Flavor Anomalies
on the Eve of the Run-2 Verdict

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- ***Theory:*** *EFT makes sense rather well of data. But hard to find convincing UV dynamics*

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

  The LHCb can, and will, perform many further tests of the above hints

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- ***BR(B_s → φ μμ)***
- ***Various other examples***

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Due to lack of time I won't say more.
But simultaneous fit to R(D) & R(D*) about 4σ away from SM

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- *R_K and R_{K^*} significance fairly low.*
  Yet interesting that all $b \to s \mu\mu$ modes go in a consistent direction

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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 $C_9^{\text{NP}} \sim -30\% \times C_9^{\text{SM}}$), or by new physics in the $SU(2)_L$ invariant direction $C_9^{\text{NP}} = -C_{10}^{\text{NP}}$, (with $C_9^{\text{NP}} \sim -12\% \times C_9^{\text{SM}}$). 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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  - *So, in general, this rotation induces <u>LUV and LFV</u> effects*

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Up to now: Fermi-like interactions involving SM fields only.
Is there any plausible dynamics generating these interactions?

First obstacle *towards a common explanation of* $b \to s \ell\ell$ *and* $b \to c \tau \nu$ *:*

- ***B → D(*) τ ν :*** *arises at tree level in the SM, and the effect is O(25%)*
  ⇨ *tree-level charged mediators?*
- ***B → K(*)ℓℓ :*** *again 25% effect, but this is a loop effect in the SM*

Second obstacle

- The needed NP is of the kind J_{quark} x J_{lepton}
  Hard to believe that it leaves no traces in J_{quark} x J_{quark} *and* J_{lepton} x J_{lepton} *as well*
  ⇨ Strong constraints from B_s mixing & purely leptonic LFV or LUV decays

Third obstacle

Most (all?) model-building possibilities involve:

- new charged (and possibly colored) states
- with masses in the TeV region and
- with significant couplings to 3rd gen. SM fermions

⇨ *Constraints from direct searches (e.g.* $\to \tau\tau$*) potentially strong*

And yes they are!
See: [Greljo-Isidori-Marzocca]
[Faroughy-Greljo-Kamenik]

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  - ***Define and measure new, clean observables sensitive to C_9 and C_{10}***