T 4: Flavour Physics 2

Time: Monday 16:15–18:00 Location: T-H17

T 4.1 Mon 16:15 T-H17

Testing Lepton Flavour Universality with $B_s^0 \to \phi\ell^+\ell^-$ decays using LHCb data — Christoph Langenbruch[1], Stefan Schael[1], •Sebastian Schmitt[1], and Eluned Smith[2] — [1]I. Phys. Inst. B - RWTH Aachen — [2]University of Zürich

In the Standard Model of Particle Physics (SM), $b \to s\ell^+\ell^-$ transitions are forbidden at tree-level and may only occur at the loop-level. The branching fractions of these so-called Flavour Changing Neutral Currents (FCNCs) can thus be significantly affected by New Physics (NP) beyond the SM. While in the SM, the coupling of the electroweak gauge-bosons is Lepton Flavour Universal (LFU), this universality can be broken in NP scenarios. Ratios of branching fractions of semileptonic rare decays with muons and electrons in the final state constitute clean SM tests. Recent measurements of LFU ratios have shown tensions of up to $3.1\,\sigma$.

The LHCb detector is located at the Large Hadron Collider (LHC) at CERN and is optimised to study rare b-hadron decays. For this purpose LHCb features high trigger efficiencies, excellent track reconstruction, and particle identification.

This talk gives an overview of the measurement of R_ϕ, which benefits from the experimentally clean $B_s^0 \to \phi\ell^+\ell^-$ environment. The analysis uses the full Run 1 and Run 2 dataset collected by LHCb which corresponds to $9\,\text{fb}^{-1}$ of integrated luminosity.

T 4.2 Mon 16:30 T-H17

Search for the lepton flavour violating decays $B^0 \to K^*(892)^0\mu^\pm e^\mp$ and $B_s^0 \to \phi(1020)\mu^\pm e^\mp$ with the LHCb experiment — •Jan-Marc Basels, Andreas Güth, and Christoph Langenbruch — I. Physikalisches Institut B, RWTH Aachen University

The conservation of lepton flavour in interactions involving charged leptons is a central property of the Standard Model (SM). Thus, every discovery of lepton flavour violation (LFV) would simultaneously be a discovery of new physics.
Designed to study the decays of heavy flavour hadrons, the LHCb detector at the Large Hadron Collider (LHC) at CERN allows for the search for LFV in $b \to s\ell^+\ell'^-$ transitions of B-mesons with unprecedented sensitivity. An additional motivation for such searches arises by recent tests of lepton flavour universality in rare $b \to s\ell^+\ell^-$ decays, which have shown tensions with the SM prediction. Any discovery of lepton flavour non-universality would generally imply the existence of LFV decays.
This talk presents the status of a search for the LFV decays $B^0 \to K^*(892)^0\mu^\pm e^\mp$ and $B_s^0 \to \phi(1020)\mu^\pm e^\mp$, based on a dataset taken with the LHCb detector during Run 1 and Run 2 of the LHC that corresponds to an integrated luminosity of $9\,\text{fb}^{-1}$. Particular focus is placed on the study and control of backgrounds and the determination of expected upper limits on the signal branching fraction.

T 4.3 Mon 16:45 T-H17

Search for the lepton flavour violating decays $B^+ \to K^+e^\pm\mu^\mp$ with the full dataset of the LHCb experiment — Johannes Albrecht, •Alexander Battig, and Elena Dall'Occo — Technische Universität Dortmund

The conservation of lepton flavour in interactions of charged leptons is an important prediction of the Standard Model of particle physics, making searches for lepton flavour violating decays of B mesons an interesting probe for New Physics. In addition, hints of lepton non-universality in $b \to sll$ transitions (measurements of R_{K^+}, $R_{K^{*0}}$) imply the violation of lepton flavour conservation. Due to the abundance of produced B-mesons and ability to precisely study them, the LHCb experiment provides an ideal environment for searches for lepton flavour violating decays of B-mesons.

In this talk, the search for the lepton flavour violating decays $B^+ \to K^+e^\pm\mu^\mp$ with the LHCb experiment is presented. The analysed data has been recorded during Run 1 and Run 2 of the LHC and corresponds to an integrated luminosity of $9.1\,\text{fb}^{-1}$.

