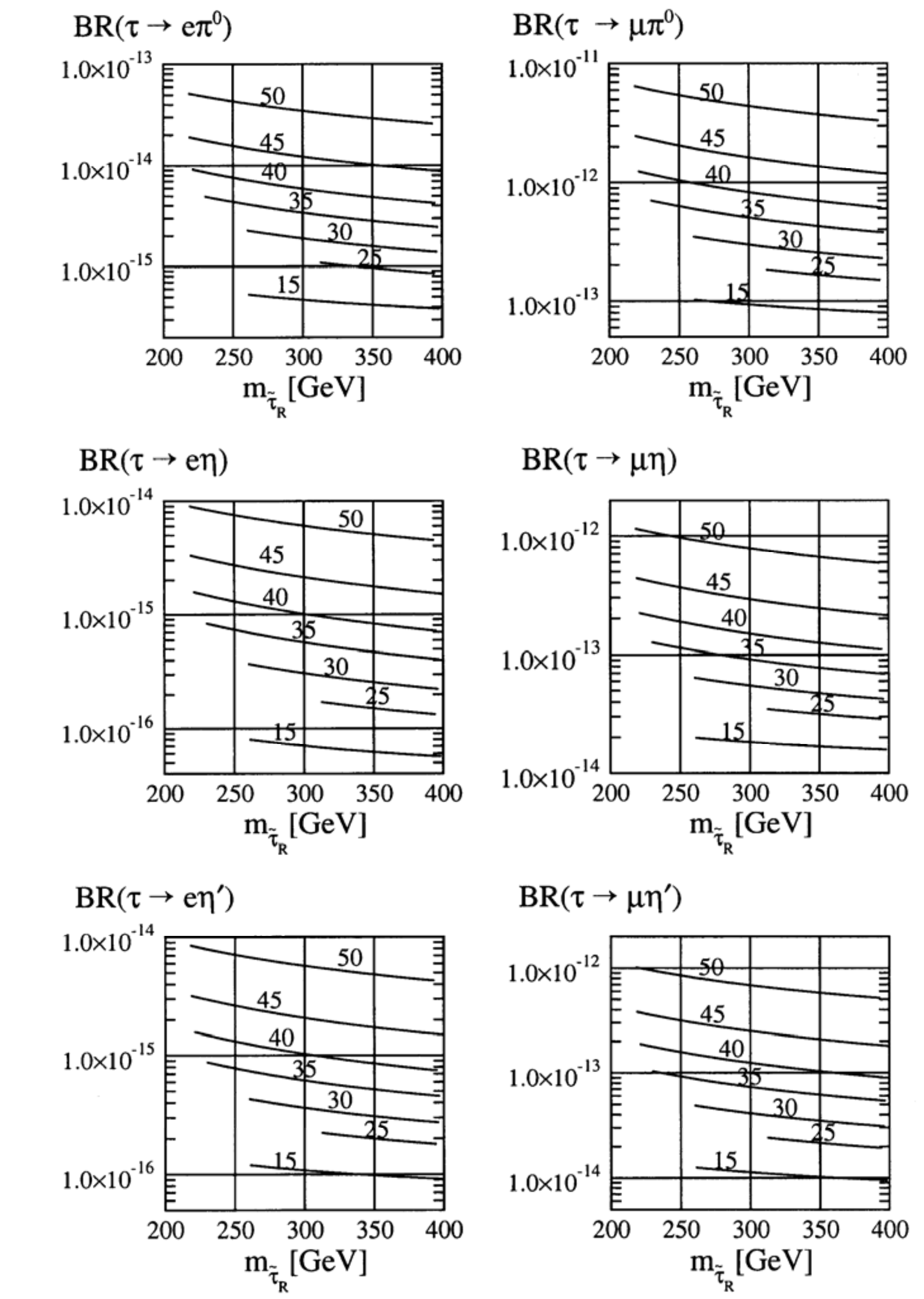


Ellis
PLB 565, 176 (2003)

