T 102: Flavour physics 4

Time: Thursday 16:00–18:00 Location: Geb. 30.41: HS 4

T 102.1 Thu 16:00 Geb. 30.41: HS 4

Isospin asymmetry in $B \to K\mu^+\mu^-$ decays — Johannes Albrecht[1], •Fabio De Vellis[1], Cristoph Langenbruch[2], Vitalii Lisovskyi[3], Biljana Mitreska[1], Thomas Oeser[4], and Stefan Schael[4] — [1]TU Dortmund University, Dortmund, Germany — [2]Heidelberg University, Heidelberg, Germany — [3]EPFL, Lausanne, Switzerland — [4]RWTH Aachen University, Aachen, Germany

Symmetries in the Standard Model come from very fundamental aspects of the theory, and tests of them play a determinant role in the understanding of the whole picture of elementary particles. Isospin symmetry predicts a branching fraction that is almost the same for decays which differ only by one spectator quark, like $B^0 \to K^0\mu^+\mu^-$ and $B^+ \to K^+\mu^+\mu^-$. For these decays, a quantity which describes differences in branching fraction, namely the asymmetry, can be defined. This is particularly convenient since it is theoretically clean and it allows canceling some experimental uncertainties.

Previous measurements on these decays from LHCb and Belle, despite being compatible with Standard Model expectations, suggested coherent deviations that could be interpreted as statistical fluctuations, or unaccounted theoretical uncertainties, or as a sign of New Physics.

In this talk an update of the asymmetry measurement on data collected at LHCb and corresponding to an integrated luminosity of 9 fb^{-1} is presented.

T 102.2 Thu 16:15 Geb. 30.41: HS 4

Measurement of the isospin asymmetry in $B \to K^*\mu^+\mu^-$ decays with LHCb — Johannes Albrecht[1], Fabio De Vellis[1], Christoph Langenbruch[2], Vitalii Lisovskyi[3], Biljana Mitreska[1], •Thomas Oeser[4], and Stefan Schael[4] — [1]Technische Universität Dortmund — [2]Universität Heidelberg — [3]EPFL — [4]RWTH Aachen

Precision measurements of rare $b \to s\ell\ell$ transitions, which are forbidden at tree level in the Standard Model (SM) and can only occur via loop-level and higher-order processes, constitute clean tests of the SM, sensitive to various potential New Physics contributions.

The isospin asymmetry $\mathcal{A}_I$ between $B^0 \to K^{*0}\mu^+\mu^-$ and $B^+ \to K^{*+}\mu^+\mu^-$ has a very clean SM prediction as many hadronic uncertainties cancel in the calculation. Previous measurements are in agreement with this prediction, within still large uncertainties.

This talk presents an overview of the analysis of the isospin asymmetry in $B \to K^*\mu^+\mu^-$ and the differential branching fraction of $B^+ \to K^{*+}\mu^+\mu^-$ using the full LHCb Run 1 and Run 2 dataset, recorded between 2011 and 2018 and corresponding to an integrated luminosity of approximately 9fb^{-1}.

T 102.3 Thu 16:30 Geb. 30.41: HS 4

Search for $B^+ \to K^{*+}\tau\tau$ with Hadronic Tagging at Belle II — •Lennard Damer, Torben Ferber, and Pablo Goldenzweig — Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology (KIT)

In recent years, intriguing hints for violation of lepton flavor universality have been accumulated in semileptonic B decays with the help of multiple experiments.

The flavor-changing neutral current process $b \to s\,\tau^+\tau^-$ is particularly sensitive to New Physics models which only couple to the third generation, or with couplings proportional to the particle mass. Some theoretical models allow for an increase in the branching fraction of up to three orders of magnitude compared to the Standard Model prediction, which is within the observable experimental range of the Belle II experiment.

This talk presents the status of the first search for $B^+ \to K^{*+}\tau\tau$ decays, where hadronic tagging is employed. By this, the corresponding B meson partner in $\Upsilon(4S)$ decays is reconstructed in a variety of hadronic decay chains to increase the selection purity.

T 102.4 Thu 16:45 Geb. 30.41: HS 4

Studies of angular and CP asymmetries in $D^+_{(s)} \to h^+\mu^+\mu^-$ decays at LHCb — Dominik Mitzel, Serena Maccolini, and •Luca Toscano — TU Dortmund University, Dortmund, Germany

The LHCb experiment has recorded the world's largest sample of charm hadron decays and takes a leading role in measurements of rare decays and searches for CP violation.

Rare semi-leptonic charm decays such as $D^+ \to \pi^+\mu^+\mu^-$ and $D_s^+ \to K^+\mu^+\mu^-$ are sensitive to beyond-standard-model effects in flavour-changing neutral current $c \to u\mu^+\mu^-$ transitions. Observables such as angular and CP asymmetries, can be defined to test the Standard Model. Null tests on these observables are performed in the vicinity of intermediate hadronic resonances, where new physics signals can be enhanced.

In this talk, the first study of angular distributions and CP asymmetries in $D^+_{(s)} \to h^+\mu^+\mu^-$ decays is presented. The analysis uses data collected by the LHCb detector from 2015 to 2018 at a centre-of-mass energy of 13 TeV, corresponding to an integrated luminosity of 6fb^{-1}. The preliminary results are showed.

T 102.5 Thu 17:00 Geb. 30.41: HS 4

Studies of resonance-enhanced angular and CP asymmetries in $\Lambda_c^+ \to p\mu^+\mu^-$ decays — •Marco Colonna, Serena Maccolini, and Dominik Mitzel — TU Dortmund University, Dortmund, Germany

The LHCb experiment has collected the largest sample of charm hadron decays, being a leader experiment in studying rare decays and investigating CP violation.

