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Short- vs Long-Distance Dynamics in $b \to s\bar{\ell}\ell$ Decays

2401.18007 Bordone, Isidori, Mächler, AT

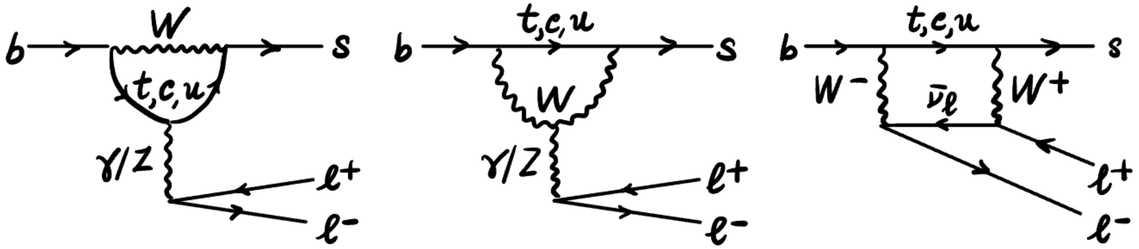
2405.17551 Isidori, Polonsky, AT

2507.17824 Isidori, Polonsky, AT

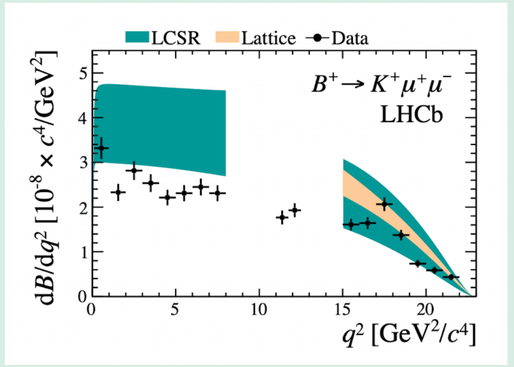
Research interests:

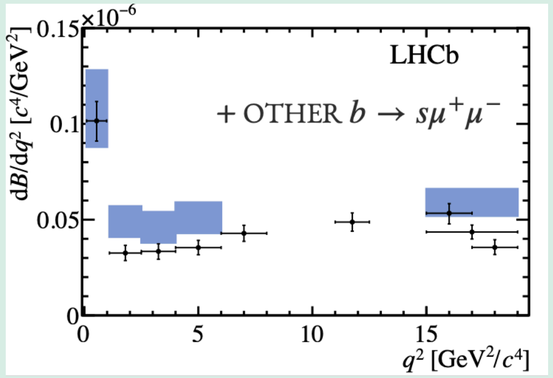
- Flavor Physics
- EFTs for BSM
- BSM Phenomenology

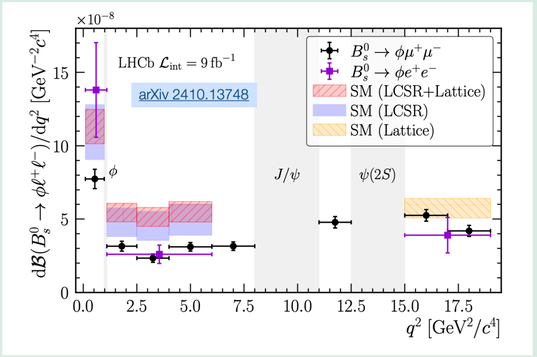
$b \to s\bar{\ell}\ell$: Flavor Changing Neutral Current -> very suppressed in the Standard Model -> very sensitive to New Physics

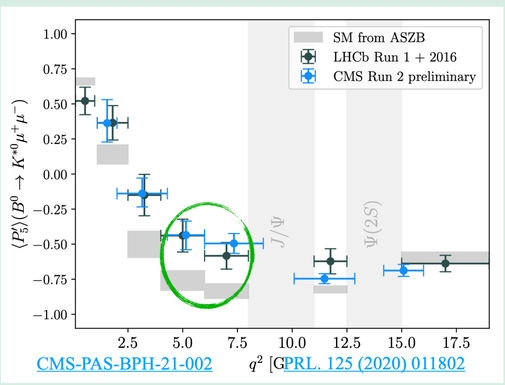


Tension with the experiments ($\sim 2\sigma$):









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Tension with the data → There's something wrong with the SM prediction

Tension with the data → There is some non-standard short dynamics...

Amplitude in the LEFT:

$$\mathcal{A}(B \to M\ell^+\ell^-) = \frac{G_F \alpha V_{ts}^* V_{tb}}{\sqrt{2}\pi}\Big[(C_9\, \ell\gamma^\mu\ell + C_{10}\, \ell\gamma^\mu\gamma_5\ell)\langle M|\bar{s}\gamma_\mu P_L b|\bar{B}\rangle$$

