T 30: Flavour Physics 3

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

T 30.1 Tue 16:15 T-H15

Time-Dependent Charge-Parity Violation at Belle II — •Caspar Schmitt — Max-Planck Institute for Physics, Munich, Germany

Overconstraining the unitarity triangle of the Cabibbo-Kobayashi-Maskawa mixing matrix by precision measurements is an essential test for the description of weak currents in the standard model (SM) of particle physics. We thereby test our present understanding of charge-parity (CP) violation in the quark sector and search for CP violation beyond the SM, necessary to explain the observed baryon-asymmetry in the universe.

We present time-dependent measurements of CP violation and flavor mixing in the B meson system using data from the Belle II Experiment. We introduce the measurement principles of time-dependent analyses at B factories and put emphasis on our latest analysis of flavor mixing in the neutral B meson system. In particular, we focus on the treatment and estimation of uncertainties resulting from residual background processes.

T 30.2 Tue 16:30 T-H15

Inclusive analysis of untagged $B \to X l^+ l^-$ decays at Belle II — •Sviatoslav Bilokin and Thomas Kuhr — Geschwister-Scholl-Platz 1, Munchen, Germany

The $b \to s(d) l^+ l^-$ processes are sensitive to New Physics phenomena since these decays may only occur through loops in the Standard Model.

This contribution describes a study of $b \to s(d) l^+ l^-$ decays at the Belle II experiment using a fully-inclusive approach, where we have no explicit restrictions on the quark hadron final states. So far, no results of fully inclusive $b \to s(d) l^+ l^-$ studies have been published because of the small signal branching ratio in the Standard Model, limited efficiency of the established tagging methods, and high rate of background processes.

This analysis intends to use machine learning techniques to reject background processes and an unrestricted tag side to measure $R(X) = \mathcal{B}(B \to X\mu^+\mu^-)/\mathcal{B}(B \to Xe^+e^-)$ as a lepton universality test, similarly to $R(K)$ and $R(K^*)$ measurements, which are known for their deviations from the Standard Model predictions.

T 30.3 Tue 16:45 T-H15

Belle II results on charmless hadronic B-decays and prospects — •Justin Skorupa, Thibaud Humair, Hans-Günther Moser, Markus Reif, and Benedikt Wach — Max Planck Institute for Physics

The Belle II experiment at the SuperKEKB e+ e- accelerator in Tsukuba, Japan, aims to constrain the parameters of the Cabibbo-Kobayashi-Maskawa matrix by measuring the size of the sides and angles of the unitary triangle associated to B-meson decays. Possible non-closure of the triangle would provide a hint for physics beyond the Standard Model. Belle II will significantly improve the accuracy of the determination of the angle ϕ_2 of the unitary triangle due to the large yield of expected charmless hadronic B-meson decays. Measurements of branching ratios of several charmless hadronic B-meson decays using 190 fb^{-1} of Belle II data are presented.

T 30.4 Tue 17:00 T-H15

Search for the lepton flavour violating decay $B^0 \to \tau^\pm \ell^\mp$ — •Nathalie Eberlein, Thomas Lück, and Thomas Kuhr — Ludwig-Maximilians-Universität, München

Lepton flavour is conserved in the Standard Model, but violated in many new physics models. An observation of the $B^0 \to \tau^\pm \ell^\mp$ decay, where $\ell = \text{e}/\mu$, would be a clear sign for new physics.

At B factories one can determine the kinematics of the signal B meson by fully reconstructing the accompanying B meson in $e^+e^- \to \Upsilon(4\text{S}) \to \text{BB}$ events. In the rest frame of the signal B meson the mono-energetic lepton provides a clean signature to identify the signal decays. This talk presents the current status of the search for $B^0 \to \tau^\pm \ell^\mp$ decays with Belle data using the Full Event Interpretation algorithm for the reconstruction of the accompanying B meson.

T 30.5 Tue 17:15 T-H15

Search for the LFV Decay $\tau \to \mu\pi^0$ — •Marton Nemeth-Csoka, Felix Meggendorfter, and Christian Kiesling — Max-Planck-Institute for Physics Munich

During its runtime from 1999 to 2010 the Belle experiment was able to confirm the Kobayashi-Maskawa theory about the occurrence of $\mathcal{CP}$ violation and by this played a decisive role in firmly establishing the Standard Model (SM). However, there is also convincing evidence for physics beyond the SM.

Belle's upgraded successor Belle II aims for a higher precision with a goal to collect 50 times more data than Belle, a total integrated luminosity of $L_{\text{int}} = 50ab^{-1}$.