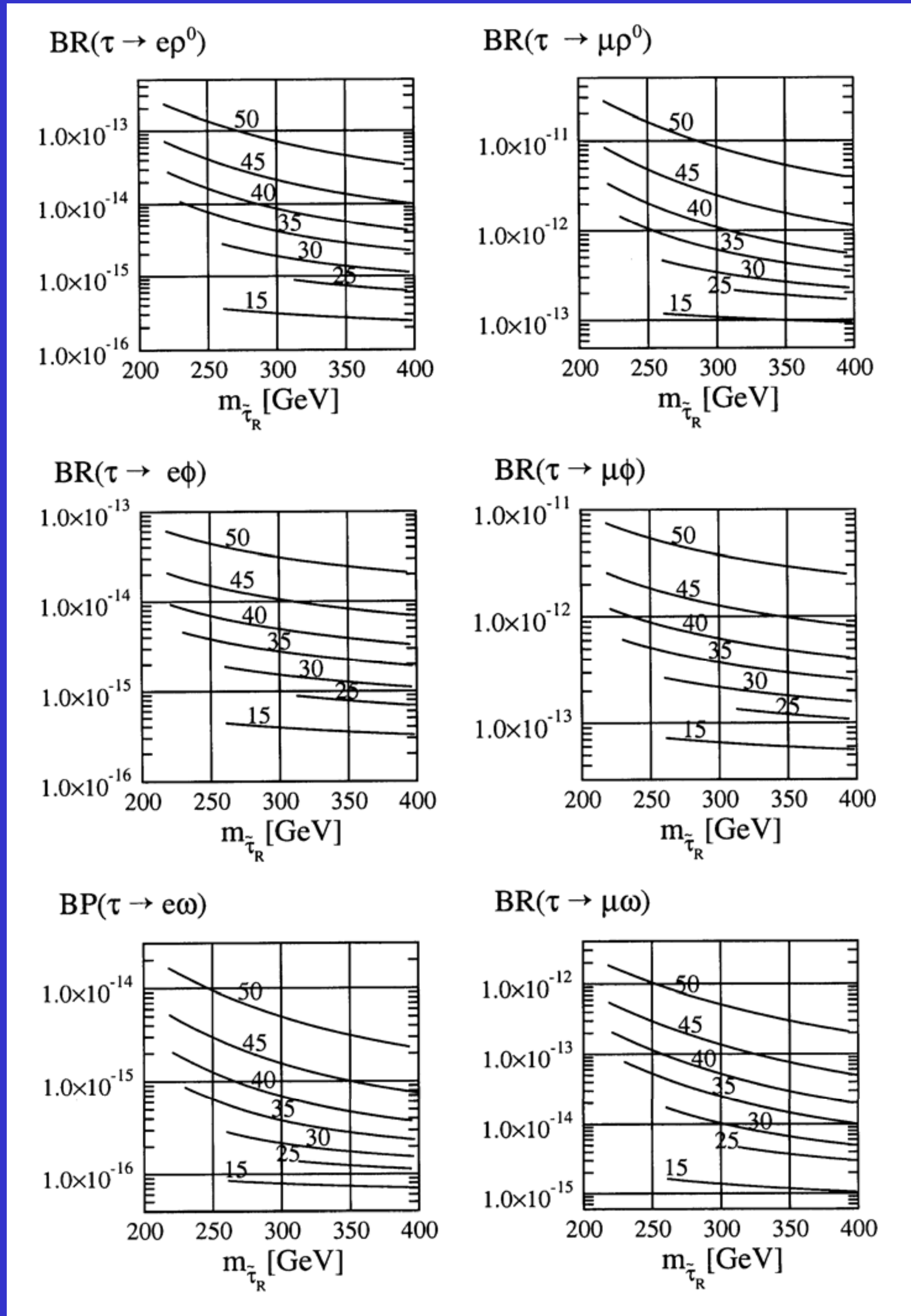

δ [rad]
δ [rad]
tanβ=2.5
tanβ=5
tanβ=10
tanβ=15
tanβ=20
tanβ=25
tanβ=30
tanβ=35
tanβ=40
tanβ=45
tanβ=50
tanβ=55
tanβ=58
0.08
0.1
0.12
m_s [GeV]

