

T 4: Quark mixing and CP violation

Time: Monday 16:00–18:00

Location: Td

T 4.1 Mon 16:00 Td

Reconstruction of tau lepton decay planes for analysing the Higgs CP at CMS — MATE FARKAS², OLENA HLUSCHENKO², WOLFGANG LOHMAN^{1,2}, DENNIS ROY², HALE SERT², SEBASTIAN SIEBERT², ACHIM STAHL², ●LUCAS WIENS^{1,2}, and ALEXANDER ZOTZ² — ¹Deutsches Elektronen-Synchrotron (DESY), Hamburg — ²III. Physikalisches Institut B, RWTH Aachen University, Germany

One of the three Sakharov conditions states that CP violation is needed to explain the matter-antimatter symmetry in our universe. In order to find more occurrences of CP violation, the Higgs Boson is now being investigated, so one can find out whether or not it is the CP-even Higgs Boson of the Standard Model or if it is in a mixed state of CP-even and CP-odd and a gateway to new physics. This analysis uses the Run 2 data of 2017 collected by the CMS detector corresponding to an integrated luminosity of 41.5fb^{-1} in proton-proton collisions with a centre-of-mass energy of 13TeV. Selecting events with a Higgs Boson decaying into a pair of tau leptons, one will find that the tracks of the tau daughters do not intersect with the interaction point. The minimal distance of such a displaced track and the interaction point is called an impact parameter and can be used in conjunction with the daughter particles momentum to reconstruct the decay plane for each tau lepton. The angle between these two planes is sensitive to the Higgs CP and thus it is vital to select well reconstructed impact parameters.

T 4.2 Mon 16:15 Td

Time-dependent measurement of CP violation in $B_s^0 \rightarrow D_s^+ D_s^-$ and $B^0 \rightarrow D^+ D^-$ decays with the LHCb experiment — LOUIS GERKEN, PHILIPP IBIS, and ●ANTJE MÖDDEN — Experimentelle Physik 5, TU Dortmund

To test the Standard Model of particle physics and search for New Physics, the LHCb experiment performs precision measurements, e.g. decay-time-dependent measurements of CP violation in decays of neutral B mesons.

In the topologically similar decays $B_s^0 \rightarrow D_s^+ D_s^-$ and $B^0 \rightarrow D^+ D^-$, the weak mixing phases ϕ_s and $\sin(2\beta)$ can be measured in the interference between the direct decay and the decay after $B_{(s)}^0 - \bar{B}_{(s)}^0$ mixing. A decay-time-dependent analysis is performed with data corresponding to an integrated luminosity of 6fb^{-1} recorded by the LHCb experiment from 2015 to 2018 at a centre-of-mass energy of 13 TeV.

The modelling of the decay-time-dependent efficiency, the calibration of the decay-time resolution, and the calibration of the Flavour Tagging will be presented in this talk.

T 4.3 Mon 16:30 Td

Measurement of CP violation in $B^0 \rightarrow \psi K_S^0$ decays with the LHCb detector using the full 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. The golden mode of this observable is $B^0 \rightarrow J/\psi K_S^0$, because of its domination by tree-level amplitudes. With new reconstruction types of the K_S^0 and the combination of different decay channels it is possible to increase the statistical sensitivity to the most precise measurement of this quantity.

In this talk the current status of the CP violation measurement in the decays $B^0 \rightarrow J/\psi(\rightarrow \ell^\pm \ell^\mp) K_S^0(\rightarrow \pi^\pm \pi^\mp)$ with $\ell = e, \mu$ and $B^0 \rightarrow \psi(2S)(\rightarrow \mu^\pm \mu^\mp) K_S^0(\rightarrow \pi^\pm \pi^\mp)$ will be presented for the full LHCb Run II dataset, which corresponds to 6fb^{-1} .

T 4.4 Mon 16:45 Td

Measurement of the B_s^0 oscillation frequency Δm_s with $B_s^0 \rightarrow D_s^+ \pi^-$ decays at the LHCb experiment — ●QUENTIN FÜHRING and KEVIN HEINICKE — Experimentelle Physik 5, TU Dortmund

The $B_s^0 - \bar{B}_s^0$ oscillation frequency Δm_s is equivalent to the mass difference of the B_s^0 mass eigenstates. This frequency is an important Standard Model measurement in its own right, and a precise measurement is crucial for reducing the systematic uncertainties associated with time-dependent CP violation measurements in the $B_s^0 - \bar{B}_s^0$ system.

At the LHCb experiment, the parameter Δm_s has previously been

measured using data of $B_s^0 \rightarrow D_s^- \pi^+$ decays, recorded in 2011, corresponding to an integrated luminosity of $\mathcal{L}_{\text{int}} = 1.0\text{fb}^{-1}$. In this talk, an updated measurement of Δm_s is presented. The analysis uses an larger dataset, recorded with the LHCb experiment between 2015 and 2018, corresponding to an integrated luminosity of $\mathcal{L}_{\text{int}} = 5.7\text{fb}^{-1}$.

