SuperB vs MEG and Mu2E and NP models predicting LFV

A.Lusiani – Pisa

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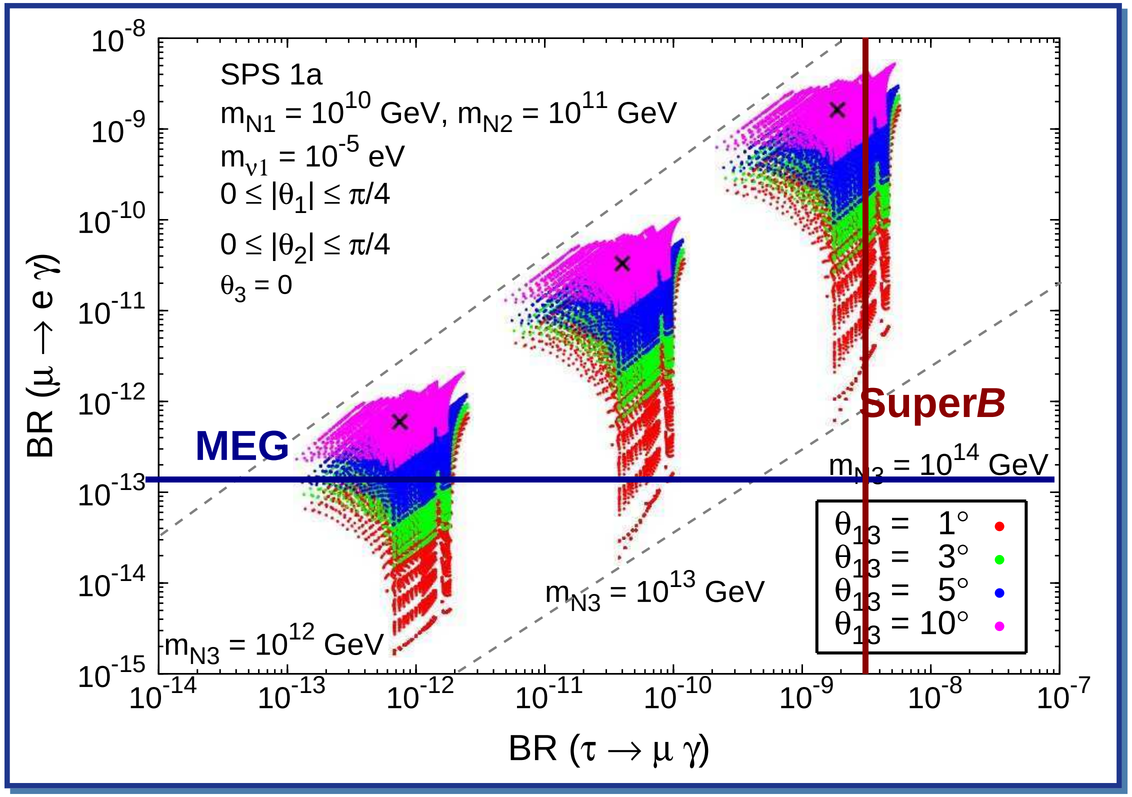
LFV 90% CL upper limit sensitivities

	BF($\mu \to e\gamma$)	$R_{\mu e} = n(\mu N \to eN)/n(\mu)$	BF($\tau \to \{\mu, e\}\gamma$)	BF($\tau \to \ell\ell\ell$)
MEG	$1{\cdot}10^{-13}$			
Mu2e		$6{\cdot}10^{-17}$		
Super*B*			$2\text{–}3{\cdot}10^{-9}$	$2\text{–}8{\cdot}10^{-10}$

- LHC experiments do not appear to be competitive
- *Belle II* comparable to Super*B* but lower design luminosity & no polarization
- typically, $\mu N \to eN$ rates are $\sim 1/100$ of $\mu \to e\gamma$ rates
  some interactions cause $\mu N \to eN$ but not $\mu \to e\gamma$
- tau and muon LFV are different processes
  - comparison depends on the NP model [BF($\tau \to \mu\gamma$) typically $\gg$ BF($\mu \to e\gamma$)]
    - typically, $\tau \to \mu\gamma$ best channel for LFV searches at B-factories
  - measurements are **complementary**

