T 123: Flavour physics 5

Time: Friday 9:00–10:30   Location: Geb. 30.41: HS 2

T 123.1   Fri 9:00   Geb. 30.41: HS 2

Measurement of $R(D^*)$ with Inclusive B Tagging at Belle II — •Thomas Ametsbichler, Thomas Lück, and Thomas Kuhr — Ludwig-Maximilians-Universität München

A fundamental axiom of the Standard Model (SM) of particle physics is the universality of the lepton coupling, $g_l(l = e, \mu, \tau)$, to the electroweak gauge bosons. The average of measurements from the BaBar, Belle and LHCb experiments have shown a 2.3σ discrepancy of $R(D^*) = \frac{\mathcal{B}(B \to D^* \tau \nu_\tau)}{\mathcal{B}(B \to D^* \ell \nu_\ell)}$, a ratio of branching fractions sensitive to the lepton coupling, with respect to the SM prediction. This discrepancy may be an indication of New Physics beyond the SM.

The goal of the presented analysis is an independent measurement of $R(D^*)$ with data from the Belle II experiment. Belle II is a so-called B Factory, which produces B meson pairs in $e^+e^- \to \Upsilon(4S) \to B\overline{B}$ reactions. While one B meson is reconstructed in $B \to D^* \tau \nu$ or $B \to D^* \ell \nu$ to measure $R(D^*)$, there are multiple ways to reconstruct the second B meson (referred to as the tag B).

In this analysis the tag B is reconstructed inclusively instead of using a hadronic or semileptonic tag as previous measurements, which improves the reconstruction efficiency at the cost of more background. It is anticipated that this approach will reduce the statistical uncertainties of the $R(D^*)$ measurement.

T 123.2   Fri 9:15   Geb. 30.41: HS 2

Inclusive Semileptonic $b \to c\ell\bar\nu$ Decays to Order $1/m_b^5$ — •Ilija S. Milutin[1], Thomas Mannel[1], and Keri Vos[2,3] — [1]Theoretical Particle Physics, Center for Particle Physics Siegen, University of Siegen, Germany — [2]Gravitational Waves and Fundamental Physics (GWFP), Maastricht University, The Netherlands — [3]Nikhef, Amsterdam, The Netherlands

Inclusive semileptonic $B \to X_c\ell\nu$ decays can be described in the Heavy Quark Expansion (HQE) and allow for a precision determination of the CKM element $|V_{cb}|$. We calculate the terms of $1/m_b^5$ and derive a "trace formula" which allows for the computation of the decay rate and kinematic moments of the spectrum up to this order in the HQE. We focus specifically on the reparametrization invariant (RPI) dilepton invariant mass q^2 moments of the spectrum, which depend on a reduced set of HQE parameters. We find 10 RPI HQE parameters at $1/m_b^5$. At this order, "intrinsic charm" (IC) contributions proportional to $1/(m_b^3 m_c^2)$ enter, which are numerically expected to be sizeable. Using the "lowest-lying state saturation ansatz" (LLSA), we estimate the size of these contributions. Within this approximation, we observe a partial cancellation between the IC and the "genuine" $1/m_b^5$ contributions, resulting in a small overall contribution.

T 123.3   Fri 9:30   Geb. 30.41: HS 2

Angular analysis of $B^0 \to D^*\mu\nu$ decay at LHCb — •Biljana Mitreska[1], Johannes Albrecht[1], Lucia Grillo[2], Gregory Ciezarek[3], Marco Gersabeck[4], Derek Yeung[4], Hasret Nur[2], Tobias Knospe[1], and Manuel Schiller[2] — [1]TU Dortmund University, Dortmund, Germany — [2]University of Glasgow, Glasgow, UK — [3]CERN, Geneva, Switzerland — [4]The University of Manchester, Manchester, UK

Semileptonic $b \to c\ell\nu$ decays are excellent probe for testing Lepton Flavour Universality and New Physics (NP) effects. A search for NP is performed with an angular analysis of $B^0 \to D^*\mu\nu$ decays in pp collision data collected by LHCb with an integrated luminosity of 3 fb^{-1}. The signal is extracted using a multidimensional fit to data using templated distributions derived from simulation and from control samples in collision data. New Physics contributions are measured via their corresponding Wilson coefficients and in several fit configurations

that allow for different New Physics operators. Form factor parameters using three parametrizations (BLPR, CLN and BGL) are measured in a Standard Model scenario.

