T 56: Flavour Physics 4

Time: Wednesday 16:15–18:30 Location: T-H15

T 56.1 Wed 16:15 T-H15

Bs mixing in scalar Leptoquark models — •Jordi Folch Eguren[1], Javier Virto[2], and Andreas Crivellin[3] — [1]University of Barcelona/TU Dortmund — [2]University of Barcelona — [3]PSI

Leptoquarks provide viable solutions to the flavour anomalies, i.e. they can explain the tensions between the measurements and the Standard Model predictions of the anomalous magnetic moment of the muon as well as b-s and b-c$\tau\nu$ processes.

However, LQs also contribute to other flavour observables, such as F = 2 processes, at the loop-level. In particular, Bs mixing provides a crucial bound in setups addressing b-c$\tau\nu$ data, often excluding a big portion of the parameter space that could otherwise account for it.

In this work, we first derive the complete leading order matching, including all five scalar LQ representations, for D0, K0 and Bs mixing (at the dimension-six level). We then calculate the next-to-leading order αs matching corrections to these F = 2 processes in generic scalar leptoquark models.

We find that the two-loop corrections increase the effects in F = 2 processes by 5-10% and significantly reduce the matching scale uncertainty.

T 56.2 Wed 16:30 T-H15

Testing the Standard Model with CP-asymmetries in flavour-specific non-leptonic decays — Tim Gershon[1], Alexander Lenz[2], •Aleksey Rusov[2], and Nicola Skidmore[3] — [1]Department of Physics, University of Warwick, Coventry, CV4 7AL, UK — [2]Center for Particle Physics Siegen, Theoretische Teilchenphysik, Universität Siegen, Walter-Flex-Str. 3, 57068 Siegen, Germany — [3]University of Manchester, Schuster Building, Manchester, M13 9PL, UK

Motivated by recent indications that the rates of colour-allowed non-leptonic channels are not in agreement with their Standard Model expectations based on QCD factorisation, we investigate the potential to study CP asymmetries with these decays. In the Standard Model, these flavour-specific decays are sensitive to CP violation in $B^0_{(s)}$–$\bar{B}^0_{(s)}$ mixing, which is predicted with low uncertainties and can be measured precisely with semileptonic decays. If there are beyond Standard Model contributions to the non-leptonic decay amplitudes, there could be significant enhancements to the CP asymmetries. Measurements of these quantities therefore have potential to identify BSM effects without relying on Standard Model predictions that might be affected by hadronic effects. We discuss the experimental prospects, and note the excellent potential for a precise determination of the CP asymmetry in $\bar{B}_s \to D_s^+\pi^-$ decays by the LHCb experiment.

T 56.3 Wed 16:45 T-H15

Endpoint divergences in QED corrections to $B_s \to \mu^+\mu^-$ — •Nicolas Seitz, Thorsten Feldmann, Tobias Huber, and Nico Gubernari — Center for Particle Physics Siegen, Theoretische Teilchenphysik, Universität Siegen

We consider leptonic B-meson decays of the form $B_s \to \mu^+\mu^-$. These are mediated in the standard model by operators of the effective weak Hamiltonian for $|\Delta B| = |\Delta S| = 1$ transitions. At leading order, only the semi-leptonic operator O_{10} contributes. If one calculates the QED corrections mediated by the operator O_7, the suppression by the fine-structure constant α is amplified by a factor $1/\lambda^2 = m_b/\Lambda_{\text{QCD}} \gg 1$ Here, one additionally obtains a quadratic logarithmic amplification $\propto \ln^2 \lambda^2$, which comes from endpoint divergences in regions of small momenta. The aim of our project is to investigate the interaction of QCD corrections on the hadronic side and the endpoint divergences of the muon propagator. An important technical tool here is the method of regions in the calculation of the loop integrals that occur.

T 56.4 Wed 17:00 T-H15

BSM effects in lifetimes of B mesons — •Jakob Müller, Alexander Lenz, Maria Laura Piscopo, and Aleksey Rusov — Center for Particle Physics Siegen, Theoretische Teilchenphysik, Universität Siegen

We study the impact of potential BSM contributions to non-leptonic b quark decays on observables like $\tau(B^+)/\tau(B_d)$ and $\tau(B_s)/\tau(B_d)$. These observables are measured with a precision of the order of several per mille. The corresponding theory predictions are obtained within the framework of the Heavy Quark Expansion.