T 4.5 Mon 17:00 Td

Measurement of CP violation in $B_s^0 \rightarrow D_s^+ D_s^-$ and $B^0 \rightarrow D^+ D^-$ decays with the LHCb experiment — ●LOUIS GERKEN, PHILIPP IBIS, and ANTJE MÖDDEN — Experimentelle Physik 5, TU Dortmund

The LHCb experiment performs measurements of CP violation to test the Standard Model of particle physics. CP-violation parameters, such as ϕ_s and $\sin(2\beta)$, can be measured in $b \rightarrow \bar{c}s$ and $b \rightarrow \bar{c}d$ transitions, respectively. These phases occur in the interference between the direct decay of the $B_{(s)}^0$ meson and the decay after mixing. In the topologically similar decays $B_s^0 \rightarrow D_s^+ D_s^-$ and $B^0 \rightarrow D^+ D^-$ a time-dependent measurement of CP violation can be performed.

In this talk, the selection of $B_s^0 \rightarrow D_s^+ D_s^-$ and $B^0 \rightarrow D^+ D^-$ candidates for these CP-violation measurements will be presented. The analysis uses data collected by the LHCb detector during 2015 to 2018 at a centre-of-mass energy of 13 TeV corresponding to an integrated luminosity of 6fb^{-1} .

T 4.6 Mon 17:15 Td

Event reconstruction techniques in the context of a Higgs boson CP analysis in the di-tau lepton final state with the CMS experiment — OLENA HLUSCHENKO, SVEN KRAUSSE, WOLFGANG LOHMANN, DENNIS ROY, HALE SERT, SEBASTIAN SIEBERT, ACHIM STAHL, and ●ALEXANDER ZOTZ — RWTH Aachen University - Physics Institute III B, Aachen, Germany

In 2020 the first measurement of the effective CP mixing angle in Higgs boson decay into two tau leptons has been performed by the CMS experiment. It was determined to be $(4 \pm 17)^\circ$ using the Run 2 data set of pp collisions of 137fb^{-1} integrated luminosity. The mixing angle was extracted from a distribution of angles between the decay planes of the tau lepton decay products in the $H \rightarrow \tau\tau$ decay. In the case of hadronic tau lepton decays via the intermediate a_1 resonance the full tau lepton kinematics including its neutrino and furthermore its polarimetric vector can be reconstructed. Requiring both tau leptons to decay via a_1 mesons allows for the reconstruction of a CP sensitive observable with higher sensitivity. However the $a_1 a_1$ final state suffers from a small branching fraction and therefore these improvements have a negligible effect on the overall sensitivity once all final states are included. In this talk, an extension of the polarimetric vector method via the inclusion of final states with an a_1 decay on one side and a single charged lepton or hadron on the other side of the $H \rightarrow \tau\tau$ decay is presented. To reconstruct the event a kinematic fit with external constraints is used and the potential improvement on the measurement of the CP mixing angle is discussed.

T 4.7 Mon 17:30 Td

Background studies in B0 mixing to hadronic final states at the Belle 2 experiment — ●CASPAR SCHMITT and THIBAUD THUMAIR for the Belle II-Collaboration — Max Planck Institute for Physics, Munich, Germany

The Belle II experiment at the SuperKEKB electron-positron collider started taking data in 2018. In this talk, we will focus on time-dependent measurements for B mesons using the new Pixel Vertex Detector. The increased precision on the vertex reconstruction will help to better constrain the CKM sector of the Standard Model of particle physics.

After shortly reviewing the first Belle II time-dependent measurements on CP violation and the mixing frequency in the B0 system, we will illustrate the various improved techniques being developed to achieve a high precision measurement of the B0 mixing frequency. These notably include the understanding and modelling of backgrounds and the decay time resolution in fully hadronic B0 decays.

T 4.8 Mon 17:45 Td

Measurement of CP violation in $B_s^0 \rightarrow J/\psi K_S^0$ decays at

LHCb — ●VUKAN JEVTIC, PATRICK MACKOWIAK, and GERWIN MEIER — Experimentelle Physik 5, TU Dortmund

With larger datasets collected by the LHCb detector and with 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 penguin contributions. One way to constrain these contributions is through the measurement

of CP -violation parameters in the closely related mode $B_s^0 \rightarrow J/\psi K_S^0$, where the tree-level decay is Cabibbo suppressed and penguin contributions are significant. The higher oscillation frequency of the B_s^0 meson and the lower branching fraction of this channel add to the challenges of this analysis, which uses the full Run II dataset collected by the LHCb experiment. In this talk the current status of the analysis will be presented.