T 15: CP-Verletzung und Mischung

Zeit: Montag 16:00–18:35 Raum: S15

Gruppenbericht T 15.1 Mo 16:00 S15

Towards a Storage Ring Electric Dipole Moment Measurement — •Jörg Pretz for the JEDI-Collaboration — Forschungszentrum Jülich — RWTH Aachen Univsersity

The Electric Dipole Moment (EDM) of elementary particles, including hadrons, is considered as one of the most powerful tools to study CP-violation beyond the Standard Model. Such CP-violating mechanisms are searched for to explain the dominance of matter over anti-matter in our universe.

Up to now EDM experiments concentrated on neutral systems, namely neutron, atoms and molecules. Storage rings offer the possibility to measure EDMs of charged particles by observing the influence of the EDM on the spin motion.

A step-wise approach starting with a proof-of-principle experiment at the existing storage ring Cooler Synchrotron COSY at Forschungszentrum Jülich, followed by an electrostatic prototype ring allowing for a simultaneous operation of counter circulating beams in order to cancel systematic effects, to the design of a dedicated 500 m circumference storage ring will be presented.

T 15.2 Mo 16:20 S15

Searches for proton EDM in electrostatic storage rings — •Artem Saleev for the JEDI-Collaboration — IKP FZJ, Jülich, Deutschland

Studies of high precision spin dynamics at the COoler SYnchrotron COSY in Jülich suggest that electric dipole moment (EDM) signal could be resolved in the frequency domain. We propose a new concept for the measurement of the proton EDM in a pure electrostatic storage rings based on the measurement of the spin tune frequency. Wien filter, matched to maintain zero Lorenz force with oscillating B-field at the beam revolution frequency and constant E-field, produces a static spin kick in horizontal direction, simultaneously the beams are circulating clockwise and counterclockwise in the meantime. Such spin rotations commute with the EDM spin rotation in the ring which leads to an EDM-related spin tune shift. If the beams have the same closed orbit, EDM signal is proportional to a spin tune difference of the two beams and unwanted effects of magnetic dipole moment spin rotations are cancelling. The present model-dependent EDM limit for protons that amounts to $7.9 \cdot 10^{-25} e$·cm can be confirmed in direct EDM measurements, if the new technique is applied at a prototype EDM storage ring proposed by the JEDI collaboration.

T 15.3 Mo 16:35 S15

Progress toward the first measurement of the deuteron Electric Dipole Moment at COSY — •Vera Shmakova for the JEDI-Collaboration — Institut für Kernphysik, Forschungszentrum Jülich, Germany — JINR, Dubna, Russia

One of the major problems of modern particle physics is the inability of the Standard Model (SM) to explain the matter-antimatter asymmetry of the Universe. Permanent electric dipole moments (EDMs) of particles violate both time reversal (T) and parity (P) invariance, and are via the CPT-theorem also CP-violating. Therefore, measurements of EDMs of fundamental particles probe new sources of CP-violation, and finding an EDM would be a strong indication for physics beyond the SM.
Up to now, EDM searches mostly focused on neutral systems (neutrons, atoms, and molecules). Storage rings, however, offer the possibility to measure EDMs of charged particles by observing the influence of the EDM on the spin motion in the ring. Direct searches of proton and deuteron EDMs using a storage ring thus bear the potential to reach sensitivities beyond 10^{-29} e·cm. In this talk I will discuss recent results of a "percursor" deuteron EDM experiment, presently being carried out at the Cooler Synchrotron COSY at Forschungszentrum Jülich.

T 15.4 Mo 16:50 S15

Suche nach CP Verletzung in $\Lambda_b \to D^0\Lambda$ — •Nis Meinert — LHCb (Uni. Rostock)

Bisher wurden für Analysen der CP Verletzung zumeist Meson- und nur wenige Baryon-Zerfälle verwendet. Letztere lieferten bis jetzt lediglich Asymmetriewerte zwischen Teilchen und Antiteilchen und wurden nicht zur Berechnung von CKM-Phasen benutzt.