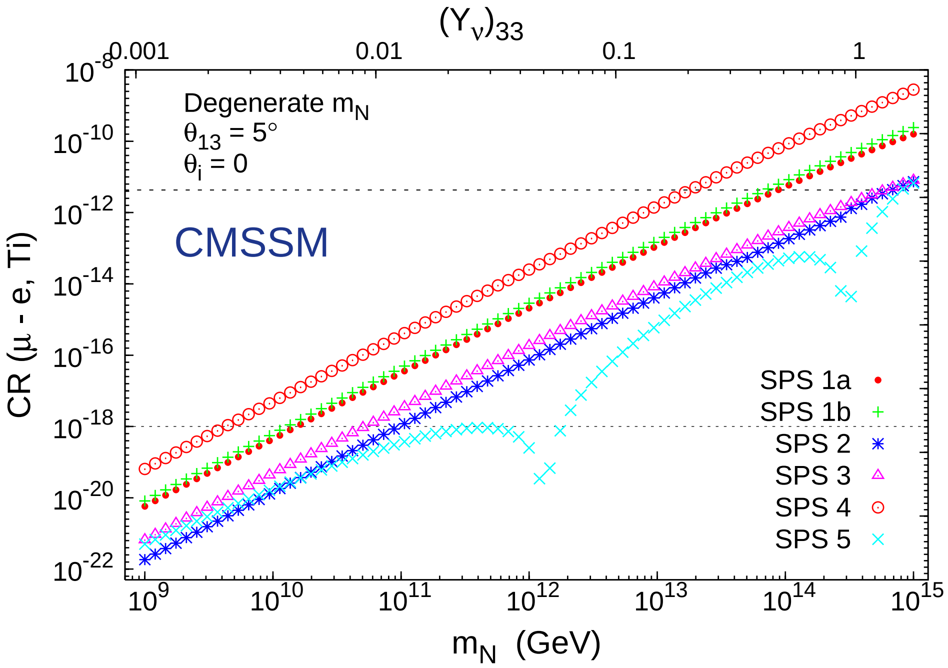
Antusch,Arganda,Herrero,Teixeira, Impact of θ_{13} on LFV with SUSY Seesaw

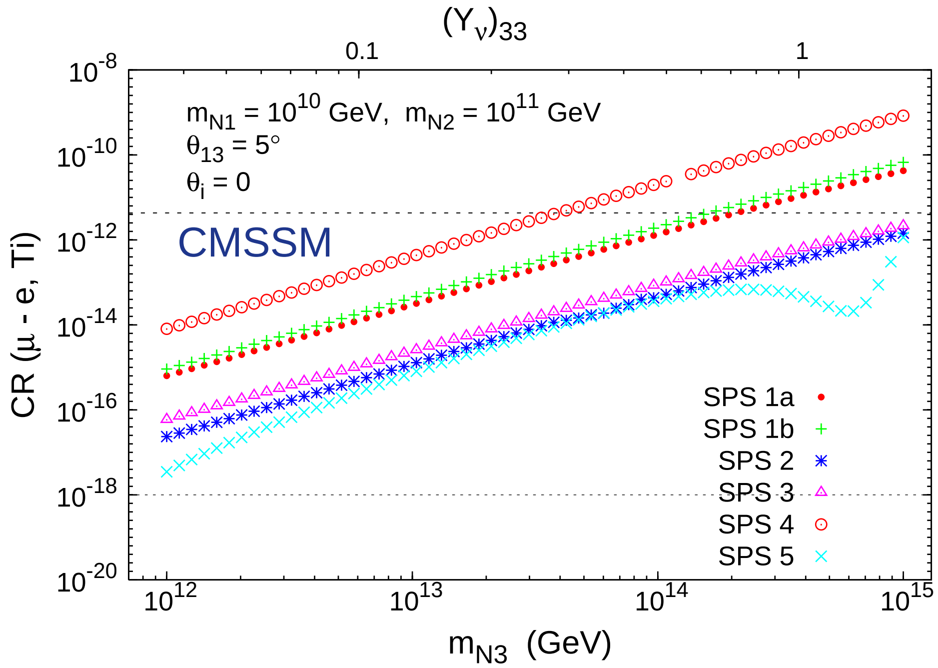


- hep-ph/0607263v2 - JHEP11(2006)090
- CMSSM-mSUGRA, hierarchical heavy ν's
- $\mu \to e\gamma$ vanishes for small θ_{13}
- $\tau \to \mu\gamma$ independent of θ_{13}

