T 30: Flavor physics: Lepton universality tests II

Time: Tuesday 17:00–18:30 Location: H-HS XIII

T 30.1 Tue 17:00 H-HS XIII

Search for the lepton flavour violating decay $B^0 \to K^{*0} e^\pm \mu^\mp$ with the LHCb detector — •Andreas Güth, Jan-Marc Basels, Christoph Langenbruch, and Stefan Schael — I. Physikalisches Institut B, RWTH Aachen University

The conservation of the individual lepton flavour quantum numbers in interactions involving charged leptons is an important prediction of the Standard Model (SM) of particle physics, making searches for lepton flavour violation (LFV) a promising probe for physics beyond the SM. With its ability for the precise study of the decays of B-mesons, that are copiously produced in proton-proton collisions at the Large Hadron Collider (LHC), the LHCb detector is a powerful tool to search for LFV in $b \to s\ell^\pm\ell'^\mp$ transitions. An additional motivation for such searches arises from recent tensions in tests of lepton universality in rare $b \to s\ell^+\ell^-$ decays, as lepton non-universality generally implies the existence of lepton flavour violating decays.

In this talk, the status of a search for the LFV decay $B^0 \to K^{*0} e^\pm \mu^\mp$ with the LHCb detector is presented, including the analysis strategy, signal selection, and the study of background processes affecting this search.

T 30.2 Tue 17:15 H-HS XIII

Search for the Lepton Flavour Violating decay $B_s^0 \to \phi\mu^\pm e^\mp$ — •Jan-Marc Basels, Andreas Güth, Christoph Langenbruch, and Stefan Schael — I. Physikalisches Institut B, RWTH Aachen

In the Standard Model (SM) of particle physics the conservation of the lepton flavour quantum numbers in interactions involving charged leptons is a fundamental principle. Thus, every discovery of lepton flavour violation (LFV) would simultaneously be a discovery of new physics.

Designed to study heavy flavour decays, the LHCb detector at the LHC at CERN allows for the search of LFV in the decays of B hadrons with unprecedented sensitivity. An additional motivation to explore LFV signatures is given by recent tests of lepton flavour universality (LFU) in B decays, which have shown individual tensions with the SM prediction. These tests studied the branching fraction ratios R_h of rare semi-leptonic B decays, defined as $R_h = \mathcal{B}(B \to h\mu^+\mu^-)/\mathcal{B}(B \to he^+e^-) \overset{\text{SM}}{=} 1$. The flavour-changing neutral-current processes are forbidden at tree-level and can only occur in electroweak loop diagrams, making $b \to s\ell^+\ell^-$ transitions sensitive to contributions from heavy particles beyond the SM. Lepton flavour non-universality would generally imply lepton flavour violation.

This talk presents the status of a search for the lepton flavour violating decay $B_s^0 \to \phi\mu^\pm e^\mp$, based on data taken with the LHCb detector. Particular focus is placed on the study and control of backgrounds, as well as on efficiency estimations from Monte Carlo simulations.

T 30.3 Tue 17:30 H-HS XIII

Search for the rare decays $B_{(s)} \to e^+e^-$ with the LHCb experiment — Johannes Albrecht, •Alexander Battig, Titus Mombächer, and Stefanie Reichert — Experimentelle Physik 5, TU Dortmund

The search for decays of the type $B^0_{(s)} \to l^+l^-$, which are strongly suppressed in the Standard Model, provide an ideal environment for searches for New Physics. Tests of lepton flavour universality ($\mathcal{R}_K$, $\mathcal{R}_{K^*}$) hint at a difference in the bahaviour of muons and electrons. In addition to the measurement of the branching ratio of the decay $B_s^0 \to \mu^+\mu^-$, which has been measured to be compatible with the Standard Model, the decay $B^0_{(s)} \to e^+e^-$ provides an additional stringent test for the Standard Model.

In this talk the search for $B^0_{(s)} \to e^+e^-$ with the LHCb experiment is presented. The analysed data set has been recorded during Run 1 and Run 2 of the LHC and corresponds to an integrated luminosity of $5\,\text{fb}^{-1}$.

T 30.4 Tue 17:45 H-HS XIII

Sensitivity of the analysis of the decays $B^0_{(s)} \to \mu^+\mu^-$ with the full dataset of the LHCb experiment — Johannes Albrecht, Maik Becker, and •Titus Mombächer — Experimentelle Phyik 5, TU Dortmund

The successful observation of the decay $B_s^0 \to \mu^+\mu^-$ by a single experiment was achieved by the LHCb collaboration using a dataset corresponding to 4.4fb^{-1}. It confirmed once more the predictions of the Standard Model and strongly constrained models for mechanisms beyond the Standard Model. However, the measurement is still statistically limited with a precision of 22 %. Also the decay $B_d^0 \to \mu^+\mu^-$ could not be measured yet.

This talk presents studies for the sensitivity to measure the decays $B_s^0 \to \mu^+\mu^-$ and $B_d^0 \to \mu^+\mu^-$ on the full Run 1 and Run 2 dataset recorded by the LHCb experiment corresponding to $9\,\text{fb}^{-1}$.

T 30.5 Tue 18:00 H-HS XIII

Analysis of $B^0_{s,d} \to \mu^+\mu^-$ decays with the full LHCb dataset — Johannes Albrecht, •Maik Becker, and Titus Mombächer — Experimentelle Physik 5, TU Dortmund

The first observation of the decay $B_s^0 \to \mu^+\mu^-$ with a single experiment was reported by the LHCb collaboration in 2017 with a significance of 7.8σ using data corresponding to 4.4 fb^{-1} of integrated luminosity. The measurement demonstrated the excellent sensitivity of the LHCb experiment in this channel, but no deviations from the Standard Model predictions were found, introducing strong constraints to New Physics models. Since the uncertainty on the result is driven by statistical limitations, an analysis with a larger dataset and improved methods is performed, which may also allow for the first observation of the decay $B_d^0 \to \mu^+\mu^-$.

In this talk the ongoing measurement of $B^0_{s,d} \to \mu^+\mu^-$ with the full LHCb dataset corresponding to 9 fb^{-1} will be presented. A focus is set on efficiencies and data-based validations.

T 30.6 Tue 18:15 H-HS XIII

Search for $B^+ \to K^+\nu\bar{\nu}$ at Belle and Belle II. — •Filippo Dattola for the Belle II-Collaboration — DESY, Hamburg, Germany

We present the status of our analysis on the rare exclusive decay $B^+ \to K^+\nu\bar{\nu}$, performed on the full Belle dataset and on the Belle II data so far collected.

Prohibited at the tree level in the Standard Model, and suffering only from hadronic form factors uncertainties, the channel is theoretically clean, and stands as an optimal probe to test possible contributions of new mediators.

The specific conditions of the experiment, such as a clean environment and a well defined initial state, strongly support the search for such decay with missing energy in its final state. Previous experimental studies by Belle and BaBar, both adopting a specific tagging for the accompanying B meson, did not led to signal evidence but only managed to put upper limits on the branching fraction. In our analysis, we use an alternative technique based on inclusive tagging aimed at improving what achieved so far.