T 123.4   Fri 9:45   Geb. 30.41: HS 2

Measuring R(D*) in hadronic one-prong τ decays at Belle II — Florian Bernlochner, Jochen Dingfelder, Markus Prim, and •Ilias Tsaklidis — Physikalisches Institut der Rheinischen Friedrich-Wilhelms-Universität Bonn

Over the last decade, several experimental results hint at the existence of lepton universality violating processes. In this work we probe such a process by measuring the R(D*) = $\mathcal{B}(B \to D^*\tau\bar\nu_\ell)/\mathcal{B}(B \to D^*\ell\bar\nu_\ell)$ ratio using hadronically decaying τ leptons as a signature. The Belle II experiment provides an excellent laboratory to study these processes within the clean experimental environment of e$^+$ e$-$ collisions. We present the current status of this measurement using the full Belle II Run 1 data set and by employing a hadronic reconstruction algorithm to fully reconstruct the accompanying B meson using a dedicated machine learning algorithm. This allows us to reconstruct the entire collision event, assigning each final state particle to a signal and tag side. We target B $\to$ D$^*\tau\nu$ decays with a single charged hadron originating from the τ decay and two missing neutrinos in the event. This allows us to measure not only the rate, but also the polarization of the τ lepton, which has increased sensitivity to New Physics contributions.

T 123.5   Fri 10:00   Geb. 30.41: HS 2

Measurement of the full set of kinematic moments of semileptonic B-meson decays with the Run 1 data set of Belle II — •Munira Khan, Florian Bernlochner, Jochen Dingfelder, and Markus Prim — Physikalisches Institut der Rheinischen Friedrich-Wilhelms-Universität Bonn

The determination of the Cabibbo-Kobayashi-Maskawa matrix element $|V_{cb}|$ relies on $b \to c\ell\nu_\ell$ transitions. The inclusive semileptonic process can be described with the Heavy Quark Expansion (HQE) and using the operator product expansion the total decay rate can be parameterized with a small number of non-perturbative parameters. These parameters cannot be determined from first principles, but their values are encoded into kinematic moments of the decay rate. In this talk we present the current status of measuring the full set of kinematic moments (q^2, M_X, E_ℓ, n_X) within a single analysis, which characterize the semileptonic $b \to c\ell\nu_\ell$ and $b \to q\ell\nu_\ell$ transitions using the Run 1 data of the Belle II experiment. This allows for the first time to properly correlate experimental uncertainties. In addition, we present preliminary fits for $|V_{cb}|$ to simulated samples to illustrate the increase in sensitivity of this approach.

T 123.6   Fri 10:15   Geb. 30.41: HS 2

Systematic Parametrization of the B-meson Light-Cone Distribution Amplitude — •Philip Carlo Lüghausen[1], Thorsten Feldmann[1], and Danny van Dyk[2] — [1]Theoretische Teilchenphysik, Center for Particle Physics Siegen, Universität Siegen — [2]Institute for Particle Physics Phenomenology, Durham University

This talk presents a novel approach to understanding B meson decays through the lens of the light-cone distribution amplitude (LCDA). Our methodology diverges from traditional model-based analyses, focusing instead on a parametrization technique that allows for direct extraction of LCDA information using both experimental and theoretical input. This approach facilitates analytical and numerical computations, aiming to provide unbiased observable estimates while managing theoretical uncertainties. The discussion includes the application to decay amplitudes, notably in the context of the $B \to \gamma\ell\nu$ decay.