

T 74: Flavor physics: CKM II

Time: Thursday 16:30–19:00

Location: H-HS XI

T 74.1 Thu 16:30 H-HS XI

Angular analysis of $B^0 \rightarrow K^{*0}e^+e^-$ at the LHCb experiment — MARTINO BORSATO, STEPHANIE HANSMANN-MENZEMER, and •JIANGQIAO HU — Physikalisches Institut, Heidelberg, Germany

The rare decay $B^0 \rightarrow K^{*0}e^+e^-$ is a flavor-changing neutral current process that occurs at loop level and is forbidden at tree level in the Standard Model. The rarity of the decay means that the modifications by contributions from new physics could be comparable with the Standard Model predictions. In particular, the study of the angular distribution of its final state particles offers an theoretically clean probe to search for new physics.

The momentum resolution of electrons is inferior than that of muons at LHCb due to the large amount of energy emitted through bremsstrahlung before the spectrometer. For this reason, the previous analysis of $B^0 \rightarrow K^{*0}e^+e^-$ at LHCb has been limited to the low dielectron mass squared (q^2) region while the angular analysis of $B^0 \rightarrow K^{*0}\mu^+\mu^-$ was carried out in the full q^2 range. However the higher q^2 region is very interesting for testing lepton flavor universality paradigm which has been recently challenged by several LHCb branching ratio measurements. In this talk, we will present the early studies in the high q^2 region for the angular analysis of $B_0 \rightarrow K^{*0}e^+e^-$ at the LHCb experiment.

T 74.2 Thu 16:45 H-HS XI

Branching fraction measurement of $B_s^0 \rightarrow \phi\mu^+\mu^-$ and search for $B_s^0 \rightarrow f_2'(1525)\mu^+\mu^-$ using LHCb data — •SOPHIE KRETZSCHMAR, CHRISTOPH LANGENBRUCH, and ELUNED SMITH — I. Physikalisches Institut B, RWTH, Aachen

The LHCb detector at CERN is an experiment optimised to study b -quarks, which are produced copiously in the proton-proton collisions at the Large Hadron Collider (LHC). The flavour-changing neutral current (FCNC) process $b \rightarrow s\ell^+\ell^-$ is of particular interest since it occurs only via higher order loop corrections in the Standard Model (SM), and thus can be significantly affected by new heavy particles beyond the SM.

The rare decay $B_s^0 \rightarrow \phi\mu^+\mu^-$ has been previously analysed by the LHCb collaboration using data taken in 2011 and 2012 during Run 1. The $B_s^0 \rightarrow \phi\mu^+\mu^-$ branching fraction was measured to be more than 3σ below the SM expectation. An updated measurement is performed including the data taken by the LHCb experiment during the LHC Run 2, which will provide more insight on the nature of this discrepancy with the SM.

A similar decay that incorporates a b - to s -quark transition is $B_s^0 \rightarrow f_2'(1525)\mu^+\mu^-$. This decay has not been observed yet, but will be accessible with the combined Run 1 and Run 2 dataset.

This talk will give an overview of the on-going analysis of the combined Run 1 and Run 2 LHCb data sample that is used to measure the branching fractions of the decay $B_s^0 \rightarrow \phi\mu^+\mu^-$ and search for $B_s^0 \rightarrow f_2'(1525)\mu^+\mu^-$.

T 74.3 Thu 17:00 H-HS XI

Angular analysis of $B_s^0 \rightarrow \phi\mu^+\mu^-$ decays — •MARCEL MATEROK, CHRISTOPH LANGENBRUCH, and ELUNED SMITH — I. Physikalisches Institut B, RWTH Aachen University

The LHCb experiment at the LHC is dedicated to the search for new phenomena beyond the Standard Model (SM) through precision measurements of heavy flavour decays. Rare semileptonic $b \rightarrow s\mu^+\mu^-$ decays are particularly interesting as they constitute flavour changing neutral currents that are forbidden at tree-level in the SM and are only allowed at loop-level. These processes are thus rare and the theoretically clean angular observables are sensitive to the effects of new, heavy particles beyond the SM.

