Global Fits of Rare $b \to s$ Decay Data

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Why Global Fits

- several decay modes
  (B, B_s, Λ_b, leptonic, semi-leptonic, radiative)
- plethora of observables
  (BR's, angular, CP asymmetries, LFU ratios, ...)
- many (finer and finer) q^2 bins
- measurements from
  LHCb, CMS, Atlas, CDF, BaBar, Belle, soon Belle II

$\Rightarrow$ more than 100 measurements that are sensitive to NP

Many Complementary Approaches

- selection of data:
  - which decay modes are included? (baryons?)
  - which observables are used (optimized or non-optimized?)
  - only low q^2 or also high q^2? narrow charmonium resonances?
  - which type of experimental analysis (likelihood fit or method of moments?)

- SM predictions:
  - which form factors are used (LCSR, lattice, combination?)
  - treatment of non-local effects
  - parametric input (which $|V_{cb}|$ is used?)

Many Complementary Approaches

- different statistical approaches
  ($\Delta\chi^2$, bayesian, frequentist?)

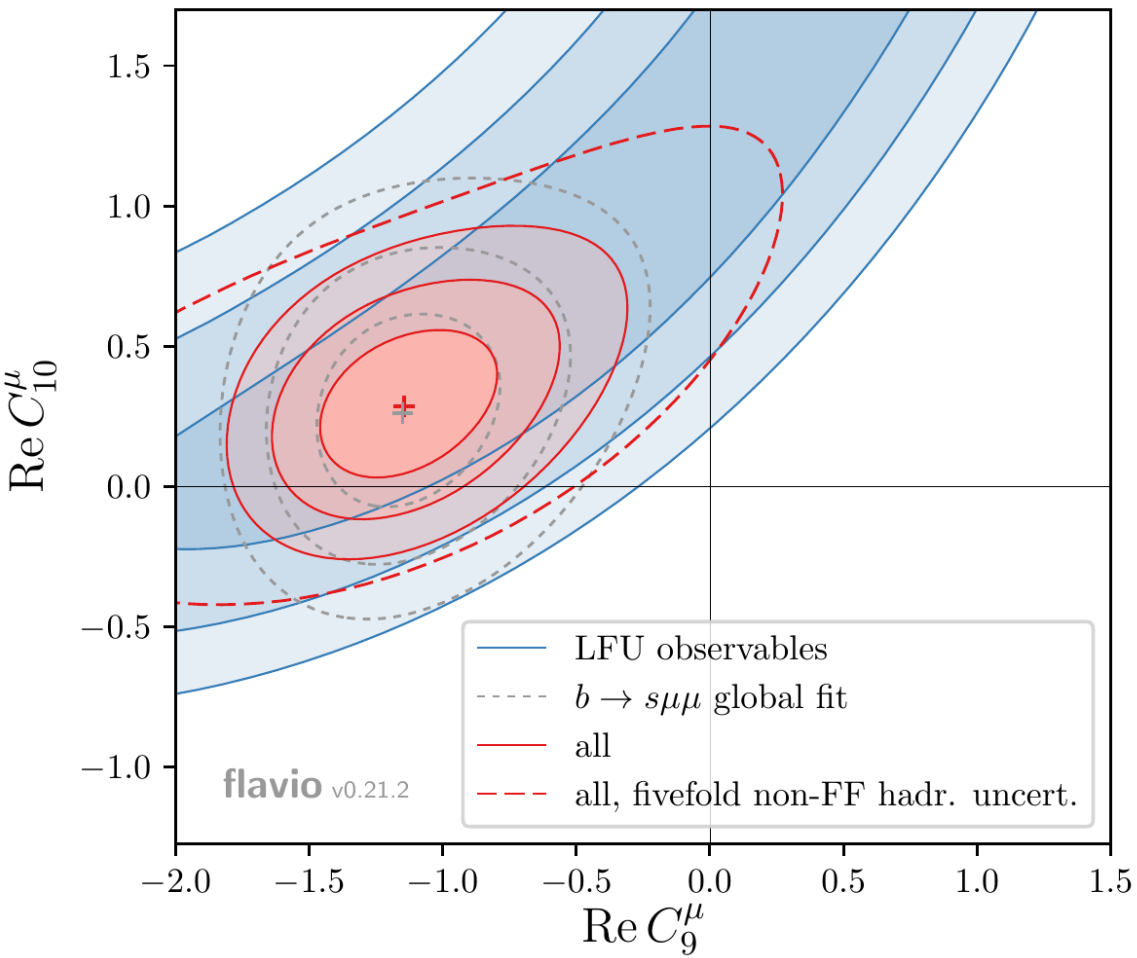
- what is actually fitted?
  - $C_7^{(\prime)}$, $C_9^{(\prime)}$, $C_{10}^{(\prime)}$
    (one at a time? several simultaneous? real or complex?)
  - scalar and tensor operators?

