T 22: Flavour physics 1

Time: Monday 16:00–18:00 Location: Geb. 30.41: HS 4

T 22.1 Mon 16:00 Geb. 30.41: HS 4

Analysis of $B^0 \to \rho^0\rho^0$ decays at Belle II — •Justin Skorupa, Hans-Günther Moser, and Yingming Yang — Max-Planck-Institut für Physik, Garching, Deutschland

Measurements of the sides and angles of the unitary triangle associated to B-meson decays are a cornerstone of the Belle II physics program. Of all angles of the unitary triangle, the angle α/ϕ_2 currently is the least precisely known.. The most precise determination of this angle comes from an analysis of isospin related $B \to \rho\rho$ decays. Of all $B \to \rho\rho$ modes, an improved measurement of $B^0 \to \rho^0\rho^0$ is expected to have the strongest impact on the precision of α/ϕ_2. In this talk, initial studies on the measurement of $B^0 \to \rho^0\rho^0$ using Belle II data are presented.

T 22.2 Mon 16:15 Geb. 30.41: HS 4

Search for the $B^0 \to D^0\bar{D}^0$ decay with the LHCb experiment — Johannes Albrecht, •Jonah Blank, Quentin Führing, and Sophie Hollitt — TU Dortmund University, Dortmund, Germany

With precise measurements of B meson decays the LHCb experiment can test the integrity of the Standard Model of particle physics. Especially $B \to DD$ decays are interesting to examine CP violation and further constrain the unitarity triangle. While decays to charged $D^{\pm}$ mesons have already been well measured, the $B^0 \to \bar{D}^0 D^0$ decay channel has not yet been observed by any experiment.
In this analysis, data collected by the LHCb experiment at $\sqrt{s} = 7$, 8 TeV and 13 TeV corresponding to an integrated luminosity of 9 fb^{-1} is used to search for the $B^0 \to \bar{D}^0 D^0$ decay channel. The topologically similar $B^0 \to \bar{D}^0\pi^+\pi^-$ decay channel is utilized as a normalisation mode to cancel systematic uncertainties. An update on the current status of the analysis will be presented.

T 22.3 Mon 16:30 Geb. 30.41: HS 4

Towards a full NNLO QCD calculation of $\Delta\Gamma$ in the B-$\overline{B}$ system — •Pascal Reeck[1], Matthias Steinhauser[1], Ulrich Nierste[1], and Vladyslav Shatbovenko[2] — [1]Karlsruhe Institute of Technology — [2]University of Siegen

In this talk I will discuss recent advances made in the calculation of the NNLO QCD corrections to the width difference between B and $\overline{B}$ mesons. This work focuses on the perturbative high-energy part of the calculation, more specifically the matching coefficients between the $\Delta B = 1$ effective operators of the Weak Interaction and the $\Delta B = 2$ transition operator are calculated as a deep expansion in m_c/m_b.

This calculation yields novel results for the NNLO contributions with penguin operators which had not been considered previously at this order. Moreover, the NNLO contributions with two current-current operators, which were previously only known up to $\mathcal{O}(m_c/m_b)$, are calculated to a higher precision.

T 22.4 Mon 16:45 Geb. 30.41: HS 4

Time-dependent studies of B_s^0-meson decays at the LHCb experiment — Johannes Albrecht and •Quentin Führing — TU Dortmund University, Dortmund, Germany

The system of neutral B_s^0 mesons provides experimental access to the CKM sector of the Standard Model. The neutral meson oscillation is not only a measurable observable itself but also enables CP-violating effects in the interference of direct decay and decay after mixing.

Flavour-specific decay modes, like $B_s^0 \to D_s^- \pi^+$, can be used for a clean measurement of the oscillation frequency Δm_s. This frequency itself can be utilized to constrain the sides of the unitarity triangles. More importantly, it is a crucial input to all time-dependent measurements of CP violation in B_s^0-meson decays.

The decay to a CP eigenstate, such as $B_s^0 \to J/\psi\,\phi$, gives access to the CP-violating phase ϕ_s. Together with this information the analysis of $B_s^0 \to D_s^{\mp} K^{\pm}$ decays allows for the determination of the CKM angle γ. While these decay modes, dominated by tree-level processes, allow for clean measurements of the CP-violating phases, in other modes effects from the presence of loop processes have to be accounted for.