The rare decay $B_s^0 \rightarrow \phi\mu^+\mu^-$ has been previously analysed by the LHCb collaboration using data taken in 2011 and 2012, during Run 1 of the LHC. Further studies of this mode are particularly motivated by recent tensions with SM predictions seen in other rare $b \rightarrow s\ell\ell$ processes.

This talk will show the progress of the measurement of the angular observables in the $B_s^0 \rightarrow \phi\mu^+\mu^-$ decay using Run 1 and 2 LHCb data samples.

T 74.4 Thu 17:15 H-HS XI

Measurement of \mathcal{A}_{CP} in $B^0 \rightarrow K^{*0}\mu^+\mu^-$ and $B^+ \rightarrow K^+\mu^+\mu^-$ decays with LHCb — •HENDRIK JAGE, CHRISTOPH LANGENBRUCH, and ELUNED SMITH — I. Physikalisches Institut B, RWTH Aachen University

The LHCb detector at CERN is an experiment dedicated to the study of heavy flavour quarks, which are abundantly produced in the proton-proton collisions at the Large Hadron Collider (LHC). Flavour-changing neutral currents (FCNC), like the $b \rightarrow s\ell^+\ell^-$ transitions common to both analysed decay modes, are forbidden in the Standard Model (SM) at tree-level and could thus be significantly affected by new heavy particles beyond the SM.

The direct CP asymmetry (\mathcal{A}_{CP}) in $B^0 \rightarrow K^{*0}\mu^+\mu^-$ and $B^+ \rightarrow K^+\mu^+\mu^-$ decays has been previously measured by the LHCb collaboration using data taken in 2011 and 2012 during the LHC Run 1. While no significant deviations from the SM predictions have been observed, the measurement is still statistically limited. An update will be performed aiming to include the additional data collected by the LHCb experiment during the LHC Run 2.

In this talk the status of the updated measurement of \mathcal{A}_{CP} in $B^0 \rightarrow K^{*0}\mu^+\mu^-$ and $B^+ \rightarrow K^+\mu^+\mu^-$ decays will be presented.

T 74.5 Thu 17:30 H-HS XI

Towards completion of the four-body contributions to $\bar{B} \rightarrow X_s\gamma$ at NLO — •LARS-THORBEN MOOS and TOBIAS HUBER — Universität Siegen

The inclusive radiative $\bar{B} \rightarrow X_s\gamma$ 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 $\bar{B} \rightarrow X_s\gamma$, namely those of $b \rightarrow s\bar{q}q\gamma$ at NLO in the strong coupling and the necessary complementing 5-particle cuts of the gluon-bremsstrahlung $b \rightarrow s\bar{q}q\gamma + g$.

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

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 74.6 Thu 17:45 H-HS XI

Measurement of CP Violation in $B_s^0 \rightarrow J/\psi K_S^0$ at LHCb — VUKAN JEVTIC, •PATRICK MACKOWIAK, and GERWIN MEIER — Experimentelle Physik 5, TU Dortmund

With larger datasets collected by the LHCb Experiment and the start of Belle II, future measurements of $\sin(2\beta)$ in the golden mode $B^0 \rightarrow J/\psi K_S^0$ will be systematically limited by the uncertainty from penguin contributions. One ingredient to constrain these contributions is the measurement of CP violation in $B_s^0 \rightarrow J/\psi K_S^0$, where the tree level contribution is Cabibbo suppressed. The larger oscillation frequency of B_s^0 compared to B_d^0 and the lower branching fraction lead to further challenges in the analysis. The talk will present the current status of the analysis in $B_s^0 \rightarrow J/\psi K_S^0$ using the full Run II dataset collected by the LHCb Experiment corresponding to an integrated luminosity of 6 fb^{-1} .

T 74.7 Thu 18:00 H-HS XI

Measurement of $\sin(2\beta)$ in the CP violating decays $B^0 \rightarrow J/\psi(\rightarrow e^\pm e^\mp)K_S^0(\rightarrow \pi^\pm \pi^\mp)$ with the LHCb experiment — VUKAN JEVTIC, PATRICK MACKOWIAK, and •GERWIN MEIER — Experimentelle Physik 5, TU Dortmund

High precision measurements of Standard Model parameters can be used to search for New Physics. The golden mode $B^0 \rightarrow J/\psi K_S^0$, which is dominated by tree-level amplitudes, provides a clean measurement of the CKM angle β . Combining the measurements of $\sin(2\beta)$ in the decays $B^0 \rightarrow J/\psi(\rightarrow \ell^\pm \ell^\mp)K_S^0(\rightarrow \pi^\pm \pi^\mp)$ with $\ell = e, \mu$ and $B^0 \rightarrow \psi(2S)(\rightarrow \mu^\pm \mu^\mp)K_S^0(\rightarrow \pi^\pm \pi^\mp)$ will lead to the most precise measurement of this quantity.