T 56.5 Wed 17:15 T-H15

NLO QCD corrections to inclusive $b \to c\ell\bar{\nu}$ decay spectra up to $1/m_b^3$ — Thomas Mannel, •Daniel Moreno, and Alexei A. Pivovarov — Center for Particle Physics Siegen, Theoretische Physik 1, Universität Siegen, 57068 Siegen, Germany

We present analytical results for higher order corrections to the decay spectra of inclusive semileptonic heavy hadron weak decays, using the heavy quark expansion (HQE). We describe the analytical computation of the spectrum of the leptonic invariant mass for $B \to X_c\ell\bar{\nu}$ up to terms of order $1/m_b^3$ within the HQE at next-to-leading order (NLO) in α_s. The full dependence of the differential rate on the mass of the final-state quark is taken into account. We discuss the implications of our results for the precision determination of the CKM matrix element $|V_{cb}|$.

T 56.6 Wed 17:30 T-H15

Towards completion of the four-body contributions to $\bar{B} \to X_s\gamma$ at NLO — Tobias Huber and •Lars-Thorben Moos — Center for Particle Physics Siegen, Theoretische Teilchenphysik, Universität Siegen

The inlusive radiative $\bar{B} \to X_s\gamma$ decay constitutes an important pillar in the indirect search for new physics and allows to constrain the parameter space of many models.

In this talk we present the ongoing efforts in the computation of four-body contributions to the process $\bar{B} \to X_s\gamma$, namely those of $b \to sgg\gamma$ at NLO in the strong coupling and the necessary complementing 5-particle cuts of the gluon-bremsstrahlung $b \to sgg\gamma + g$.

Although these corrections are expected to be small, this computation formally completes the NLO contributions to $\bar{B} \to X_s\gamma$.

Since the anomalous dimensions are already computed to a sufficient order, the main tasks are the systematic generation of the 1-loop amplitude, the automation of the phase space integration, the infrared-regularization and finally the renormalization of the diagrams including the operator mixing.

The results obtained so far are shown and the further structure of the calculation is outlined.

T 56.7 Wed 17:45 T-H15

Improved theory determination of $|V_{ub}|$ from inclusive B-decays — •Kevin Olschewsky — Center for Particle Physics (CPPS), Siegen University

Inclusive B-meson decays into light final state particles like the semileptonic $\bar{B} \to X_u\ell\bar{\nu}$ are of great importance for the precise determination of the Cabbibo-Kobayashi-Maskawa (CKM) matrix element $|V_{ub}|$. With the unprecedented amount of experimental data, it becomes more and more important to have sound theoretical predictions with small and controllable uncertainties.

In order to obtain the $\bar{B} \to X_u\ell\bar{\nu}$ decay rate, the much larger $b \to c$ background has to be removed by appropriate kinematical cuts. Theoretically the calculation of partial decay rates in this region of phase space where $\bar{B} \to X_c\ell\bar{\nu}$ decays are suppressed requires the introduction of a non-perturbative distribution function; the "shape function" (SF).

In this talk I will present an update for the BLNP framework, which is based on the soft-collinear effective field theory framework. This includes updates for all known perturbative quantities as well as new parameterizations for the SF. Our systematic approach in modelling the SF allows us to provide a sound error analysis based on even higher orders in the Heavy Quark Expansion than before.

T 56.8 Wed 18:00 T-H15

Dispersive bounds for local form factors of $\Lambda_b \to \Lambda$ — Thomas Blake[1], Stefan Meinel[2], •Muslem Rahimi[3], and Danny van Dyk[4] — [1]Department of Physics, University of Warwick, UK — [2]Department of Physics, University of Arizona, USA — [3]Center for Particle Physics Siegen, Theoretische Physik 1, Universität Siegen, Germany — [4]Physik Department T31, Technische Universität München, Germany

We investigate the 10 form factors relevant to the b-baryon decay $\Lambda_b \to \Lambda\ell^+\ell^-$ by combining information of Lattice QCD and dispersive bounds. To this end, we use a parametrization of the local form

factors in terms of orthonormal polynomials with respect to the dispersive integral kernel. Our approach provides control over the form factor uncertainties due to truncation of the series expansion and extrapolation to the region of low momentum transfer, which is of great phenomenological interest.

T 56.9 Wed 18:15 T-H15

B-meson decay into a proton and dark antibaryon from QCD light-cone sum rules — Alexander Khodjamirian and •Marcel Wald — Center for Particle Physics Siegen, Theoretische Teilchenphysik, Universität Siegen

Recently, a B-Mesogenesis scenario was suggested to simultaneously solve the baryon asymmetry and relic dark matter abundance problems. In this scenario, decays of B-mesons into a baryon and dark antibaryon in the final state are expected with an appreciable branching fraction within the reach of modern B factories. We suggest to apply QCD light-cone sum rules to the decay mode $B^+ \to p\Psi$, where Ψ is a dark antibaryon. With this method we obtain the $B \to p$ hadronic matrix element of the three-quark effective operator in terms of the nucleon light-cone distribution amplitudes and estimate the partial width.