

## T 94: Flavour Physics VI

Time: Friday 9:00–10:30

Location: VG 1.104

T 94.1 Fri 9:00 VG 1.104

**Test of Lepton Flavour Universality with  $\Lambda_b^0 \rightarrow pK^- \ell^+ \ell^-$  decays at LHCb** — JOHANNES ALBRECHT<sup>1</sup>, VITALII LISOVSKIY<sup>2</sup>, and ●JANNIS SPEER<sup>1</sup> — <sup>1</sup>TU Dortmund University, Dortmund, Germany — <sup>2</sup>CPPM, Marseille, France

Rare decays mediated by  $b \rightarrow s\ell^+\ell^-$  transitions provide a diverse range of probes for the SM. These include null tests of fundamental principles of the SM, such as lepton flavour universality (LFU), which asserts that the gauge bosons couple equally to all three generations of leptons.

The LHCb experiment has performed several measurements of LFU in rare decays, most prominently the ratio of branching fractions between  $b$ -meson decays with electrons and muons in the final state. LFU can also be studied in rare  $b$ -baryon decays, which are affected by partly orthogonal experimental and theoretical uncertainties. The first measurement of the ratio of branching fractions of the decays  $\Lambda_b^0 \rightarrow pK^- e^+ e^-$  and  $\Lambda_b^0 \rightarrow pK^- \mu^+ \mu^-$ ,  $R_{pK}^{-1}$ , was performed by the LHCb collaboration using  $pp$  collision data corresponding to an integrated luminosity of  $4.7\text{fb}^{-1}$ . The ratio was measured to be  $R_{pK}^{-1} = 1.17_{-0.16}^{+0.18} \pm 0.07$  in the dilepton mass-squared range  $0.1 < q^2 < 6.0\text{GeV}^2/c^4$  and the  $pK$  mass range  $m(pK) < 2600\text{MeV}/c^2$ . The updated measurement of  $R_{pK}^{-1}$  aims to minimize the uncertainties by using the full  $9\text{fb}^{-1}$  LHCb  $pp$  dataset and implementing enhanced analysis techniques.

This contribution provides an update on the current progress of the ongoing analysis.

T 94.2 Fri 9:15 VG 1.104

**Search for  $B^+ \rightarrow K^{*+} \tau^+ \tau^-$  with Hadronic Tagging at the Belle II experiment** — ●LENNARD DAMER, TORBEN FERBER, and PABLO GOLDENZWEIG — Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology (KIT)

In recent years, intriguing hints for violation of lepton flavor universality have been accumulated in semileptonic  $B$  decays with the help of various experiments.

The flavor-changing neutral current process  $b \rightarrow s\tau^+\tau^-$  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  $B^+ \rightarrow K^{*+} \tau^+ \tau^-$  decays along with an estimate on the signal sensitivity.

T 94.3 Fri 9:30 VG 1.104

**Fully inclusive analysis of untagged  $B \rightarrow X\ell^+\ell^-$  decays at Belle II** — ●ARUL PRAKASH, SVIATOSLAV BILOKIN, NIKOLAI KRUG, and THOMAS KUHR — Ludwig-Maximilians-Universität München

In recent years various deviations from the standard model expectation were observed in  $b \rightarrow s\ell^+\ell^-$  measurements, dominated by exclusive studies. The combined deviations, while being large, are still not above the  $5\sigma$  discovery threshold, partially owing to theoretical uncertainties. Precision measurements of inclusive  $B \rightarrow X\ell^+\ell^-$  decays can provide invaluable complementary information to scrutinize anomalies observed in their exclusive decay counterparts. However, limited tagging efficiency, small Standard Model signal and very high background rate make these measurements extremely challenging, with no results being published so far.

In our work, we will evaluate the chances of a  $5\sigma$  result with data

from the Belle and Belle II experiments and estimate systematics with Monte Carlo simulations. We will apply machine learning algorithms to tackle background rejection. We will finally measure the branching fractions  $B(B \rightarrow X\mu^+\mu^-)$  and  $B(B \rightarrow Xe^+e^-)$  which will be key to constrain potential New Physics contributions.