- N_i = right-handed neutrinos
- ν_i = left-handed neutrinos
- θ_i = N complex mixing angles
- θ_{13} refers to PMNS mixing matrix angle

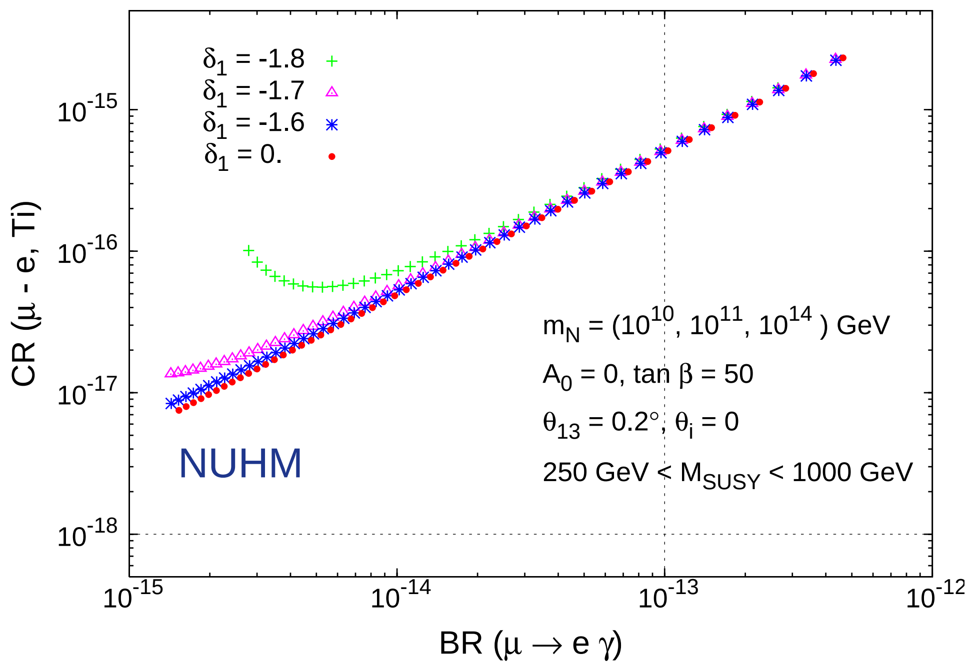
Arganda/Herrero/Teixeira, $\mu - e$ conversion in nuclei with CMSSM seesaw. . . , 0707.2955v2 [hep-ph]





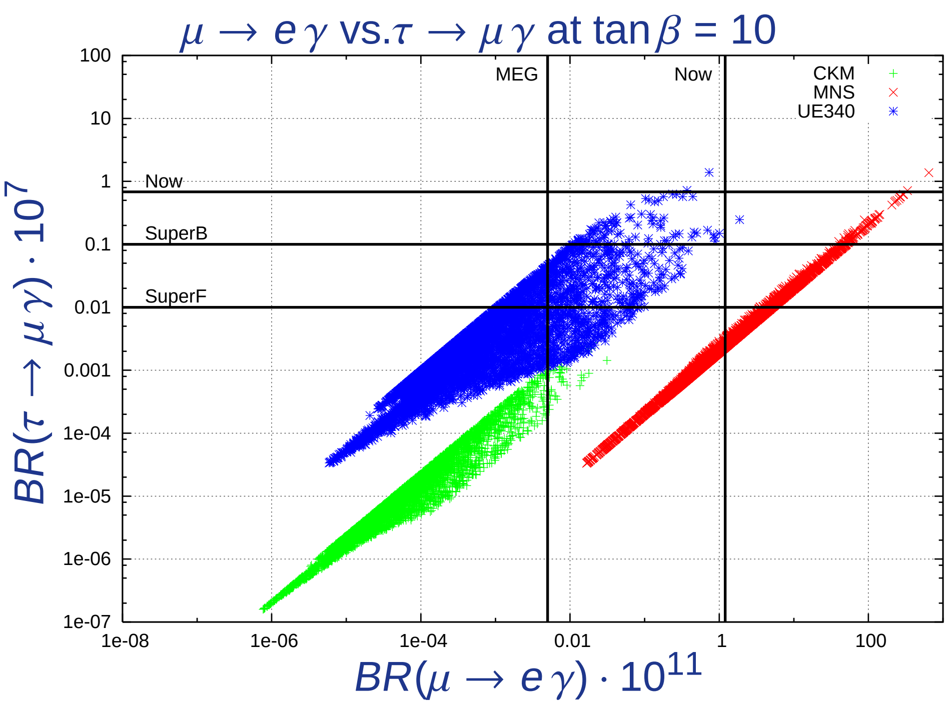
- same assumptions as former publication

