T 63: Flavorphysik II

Zeit: Mittwoch 16:00–18:30 | Raum: S15

T 63.1 Mi 16:00 S15

Measurement of the ratio $R_{K^{*0}}$ using Run 1 + 2 data of the LHCb experiment — •Stephan Escher, Sarah Beranek, Christoph Langenbruch, Stefan Schael, and Eluned Smith — RWTH Aachen, Germany

In the Standard Model (SM) of particle physics flavour-changing neutral-current processes are forbidden at tree-level and can only occur in electroweak loop diagrams. Therefore, $b \to s$ transitions are rare and sensitive to heavy particles beyond the SM. In this theory the coupling of gauge bosons to leptons are independent of their flavour, which is known as lepton flavour universality (LFU). Thus, the $R_{K^{*0}}$ ratio, defined as $R_{K^{*0}} = \mathcal{B}(B^0 \to K^{*0}\mu^+\mu^-)/\mathcal{B}(B^0 \to K^{*0}e^+e^-)$, is predicted to be unity in the SM (neglecting lepton mass effects). The existence of new particles, that couple differently to electrons and muons, could influence the $R_{K^{*0}}$ ratio significantly and lead to deviations from unity.

To this date, the most precise measurement of $R_{K^{*0}}$ is performed by the LHCb collaboration using Run 1 data showing a deviation of $2.4 - 2.5$ standard deviations (σ) from the SM expectations.

This talk will present the strategy of the analysis using the combined Run 1 and 2 LHCb data sample, which will allow for a more precise determination of $R_{K^{*0}}$. Particular emphasis will be on the study and control of backgrounds.

T 63.2 Mi 16:15 S15

Probing lepton flavour universality with $R_{K\pi\pi}$: Studies of the decay $B^+ \to K^+\pi^+\pi^-e^+e^-$ with the LHCb experiment — Johannes Albrecht, •Maik Becker, Stefanie Reichert, and Tobias Tekampe — Experimentelle Physik 5, TU Dortmund

The Standard Model of particle physics predicts universal couplings of gauge bosons to leptons, which can be tested by measuring the ratio of branching fractions of $b \to s\ell^+\ell^-$ decays with equal hadronic and different leptonic components in the final state. Results of recent measurements of this kind like R_K or R_{K^*} show tensions with the Standard Model predictions.

The observable $R_{K\pi\pi}$, defined as the ratio of the branching fractions of the decays $B^+ \to K^+\pi^+\pi^-e^+e^-$ and $B^+ \to K^+\pi^+\pi^-\mu^+\mu^-$, is explored as a similar but fully independent probe.

In this talk the ongoing measurement of $R_{K\pi\pi}$ will be presented. A focus is set on studies of the final state with electrons.

T 63.3 Mi 16:30 S15

Test of lepton flavour universality using the branching fraction ratio R_ϕ — •Simon Nieswand, Sarah Beranek, Christoph Langenbruch, Stefan Schael, and Eluned Smith — I. Physikalisches Institut, RWTH Aachen University

The LHCb detector at the LHC is designed for the search for New Physics (NP) beyond the Standard Model (SM) in heavy flavour decays. Particularly interesting are rare decays of b-hadrons that proceed via $b \to s$ transitions. In the SM, these flavour changing neutral currents are forbidden at tree-level. They can only occur at loop-level and can be influenced by heavy non-SM particles. Therefore, the branching fractions of decays like $B_s^0 \to \phi\ell^+\ell^-$ are sensitive probes for NP.

Especially clean theory predictions are available for the ratios of rare semileptonic $b \to s$ decays with muons and electrons in the final state. Due to lepton universality, these ratios should be close to unity in the SM. The LHCb collaboration observed interesting tensions with the SM predictions for the ratios R_{K^*} and R_K corresponding to $2.4 - 2.5$ and 2.6 standard deviations (σ), respectively. Therefore, it is interesting to study further rare B decays for a similar behavior.

In this talk the analysis strategy to measure the branching fraction ratio $R_\phi = \mathcal{B}\left(B_s^0 \to \phi\mu^+\mu^-\right)/\mathcal{B}\left(B_s^0 \to \phi e^+e^-\right)$ and the current status of the on-going analysis of the combined Run 1 and Run 2 LHCb data sample will be presented.