T 94.4 Fri 9:45 VG 1.104

**Early measurement of  $r_{J/\psi}^{K,K^*}$  with 2024 data** — JOHANNES ALBRECHT<sup>1</sup>, MICHELE ATZENI<sup>2</sup>, LUKAS CALEFICE<sup>3</sup>, ANGEL FERNANDO CAMPOVERDE QUEZADA<sup>4</sup>, JAMES GOODING<sup>1</sup>, CARLA MARIN BENITO<sup>5,3</sup>, ●LORENZO NISI<sup>1</sup>, RENATO QUAGLIANI<sup>5</sup>, ALESSANDRO SCARABOTTO<sup>1</sup>, ELUNED SMITH<sup>2</sup>, and POL VIDRIER VILLALBA<sup>3</sup> — <sup>1</sup>TU Dortmund University, Dortmund, Germany — <sup>2</sup>Massachusetts Institute of Technology, Cambridge, United States — <sup>3</sup>Universitat de Barcelona, Barcelona, Spain — <sup>4</sup>University of Chinese Academy of Sciences, Beijing, China — <sup>5</sup>CERN, Geneva, Switzerland

During 2024, the LHCb experiment collected more than  $9\text{fb}^{-1}$  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  $B^{+(0)} \rightarrow K^{+(0*)} \mu^+ \mu^-$  and  $B^{+(0)} \rightarrow K^{+(0*)} e^+ e^-$  decays. The  $J/\psi \rightarrow \ell\ell$  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 94.5 Fri 10:00 VG 1.104

**Dalitz analysis on  $B^+ \rightarrow K_S^0 \pi^+ \pi^0$**  — ●OSKAR TITTEL, STEFAN WALLNER, HANS-GÜNTHER MOSER, and MARKUS REIF — Max-Planck Institut für Physik, München

The Belle II experiment in Tsukuba, Japan, is working at the high-intensity frontier of the search for physics beyond the Standard Model (SM). A direct test of the SM is the verification of the so-called "isospin sum-rule" in the  $B \rightarrow K^* \pi$  system, which depends on the branching fractions (BF's) and the direct CP asymmetries of all  $B \rightarrow K^* \pi$  decay modes. These quantities can be extracted from Dalitz analyses on the decay channels  $B^0 \rightarrow K^+ \pi^- \pi^0$  and  $B^+ \rightarrow K_S^0 \pi^+ \pi^0$ .

I will present the Belle II experiment, introduce the isospin sum rule and show the current state of the analysis on  $B^+ \rightarrow K_S^0 \pi^+ \pi^0$ .

T 94.6 Fri 10:15 VG 1.104

**Search for the  $B^0 \rightarrow D^0 \bar{D}^0$  decay with the LHCb experiment** — JOHANNES ALBRECHT, ●JONAH BLANK, QUENTIN FÜHRING, and SOPHIE HOLLITT — TU Dortmund University, Dortmund, Germany

With precise measurements of  $B$  meson decays, the LHCb experiment can test the integrity of the Standard Model of particle physics.  $B \rightarrow DD$  decays are particularly interesting probes of  $CP$  violation, further constraining the unitarity triangle. While decays to charged  $D^\pm$  mesons have already been well measured, the  $B^0 \rightarrow \bar{D}^0 D^0$  decay channel has not yet been observed by any experiment. In this analysis, data collected in  $pp$  collisions by the LHCb experiment at  $\sqrt{s} = 7, 8$  and  $13\text{TeV}$  corresponding to an integrated luminosity of  $9\text{fb}^{-1}$  is used to search for the  $B^0 \rightarrow \bar{D}^0 D^0$  decay channel. The topologically similar  $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$  decay channel is utilized as a normalisation mode to cancel systematic uncertainties.

An update on the current status of the analysis will be presented.