Results

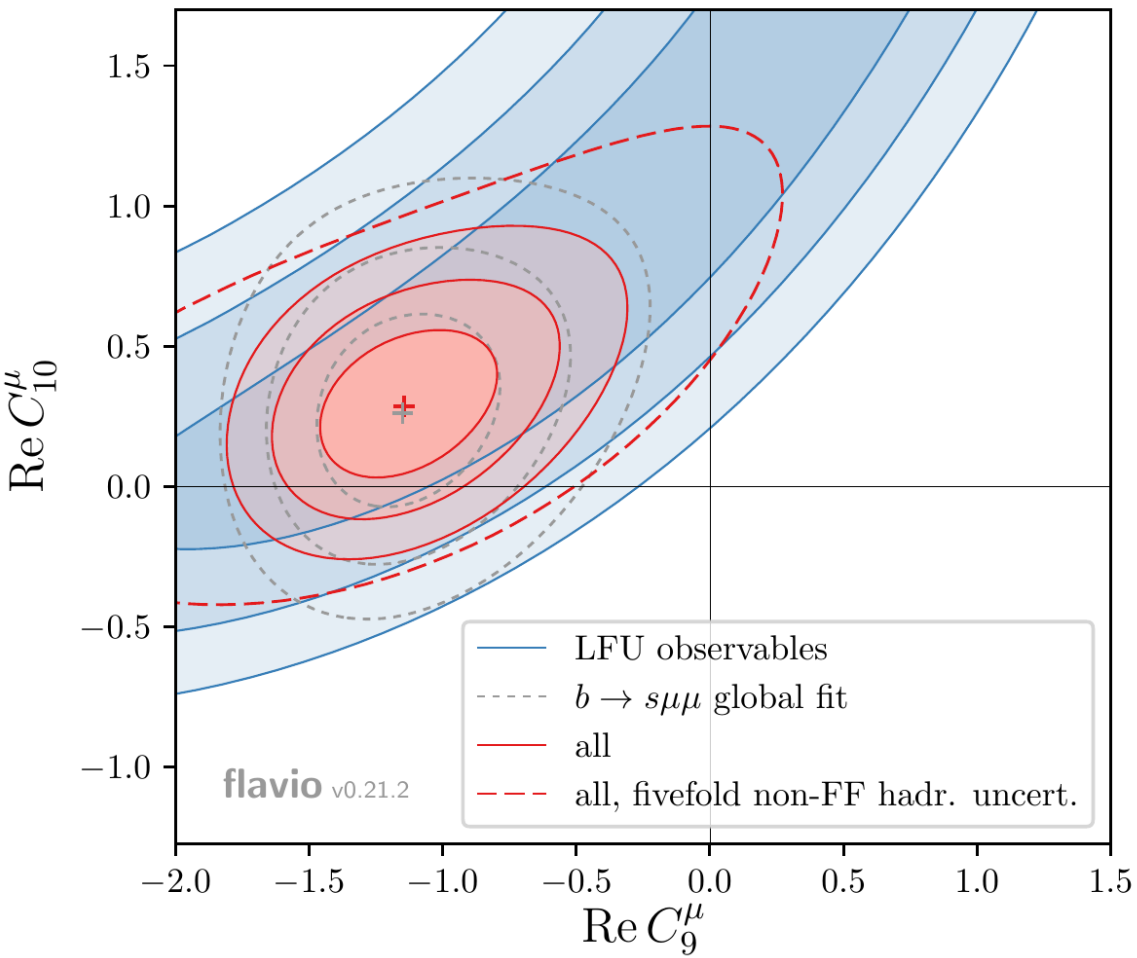
- fit of $\mu^+\mu^-$ data:
  - consensus: $\Delta C_9^\mu \sim -1.5$
  - no consensus: New Physics or Standard Model?

- Lepton Universality ratios:
  - consensus: $\Delta C_9^\mu - \Delta C_{10}^\mu - \Delta C_9^e + \Delta C_{10}^e \sim -1.5$
  - consensus: has to be New Physics

Results


1.5
1.0
0.5
0.0
−0.5
−1.0
−2.0
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
$\mathrm{Re}\, C_{10}^{\mu}$
$\mathrm{Re}\, C_{9}^{\mu}$
LFU observables
$b \to s\mu\mu$ global fit
all
all, fivefold non-FF hadr. uncert.
flavio v0.21.2

Results



our nominal uncertainties + including all data

$\Delta\chi^2 \sim 36$

Statistical Significance

- Disclaimer: I don't know statistics
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- What does $\Delta\chi^2 = 36$ actually mean? 6σ?
- Look elsewhere effect??

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- more difficult to explain where the results come from:
  - our observables are not necessarily intuitive ("What the heck is P_5'?")
  - global fits are to some extent a "black box"
  - can we somehow deconstruct them?