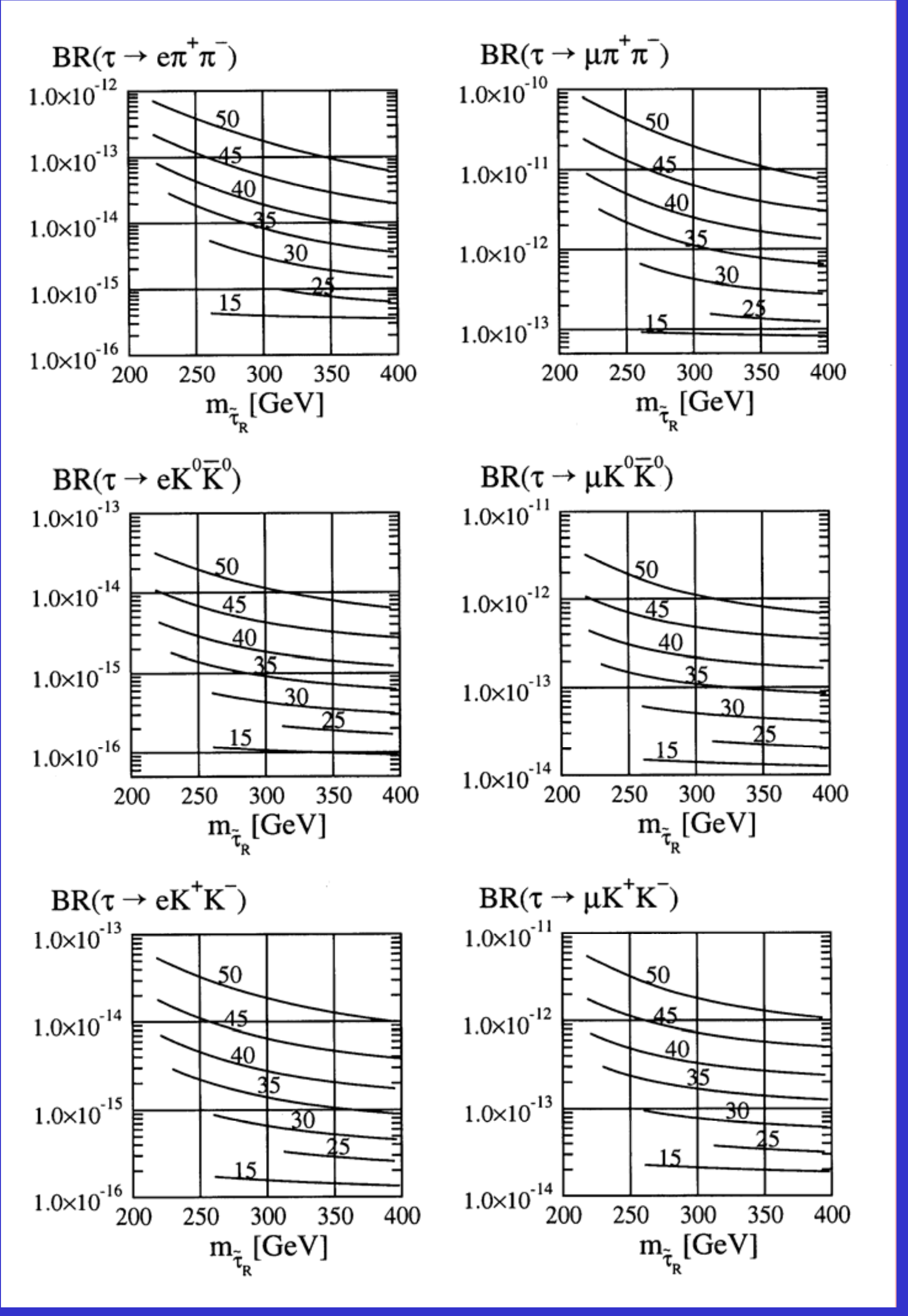
$BR(\mu \to e\gamma)$ $\Delta a_{\mu,MSSM}$