T 63.4 Mi 16:45 S15

Measurement of the branching fraction of $B \to D^{**}(D^{(*)}\pi^0)\ell\nu$ in the context of a $R(D^{(*)})$ analysis at the Belle experiment — Florian Bernlochner, Pablo Goldenzweig, Felix Metzner, and •Maximilian Welsch — ETP, KIT, Karlsruhe

The observed ratios of semi-tauonic decays involving D and D^* mesons, $R(D^{(*)})$, are in strong tension with the Standard Model expectation. Recent measurements point to a deviation of about four standard deviations. One of the main backgrounds in the experimental determination are processes from $B \to D^{**}(D^{(*)}\pi^0)\ell\nu$, where D^{**} denotes one of the four 1P excited D meson states. In this work, a direct measurement of these channels is carried out and this talk presents the current status of measuring $\mathcal{B}(B \to D^{**}(D^{(*)}\pi^0)\ell\nu)$ using the full Belle dataset of 772 million $B\bar{B}$ pairs and a novel hadronic tagging method.

T 63.5 Mi 17:00 S15

Measurement of $B \to D^{(*)}\tau\nu$ via the ratios $R(D^{(*)})$ at Belle and under utilisation of the Belle II software — Florian Bernlochner, Michael Feindt, Pablo Goldenzweig, •Felix Metzner, and Maximilian Welsch — ETP, KIT, Karlsruhe

The discrepancy observed for the ratios $R(D^{(*)})$ of the decays $B \to D^{(*)}\tau\nu$ relative to the light lepton modes $B \to D^{(*)}\ell\nu$ ($\ell = e, \mu$) between the experimental results and the Standard Model predictions is one of the persistent flavour anomalies with a significance of four standard deviations. The new Belle II software framework and the therein included conversion tool B2BII allows to reevaluate the Belle data set of 772 million B$\bar{\text{B}}$-pairs recorded from 1999 until 2010 using the improved algorithms of the modern framework. With this approach a new measurement of the ratios $R(D^{(*)})$ with an improved hadronic tagging algorithm — the Full Event Interpretation — is carried out. Profiting from the higher reconstruction efficiency, due to the new tagging algorithm, this analysis aims to provide new insights into these semileptonic B-decays.

In this talk, the procedure and the current status of the analysis will be presented.

T 63.6 Mi 17:15 S15

Search for $B_s^0 \to \psi(2S)K_S^0$ decays at the LHCb experiment — Vukan Jevtic, •Jasper Lammering, and Patrick Mackowiak — Experimentelle Physik 5, TU Dortmund

The decay $B_s^0 \to \psi(2S)K_S^0$ has not been observed yet but is predicted by the Standard Model. In a previous analysis, where CP-violation was measured in $B^0 \to \psi(2S)K_S^0$, performed by LHCb using the Run I dataset, a hint for the B_s decay has been seen. Therefore the observation is expected by analyzing more data and developing a specialized selection for such decays. In order to cancel systematic uncertainties, the ratio of branching fractions $\mathcal{B}(B_s^0 \to \psi(2S)K_S^0)/\mathcal{B}(B^0 \to \psi(2S)K_S^0)$ is measured. In this talk, the current status of the analysis using the complete LHCb dataset corresponding to an integrated luminosity of 9 fb^{-1} is presented.

T 63.7 Mi 17:30 S15

Measurement of the ratio of branching fractions of the decays $\Lambda_b^0 \to \psi(2S)\Lambda^0$ and $\Lambda_b^0 \to J/\psi\Lambda^0$ at LHCb — •Patrick Mackowiak — Experimentelle Physik 5, TU Dortmund

The aim of this analysis is the measurement of the ratio of branching fractions $\text{Br}(\Lambda_b^0 \to \psi(2S)\Lambda^0)/\text{Br}(\Lambda_b^0 \to J/\psi\Lambda^0)$, where the decay of the Λ_b^0 is reconstructed through the decays of $\psi(2S) \to \mu\mu$ or $J/\psi \to \mu\mu$ and $\Lambda^0 \to p\pi$. A measurement of the ATLAS collaboration of this ratio shows a deviation to a theory prediction and similar ratios from the b meson sector. Using data from the LHCb experiment, a more sensitive result is expected. By measuring the ratio of branching fractions, systematic uncertainties, uncertainties from the measured luminosity, and from fragmentation effects cancel.

