T 29: Flavour Physics II

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

T 29.1 Tue 16:15 KH 01.011

Branching fraction measurement of the $\Lambda_b^0 \to p\pi\mu^+\mu^-$ decay with Run 1 + Run 2 data at LHCb — •Piera Battista[1,2] and Marie-Helene Schune[1] — [1]IJCLab, Orsay — [2]TU Dortmund

Rare decay transitions are powerful tools to search for New Physics. Flavour physics experiments have extensively studied $b \to s\ell^+\ell^-$ transitions in a multitude of various modes and have found tensions with the Standard Model. To further the study of Flavour Changing Neutral Currents, $b \to d\ell^+\ell^-$ transitions are the next object of study, as they are additionally Cabibbo suppressed. The baryonic $\Lambda_b^0 \to p\pi\mu^+\mu^-$ transition is part of this family of decays. This mode was first observed in LHCb using pp-collision Run 1 data with 3 fb^{-1} luminosity, and its branching fraction was measured to be $(6.9 \pm 1.9 \pm 1.1^{+1.3}_{-1.0}) \times 10^{-8}$. This talk will present the ongoing efforts to update the branching fraction measurement, incorporating Run 2 data and achieving a 9 fb^{-1} luminosity, in order to reduce the uncertainties. In addition, a study of the differential branching fraction in bins of di-muon momentum q^2 is presented, representing the first measurement of this type in this mode.

T 29.2 Tue 16:30 KH 01.011

Electromagnetic corrections to leptonic charm decays — •Aritra Biswas[1], Max Ferre[2], Jack Jenkins[1], and Ipsita Ray[3] — [1]University of Siegen, Siegen, Germany — [2]Johannes Gutenberg University, Mainz, Germany — [3]University of Montreal, Montreal, Canada

We investigate the soft photon energy spectrum of leptonic charm decays $D_{(s)} \to l\nu(\gamma)$, $l = \mu, \tau$ at fixed order in the electromagnetic coupling, including hadronic substructure effects that are the dominant sources of theoretical uncertainty. We address the different scales involved in the problem with respect to the heavy and light leptonic final states. We find that the leading electromagnetic corrections are comparable to the experimental precision at BESIII in general. We also incorporate the effect of these corrections on model dependent/independent constraints in BSM scenarios and comment on the shift in the corresponding parameter space resulting from the inclusion of these corrections in the Standard Model estimate.

T 29.3 Tue 16:45 KH 01.011

Measurement of the $\pi^0 \to e^+e^-\gamma$ decay at NA62 — •Celia Polivka — Mainz Universitaet

The current value for the $\pi_D^0 \to e^+e^-\gamma$ Dalitz decay is $\mathcal{B}r(\pi_D^0) = (1.174 \pm 0.035) \cdot 10^{-2}$ and has a large uncertainty. This is a limiting factor for other measurements that use the Dalitz decay as normalisation channel. This analysis aims to improve the precision on this measurement using data from the NA62 experiment at CERN. The π^0 mesons are tagged by $K^+ \to \pi^+\pi^0$ decays. The π_D^0 is then identified by reconstruction of the three track vertex of e^+, e^- and π^+. Presented are the status of the analysis and an outlook on the precision of the measurement.

T 29.4 Tue 17:00 KH 01.011

Search for $B^+ \to K^{*+}\tau^+\tau^-$ with Hadronic Tagging at the Belle II Experiment — •Lennard Damer, Torben Ferber, and Pablo Goldenzweig — Institute of Experimental Particle Physics, Karlsruhe Institute of Technology, Karlsruhe, Germany

In recent years, hints for violation of lepton flavor universality have been observed in semileptonic B decays by various experiments. The flavor-changing neutral current process $b \to s\tau^+\tau^-$ is particularly sensitive to models which feature large couplings to third generation leptons or couplings proportional to the particle mass. Some theoretical models allow for an increase in the branching fraction of up to three orders of magnitude compared to the Standard Model prediction, which is within the observable range of the Belle II experiment. In this analysis, hadronic tagging is employed where the corresponding B meson partner in $\Upsilon(4S)$ decays is reconstructed in a variety of hadronic decay chains to increase the selection purity. This talk presents the status of the first search for $B^+ \to K^{*+}\tau^+\tau^-$ decays along with an estimate on the signal sensitivity.

T 29.5 Tue 17:15 KH 01.011

Early measurement of $r_{J/\psi}^{K,K^*}$ with 2024 data — Johannes Albrecht[1], Michele Atzeni[2], Lukas Calefice[3], Angel Fernando Campoverde Quezada[4], James Gooding[1], Carla Marin Benito[5,3], •Lorenzo Nisi[1], Renato Quagliani[5], Alessandro Scarabotto[1], Eluned Smith[2], and Pol Vidrier Villalba[3] — [1]TU Dortmund University, Dortmund, Germany — [2]Massachusetts Institute of Technology, Cambridge, United States — [3]Universitat de Barcelona, Barcelona, Spain — [4]University of Chinese Academy of Sciences, Beijing, China — [5]CERN, Geneva, Switzerland

During 2024, the LHCb experiment collected more than 9 fb^{-1} of integrated luminosity for pp collisions, recording approximately as many collisions as between 2011 and 2018. The performance of the upgraded LHCb detector in Run 3 of the LHC must be fully understood to perform precise measurements with this new dataset.

