T 8: Flavour Physics I

Time: Monday 16:15–18:15 Location: KH 01.011

T 8.1 Mon 16:15 KH 01.011

Sensitivity study on combined analysis of beyond the Standard Model contributions in $B^0 \to D^{*-}\tau^+\nu_\tau$ decay. — •Marco Colonna — TU Dortmund University

Semileptonic $b \to c\ell\nu$ decays are excellent probe for testing Lepton Flavour Universality and New Physics effects. New Physics contributions are measured via their corresponding Wilson coefficients and in several fit configurations including different New Physics operators. A study of sensitivity of a combined measurement of Wilson coefficients using of $B \to D^*\tau\nu$ decays in proton-proton collision data collected by LHCb and electron-positron collision data from Belle II has been done, showing enhanced sensitivity from shared parameters between different datasets. We discuss the most recent progress in developing data reinterpretation techniques, as well as the prospects and challenges for direct measurements of New Physics in semileptonic decays at the collider experiments.

T 8.2 Mon 16:30 KH 01.011

Search for $B^- \to \Lambda_c^+ \bar{p}\ell^-\bar{\nu}_\ell$ at the Belle II experiment — •Verena Mendel, Torben Ferber, Pablo Goldenzweig, and Raynette Van Tonder — Institute of Experimental Particle Physics, Karlsruhe Institute of Technology, Karlsruhe, Germany

About 90% of the inclusive semileptonic $B \to X_c\ell\nu$ branching fraction can be accounted for by summing the branching fractions of known exclusive $B \to D^{(*)}(\pi)\ell\nu$ decays. Semileptonic B decays to charmed baryons may account for some of the remaining difference. These decays are poorly understood theoretically and may provide additional insight into the longstanding inclusive/exclusive puzzle in determinations of the CKM matrix element $|V_{cb}|$.
In this talk, we present the status of the first search for $B^- \to \Lambda_c^+ \bar{p}\ \ell^-\ \bar{\nu}_\ell$, which is the lightest final state containing charmed baryons and is expected to be the dominant individual baryonic mode. The analysis is conducted at the Belle II experiment, located at the SuperKEKB asymmetric e^+e^- collider. We employ a hadronic tagging approach, where the accompanying B meson in $e^+e^- \to \Upsilon(4S) \to B^+B^-$ events is fully reconstructed via hadronic decay chains. The signal side is reconstructed in the electron and muon modes, with the Λ_c^+ reconstructed in the decay channels $\Lambda_c^+ \to pK^-\pi^+$ and $\Lambda_c^+ \to pK_S^0$.

T 8.3 Mon 16:45 KH 01.011

Two-loop corrections to the penguin amplitude a_6 in QCD factorization — Guido Bell[1], Kevin Brune[2], Tobias Huber[1], and •Sandra Kvedaraite[1] — [1]Universität Siegen, Siegen, Germany — [2]Johannes Gutenberg-Universität Mainz, Mainz, Germany

The QCD penguin amplitude plays a central role in understanding CP violation in non-leptonic B-meson decays. It arises from the loop-induced weak-interaction process $b \to D\sum_{q=u,d,s} q\bar{q}$, where $D = d, s$, and can be expressed in terms of the leading-power amplitude a_4 and the higher-twist amplitude a_6. Even though a_6 is power-suppressed in the heavy-quark limit, chiral enhancement makes it numerically comparable to a_4, making it relevant for branching ratios and CP-violating observables. While a_4 is known to next-to-next-to-leading order, a_6 is currently available only at next-to-leading order. In this talk, I will present recent progress towards the two-loop calculation of a_6 in the QCD factorization approach to non-leptonic B-meson decays.

T 8.4 Mon 17:00 KH 01.011

One-loop improved modelling of hadronic light-cone distributions amplitudes in HQET — Riccardo Bartocci[1], Philipp Böer[2], Max Ferré[3], Thorsten Feldmann[4], Nico Gubernari[5], and •Daniel Vladimirov[4] — [1]Institut für Theoretische Teilchenphysik, Karlsruhe Institute of Technology (KIT), 76128 Karlsruhe, Germany — [2]CERN, Theoretical Physics Department, CH-1211 Geneva 23, Switzerland — [3]PRISMA+ Cluster of Excellence & Mainz Institute for Theoretical Physics, Johannes Gutenberg University, D-55099 Mainz, Germany — [4]Center for Particle Physics Siegen, Universität Siegen, 57068 Siegen, Germany — [5]Helmholtz-Institut für Strahlen- und Kernphysik (Theorie) and Bethe Center for Theoretical Physics, Universität Bonn, 53115 Bonn, Germany

Light-cone distribution amplitudes (LCDAs) parametrize the relevant hadronic information in factorization-based predictions for exclusive reactions with large energy/momentum transfer. In this talk we focus on the LCDAs of heavy hadrons containing one heavy b-quark in the framework of heavy-quark effective theory (HQET). We explain how theoretical information about the so-called "radiative tail" in fixed-order perturbation theory can be consistently implemented in the construction of models or generic parametrizations of the LCDAs. As a specific example, we apply our approach to a generalized 3-particle LCDA of the B-meson, where the light quark and gluon field are separated along *opposite* light-cone directions, and briefly discuss the phenomenological relevance for rare exclusive B-meson decays.

