Lepton Flavor Violation in B Decays

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❶ (+ ❷ + ❸) $\Rightarrow$ *There seems to be BSM LFNU and the effect is in $\mu\mu$, not ee*

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- *Yet, focusing (for the moment) on the $b \to s$ discrepancies*

  - ***Q1:*** *Can we (easily) make theoretical sense of data?*
  - ***Q2:*** *What are the most immediate signatures to expect ?*

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- *Rotating q and ℓ to the mass eigenbasis generates LFV interactions.*

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- *Advocating the same (V – A) x (V – A) structure also for the corrections to $C_{9,10}^{SM}$ (in the μμ-channel only!) would account for:*
  - *R_K lower than 1*
  - *$B \to K \mu\mu$ & $B_s \to \mu\mu$ BR data below predictions*
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- *A fully quantitative test requires a global fit.*

new physics contributions to the Wilson coefficients. We find that the by far largest decrease in the χ^2 can be obtained either by a negative new physics contribution to C_9 (with $C_9^{\rm NP} \sim -30\% \times C_9^{\rm SM}$), or by new physics in the $SU(2)_L$ invariant direction $C_9^{\rm NP} = -C_{10}^{\rm NP}$, (with $C_9^{\rm NP} \sim -12\% \times C_9^{\rm SM}$). A positive NP contribution to C_{10} alone would also improve the fit, although to a lesser extent. [Altmannshofer, Straub, EPJC '15]

For analogous conclusions, see also [Ghosh, Nardecchia, Renner, JHEP '14]

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Glashow, DG, Lane, PRL 2015

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mass basis (refers to $(d_L)_i$, $(\ell_L)_i$)

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$$R_K \approx \frac{|C_9^{(\mu)}|^2 + |C_{10}^{(\mu)}|^2}{|C_9^{(e)}|^2 + |C_{10}^{(e)}|^2} \simeq \frac{2|C_{10}^{\mathrm{SM}} + \delta C_{10}|^2}{2|C_{10}^{\mathrm{SM}}|^2}$$

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implying (within our model) the correlations

$$\frac{BR(B_s \to \mu\mu)_{exp}}{BR(B_s \to \mu\mu)_{SM}} \simeq R_K \simeq \frac{BR(B^+ \to K^+ \mu\mu)_{exp}}{BR(B^+ \to K^+ \mu\mu)_{SM}}$$

Another good reason to pursue accuracy in the $B_s \to \mu\mu$ measurement

See also Hiller, Schmaltz, PRD 14

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- ☑ *An analogous argument holds for purely leptonic modes*

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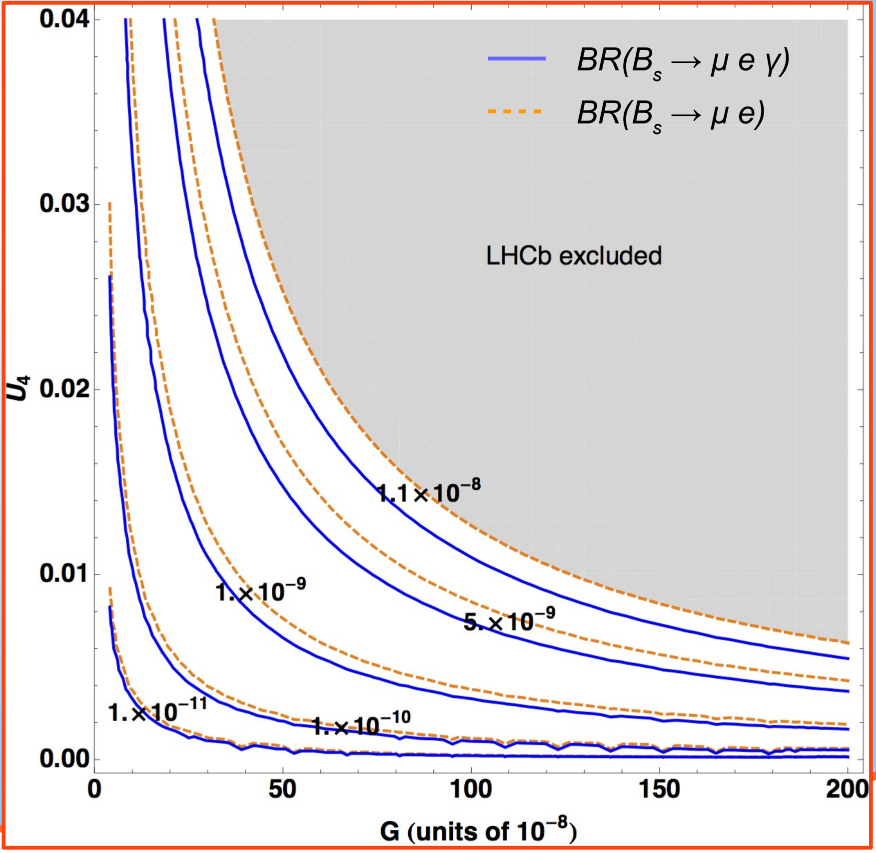