T 4.4 Mon 17:00 T-H17

Test of Lepton Flavour Universality (LFU) in $\Lambda_b \to \Lambda\ell\ell$ with the LHCb experiment — Flavio Archilli[1], Simone Bifani[2], Vlad Dedu[3], Lex Greeven[3], Sietske Keijzer[3], Mick Mulder[4], Niladri Sahoo[2], Marco Santimaria[5], Silvia Sole[3], Paul Swallow[2], Niels Tuning[3], Maarten Veghel[3], •Chishuai Wang[1], and Nigel Watson[2] — [1]Physikalisches Institut, Heidelberg, Germany — [2]University of Birmingham, UK — [3]Nikhef, Netherlands — [4]University of Groningen, Netherlands — [5]INFN, Frascati, Italy

The Flavour Changing Neutral Current (FCNC) transition $b \to s\ell\ell$ is highly suppressed in the Standard Model (SM), which makes it susceptible to the impact of possible New Physics (NP).

In the SM, the electroweak interaction does not distinguish between the three generations of leptons. However, several recent studies of LFU using $b \to s\ell\ell$ processes, e.g. $R_K = \frac{\mathcal{B}(B^+\to K^+\mu\mu)}{\mathcal{B}(B^+\to K^+ee)}$ and $R_{K^{*0}} = \frac{\mathcal{B}(B^0\to K^{*0}\mu\mu)}{\mathcal{B}(B^0\to K^{*0}ee)}$ measurements, have shown deviations from the SM expectations.These ratios have the advantage that theoretical uncertainties from the hadronization cancel, which makes them relatively clean observables. For the $\Lambda_b \to \Lambda\ell\ell$ system, a similar observable $R_\Lambda = \frac{\mathcal{B}(\Lambda_b\to\Lambda\mu\mu)}{\mathcal{B}(\Lambda_b\to\Lambda ee)}$ can be defined. The measurement of R_Λ will provide an independent test with respect to the tests of LFU performed with the B-mesons.

This talk will present the ongoing study of the R_Λ measurement at LHCb, using the data collected by the LHCb experiment during the years 2011-2012 and 2015-2018.

T 4.5 Mon 17:15 T-H17

Search for lepton flavour violation in four-body charm decays at LHCb — •Daniel Unverzagt — Physikalisches Institut, Heidelberg, Germany

LHCb is playing a leading role in the study of rare and forbidden decays of charm hadrons, which might reveal effects beyond the Standard Model. This talk aims in particular to motivate the search for lepton flavour violation in four-body charm decays. In addition an overview about the current status of an analysis studying neutral charm hadrons decaying to two hadrons and an electron and muon, $D^0 \to hh\mu e$ with $h = \pi^\pm, K^\pm$, is provided.

T 4.6 Mon 17:30 T-H17

Angular analysis of $B^0 \to K^*e^+e^-$ decays — Martino Borsato, Fabian Glaser, and •Jiangqiao Hu — Physikalisches Institut - Universität Heidelberg

Over the last decade, the LHCb detector at the Large Hadron Collider (LHC) collected the world largest sample of beauty hadron decays. This dataset allowed to study rare transitions of a b quark into an s quark and a pair of charged leptons ($b \to s\ell\ell$) with unprecedented precision and unearthed a series of anomalies that could be a sign of dynamics beyond the Standard Model. Namely, the angular distributions of $b \to s\mu\mu$ decays do not agree with theoretical predictions and their rate is lower than that observed in $b \to see$ decays, in contrast to the expectation dictated by the SM symmetry of lepton universality. A key measurement to solve this puzzle is the angular analysis of $B^0 \to K^*e^+e^-$ decays. In this talk I will present my contribution to this analysis, focusing on the difficult kinematic region of high dielectron invariant mass. Advanced analysis techniques are used to classify signal candidates, characterise background contributions and measure the angular properties of the decay.

T 4.7 Mon 17:45 T-H17

Angular analysis of the decay $B^0 \to K^{*0}\mu^+\mu^-$ — Leon Carus[1], Christoph Langenbruch[1], •Thomas Oeser[1], and Eluned Smith[2] — [1]I. Physikalisches Institut B, RWTH Aachen University — [2]Physik-Institut, University of Zurich

Recently, several tensions between measurements and Standard Model predictions emerged in the area of $b \to s\ell\ell$ decays in measurements of branching fractions, angular observables, and tests of lepton universality. Additional experimental information, such as angular observables determined from the angular distribution of $b \to s\ell\ell$ decays, can provide deeper insight into the nature of potential New Physics contributions.

A previous measurement of the angular distribution of $B^0 \to K^{*0}(\to K^+\pi^-)\mu^+\mu^-$ decays, performed by the LHCb collaboration using data collected during Run 1 and 2016, found tensions with Standard Model predictions at the level of 3 standard deviations.

This talk will present an overview of the update of this analysis, including LHCb data collected in 2017 and 2018.