Measurements of ratios between B meson decays to final states containing different lepton pairs can be used to study lepton flavour universality, e.g., R_{K,K^*} between $B^{+(0)} \to K^{+(0*)}\mu^+\mu^-$ and $B^{+(0)} \to K^{+(0*)}e^+e^-$ decays. The $J/\psi \to \ell\ell$ resonant modes are commonly used as control channels and their ratio $r_{J/\psi}^{K,K^*}$ is well-understood to be consistent with unity. As such $r_{J/\psi}^{K,K^*}$ can be used to validate detector performance and data-MC corrections.

This contribution presents the progress towards a measurement of $r_{J/\psi}^{K,K^*}$ using 2024 data.

T 29.6 Tue 17:30 KH 01.011

Search for $B_c^+ \to B_s^0\mu^+\nu_\mu$ decays at LHCb — •Mikhail Chekal and Marco Gersabeck — Albert-Ludwigs-Universität Freiburg, Freiburg im Breisgau, Germany

Semileptonic decays are useful for probing new physics as they can be used to test lepton flavour universality. To date, $B_c^+ \to J/\psi\ell^+\nu_\ell$ remains the only semileptonic B_c^+ decay channel to be observed. A search for the semileptonic decay $B_c^+ \to B_s^0\mu^+\nu$ using the LHCb Run 3 data collected in 2024–2025 is presented. The strategy is to extract the $B_c^+ \to B_s^0\pi^+$ yield, which serves as the normalization channel, as well as the combined $B_c^+ \to B_s^0\mu^+\nu$ and $B_c^+ \to B_s^{*0}\mu^+\nu$, and compute their ratio of branching fractions. The B_s^0 candidates are reconstructed as $B_s^0 \to D_s^-(K^+K^-\pi^-)\pi^+$ and the results will later be combined with those of the second group working on the $B_s^0 \to J/\psi\phi$ channel. Methods, used for B_s^0 and B_c^+ candidates selection for the normalization and signal channels are presented.

T 29.7 Tue 17:45 KH 01.011

Update of the SM prediction for $\bar{B} \to X_s\gamma$ — •Tobias Huber[1], Mikolaj Misiak[2], Matthias Steinhauser[3], Mateusz Czaja[3], Michal Czakon[4], Kay Schönwald[5], Abdur Rehman[6], and Marco Niggetiedt[7] — [1]Theoretische Physik 1, Center for particle physics Siegen, University of Siegen, Germany — [2]Institute of Theoretical Physics, University of Warsaw, Poland. — [3]Institute for theoretical particle physics, KIT, Karlsruhe, Germany — [4]Institut f. Theoretische Teilchenphysik und Kosmologie, RWTH Aachen University, Germany — [5]CERN theory group, CERN, Geneva, Switzerland — [6]Department of Physics, University of Alberta, Edmonton, Canada — [7]Max Planck Institute for Physics, Munich, Germany

We will provide an update of the SM theory prediction for $\mathcal{B}(\bar{B} \to X_s\gamma)$, including, in particular, NNLO $Q_{1,2} - Q_7$ interferences with exact charm-quark mass dependence. Also phenomenologial implications such as constraints on the charged-Higgs mass in two-Higgs-doublet models will be given.

T 29.8 Tue 18:00 KH 01.011

B-meson decay width up to $1/m_b^3$ corrections within and beyond the Standard Model — •Ali Mohamed[1], Alexander Lenz[1], Martin Lang[1], Maria Laura Piscopo[2,3], and Alexey Rusov[4] — [1]Siegen University, Siegen, Germany — [2]Nikhef, Amsterdam, Netherlands — [3]Vrije Universiteit Amsterdam, Amsterdam, Netherlands — [4]Technische Universität München, München, Germany

We determine subleading power corrections to heavy-hadron decay rates within and beyond the Standard Model. In the SM, we compute previously unknown penguin-induced contributions to the chromomagnetic $(1/m_Q^2)$ and Darwin $(1/m_Q^3)$ operators in the Heavy Quark Expansion, improving predictions for B-hadron lifetimes.

Motivated by tensions in colour-allowed non-leptonic decays, we ex-

tend the analysis to a general BSM framework and provide complete contributions to the Wilson coefficients of the chromomagnetic and Darwin operators, including the calculation of BSM Weak Annihilation contributions. This completes the dimension-six BSM operator basis for non-leptonic decays.

Our results enable precise global SM analyses and model-independent new physics searches using lifetime observables such as $\tau(B_s)/\tau(B_d)$, closing a critical gap in the theoretical description of these quantities.