T 81: Flavour physics IV

Time: Thursday 16:00–18:30 Location: Tf

T 81.1 Thu 16:00 Tf

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

In the past few years there has been increasing interest in $b \to s\ell\ell$ processes, due to the emergence of several intriguing tensions between measured observables and SM predictions. Of particular interest is the study of angular distributions of such decays, where measurements of angular observables can offer detailed insight on the nature of potential new physics models. A previous measurement of the angular distribution of $B^0 \to K^{*0}(\to K^+\pi^-)\mu^+\mu^-$ decays at LHCb, using data collected during Run 1 and 2016, found a tension at the level of 3 standard deviations with the Standard Model. This talk will present the current status of the update of this angular analysis, including LHCb data collected during 2017 and 2018.

T 81.2 Thu 16:15 Tf

Angular analysis of the $B^+ \to K^{*+}\mu^+\mu^-$ decay — Martino Borsato[1], Michel De Cian[2], •David Gerick[1], and Renata Kopecna[1] for the LHCb-Collaboration — [1]Physikalisches Institut, Universität Heidelberg — [2]EPFL, Lausanne

In this talk the angular analysis of the $B^+ \to K^{*+}\mu^+\mu^-$ decay with the subsequent decays $K^{*+} \to K^0_S\pi^+$ and $K^0_S \to \pi^+\pi^-$ is presented. The full data set collected by the LHCb experiment during the first two periods of pp collisions at the Large Hadron Collider in the years 2011 – 2018 is used. In total, 737 ± 34 signal candidates are selected. A four-dimensional maximum-likelihood fit is used to extract two sets of angular observables in ten different intervals of the invariant dimuon mass squared, q^2. The fit uses angular folds of the differential decay rate to stabilize the fit and random re-sampling of the data to obtain the correlations between all angular observables.
For most observables and in most q^2 intervals the resulting values are compatible with Standard Model predictions. However, most prominently the CP-averaged angular observables $A_{\rm FB}$ (P_2) and S_5 (P'_5) show significant discrepancies in the q^2 region below the J/ψ resonance. This pattern of deviation is coherent with previous measurements in the isospin-partner decay of the B^0 meson.

T 81.3 Thu 16:30 Tf

Inclusive tagging search for $B^\pm \to K^\pm\nu\bar{\nu}$ at the Belle II experiment, with focus on a novel validation procedure. — •Filippo Dattola — Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany

The experimental measurement of the rare, flavour-changing neutral current decay $B^\pm \to K^\pm\nu\bar{\nu}$ represents a powerful probe allowing to test the validity of the Standard Model and the possible existence of physics beyond it. Predicted with high level of accuracy by the Standard Model, the decay has not been experimentally observed yet. A search for the decay is performed by means of an inclusive tagging technique applied to a data sample, collected by the Belle II experiment at the $\Upsilon(4S)$ resonance mass, corresponding to an integrated luminosity of 63 fb^{-1}. Particular focus in this talk will be given to a novel approach that enables to validate the inclusive tagging technique on the $B^\pm \to J/\psi K^\pm$ control channel by modifying the reconstructed events in order to reproduce the topology and the kinematics of the $B^\pm \to K^\pm\nu\bar{\nu}$ events of interest.

T 81.4 Thu 16:45 Tf

Test of lepton flavour universality with $b \to s\ell\ell$ decays at the LHCb experiment — Johannes Albrecht, Vitalii Lisovskyi, and •Alex Seuthe — Technische Universität Dortmund

Current measurements of the LHCb experiment hint to deviations from Standard Model predictions in tests of lepton flavour universality. Examples for this are the measurements of $R_{K^{*0}}$ and R_K, the ratios of the branching fractions of the decays $B^0 \to K^{*0}\mu^+\mu^-$ and $B^0 \to K^{*0}e^+e^-$, and $B^+ \to K^+\mu^+\mu^-$ and $B^+ \to K^+e^+e^-$, respectively. For conclusive results the measurements have to include the full LHCb dataset. In this talk the updated simultaneous measurement of $R_{K^{*0}}$ and R_K, which is currently under preparation, is presented.

T 81.5 Thu 17:00 Tf

Search for the $B \to K^*\nu\bar{\nu}$ decay at Belle II — •Jiyong Jeong and Thomas Kuhr — Ludwig-Maximilians-Universität München

The rare decay $B \to K^*\nu\bar{\nu}$ is a flavor-changing neutral current process, which is suppressed in the standard model and thus sensitive to new physics contributions. We search for this decay in $\Upsilon(4S)$ events produced at the SuperKEKB e^+e^- collider. B mesons are collected and reconstructed from $\Upsilon(4S) \to B\bar{B}$ decays. The K^* is reconstructed in the Belle II detector from its daughter kaon and pion particles. The missing energy and momentum of the neutrinos is inferred from the reconstructed second B meson in the event and the known beam energies. Monte-Carlo simulated data is applied to optimize the separation between signal and background and to estimate the sensitivity of the search.

