T 6: Flavour physics I

Time: Monday 16:00–18:30 Location: Tf

T 6.1 Mon 16:00 Tf

Lepton universality and lepton flavor conservation tests with dineutrino modes — •Hector Gisbert, Rigo Bause, Marcel Golz, and Gudrun Hiller — TU Dortmund

$SU(2)_L$-invariance links charged dilepton $\bar{q}\,q'\,\bar{\ell}\,\ell$ and dineutrino $\bar{q}\,q'\,\bar{\nu}\,\nu$ couplings. This connection can be established using SMEFT and holds model-independently if only SM-like left-handed light neutrinos are present. It allows to perform complementary experimental tests of lepton universality and charged lepton flavor conservation with flavor-summed dineutrino observables. The phenomenological implications of this novel idea will be discussed in detail.

T 6.2 Mon 16:15 Tf

Search for the lepton flavour violating decay $\tau^- \to \mu^-\mu^+\mu^-$ with the LHCb experiment — •Rowina Caspary, Flavio Archilli, Giulia Frau, and Chishuai Wang for the LHCb-Collaboration — University of Heidelberg, Physikalisches Institut Heidelberg, Germany

Lepton flavour violationg (LFV) decays are within the Standard Model only possible by higher order diagrams including neutrino oscillation. Thus they are highly suppressed. However, some theories including beyond Standard Model phenomena predict branching fractions within an experimentally accessible range. The LHCb experiment is well equipped to search for these decays due to its excellent vertex and momentum resolution and its particle identification capabilities. An upper limit on the branching fraction of the LFV decay $\tau^- \to \mu^-\mu^+\mu^-$ has been measured by the LHCb experiment using data collected in the years 2011 and 2012. In this talk we present the expected sensitivity of the analysis exploiting the data taken in the years 2016 and 2018 and we will discuss improvements to the original analysis strategy.

T 6.3 Mon 16:30 Tf

A feasibility study for the search of lepton flavour violating decay $\tau^- \to \phi(K^+K^-)\mu^-$ at LHCb — •Chishuai Wang, Flavio Archilli, Rowina Caspary, and Giulia Frau for the LHCb-Collaboration — Physikalisches Institut, Heidelberg, Germany

The Lepton Flavour Violating (LFV) decays are highly suppressed in the Standard Model and only possible via higher order diagrams including neutrino oscillation. However, potential new physics models can significantly enhance their branching frations. For example, leptoquark hinted by some recent test of lepton univerisality might have significant contributions to the decay $\tau^- \to \phi(K^+K^-)\mu^-$. In this talk, we will present a feasibility study to search LFV decay $\tau^- \to \phi(K^+K^-)\mu^-$ based on the data collected by LHCb experiment during the years from 2016 to 2018. In LHCb, copious τ leptons are produced in the decays of $D_s^\pm$, $D^\pm$ and b-hadrons. This search is dominated by a background decay $D_s^+ \to \phi(K^+K^-)\mu^+\nu_\mu$ which is highly similar with the signal in decay topology.

T 6.4 Mon 16:45 Tf

First Results and Prospects for $\tau \to e + \alpha$(invisible) at Belle II — •Thomas Kraetzschmar for the Belle II-Collaboration — Max-Planck-Insitut für Physik (Werner-Heisenberg-Insitut), München, Deutschland

The Belle II experiment at SuperKEKB, an asymmetric e^+e^- collider, aims at a total integrated luminosity of 50 ab^{-1}, to pursue a rich program of Standard Model and Beyond the Standard Model physics. Until the end of 2020 and beginning of 2021 about 100 fb^{-1} were collected at the $\Upsilon(4S)$ resonance. This results in a sizeable sample of τ pairs, enabling detailed studies of Standard and Beyond the Standard Model measurements, including searches for Lepton Flavor Violating (LFV) decays. One of the first channels where competitive limits are expected is the $\tau \to e + \alpha$(invisible) process, where α is a Goldstone boson. Here, the currently best limit has been obtained by ARGUS with an integrated luminosity of 475 pb^{-1}. Belle II is expected to be able to improve on this result already with the data recorded. This contribution will discuss the expected reach of the measurements with the current data set, and the progress towards a new upper limit.