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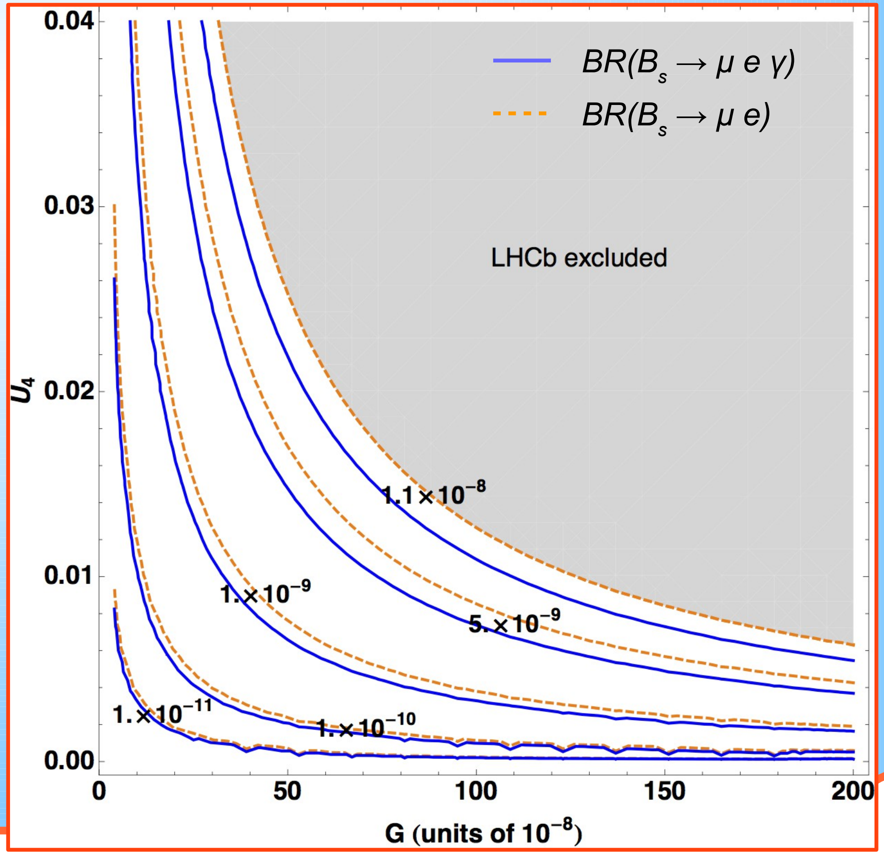
Enhancement by ~ 30%

⇨ *Inclusion of the radiative mode more-than-doubles statistics of the non-radiative*



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  - ***Data vs. theory:*** *Discrepancies go in a consistent direction.*
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- *Early to draw conclusions. But Run II will provide a definite answer*

Conclusions

- *In flavor physics there are by now several persistent discrepancies with respect to the SM.*

  Their most convincing aspects are the following:

  - ***Experiments:*** *Results are consistent between LHCb and B factories.*
  - ***Data:*** *Deviations concern two independent sets of data:* $b \to s$ *and* $b \to c$ *decays.*
  - ***Data vs. theory:*** *Discrepancies go in a consistent direction.*
    A BSM explanation is already possible within an EFT approach.

- *Early to draw conclusions. But Run II will provide a definite answer*

- *Timely to propose further tests. One promising direction is that of LFV.*
  Plenty of channels, many of which largely untested.