In unserer Analyse suchen wir daher nach dem Baryonen-Zerfall $\Lambda_b \to \Lambda D^0/\overline{D}^0$. Die Analyse der Subzerfälle $D^0 \to K\pi$ und $D^0 \to KK/\pi\pi$ erlaubt die Anwendung der ADS- und GLW-Methoden, welche jeweils Zugang zu der CKM-Phase γ gewähren.

Die Rekonstruktion dieser Zerfälle ist auf Grund der langlebigen Λ-Teilchen, der starken Unterdrückung ($\propto \lambda^3$ in der Wolfenstein-Parametrisierung) und dominanten Untergründe (Reflexionen) wie z.B. $B_s \to D^0 K_S$ ($\propto \lambda^2$) herausfordernd. Die einzigartige Produktionsrate von Λ_b-Baryonen und die besonders effiziente Λ_b-Rekonstruktion am LHCb-Experiment kompensieren diese Nachteile jedoch teilweise.

Präsentiert wird der aktuellen Stand der Analyse mit Daten aus Run 1 und Teilen von Run 2. Insbesondere werden Eigenschaften von Reflexionen im Allgemeinen und die Unterdrückung von $B_s \to D^0 K_S$ Zerfällen im Speziellen diskutiert.

T 15.5 Mo 17:05 S15

***CP* violation and lifetime measurements in the decay $B_s^0 \to J/\psi K^- K^+$ with the LHCb experiment** — Stephanie Hansmann-Menzemer and •Simon Stemmle — Physikalisches Institut Heidelberg

Within the Standard Model (SM) the CP violating phase ϕ_s of the decay $B_s^0 \to J/\psi K^- K^+$ can be precisely constrained from indirect measurements. This makes the direct measurement of ϕ_s a sensitive test of the SM. A flavor tagged, time dependent angular analysis of $B_s^0 \to J/\psi K^- K^+$ and $\bar{B}_s^0 \to J/\psi K^- K^+$ decays is presented, using $2\,\text{fb}^{-1}$ of proton-proton collision data, recorded by the LHCb experiment in 2015 and 2016. Besides the CP violating phase, also the lifetime splitting $\Delta\Gamma_s$ in the B_s^0 meson system and the decay width difference, $\Gamma_s - \Gamma_d$, between B_s^0 and B^0 mesons is precisely measured. The results are combined with the corresponding LHCb Run I analysis.

T 15.6 Mo 17:20 S15

Measurement of the weak mixing phase ϕ_s in $B_s^0 \to D_s^+ D_s^-$ decays with the LHCb experiment — •Louis Gerken, Philipp Ibis, Antje Mödden, and Margarete Schellenberg — Experimentelle Physik 5, TU Dortmund

One research priority of the LHCb experiment is testing the Standard Model by the precise measurement of *CP*-violating parameters. In B_s^0-meson decays with $b \to c\bar{c}s$ transitions, the weak mixing phase ϕ_s can be measured in the interference between the decay with and without B_s^0-$\overline{B_s^0}$ mixing. Since ϕ_s is predicted to be small in the Standard Model, a significant deviation to this prediction could be evidence of New Physics.

In this talk the current status of the $B_s^0 \to D_s^+ D_s^-$ analysis will be presented. The analysis aims to measure ϕ_s by using data corresponding to an integrated luminosity of $6\,\text{fb}^{-1}$ collected by the LHCb detector during 2015 to 2018 at a centre-of-mass energy of 13 TeV.

T 15.7 Mo 17:35 S15

Measurement of *CP* violation in $B^0 \to J/\psi K_S^0$ decays with the LHCb detector using Run II data — •Vukan Jevtic and Patrick Mackowiak — 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 in the interference of mixing and the decay in the $B^0 \to J/\psi K_S^0$ channel at LHCb reached a sensitivity for $\sin(2\beta)$ that is comparable to measurements of Belle I and BaBar. Due to the higher centre-of-mass energy of $\sqrt{s} = 13\,\text{TeV}$ at the LHC in Run II, more data was taken at higher rates, which helps to increase the statistical significances of analyses. At the same time, this poses new 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 measurement of the *CP*-violation parameters in $B^0 \to J/\psi(\to \mu\mu)K_S^0(\to \pi^+\pi^-)$ decays will be presented and new reconstruction possibilities of K_S^0 mesons will be discussed.