T 6.5 Mon 17:00 Tf

The pion light-cone distribution amplitude from the pion electromagnetic form factor — Shan Cheng[1], Alexander Khodjamirian[2], and •Aleksey Rusov[2] — [1]Hunan University, Changsha, China — [2]Universität Siegen, Germany

We suggest a new way of probing the pion light-cone distribution amplitude using the dispersion relation for the pion electromagnetic form factor. It relates the spacelike pion form factor, for which the QCD light-cone sum rule is used, with the timelike form factor obtained from the data. Adopting for the pion twist-2 distribution amplitude an ansatz with the first few Gegenbauer polynomials, it is possible to fit their coefficients $a_{2,4,6,\ldots}$ (Gegenbauer moments) from the dispersion relation. For the exploratory fit we use the data of the BaBar collaboration. The results definitely exclude the asymptotic shape of the twist-2 distribution amplitude, also the model with a single $a_2 \neq 0$ is disfavoured by the fit. Considering scenarios with $a_{n>2} \neq 0$, we find that the fitted values of the second and fourth Gegenbauer moments cover the intervals $a_2(1\mathrm{GeV}) = (0.22-0.33)$, $a_4(1\mathrm{GeV}) = (0.12-0.25)$. The higher moments starting from a_8 are consistent with zero, albeit with large uncertainties.

T 6.6 Mon 17:15 Tf

Search for $\pi^o \to$ *invisible* decays with the NA62 experiment — •Letizia Peruzzo — Johannes Gutenberg University, Mainz

The search for new physics beyond the Standard Model (SM) is one of the most active fields in particle physics. Complementary to direct searches for new processes at high-energy scale, rare or forbidden SM decays are investigated to look for deviations from the predictions. The NA62 experiment at the CERN SPS, designed for the measurement of the ultra-rare decay $K^+ \to \pi^+\nu\bar{\nu}$, investigates new-physics contributions in the kaon and pion sector. The highly efficient, hermetic photon-veto system makes NA62 a perfect apparatus for a high-sensitivity search for π^o decays into invisible particles. In a fraction of data collected by NA62 in 2017, about 8.4×10^9 π^o mesons have been tagged from the reconstruction of the second most-abundant K^+ decay, $K^+ \to \pi^+\pi^o(\gamma)$. The background rejection power for visible π^o decays, ranging from $\mathcal{O}(10^8)$ to $\mathcal{O}(10^9)$, is estimated by the combination of data-based studies and Monte Carlo simulations, a novel experimental technique with respect to that used in the most sensitive previous experimental result. The analysis is performed with the blind technique for a cut-based signal region. No signal is observed in excess of the expected background fluctuations. The resulting upper limit on the branching ratio, $\mathrm{BR}(\pi^o \to \mathit{invisible}) \leq 4.4 \times 10^{-9}$ at 90% confidence level, improves on the previous best limit by a factor of 60. As a by-product of the analysis, the decay $K^+ \to \pi^+X$ is investigated, where X is a neutral particle escaping detection with a mass in the range 0.110–0.155 GeV/c^2 and rest lifetime greater than 100 ps.

T 6.7 Mon 17:30 Tf

Evidence for the decay $K^+ \to \pi^+\nu\bar{\nu}$ from the NA62 experiment at CERN — •Radoslav Marchevski — JGU Mainz

The ultra-rare decay $K^+ \to \pi^+\nu\bar{\nu}$ benefits from a precisely predicted branching ratio in the SM of $(8.4 \pm 1.0) \times 10^{-11}$, being almost free from theoretical uncertainties, and most importantly of very high sensitivity to a variety of beyond-the-standard-model scenarios, making it one of the best candidates to reveal indirect effects of new physics in the flavour sector. The NA62 experiment at the CERN SPS, designed to measure the branching ratio of $K^+ \to \pi^+\nu\bar{\nu}$ with a decay-in-flight technique, collected data in 2016-2018. New results from the analysis of the 2018 data, the largest data set so far collected, will be presented. The result represents the most accurate measurement of this ultra-rare decay achieved so far. Future prospects and plans for further data taking starting in 2021 will also be presented.