At the LHCb experiment, these decay-time-dependent studies can be performed with high sensitivity, as the fast B_s^0 oscillation can be well resolved due to the $\mathcal{O}(50\,\text{fs})$ decay-time resolution of the detector. The crucial information of the B_s^0-meson flavour at the time of its production is derived by various flavour-tagging algorithms.

An overview of the latest published analyses and ongoing developments in this field will be presented.

T 22.5 Mon 17:00 Geb. 30.41: HS 4

A Generic Search Strategy for CP Violation in B-meson Decays at Belle II — •Rab Scholz-McCulloch, Nikolai Hartmann, and Thomas Kuhr — LMU, Munich, Germany

CP violation is a fundamental contributor to the observed matter-antimatter asymmetry in our Universe. However, the currently only known sources of CP violation are insufficient to explain the asymmetry that we observe. Therefore, it is crucial to search for previously unaccounted sources of CP violation that may have been overlooked by past measurements targeting specific models. This study aims to measure the asymmetries in the decays of B mesons at the Belle II experiment generically. The goal is to develop an analysis strategy for detecting asymmetries without relying on assumptions about a specific model.

T 22.6 Mon 17:15 Geb. 30.41: HS 4

Measurement of the branching ratios of the decays $B^0 \to D^-K^+$ and $B^0 \to D^{*-}K^+$ at the Belle II experiment — •Zeynep Su Selcuk, Sviatoslav Bilokin, and Thomas Kuhr — Ludwig-Maximilians-Universität München

The theoretical predictions for the decay $B^0 \to D^{(*)-}K^+$ have been greatly improved recently and show significant deviations from the current experimental measurements. These deviations may be caused by systematic shifts in the previous experimental measurements or can even indicate contributions from the New Physics. Therefore, the goal of the presented analysis is to investigate this situation by measuring the branching fractions for the decay modes $B^0 \to D^-K^+$ and $B^0 \to D^{*-}K^+$ using Belle II data with an integrated luminosity of 362 fb^{-1}. In this analysis particle identification is done using the neural network variables, which leads to enhanced signal efficiency and improved background suppression with respect to the previous analyses at Belle or Belle II.

T 22.7 Mon 17:30 Geb. 30.41: HS 4

Nonleptonic B decays at NNLO — •Manuel Egner[1], Matteo Fael[2], Kay Schönwald[3], and Matthias Steinhauser[1] — [1]Karlsruhe Institute of Technology — [2]CERN — [3]University of Zürich

The decay of B mesons can be predicted within the Heavy Quark Expansion as the decay of a free bottom quark plus corrections which are suppressed by powers of $1/m_b$. This talk will describe the calculation of the NNLO corrections to nonleptonic decays of a free bottom quark including charm quark mass effects. In particular we will describe challenges in connection to the computation of master integrals, the renormalization of the effective Hamilton operator and the problems which arise from calculating traces with γ_5 in $d \neq 4$ dimensions.

T 22.8 Mon 17:45 Geb. 30.41: HS 4

Dimension-6 HQET Sum Rules for Beyond the Standard Model — •Zachary Wüthrich, Matthew Black, and Alexander Lenz — University of Siegen, Germany

Precise determination of hadronic matrix elements plays a crucial role for interpreting potential deviations from the Standard Model observed in experiments testing flavor physics. While lattice QCD provides first-principles calculations, current results are still limited to a subset of the operators that may appear in theories of new physics. The sum rule approach allows for a complementary determination of matrix elements directly from QCD, with theoretical uncertainties that can be systematically improved order-by-order in perturbation theory.

Previous research successfully ascertained Standard Model hadronic matrix elements for dimension-six ΔF=0,2 operators, demonstrating competitiveness with lattice findings. Our aim is to expand upon these findings by including the entire set of four-quark QCD operators for lifetimes, crucial in scenarios Beyond the Standard Model, where lattice results are currently absent. This extension includes operators with Dirac structures not previously examined in sum rules analyses documented in existing literature. This will provide for the first time bag parameter results which can increase the precision of a wide variety of new physics theories. The bag parameter results will be determined using HQET sum rules for three-point correlators, which requires a three-loop computation. In addition there is a one-loop computation of the QCD-HQET matching required.