This work focuses is on the lepton flavor violating decay $\tau \to \mu\pi^0$ with the goal to explore the prospects of finding New Physics in this particular channel.

In the analysis, the decay simulated by a Monte Carlo software including detectors and full reconstruction to get an understanding of the overall kinematics. When studying the background, the largest background is that of the pair production of muons, together with light quarks and τ that decay according to the predictions of the SM.

After applying kinematic cuts and requiring a moderate confidence threshold for the identification of the muon, only 5.3% of the signal is left, but the background is fully suppressed in a sample equaling $100fb^{-1}$.

T 30.6 Tue 17:30 T-H15

Analysis of $B \to \mu\nu$ with inclusive tagging at Belle II — Florian Bernlochner, Jochen Dingfelder, •Daniel Jacobi, Peter Lewis, and Markus Prim for the Belle II-Collaboration — Physikalisches Institut der Rheinischen Friedrich-Wilhelms-Universität Bonn

$B\overline{B}$ meson pairs are the dominant decay products of the $\Upsilon(4S)$ resonance, which is produced in large amounts in e^+e^- collisions at the SuperKEKB collider in Japan, and their decays are measured by the Belle II experiment. Leptonic B meson decays such as $B \to \mu\nu$ are highly CKM- and helicity-suppressed. In a two-body decay like $B \to \mu\nu$, the muon momentum is exactly known in the rest frame of the signal-side B meson. By boosting the signal-side muon into that frame, a better signal resolution and improved sensitivity can thus be achieved compared to the center-of-mass frame. This requires a high-precision for the boost vector, which can be determined from the rest of the event that contains the decay products of the second B meson. At the same time, this information can be used to reconstruct the kinematics of the signal-side B meson. Boosted decision trees are trained to suppress background and increase signal purity. This talk will discuss the current status of the analysis and present approaches to maximize the sensitivity of the measurement of $B \to \mu\nu$ at Belle II, and will additionally provide an outlook on the search for sterile neutrinos.

T 30.7 Tue 17:45 T-H15

First Results and Prospects for $\tau \to \ell + \alpha(\text{invisible})$ 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 the beginning of 2021, 62.8 fb^{-1} were collected at the $\Upsilon(4S)$ resonance. This data set 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 $\tau \to \ell + \alpha(\text{invisible})$ 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 will improve on this result with the recorded data. This contribution will discuss the first results of this search.

T 30.8 Tue 18:00 T-H15

Tau lifetime measurement at Belle II — •Anselm Baur and Daniel Pitzl — Deutsches Elektronen Synchrotron (DESY), Hamburg, Germany

The tau-lepton lifetime represents a fundamental parameter within the Standard Model framework, contributing to the test of lepton flavor universality. Exploiting the vertex detector resolution and the tiny

beam spot size at the interaction point, Belle II is expected to improve the present tau-lifetime value. The event topology where one tau decays to three charged hadrons (3-prong) and the other tau goes to a charged pion or lepton, allows to have an higher event yield respect to 3-prong vs 3-prong topology studied by Belle. Therefore, a measurement with a statistical uncertainty competitive with the world average could already be performed using Zech's Monte Carlo re-weighting method with an early Belle II dataset.

T 30.9 Tue 18:15 T-H15

Optimization of the K_L^0 detection and rejection at Belle II — Florian Bernlochner, Jochen Dingfelder, Peter Lewis, and •Lucas Stötzer for the Belle II-Collaboration — Physikalisches Institut der Rheinischen Friedrich-Wilhelms-Universität Bonn

We investigate an optimization of the reconstruction of K_L^0 mesons in the Belle II experiment. K_L^0 mesons are challenging to detect and identify because they are chargeless, and due to their long lifetime they typically do not decay within the Belle II detector. The main way to detect them is via hadronic showers in the K-Long-Muon detector (KLM). However, the detection efficiency is low and background clusters are common, which limits the usability of the KLM clusters in physics analyses. Thus, we seek to improve the discrimination between KLM clusters produced by K_L^0 showers and background sources using a clean sample of K_L^0 mesons from the process $e^+e^- \to \gamma_{\mathrm{ISR}}\,[\phi \to K_L^0 K_S^0]$. The K_S^0 will mainly decay to two charged pions. Thus, by finding the high energy photon (γ_{ISR}) and reconstructing the K_S^0 from the pions, the four-momentum of the K_L^0 can be inferred. This allows for a direct comparison between KLM clusters from K_L^0 and background sources. Further, we investigate whether K_L^0 showers deposited in the electromagnetic calorimeter can be used to improve the K_L^0 detection efficiency while maintaining high purity.