T 18: Flavor physics: algorithms

Time: Monday 16:30–18:00 Location: L-3.001

T 18.1 Mon 16:30 L-3.001

Automating a historic code base for a high precision B_s^0 oscillation frequency measurement with LHCb data — Quentin Führing and •Kevin Heinicke — Experimentelle Physik 5, TU Dortmund

The upcoming, third data taking period of the Large Hadron Collider will provide a significantly increased dataset, required to continue the systematic search for physics beyond the Standard Model.

Many measurements using the already existing LHC dataset will be repeated, facing new challenges due to the increased statistics. In this talk, a brief overview of the ongoing, updated measurement of the B_s^0-meson oscillation frequency Δm_s using a sample of $B_s^0 \to D_s^- \pi^+$ decays, recorded by LHCb between 2015 and 2018 at $\sqrt{s} = 13$TeV is given. The tool stack to automate large parts of the analysis pipeline is presented, combining up-to-date python packages with existing, historically grown `C++` code and showcasing possible best practices to speed up upcoming, similar analyses.

T 18.2 Mon 16:45 L-3.001

HAMMER: a tool for new physics searches in semileptonic decays at Belle II and LHCb — Florian Bernlochner[1], Jochen Dingfelder[1], •Stephan Duell[1], Zoltan Ligeti[2], Michele Papucci[2], and Dean Robinson[2] — [1]Rheinische Friedrich-Wilhelms-Universität Bonn — [2]Lawrence Berkeley National Laboratory

The search for new physics involving semileptonic b-hadron decays requires large, dedicated Monte Carlo data sets, in order to accurately model acceptance and selection efficiencies. We present the HAMMER reweighting tool, developed for and in conjunction with the LHCb and Belle II experiments, that makes use of an efficient event and histogram reweighting strategy, permitting computationally inexpensive exploration of new physics effects in the fully differential phase space. The HAMMER approach also permits to study the effects of different choices for hadronic form-factor parametrizations describing the semileptonic b-hadron decays, which are crucial for the measurement of the CKM elements $|V_{cb}|$ and $|V_{ub}|$. In this talk we present various example applications of this tool, both for new physics and CKM matrix studies, and summarize the features of the released version 1.0.

T 18.3 Mon 17:00 L-3.001

Flavour tagging developments at LHCb — •Quentin Führing, Kevin Heinicke, and Vukan Jevtic — Experimentelle Physik 5, TU Dortmund

The LHCb experiment at the Large Hadron Collider performs precise measurements of *CP* violation in the B meson sector. For such measurements knowledge of the B meson flavour at production is necessary.

At LHCb the production flavour of B mesons is determined by various flavour tagging algorithms. All of these algorithms exploit hadronisation processes in the B meson production, where various particles are produced in correlation to the initial B flavour.

A new approach in the LHCb flavour tagging is an inclusive flavour tagging algorithm, which evaluates near all tracks of an event by using a recurrent neural network. The current state of the inclusive flavour tagging algorithm development will be presented.

T 18.4 Mon 17:15 L-3.001

Calibration of Belle II hadronic tagging on Belle data — Florian Bernlocher[4], Thomas Kuhr[3], •Kilian Lieret[1,2], Felix Metzner[1,2], Markus Prim[3], and Maximilian Welsch[4] — [1]Ludwig Maximilian Universität — [2]Excellence Cluster Origins — [3]Karlsruhe Institute of Technology — [4]Rheinische Friedrich-Wilhelms-Universität Bonn

The Belle II experiment at the SuperKEKB accelerator produces pairs of B mesons. As the center of mass energy is known, the kinematics of one B meson (the signal B) are determined if the other B meson (the tag B) is fully reconstructed.

The tag B meson can be reconstructed in different channels and using different techniques. This analysis considers hadronic B decays reconstructed with the FEI (Full Event Interpretation), an algorithm relying heavily on machine learning techniques.

Because imperfections in the MC simulation may result in a different tag B reconstruction efficiency than in real data, the FEI must be calibrated. By considering a well known decay mode on signal side (here inclusive $B \longrightarrow X\ell\nu_\ell$), calibration weights can be calculated.

The calibration is performed for the full Belle dataset of $710\,\mathrm{fb}^{-1}$, which has been converted in order to be analyzed with the Belle II software framework. The results of the calibration will be first used for an update of Belle results for $B \longrightarrow D^{(*)}\ell\nu_\ell$ decays that profit from the improved Belle II reconstruction software.

T 18.5 Mon 17:30 L-3.001

Extending the Full Event Interpretation to the Y(5S) system — •Moritz Bauer and Pablo Goldenzweig for the Belle II-Collaboration — KIT Karlsruhe

The Belle experiment has, in addition to the data collected at the $\Upsilon(4S)$ resonance, also collected 121 fb^{-1} of data at the $\Upsilon(5S)$ resonance. The decay products of this resonance include B_s mesons which present interesting channels to test the standard model. Until now, it has not been possible to apply Belle II's new B meson tagging algorithm, the Full Event Interpretation (FEI), to the $\Upsilon(5S)$ dataset. This multivariate exclusive tagging algorithm uses O(10k) decay channels to recombine final-state particles to B mesons which increases the tagging-efficiency significantly compared to cut-based methods.

This talk presents the development and validation of the FEI at the $\Upsilon(5S)$ resonance.

T 18.6 Mon 17:45 L-3.001

Studies for the measurement of $|V_{ts}|$ in top quark decays — Johannes Erdmann, Kevin Kröninger, and •Sonja Zeissner — TU Dortmund, Experimentelle Physik IV

The full Run-2 dataset collected by the ATLAS Detector at the LHC allows for the search of decay processes that were so far unobservable. In this talk, we look at steps towards measuring the CKM matrix element $|V_{ts}|$ in top quark decays. The focus will be on the calibration of a deep neural network s-tagging algorithm and its application to the measurement.