T 15.8 Mo 17:50 S15

Measurement of the decay-time-dependent *CP* asymmetry in $B^0 \to D^{*+} D^-$ with the LHCb experiment — •Philipp Ibis, Antje Mödden, and Margarete Schellenberg — Experimentelle Physik 5, TU Dortmund

The LHCb experiment searches for physics beyond the Standard Model by performing precision measurements. Among these are decay-time-dependent measurements of *CP* violation in decays of neutral B mesons.

In $B^0 \to D^{*+}D^-$ decays, *CP* is violated in the interference of direct decays and decays after mixing of the B^0 mesons. Time-dependent measurements of decays of initial B^0 and $\bar{B}^0$ mesons allow the determinaion of the *CP* asymmetry and give access to the CKM angle β. As this decay entails a Cabibbo-suppressed $b \to c\bar{c}d$ transition, loop-level Feynman graphs are not additionally suppressed compared to tree-level transitions. Thus, a measurement of *CP* violation in this channel complements measurements in $B^0 \to J/\psi K^0_S$ decays, which involve non-suppressed $b \to c\bar{c}s$ transitions.

The current status of the analysis is presented using the full LHCb dataset corresponding to an integrated luminosity of $9\,\text{fb}^{-1}$.

T 15.9 Mo 18:05 S15

Measurement of the B_s^0 oscillation frequency Δm_s with $B_s^0 \to D_s^- \pi^+$ decays at the LHCb experiment — Robin Eichhorn and •Kevin Heinicke — Experimentelle Physik 5, TU Dortmund

One way to uncover hiding places for New Physics are precise measurements of the *CP* parameters in the Standard Model. To extract the currently least known CKM-angle γ with the latest LHCb dataset of $B_s^0 \to D_s^{\mp} K^{\pm}$ decays, the B_s^0-$\overline{B}_s^0$ oscillation frequency Δm_s is needed as an external input.

At the LHCb experiment, the parameter Δm_s has so far only been measured using data of $B_s^0 \to D_s^- \pi^+$ decays, recorded in 2011, corresponding to an integrated luminosity of $\mathcal{L}_{\text{int}} = 1.0\,\text{fb}^{-1}$. The uncertainty of this measurment is one of the leading systematic uncertainties of the current measurement of γ with the LHCb experiment. In this talk, the current status of an updated measurement of Δm_s is presented. The analysis is using an extended dataset, recorded with the LHCb experiment between 2015 and 2017, corresponding to an integrated luminosity of $\mathcal{L}_{\text{int}} = 3.6\,\text{fb}^{-1}$.

T 15.10 Mo 18:20 S15

Determination of the resolution function of the B0 anti-B0 decay time difference — •Ketevan Parlagashvili, Vladimir Chekelian, Christian Kiesling, Luigi Li Gioi, and Hans-Günther Moser for the Belle 2-Collaboration — Max-Planck-Institut für Physik, Munich, Germany

One of the goals of the Belle II experiment at SuperKEKB is the study of the CP asymmetries in the time evolution of the neutral B mesons. A clean laboratory to study the two-state system of B0 and anti-B0 mesons is provided by the $\Upsilon(4S)$ resonance which can be produced in e+ e- annihilation at the center of mass energy of 10.58 GeV. Belle II is equipped with an entirely new tracking system, in particular with a low material budget pixel vertex detector, only 14 mm away from the interaction region. In contrast to its predecessor KEKB, SuperKEKB is exhibiting a very small collision spot for the production of a B meson pair. This may have a strong impact on the analysis methods used so far for the determination of the decay time difference between a B meson in a chosen CP eigenstate and its flavor-determining companion. The goal is to determine the experimental resolution function of the distance (translated to the difference of the decay times) between the vertices of the two B mesons as a function of the different decay vertex qualities and vertex detector running conditions.