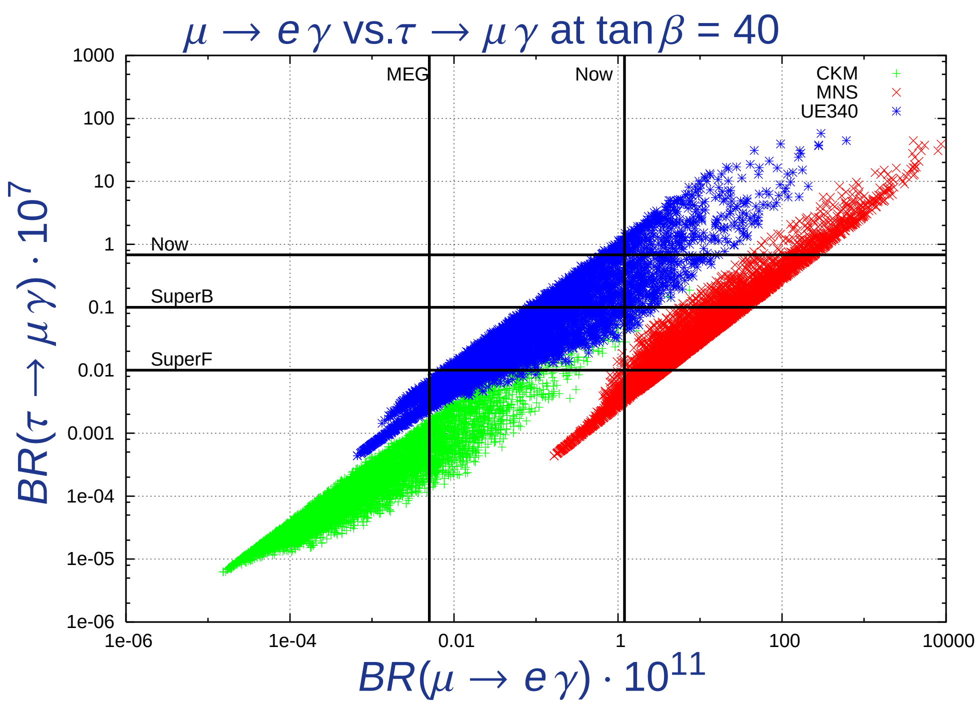
Arganda/Herrero/Teixeira, $\mu - e$ conversion in nuclei with CMSSM seesaw. . . , 0707.2955v2 [hep-ph]



- $\dfrac{R_{\mu e}}{\text{BF}(\mu \to e\gamma)} \sim \dfrac{1}{160}$ (**correlation**, lost when higgs-mediated LFV process prevails)

hep-ph/0605139v2, L. Calibbi, A. Faccia, A. Masiero, S. K. Vempati,
Lepton Flavour Violation from SUSY–GUTs:
Where do we stand for MEG, PRISM/PRIME and a Super Flavour factory