T 81.6 Thu 17:15 Tf

Measurement of the ratio $R_{K^{*0}}$ using Run 1 + 2 data of the LHCb experiment — •Stephan Escher, Christoph Langenbruch, Stefan Schael, Sebastian Schmitt, 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 the SM 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 updated $R_{K^{*0}}$ analysis using the combined Run 1 and 2 LHCb data sample, which is currently in LHCb review. Particular emphasis will be on the validation of fit yields and efficiencies of the control channel as well as on rare mode fits and sensitivities.

T 81.7 Thu 17:30 Tf

Measurement of the ratio $R_{K\pi\pi}$ with the LHCb experiment — Christoph Langenbruch, •Johannes Heuel, and Stefan Schael — I. Physikalisches Institut B, RWTH Aachen University

In the Standard Model (SM) of particle physics, the coupling of electroweak gauge bosons to all leptons is universal. Stringent tests of this Lepton Flavour Universality (LFU) are possible by measuring ratios of rare $b \to s\ell\ell$ decays with different leptons in the final state. These decays are loop-suppressed in the SM and therefore sensitive to new heavy particles beyond the SM.

The LHCb experiment is ideally suited for the study of rare b hadron decays due to its large acceptance, the high trigger efficiencies and the excellent tracking and particle identification. Recent measurements of $b \to s\ell\ell$ ratios published by the LHCb Collaboration show tensions with the SM predictions of up to 2.5 standard deviations. Therefore, further studies of LFU tests using other rare B decay channels are crucial.

The current status of the ongoing measurement of the ratio $R_{K\pi\pi}$ of the branching fractions of the decays $B^+ \to K^+\pi^+\pi^-\mu^+\mu^-$ and $B^+ \to K^+\pi^+\pi^-e^+e^-$ is presented. The measurement is experimentally challenging as the hadronic system is measured inclusively.

T 81.8 Thu 17:45 Tf

Final state hadron multiplicity of charmless semileptonic B-decays at Belle — Florian Bernlochner, Jochen Dingfelder, •Alexander Ermakov, and Peter Lewis for the Belle-Collaboration — Physikalisches Institut der Rheinischen Friedrich-Wilhelms-Universität Bonn, 53115 Bonn, Germany

The Belle experiment dataset with an integrated luminosity of 711 fb^{-1} from e^+e^- collisions allows the investigation of charmless semileptonic B-decays and their properties. These decays are interesting, because they give access to the modulus of the CKM-matrix element V_{ub}, when combined with theory predictions. Inclusive and exclusive measurements of these decays yield different values of the modulus of V_{ub}.

Measurements at different experiments agree on this persistent tension at the 3σ level. A large source of systematic uncertainties for these types of decays can be related to the modeling of the final state hadron multiplicity. As the reconstruction and selection efficiencies of these decays depend upon the final state hadron multiplicity the related uncertainty can be reduced, if the analysis incorporates the final state hadron multiplicity dependency explicitly. Resonant and non-resonant signal contributions can thus be studied simultaneously. The talk describes the selection of $B \to X_u \ell \nu$ decays, the variables used for signal selection and background suppression, the different signal subsamples, the impact of incorporating the final state hadron multiplicity as an extraction variable as well as the systematic uncertainties on the determination of the branching fraction of charmless semileptonic B-decays.

T 81.9 Thu 18:00 Tf

Search for the $B^0 \to D^0 \bar{D}^0$ decay with the LHCb experiment. — •JONAH BLANK and SOPHIE HOLLITT — Experimentelle Physik 5, TU Dortmund

With precise measurements of B meson decays the LHCb experiment can test the integrity of the Standard Model of particle physics. Especially $B \to D\,D$ are interesting to examine CP violation and further constrain the unitarity triangle. While decays to charged $D^{\pm}$ mesons have already been found and well measured, the $B \to D^0 \bar{D}^0$ decay channel has not yet been observed by any experiment.

In this analysis, data collected by the LHCb experiment at $\sqrt{s} = 7, 8$ and 13 TeV corresponding to $9\,\mathrm{fb}^{-1}$ is used to search for the $B^0 \to D^0 \bar{D}^0$ decay channel. The $B^0 \to \bar{D}^0 \pi^+ \pi^-$ decay channel is used as a normalisation mode to control high theory uncertainties. The current status of the analysis will be presented.

T 81.10 Thu 18:15 Tf

Untagged $\overline{B}^0 \to D^{*+} \ell^- \overline{\nu}_\ell$ studies with Belle II — Florian Bernlochner, Lu Cao, Jochen Dingfelder, and •Chaoyi Lyu for the Belle II-Collaboration — Physikalisches Institut der Rheinischen Friedrich-Wilhelms-Universität Bonn, 53115 Bonn, Germany

The precise determination of the CKM matrix element $|V_{cb}|$ and semileptonic form factors in B meson decays are important for carrying out precision tests of the flavour sector of the Standard Model and to search for new physics. The decay of $\overline{B}^0 \to D^{*+} \ell^- \overline{\nu}_\ell$ is particularly well suited to determine $|V_{cb}|$ due to its large branching fraction, small backgrounds and the availability of lattice data to describe the form factors. In this talk, I will present the current status of establishing an untagged measurement of the $\overline{B}^0 \to D^{*+} \ell^- \overline{\nu}_\ell$ branching fraction and form factors using early Belle II data. In addition, I will report on the status of the determination of the slow pion reconstruction efficiency using fully hadronic B-meson decays.