The talk will cover the current status of the analysis using the Run I dataset of the LHCb experiment, which corresponds to an integrated luminosity of 3 fb^{-1}.

T 63.8 Mi 17:45 S15

Search for the decay $B_s^0 \to D^{*+}D^{*-}$ with the LHCb experiment — Kevin Heinicke, Philipp Ibis, •Jan Langer, Antje Mödden, and Margarete Schellenberg — Experimentelle Physik 5, TU Dortmund

The LHCb experiment is dedicated to search for New Physics beyond the Standard Model through precision measurements of B-meson decays. This analysis aims to observe the decay $B_s^0 \to D^{*+}D^{*-}$ and measure its branching fraction. In order to reduce systematic uncertainties, the branching fraction is measured relative to the decay

$B^0 \to D^{*+}D^{*-}$. A next step of the analysis could be a measurement of the time dependent CP violation in $B^0 \to D^{*+}D^{*-}$ decays. As this decay involves a pseudoscalar meson decaying into two vector mesons, an angular analysis is planned.

In this talk the current status of the analysis will be presented, using the full dataset of the LHCb experiment corresponding to an integrated luminosity of $9\,\text{fb}^{-1}$.

T 63.9   Mi 18:00   S15

Erste Studien von inklusiven B $\to$ X$\ell\nu_\ell$ Zerfällen mit dem Belle II Experiment — •Stephan Duell[1], Jochen Dingfelder[1], Florian Bernlochner[2] und Peter Lewis[1] — [1]Rheinische Friedrich-Wilhelms-Universität Bonn — [2]Karlsruher Institut für Technologie

In diesem Vortrag wird eine Analyse von inklusiven semileptonischen B-Zerfällen mit den ersten Kollisionsdaten des neuen SuperKEKB Beschleunigers vorgestellt, in der das inklusive semileptonische Verzweigungsverhältnis $\mathcal{B}(B \to X\ell\nu_\ell)$ gemessen und die Leistungsfähigkeit des Belle II Detektors mit ersten Daten charakterisiert werden soll. Zur Unterscheidung zwischen $\Upsilon(4S) \to B\bar{B}$ Ereignissen und Untergrundereignissen wird ein zweites Lepton mit hohem Impuls in jedem Ereignis rekonstruiert. Anschließend können Ladungs- und Winkelabhängigkeiten zwischen den beiden Leptonen ausgenutzt werden, um semileptonische B-Zerfälle von anderen Zerfällen zu unterscheiden. Die Analyse basiert auf einem frühen Datensatz (500pb^{-1}), den das Belle II Experiment im Sommer 2018 mit dem SuperKEKB Beschleuniger in Japan aufgezeichnet hat. Der aktuelle Status der Messung wird präsentiert.

T 63.10   Mi 18:15   S15

Measurement of inclusive differential kinematic distributions for $|V_{ub}|$ — Florian Bernlochner, Lu Cao, William Sutcliffe, and •Raynette van Tonder — Karlsruhe Institute of Technology, Germany

The discrepancy between inclusive and exclusive measurements of the CKM matrix element $|V_{ub}|$ has posed a longstanding puzzle. Since one of the major difficulties involved with the inclusive $|V_{ub}|$ measurement is the determination of the non-perturbative distribution function describing the internal Fermi motion of the b-quark, innovative new analysis strategies aimed toward reducing model uncertainties have been suggested. One of these approaches proposes to measure key kinematic differential distributions of $B \to X_u l\nu$ decays and combine them into a global, data-driven fit, which would simultaneously determine $|V_{ub}|$ as well as other useful parameters. This analysis makes use of hadronic tagging and is performed on the full dataset of the Belle experiment comprising 772 million $B\bar{B}$ pairs. In order to test analysis techniques under development for the above-mentioned measurement, the more abundant phase space region of $B \to X_c l\nu$ decays is exploited. This talk will show the current analysis status as well as differential kinematic distributions for B $\to X_c l\nu$ decays.