

EPFL Testing Lepton Flavour Universality in $b \rightarrow s \ell \ell$ decays at LHCb

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What is Lepton Flavour Universality (LFU)?

For the Standard Model of particle physics the 3 lepton generations are identical except for their masses. LFU is an "accidental symmetry" of the SM verified e.g. in $\Gamma(B \rightarrow \ell \ell \nu)$ (with a precision $\sim 1\%$)

Standard Model

fermion generations

Standard Model

Why $b \rightarrow s \ell \ell$ decays?

Flavour changing neutral currents are ideal to study LFU

- Very small SM amplitudes (forbidden at tree level), sensitive to new physics contributions
- New particles can enter loops and/or create new diagrams

Why the LHCb detector?

- Single arm forward spectrometer ($2 < \eta < 5$)
- Specialised in precision measurements of decays of particles containing b quarks
- Electron reconstruction more challenging than muons μ
- They can emit bremsstrahlung photons leading to a not trivial energy reconstruction

A specific decay: $B^0 \rightarrow K^* \mu^+ \mu^-$

- R_{K^*} measured as a double ratio, using the resonant high-stat channel $B^0 \rightarrow K^* \mu^+ \mu^-$
- $B^0 \rightarrow K^* \mu^+ \mu^- \rightarrow \mu^+ \mu^-$ does not happen via loop or box diagrams, thus not sensitive to new physics
- R_{K^*} value unaffected, but reduced uncertainties coming from differences in lepton reconstruction

Yields from fits

Fit to the B meson mass shape in the four decay modes

Efficiencies from simulation

How to check if the estimations of the efficiencies are correct?

By computing the single ratio $\epsilon_{\mu\mu} / \epsilon_{ee}$

Simulation does not describe perfectly the detector response in b trigger channels

Several corrections needed to measure as much as possible the ratio

Outlook

Improved dataset allows to measure for the first time $R_{K^*} \rightarrow R_{K^*}(\mu\mu)$ and test LFU in the very high q^2 region

More detailed studies will be possible with the Future Run 3 dataset

$R_{K^*}(\mu\mu)$ value will be known, time to have results soon!