Suppressed semi-leptonic decays of charm baryons, like $\Lambda_c^+ \to p\mu^+\mu^-$, may shed a light on beyond-standard-model effects appearing in $c \to u\mu^+\mu^-$ transitions. Performing measurements of null test observables, like angular and CP asymmetries in the phase space regions where the physics signal is enhanced by the contribution of intermediate hadronic resonaces, allows to scrutinize the prediction of the Standard Model.

The talk presents the analysis and the methods applied to measure for the first time the CP and angular asymmetries of the $\Lambda_c^+ \to p\mu^+\mu^-$ decay in the phase space region dominated by the ϕ resonance contribution. The analysis uses data collected by the LHCb detector from 2016 to 2018 at a centre-of-mass energy of 13 TeV, corresponding to an integrated luminosity of 6fb^{-1}.

T 102.6 Thu 17:15 Geb. 30.41: HS 4

Measurement of $\mathcal{R}(D)$ and $\mathcal{R}(D^*)$ with semileptonic tagging at Belle II — Florian Bernlochner, Jochen Dingfelder, Peter Lewis, and •Alina Manthei — Physikalisches Institut der Rheinischen Friedrich-Wilhelms-Universität Bonn

The Belle II experiment at the SuperKEKB asymmetric-energy collider, where electrons and positrons are collided at the $\Upsilon(4S)$ resonance, is able to collect a large number of events with $B\overline{B}$ pairs. The analysis of semitauonic decays of these B mesons allows for tests of lepton flavour universality.Existing experimental results on the ratios of the branching fractions $\mathcal{R}(D) = \mathcal{B}(\overline{B} \to D\tau^-\overline{\nu})/\mathcal{B}(\overline{B} \to D\ell^-\overline{\nu})$ and $\mathcal{R}(D^*) = \mathcal{B}(\overline{B} \to D^*\tau^-\overline{\nu})/\mathcal{B}(B^* \to D\ell^-\nu^-)$, where ℓ denotes an electron or muon, are in tension with the Standard Model (SM) predictions, which might hint at physics beyond the SM, such as the presence of charged Higgs bosons or leptoquarks. A combined analysis of $\mathcal{R}(D)$ and $\mathcal{R}(D^*)$ with measurements from Belle, BaBar and LHCb yields a divergence from the SM prediction by $> 3\sigma$, where σ indicates the standard deviation. Thus, further investigations of these decays with the recently collected data by Belle II are necessary. In order to measure the semitauonic B decay as exact as possible, a reconstruction of the respective other B meson in the event in semileptonic modes is performed, a technique known as tagging. In this talk, a signal extraction strategy for such a measurement of $\mathcal{R}(D^{(*)})$ using these data will be outlined and its results will be presented.

T 102.7 Thu 17:30 Geb. 30.41: HS 4

Improving $\text{R}(\text{D}^{(*)})$ with hadronic FEI and leptonic tau decays with Belle II Run 1 data. — •Agrim Aggarwal, Florian Bernlochner, Jochen Dingfelder, and Markus Prim — Physikalisches Institut der Rheinischen Friedrich-Wilhelms-Universität Bonn

In the Standard Model (SM) of particle physics, the W boson couples identically to the three lepton flavors. This concept is known as Lepton Flavor Universality (LFU). In extensions of the SM, additional particles, which couple to the $b - c - \tau - \nu_\tau$ vertex, are able to modify the coupling to the three lepton flavors. At Belle II, this can be studied using $B \to D^{(*)}\tau\bar{\nu}_\tau$ decays and by probing ratios of the form $\text{R}(D^*) = \mathcal{B}(B \to D^{(*)}\tau\bar{\nu}_\tau)/\mathcal{B}(B \to D^{(*)}\ell\bar{\nu}_\ell)$. We present the current

status of an improved analysis strategy to determine R(D^*) using 364 fb^{-1} of integrated luminosity of Run 1 collision data of the Belle II experiment.

T 102.8 Thu 17:45 Geb. 30.41: HS 4

Measurement of the branching ratio and q^2-spectrum of $B \to D^{**}\ell\nu$ decays at Belle II — •Eylül Ünlü, Thomas Lück, and Thomas Kuhr — Ludwig-Maximilians-Universität München

There is currently some tension between the measured value of $R(D^*) = \mathcal{B}(B \to D^*\tau\nu_\tau)/\mathcal{B}(B \to D^*\ell\nu_\ell)$ and the Standard Model prediction, hinting at lepton universality violation. Semileptonic B meson decays to D^{**} mesons are background to the $R(D^*)$ measurement, where D^{**} denotes the orbitally excited P-wave charm mesons: $D_1(2420)$, $D_2^*(2460)$, $D_0^*(2300)$, and $D_1^{'}(2430)$. These decays are not well understood, and there are discrepancies between past measurements of their yields by BaBar and Belle. Hence, improved understanding of these decays would reduce the systematic uncertainty on $R(D^*)$ measurements.

The aim of the present study is to use simulation and data from the Belle II experiment to study these decays, in particular to determine the q^2 spectrum, which is a key input for theory.

We reconstruct one of the B mesons from the $\Upsilon(4S) \to BB$ decay in the signal channel, $B \to D^{**}(D^*\pi)\ell\nu$. The other B meson is reconstructed in hadronic decay channels using the Full Event Interpretation algorithm, which provides a tag B sample with well determined kinematics. The signal yield is obtained by a fit to the mass difference $M(D^*\pi) - M(D^*)$. The resulting q^2 spectrum is fitted by a differential decay rate model after correcting for detector resolution effects.

The current status of the analysis will be presented including results on simulation and some sources of systematic uncertainty.