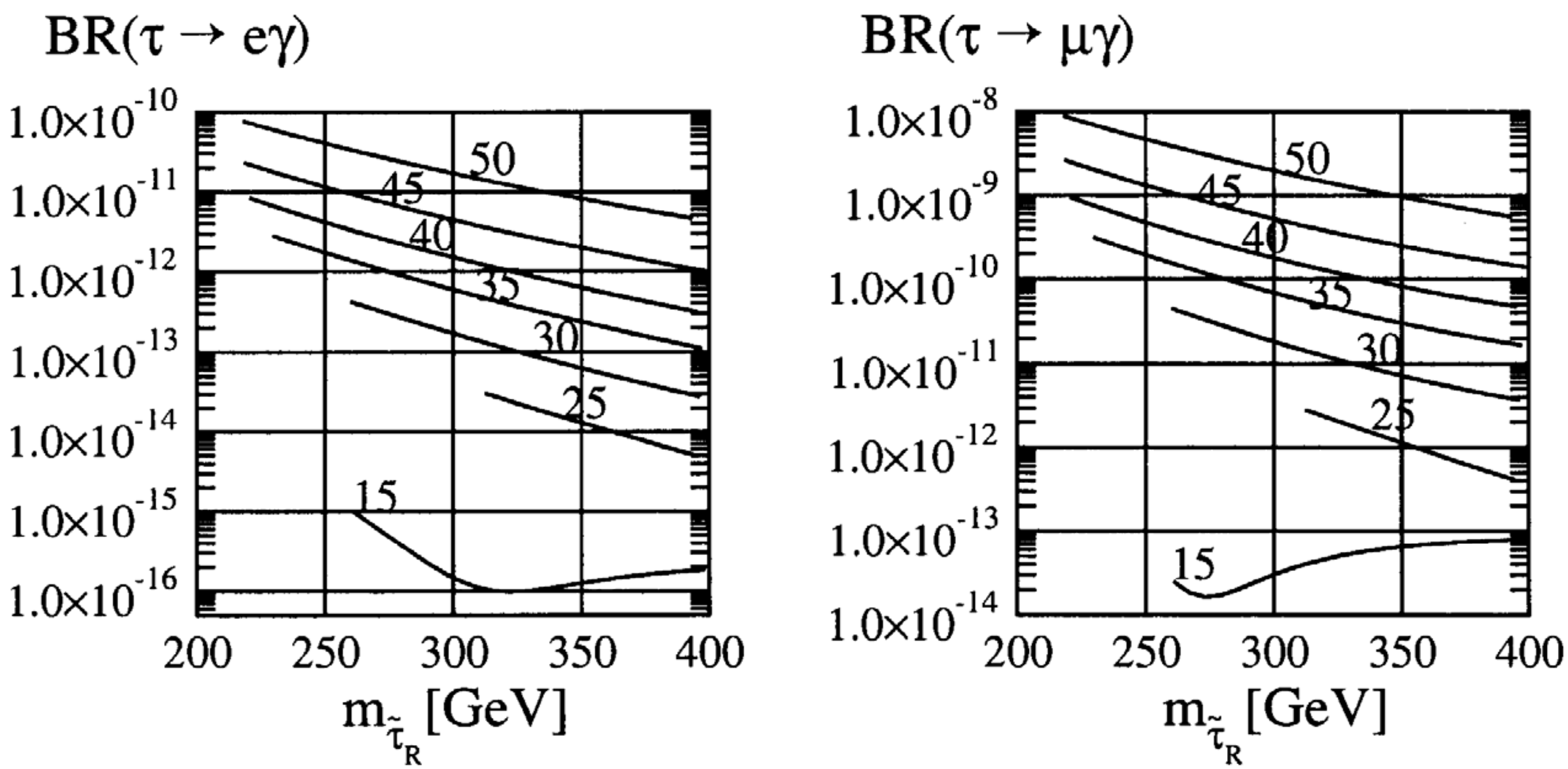




BR(τ → eπ⁰)
BR(τ → μπ⁰)
BR(τ → eη)
BR(τ → μη)
BR(τ → eη′)
BR(τ → μη′)
200 250 300 350 400
m [GeV]
50 45 40 35 30 25 15


BR(τ → eρ⁰)
BR(τ → μρ⁰)
BR(τ → eϕ)
BR(τ → μϕ)
BP(τ → eω)
BR(τ → μω)
1.0×10^-11
1.0×10^-12
1.0×10^-13
1.0×10^-14
1.0×10^-15
1.0×10^-16
200 250 300 350 400
m_τ̃R [GeV]
50
45
40
35
30
25
15


BR(τ → eπ+π−)
BR(τ → μπ+π−)
BR(τ → eK0K̄0)
BR(τ → μK0K̄0)
BR(τ → eK+K−)
BR(τ → μK+K−)
1.0×10-12
1.0×10-13
1.0×10-14
1.0×10-15
1.0×10-16
1.0×10-10
1.0×10-11
1.0×10-12
1.0×10-13
1.0×10-14
50
45
40
35
30
25
15
200
250
300
350
400
m_τ̃R [GeV]



BR(τ → eγ)
1.0×10^-10
1.0×10^-11
1.0×10^-12
1.0×10^-13
1.0×10^-14
1.0×10^-15
1.0×10^-16
50
45
40
35
30
25
15
200
250
300
350
400
m_τ̃R [GeV]
BR(τ → μγ)
1.0×10^-8
1.0×10^-9
1.0×10^-10
1.0×10^-11
1.0×10^-12
1.0×10^-13
1.0×10^-14
50
45
40
35
30
25
15
200
250
300
350
400
m_τ̃R [GeV]