T 8.5 Mon 17:15 KH 01.011

Measurement of the Differential Branching Ratio, Lepton Angular Distribution and Determination of the CKM Matrix Element $|V_{cb}|$ in Inclusive $B \to X_c\ell\nu$ Semileptonic Decays using Belle II Data — •Rajeshwari Roy, Florian Bernlochner, Markus Prim, and Munira Khan — Physikalische Institut der Rheinische Friedrich-Wilhelms- Universität Bonn

We present a measurement of the differential branching ratio and lepton angular distribution in inclusive semileptonic $B \to X_c\ell\nu$ decays using data collected with the Belle II detector corresponding to an integrated luminosity of 365 fb^{-1}, recorded at the $\Upsilon(4S)$ resonance. Signal candidates ($b \to c\ell\bar{\nu}_\ell$) are selected using a tag-side full-event interpretation, enabling precise reconstruction of the kinematics in the inclusive decay. The differential branching ratios as functions of the lepton momentum, momentum transfer q^2, and lepton helicity angle $\cos\theta_\ell$ are calculated incorporating efficiency corrections and including a comprehensive evaluation of systematic uncertainties using the Sysvar framework, which provides a consistent treatment of arbitrary correlations arising from systematic effects affecting shapes in simultaneous template fits. A global fit to the measured spectra within the HQE formalism yields an updated determination of the Cabibbo-Kobayashi-Maskawa matrix element $|V_{cb}|$, contributing to resolving the difference between inclusive and exclusive determinations of $|V_{cb}|$.

T 8.6 Mon 17:30 KH 01.011

Search for $B \to \Lambda_c p\ell\nu$ decays at Belle II — •Tim Müller, Markus Prim, Valerio Bertacchi, and Florian Bernlochner — Physikalisches Institut der Rheinischen Friedrich-Wilhelms-Universität Bonn

The branching fraction of the inclusive semileptonic decays $B \to X_c\ell\nu$ is around 10 % and is experimentally and theoretically well understood. On the other hand, the exclusive semileptonic decays of the B-meson add up to only 9 % of the branching ratio. This gap might originate from baryonic semileptonic decays such as $B \to \Lambda_c p\ell\nu$, which have not been directly measured yet. We aim to solve this gap by further investigating this decay and determining its absolute branching ratio.

To achieve this, a tag-side full-event interpretation is performed by reconstructing the tag B meson in both hadronic and semileptonic decay channels to maximize the available statistics. The SysVar framework is then being used to evaluate systematic uncertainties for template fitting via pyhf. In this talk we present the motivation, analysis strategy and preliminary results of this ongoing analysis.

T 8.7 Mon 17:45 KH 01.011

An effective hadronic field theory for B-meson decays at high recoil — •Jaime del Palacio Lirola, Thorsten Feldmann, and Jack Jenkins — University of Siegen

We construct an effective hadronic Lagrangian for heavy-meson decays into energetic pseudo-Goldstone bosons of chiral symmetry breaking, by exploring the interplay between two already existing Effective Field Theory frameworks: Heavy Hadron Chiral Perturbation Theory, and Soft-Collinear Effective Theory (SCET). In the new theory, the dynamical degrees of freedom are given by quasi-static heavy meson fields coupled to soft and collinear pions, kaons and η mesons. In this talk we focus on the matching of external heavy-to-light currents in SCET onto effective operators in the hadronic Lagrangian. From our result, we calculate the 1-loop corrections for the external current, which determines the non-analytic dependence on the light meson mass, known as "chiral logarithms". This information is needed to perform the chiral extrapolation in lattice-QCD data, and to estimate $SU(3)$ breaking effects in heavy-to-light form factors, both at large recoil (low q^2).

T 8.8 Mon 18:00 KH 01.011

QCDF amplitude estimates for $B \to V_L V_L$ decays using a data-driven approach — •Anshika Bansal[1], Aritra Biswas[1], Tobias Huber[1], Joaquim Matias[2], and Gilberto Tetlalmatzi-Xolocotzi[1] — [1]Theoretical Particle Physics, Center for Particle Physics Siegen, University of Siegen — [2]Institut de Física d*Altes Energies (IFAE), The Barcelona Institute of Science and Technology, Campus UAB, 08193 Bellaterra (Barcelona)

QCD factorisation (QCDF) is one of the main theoretical frameworks to compute the amplitudes of non-leptonic decays of B-mesons. However, these calculations are polluted by infrared divergences arising, for example, from the weak annihilation topologies. These effects cannot be computed using first-principle calculations and can only be parametrised, which leads to sizable theoretical uncertainties. In this talk, I will discuss a data-driven approach to estimate QCDF amplitudes for B-meson decaying to two charmless vector mesons. This is done by exploiting the relations between QCDF amplitudes and the SU(3) invariant amplitudes. One key aspect of this analysis is the introduction of SU(3) breaking effects.