T 6.8 Mon 17:45 Tf

Rare charm $c \to u\nu\bar{\nu}$ dineutrino null test for e^+e^-–machines — •Rigo Bause, Hector Gisbert, Marcel Golz, and Gudrun Hiller — TU Dortmund

Rare $|\Delta c| = |\Delta u| = 1$ transitions into dineutrinos are strongly GIM-suppressed and constitute excellent null tests of the standard model. While branching ratios of $c \to u\,\nu\bar{\nu}$ transitions are experimentally unconstrained, signals of new physics can be just around the corner.

Signatures of these modes, including $D \to P\,\nu\bar{\nu}$ or $D \to P^+P^-\,\nu\bar{\nu}$ with $P = \pi, K$, $\Lambda_c \to p\,\nu\bar{\nu}$, contain missing energy and are well suited for experimental searches at e^+e^-–facilities, such as BES III, Belle II

and future e^+e^-–colliders, such as the FCC-ee running at the Z.

Using current bounds on $c \to u\,\ell^+\ell^-$ transitions, model-independent upper limits on branching ratios assuming lepton universality and charged lepton flavour conservation are presented (arxiv:2010.02225). An observation in excess of these upper limits implies a breakdown of the corresponding symmetry.

T 6.9 Mon 18:00 Tf

Radiative three-body D-meson decays in and beyond the standard model — •Nico Adolph[1], Joachim Brod[2], and Gudrun Hiller[1] — [1]Technische Universität Dortmund, Dortmund, Deutschland — [2]University of Cincinnati, Cincinnati, USA

We study radiative charm decays $D \to P_1P_2\gamma$, $P_{1,2} = \pi, K$ in QCD factorization at leading order and within heavy hadron chiral perturbation theory. Branching ratios including resonance contributions are around $\sim 10^{-3}$ for the Cabibbo-favored modes into $K\pi\gamma$ and $\sim 10^{-5}$ for the singly Cabibbo-suppressed modes into $\pi^+\pi^-\gamma, K^+K^-\gamma$, and thus in reach of the flavor factories BES III and Belle II. Dalitz plots and forward-backward asymmetries reveal significant differences between the two QCD frameworks; such observables are therefore ideally suited for a data-driven identification of relevant decay mechanisms in the standard-model dominated $D \to K\pi\gamma$ decays. This increases the potential to probe new physics with the $D \to \pi^+\pi^-\gamma$ and $D \to K^+K^-\gamma$ decays, which are sensitive to enhanced dipole operators. CP asymmetries are useful to test the SM and look for new physics in neutral $|\Delta C| = 1$ transitions.

T 6.10 Mon 18:15 Tf

Search for D^* and D Mesons at Belle using hadronic tagging of B Mesons — •Maximilian Graf, Florian Bernlochner, Jochen Dingfelder, Michael Eliachevitch, Markus Prim, Wiliam Sutcliffe, and Maximilian Welsch for the Belle II-Collaboration — Physikalisches Institut der Rheinischen Friedrich-Wilhelms-Universität Bonn, 53115 Bonn, Germany

Belle II is a next generation Super$B$-Factory located in Tsukuba in Japan, that recently started its first physics data taking period. One particular important result Belle II aims to measure is the CKM matrix element V_{cb}. One clean approach for such measurements involves hadronic tagging, where low yields are balanced by very clean samples. In this talk, I present the current status of measurements of semileptonic $B \to D^{(*)}\,\ell\bar{\nu}_\ell$ decays and their role in calibrating hadronic tagging efficiencies. In addition, I present first background subtracted spectra of the recoil parameter w and the relevant decay angles for the D^* final state.