Process	T.u.b.					E.u.b.
	30	35	40	45	50	
$\mu \to e\gamma$	6.3×10^{-14}	3.6×10^{-13}	9.8×10^{-13}	2.5×10^{-12}	7.4×10^{-12}	1.2×10^{-11}
$\tau \to e\gamma$	4.2×10^{-13}	2.8×10^{-12}	8.3×10^{-12}	2.3×10^{-11}	7.8×10^{-11}	1.1×10^{-7}
$\tau \to \mu\gamma$	4.5×10^{-11}	3.2×10^{-10}	9.4×10^{-10}	2.7×10^{-9}	9.0×10^{-9}	6.8×10^{-8}
$\tau \to e\pi^0$	2.3×10^{-15}	4.9×10^{-15}	9.2×10^{-15}	1.9×10^{-14}	5.2×10^{-14}	1.9×10^{-7}
$\tau \to \mu\pi^0$	3.5×10^{-13}	7.0×10^{-13}	1.2×10^{-12}	2.5×10^{-12}	6.5×10^{-12}	4.3×10^{-7}
$\tau \to e\eta$	3.7×10^{-16}	8.3×10^{-16}	1.6×10^{-15}	3.3×10^{-15}	9.0×10^{-15}	2.3×10^{-7}
$\tau \to \mu\eta$	6.4×10^{-14}	1.3×10^{-13}	2.2×10^{-13}	4.4×10^{-13}	1.2×10^{-12}	1.3×10^{-7}
$\tau \to e\eta'$	4.3×10^{-16}	8.8×10^{-16}	1.6×10^{-15}	3.2×10^{-15}	8.5×10^{-15}	10×10^{-7}
$\tau \to \mu\eta'$	4.9×10^{-14}	1.0×10^{-13}	1.9×10^{-13}	3.8×10^{-13}	1.0×10^{-12}	4.1×10^{-7}
$\tau \to e\rho^0$	2.8×10^{-15}	1.1×10^{-14}	2.8×10^{-14}	7.3×10^{-14}	2.3×10^{-13}	2.0×10^{-6}
$\tau \to \mu\rho^0$	4.6×10^{-13}	1.4×10^{-12}	3.4×10^{-12}	8.5×10^{-12}	2.8×10^{-12}	6.3×10^{-6}
$\tau \to e\phi$	1.9×10^{-15}	4.6×10^{-15}	9.3×10^{-15}	2.1×10^{-14}	6.1×10^{-14}	6.9×10^{-6}
$\tau \to \mu\phi$	2.7×10^{-13}	6.1×10^{-13}	1.2×10^{-12}	2.6×10^{-12}	7.5×10^{-12}	7.0×10^{-6}
$\tau \to e\omega$	2.9×10^{-16}	8.7×10^{-16}	2.7×10^{-15}	5.2×10^{-15}	1.6×10^{-14}	—
$\tau \to \mu\omega$	1.7×10^{-14}	7.8×10^{-14}	2.1×10^{-13}	5.5×10^{-13}	1.8×10^{-12}	—
$\tau \to e\pi^+\pi^-$	5.4×10^{-15}	2.9×10^{-14}	8.1×10^{-14}	2.2×10^{-13}	7.2×10^{-13}	8.7×10^{-7}
$\tau \to \mu\pi^+\pi^-$	6.6×10^{-13}	3.2×10^{-12}	8.9×10^{-12}	2.4×10^{-11}	8.0×10^{-11}	2.8×10^{-7}
$\tau \to eK^0\overline{K}^0$	5.6×10^{-16}	1.8×10^{-15}	4.3×10^{-15}	1.1×10^{-14}	3.2×10^{-14}	2.2×10^{-6}
$\tau \to \mu K^0\overline{K}^0$	6.1×10^{-14}	1.9×10^{-13}	4.4×10^{-13}	1.1×10^{-12}	3.2×10^{-12}	3.4×10^{-6}
$\tau \to eK^+K^-$	8.8×10^{-16}	2.9×10^{-15}	7.1×10^{-15}	1.8×10^{-14}	5.4×10^{-14}	3.0×10^{-7}
$\tau \to \mu K^+K^-$	9.5×10^{-14}	3.0×10^{-13}	7.2×10^{-13}	1.8×10^{-12}	5.5×10^{-12}	11.7×10^{-7}

Conclusion

* *SL LFV BRs to small for finding LFV in the model considered*
* *$B(\tau \to \mu\gamma)$ close to the present exp. upper bound*