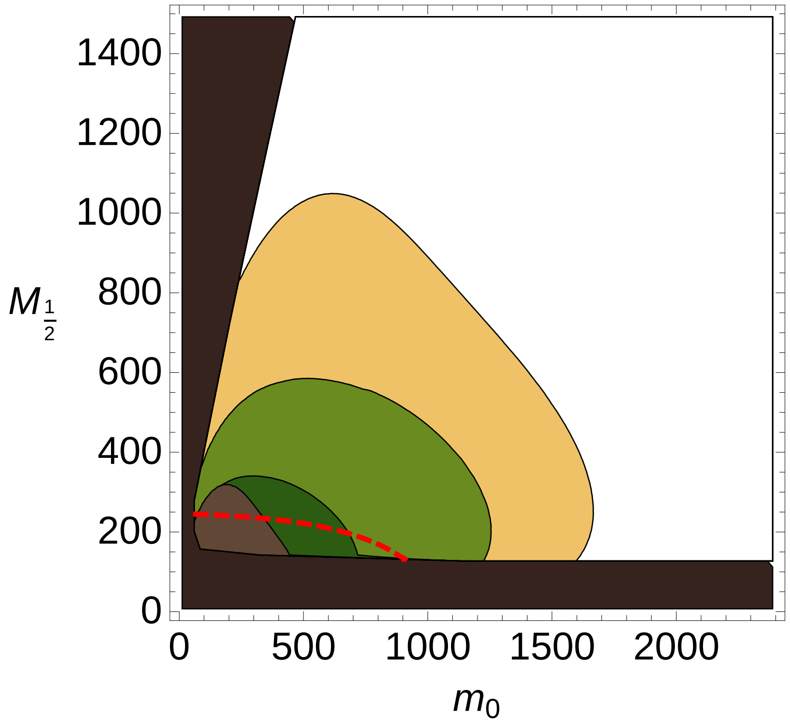


- SUSY GUT SO(10) with see-saw, either CKM or PMNS mixing

hep-ph/0605139v2, L. Calibbi, A. Faccia, A. Masiero, S. K. Vempati,
Lepton Flavour Violation from SUSY–GUTs:
Where do we stand for MEG, PRISM/PRIME and a Super Flavour factory

- $\tau \to \mu\gamma / \mu \to e\gamma \sim 1000$; $\mu \to e\gamma / R_{\mu e} \sim 100$
- mu2e is 3-4 orders of magnitude better than SuperB and explores the whole parameter space
- but a Super Flavour factory would be higly complementary
- $U_{e3} = 0$ ➞ PMNS case is better constrained by $\tau \to \mu\gamma$ than $\mu \to e\gamma$

L. Calibbi, J. Jones-Perez, A. Masiero, J.-h. Park, W. Porod, O. Vives, SU(3) Flavour Symmetries and CP Violation, 0909.2501v1 [hep-ph]



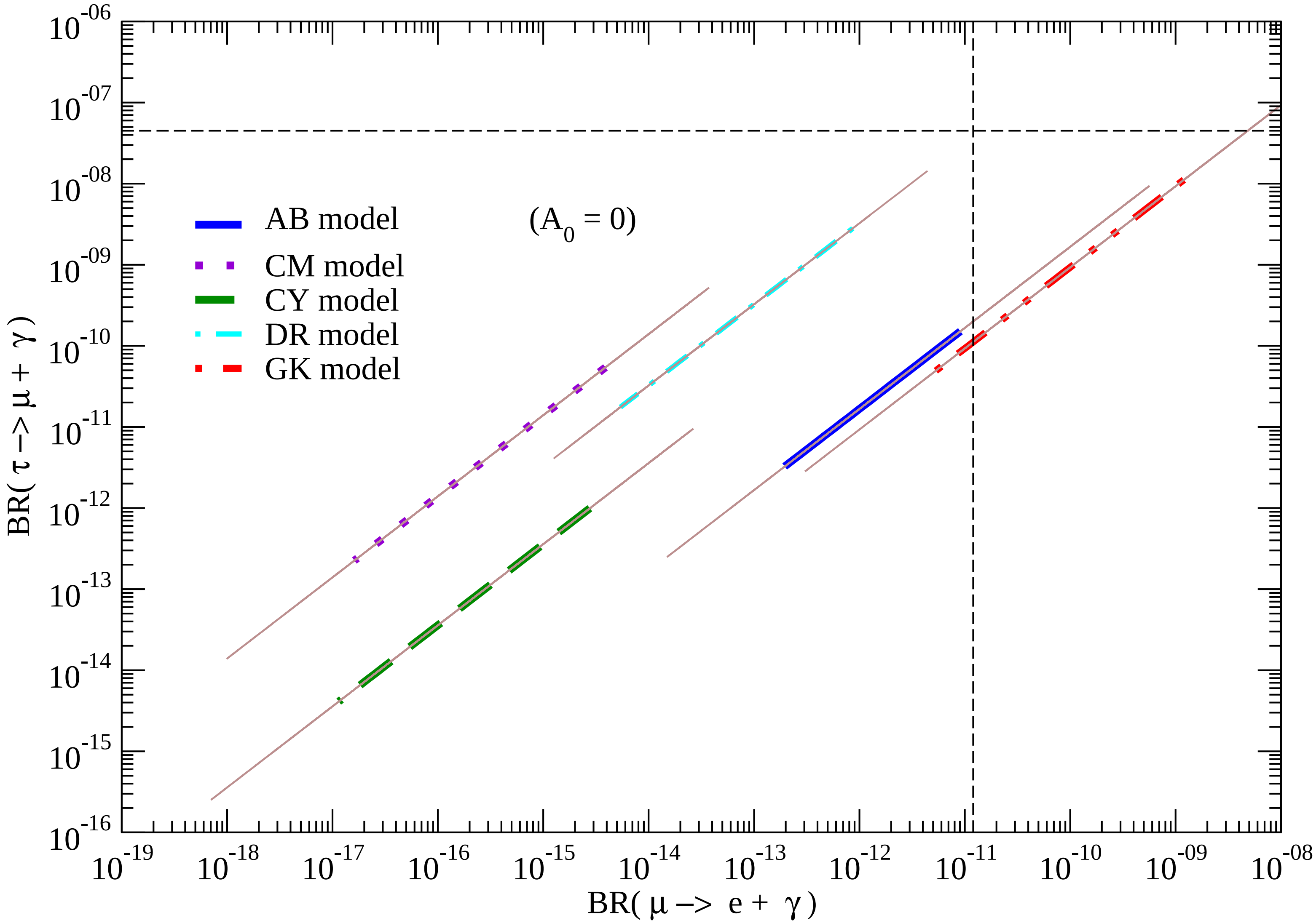
- MSSM with $SU(3)$ flavour symmetry (**RVV**), correlates LFV on different generations
- brown → MEGA, green → BaBar+Belle
- light brown → future MEG, light green → Super Flavour Factory

