T 51: Flavor physics: CKM I

Time: Wednesday 16:30–19:00 Location: H-HS XI

T 51.1 Wed 16:30 H-HS XI

Untagged Analysis of $B \to \pi\ell\bar{\nu}_\ell$ using Early Belle II Data — Florian Bernlochner, Jochen Dingfelder, •Svenja Granderath, and Peter Lewis for the Belle II-Collaboration — Rheinische Friedrich-Wilhelms-Universität Bonn

A discrepancy between the results of exclusive and inclusive measurements of the CKM matrix element $|V_{ub}|$ persists. The charmless semileptonic decay $B \to \pi\ell\bar{\nu}_\ell$ is one of the most accessible and powerful channels for determining $|V_{ub}|$ in exclusive modes. Using data from the Belle II experiment, a new precision measurement of $|V_{ub}|$ will become possible. In preparation for this, an untagged measurement method for extracting $B \to \pi\ell\bar{\nu}_\ell$ events is developed using early Belle II data. Lepton and pion candidates are combined to form $B \to \pi\ell\bar{\nu}_\ell$ candidates. In order to increase the purity, a boosted decision tree is employed to suppress continuum and other backgrounds. This talk will discuss the current status of the analysis and present an outlook on the precision of future Belle II $|V_{ub}|$ measurements.

T 51.2 Wed 16:45 H-HS XI

V_{ub} analysis at Belle II — •Yaroslav Kulii and Thomas Kuhr for the Belle II-Collaboration — Ludwig-Maximilians-Universität München

The flavour mixing of quarks, generated by the CKM matrix, has been experimentally confirmed a long time ago and since then has been a subject of various studies.

While the complex phase generates CP-violation, the moduli of the CKM matrix elements define the overall transition rate of quarks between generations. Discrepancies between results coming from inclusive and exclusive determination of the V_{ub} element (i.e. $b \to u$ quark transition rate) have been a matter of dispute.

In this study the data from Belle and Belle II experiments as well as corresponding experimental and theoretical techniques are used for further analysis of $b \to u$ quark transition rate. The studied processes are in particular $B \to \pi^+\ell^-$ decays.

T 51.3 Wed 17:00 H-HS XI

Precision measurement of the CKM matrix element V_{cb} with the Full Event Interpretation at Belle — •Markus Prim[1], Florian Bernlochner[2], Jochen Dingfelder[2], Pablo Goldenzweig[1], Thomas Kuhr[3], Kilian Lieret[3], Felix Metzner[1], and Maximilian Welsch[2] — [1]Karlsruher Institut für Technologie — [2]Rheinische Friedrich-Wilhelms-Universität Bonn — [3]Ludwig Maximilian Universität

Precision measurements of the CKM matrix element V_{cb} can be done using three established methods: either by studying exclusive $B \to D\ell\nu$ decays, exclusive $B \to D^*\ell\nu$ decays or by studying inclusive $b \to c\ell\nu$ transitions. Exclusive and inclusive determinations show a persistent tension at the 2 - 3 sigma level. In recent measurements the dependence of the used exclusive form factor parametrizations was explored as a possible source of the discrepancy. In this presentation we show the status of re-analyzing the full Belle data set of 711/fb of integrated luminosity using an improved hadronic tagging algorithm called the Full Event Interpretation (FEI). Semileptonic $B \to D\ell\nu$ and $B \to D^*\ell\nu$ decays are reconstructed and simultaneously analyzed to measure form factors and V_{cb}. The fit is carried out in the HAMMER framework, which provides predictions for all relevant form factor parameterizations, and fully differentially in the recoil parameter w and the three D^* decay angles.

T 51.4 Wed 17:15 H-HS XI

Measurement of inclusive differential kinematic distributions for $|V_{cb}|$ — Florian Bernlochner, Lu Cao, Jochen Dingfelder, William Sutcliffe, and •Raynette van Tonder — University of Bonn, 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 $B \to X_u\ell\bar{\nu}_\ell$ 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 $B \to X_c\ell\bar{\nu}_\ell$ decays is exploited. This talk will show the current analysis status as well as differential kinematic distributions for $B \to X_c\ell\bar{\nu}_\ell$ decays.

T 51.5 Wed 17:30 H-HS XI

Untagged $\overline{B}^0 \to D^{*+}\ell^-\overline{\nu}_\ell$ studies with Belle II — Florian Bernlochner, Lu Cao, Jochen Dingfelder, and •Chaoyi Lyu — The University of Bonn, 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. In particular, I will show results using first Belle II data and present detailed comparisons between simulated and recorded $\overline{B}^0 \to D^{*+}\ell^-\overline{\nu}_\ell$ decays.