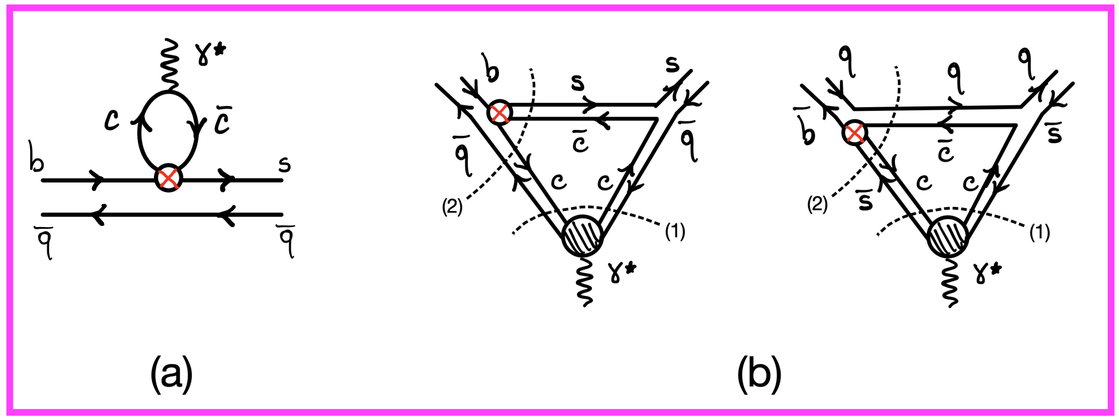
$$-\frac{1}{q^2}\ell\gamma^\mu\ell\ (2im_b C_7\langle M|\bar{s}\sigma_{\mu\nu}q^\nu P_R b|B\rangle + \mathcal{H}_\mu)\Big]$$

LOCAL FORM FACTORS — lattice QCD + light-cone sum rules

$$\mathcal{H}_\mu \propto \bar{\ell}\gamma^\mu\ell \int d^4x e^{iqx}\langle H_\lambda|T\{j_\mu^{\rm em}(x), \sum_{i=1,6} C_i\mathcal{O}_i(0)\}|B\rangle$$

NON-LOCAL FORM FACTORS — generate charm-loop diagrams

[Ciuchini, Fedele, Franco, Paul, Silvestrini, Valli, 2212.10516]



(a) Quite small, especially at low q^2

(b) Hard to apply dispersive methods, possible anomalous threshold... How much do they change the SM contribution?

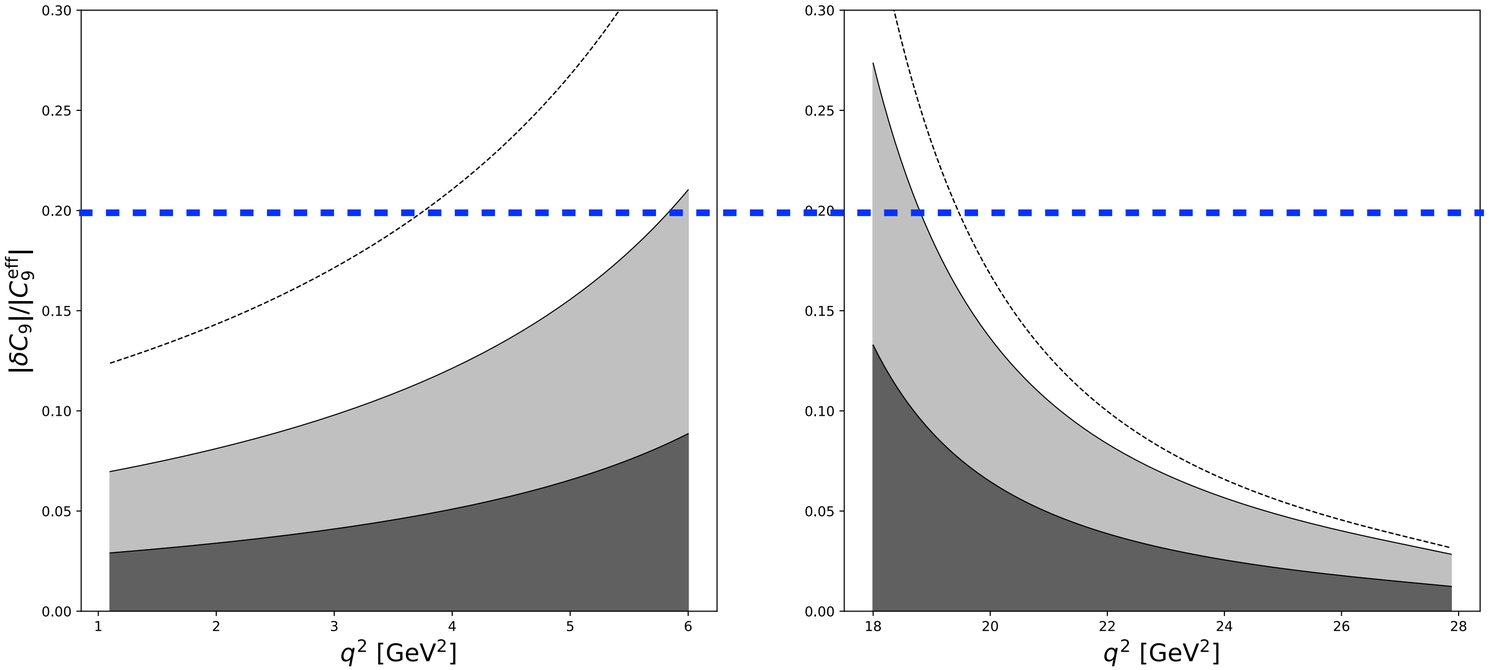
The effect of the non-local form factor can be reabsorbed into C_9: we need $\sim 20\,\%$ shift from the SM value to explain the tension.

We build a model based on:

- Heavy Hadron Chiral Perturbation Theory
- SU(3) light-flavor symmetry
- Heavy-quark spin symmetry
- Extraction of couplings from data on B decays

Electromagnetic monopole/dipole form factors from data to extend the point-like description

Results:



A high level of conspiracy seems to be required to obtain an $\mathcal{O}(20\%)$ shift in C_9 in the whole q^2 range... Can't fully explain the tension... New Physics?

Thank you!