C.H.Albright, Mu-Chun Chen, LFV in Predictive Susy GUT Models, 0802.4228v3 [hep-ph]

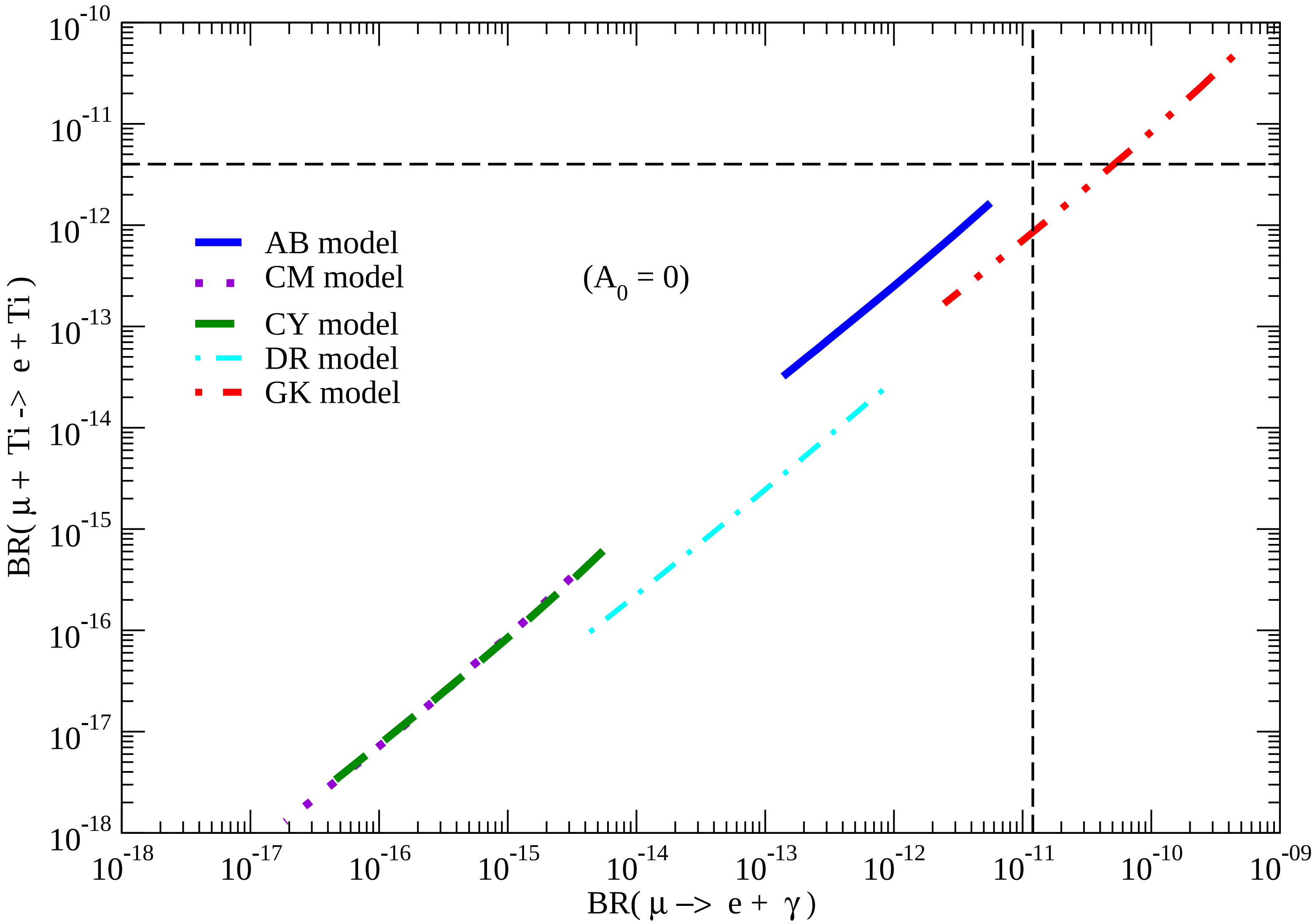
- compute LFV rates for 5 SUSY GUT SO(10) models
  - Albright - Barr $SO(10)$ Model
  - Chen - Mahanthappa $SO(10)$ Model
  - Cai - Yu $SO(10)$ Model
  - Dermisek - Raby $SO(10)$ Model
  - Grimus - Kuhbock $SO(10)$ Model