T 51.6 Wed 17:45 H-HS XI

Measurement of the $B_s \to K^0_S K^0_S$ branching fraction at LHCb — Timon Schmelzer, Moritz Demmer, and •Sophie Hollitt — Experimentelle Physik 5, TU Dortmund

Decays of b hadrons to final states containing only long-lived particles, such as K^0_S mesons or Λ^0 baryons, have never been reported in a hadronic production environment. Of these long-lived final states, the decay $B^0_s \to K^0\overline{K}^0$ has a relatively large predicted branching fraction, and is dominated by $b \to s\bar{d}d$ electroweak penguin transitions.

In this talk, a measurement of the branching ratio of $B_s \to K^0_S K^0_S$ decays is presented, using data collected by the LHCb experiment in 2011–2012 and 2015–2016 corresponding to a total of 5 fb^{-1} of hadronic collision data. This branching ratio is measured relative to the normalisation channel $B^0 \to \phi K^0_S$. As part of the same analysis, evidence for the $B^0 \to K^0_S K^0_S$ decay mode is also presented.

T 51.7 Wed 18:00 H-HS XI

Measurement of the weak mixing phase ϕ_s in $B^0_s \to D^+_s D^-_s$ decays with the LHCb experiment — •Louis Gerken, Philipp Ibis, and Antje Mödden — Experimentelle Physik 5, TU Dortmund

The LHCb experiment performs precision measurements of *CP* violation to test the Standard Model of particle physics. In $B^0_s \to D^+_s D^-_s$ decays, the *CP*-violating parameter ϕ_s can be measured. This weak mixing phase arises in the interference between the direct decay of the B^0_s meson and the decay after mixing.

In this talk, the selection of $B^0_s \to D^+_s D^-_s$ candidates for a measurement of ϕ_s will be presented. A challenging part of the selection is the suppression of hadronic background decays. The analysis uses the full Run II dataset corresponding to an integrated luminosity of 6 fb^{-1} collected during 2015 to 2018 at a centre-of-mass energy of 13 TeV.

T 51.8 Wed 18:15 H-HS XI

Time-dependent measurement of *CP* violation in $B^0_s \to D^+_s D^-_s$ decays with the LHCb experiment — Louis Gerken, Philipp Ibis, and •Antje Mödden — Experimentelle Physik 5, TU Dortmund

The LHCb experiment aims to test the Standard Model of particle physics and searches for New Physics by performing precision measurements, e.g. decay-time-dependent measurements of *CP* violation in decays of neutral B mesons.

In the decay $B^0_s \to D^+_s D^-_s$, the weak mixing phase ϕ_s arises in the interference between the decay with and without $B^0_s - \bar{B}^0_s$ mixing. This phase can be determined in a decay-time-dependent measurement. The analysis uses data collected by the LHCb experiment from 2015 to 2018 at a centre-of-mass energy of 13 TeV corresponding to an integrated luminosity of 6 fb^{-1}.

In this talk, the modelling of the decay-time-dependent efficiency,

the calibration of the decay-time resolution and the calibration of the Flavour Tagging is presented.

T 51.9 Wed 18:30 H-HS XI

Studies of $B^0_{(s)} \to D^{(*)+}D^-$ decays with the LHCb experiment — •Philipp Ibis, Antje Mödden, and Margarete Schellenberg — Experimentelle Physik 5, TU Dortmund

The LHCb experiment searches for physics beyond the Standard Model by performing high precision tests of beauty and charm hadrons. Among these are decay-time-dependent measurements of *CP* violation of neutral meson.

In $B^0 \to D^{(*)+}D^-$ decays, *CP* violation occurs in the interference of direct decays and decays after mixing of the B^0 mesons. Time-dependent measurements of decays of initial B^0 and $\bar{B}^0$ mesons allow the determination of the *CP* asymmetry and give access to the CKM angle β.

Analyses of *CP* violation in $B^0 \to D^+D^-$ and $B^0 \to D^{*+}D^-$ decays are presented using the full LHCb dataset. Also, a measurement of the branching ratio of the decay $B^0_s \to D^{*+}D^-$ relative to $B^0 \to D^{*+}D^-$ is presented.

T 51.10 Wed 18:45 H-HS XI

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

At the LHCb experiment precise measurements are performed to search for physics beyond the Standard Model. For this it is important to observe new decays and measure their branching ratio. The aim of this analysis is to observe the decay $B^0_s \to D^{*+}D^{*-}$ and to measure the branching ratio relative to the decay $B^0_d \to D^{*+}D^{*-}$. This cancels dominant, systematic uncertainties in the relative branching ratio. This analysis can also be used to perform an angular analysis and a time-dependent measurement of *CP* violation in the control channel.

The current status of the analysis, in which the full data set of the LHCb experiment corresponding to an integrated luminosity of $9\,\mathrm{fb}^{-1}$, is presented.