In this talk the current status of the CP violation measurement in the decays $B^0 \rightarrow J/\psi(\rightarrow e^\pm e^\mp)K_S^0(\rightarrow \pi^\pm \pi^\mp)$ will be presented for

the full LHCb Run II dataset, which corresponds to 6fb^{-1} .

T 74.8 Thu 18:15 H-HS XI
Measurement of CP violation in $B^0 \rightarrow [c\bar{c}]K_S^0$ decays with the LHCb experiment using Run II data — ●VUKAN JEVTIC, PATRICK MACKOWIAK, and GERWIN MEIER — Experimentelle Physik 5, TU Dortmund

The measurement of the CKM angle β is an important precision test of the Standard Model. Previous measurements of CP -violation parameters in $B^0 \rightarrow J/\psi K_S^0$ decays using the Run I dataset that was taken at centre-of-mass energies of 7 and 8 TeV reached a sensitivity for the parameter $\sin(2\beta)$ comparable to Belle and BaBar. With the full LHCb Run II dataset at $\sqrt{s} = 13\text{TeV}$, the statistical significance of this measurement is expected to increase as more data was collected at higher rates. At the same time, this poses challenges, for example in the reconstruction of particle tracks in datasets with high background contamination and track multiplicities. In this talk, the status of the ongoing measurement of the CP -violation parameters will be presented with a focus on the decays $B^0 \rightarrow J/\psi(\rightarrow \mu\mu)K_S^0(\rightarrow \pi^+\pi^-)$ and $B^0 \rightarrow \psi(2S)(\rightarrow \mu\mu)K_S^0(\rightarrow \pi^+\pi^-)$.

T 74.9 Thu 18:30 H-HS XI
 B^0 -meson mixing rediscovery using hadronic b to c transitions at Belle II — ●SVIATOSLAV BILOKIN for the Belle II-Collaboration — Ludwig-Maximilians-Universität München

The Belle II experiment at the SuperKEKB asymmetric energy e^+e^- collider is a substantial upgrade of the B factory facility at the Japanese

KEK laboratory. The design luminosity of the machine is $8 \times 10^{35}\text{cm}^{-2}\text{s}^{-1}$ and the Belle II experiment aims to record 50ab^{-1} of data, a factor of 50 more than its predecessor. The Belle II collaboration has successfully recorded and processed about 10fb^{-1} of data at the $\Upsilon(4S)$ resonance in 2019.

This contribution presents the $B^0\text{-}\bar{B}^0$ mixing rediscovery in hadronic B -meson decays using the collected Belle II data. This analysis is a first necessary step towards an improvement of unitarity triangle measurements and New Physics searches in radiative penguin decays.

T 74.10 Thu 18:45 H-HS XI
 CP -Violation in Multi-Body B Decays — ●KEVIN OLSCHESKY¹, THOMAS MANNEL¹, and KERI VOS² — ¹Universität Siegen, Siegen, Germany — ²TU München, Garching, Germany

Charmless two and three-body B decays are interesting probes of CP violation. In the Standard Model (SM), CP violation is induced by a weak phase described by the CKM matrix. For charged B decays, only direct CP violation occurs, which requires both a weak CP -violating and a strong CP -conserving phase. While the first is given by the CKM-phase in SM, it is extremely challenging to calculate the strong phase in a QCD based framework due to hadronic and rescattering effects.

The current analysis of multi-body B decays is usually done with a resonant 2+1 description, which does not include $D\bar{D}$ threshold effects. These effects can provide an important mechanism in order to generate a non-trivial strong phase that may explain the large CP asymmetries observed at high invariant masses. We propose an addition to current resonance models including such threshold effects.