Models	BR($\tau \to \mu\gamma$)/BR($\mu \to e\gamma$)	BR($\tau \to e\gamma$)/BR($\mu \to e\gamma$)	BR($\mu + Ti \to e + Ti$)/BR($\mu \to e\gamma$)
AB	16.7	0.09	0.33
CM	1.3×10^4	171	0.11
CY	400	6.5	0.11
DR	3.3×10^3	61.0	0.026
GK	10.0	1.0	0.12

C.H.Albright, Mu-Chun Chen, LFV in Predictive Susy GUT Models



C.H.Albright, Mu-Chun Chen, LFV in Predictive Susy GUT Models



R.Barbieri, G.Isidori, J.j.Perez, P.Lodone, D.M.Straub,
U(2) and Minimal Flavour Violation in Supersymmetry, 1105.2296v1 [hep-ph]

- BF($\tau \to \mu\gamma$)/BF($\mu \to e\gamma$) $\sim$ 1000

hep-ph/0702136, M. Blanke, A.J. Buras, B. Duling, A. Poschenrieder, C. Tarantino,
Charged Lepton Flavour Violation and $(g-2)_\mu$ in the LHT model:...

- most LFV BRs within 0.01 – 100 of each other, no defined flavour hierarchy
- Mu2e much more sensitive than Super*B* (explores 5 orders of magnitudes more)

Features of NP models LFV predictions

- J.Hisano, 0807.0149v1 [hep-ph]: **SUSY LFV rates naturally exceed experimental bounds**
- BF$(\mu \to e\gamma) \sim \frac{\alpha}{4\pi}\left(\frac{m_W}{m_{SUSY}}\right)^4 \sin^2\theta_{e\mu}\left(\frac{\Delta m^2_{\tilde{l}}}{m^2_{SUSY}}\right)^2$ J.Hisano, 0807.0149v1 [hep-ph]
  - $\tau \to \mu\gamma$ and $\mu \to e\gamma$ driven by **different** unknown parameters

→ viable NP models need to implement constraints from today's LFV limits

  - universal scalar mass hypothesis (squarks & leptons)
  - alignment hypothesis ($\sin\theta_{e\mu} \ll 1$) (flavour symmetries)
  - decoupling hypothesis: heavy 1st and 2nd generation squarks and sleptons

Conclusions

- published NP models LFV predictions: Mu2e more sensitive than MEG more sensitive than Super*B*
- **correlations** between muon and tau LFV come
  - partly from experimental constraints on NP parameters
  - but also from **assumptions** driven by elegance, simplicity, similarity with low energy physics (flavour symmetries, mixing & mass hierarchies)
- muon and tau LFV measurements are **both necessary** to probe the most general NP structure that is allowed by today's measurements

I thank O.Vives, M.Ciuchini and A.Masiero for useful conversations.