T 78: Electroweak Interactions II

Time: Thursday 16:00–18:15 Location: Tc

T 78.1 Thu 16:00 Tc

Isolating systematic effects with beam polarisation at e^+e^- colliders — •Jakob Beyer[1,2] and Jenny List[1] — [1]DESY Hamburg — [2]Universität Hamburg

Future high-energy e^+e^- colliders will provide some of the most precise tests of the Standard Model. Statistical uncertainties are expected to improve by orders of magnitude over current measurements. This provides a new challenge in accurately assessing and minimizing systematic uncertainties. Beam polarisation may hold a unique potential to isolate and determine the size of systematic effects. So far, studies have mainly focused on the statistical improvements from beam polarisation. This study aims to assess the impact on systematic uncertainties. A combined fit of precision observables, such as cross-sections, asymmetries and anomalous gauge couplings, together with systematic effects is performed on 2-fermion and 4-fermion final-states. Different setups of available beam polarisations and luminosities are tested with and without systematic effects. The dependence of the uncertainties and correlations for the varying setups informs the relevance of beam polarisation for isolating systematic effects. Effects observed for this analysis may qualitatively apply to other analyses as well. Future collider efforts can use this knowledge in their design studies to maximize their physics potential.

T 78.2 Thu 16:15 Tc

Test of the universality of tau and muon lepton couplings in W boson decays with the ATLAS detector — •Nicolas Köhler — CERN, Meyrin, Schweiz

The universality of the lepton couplings to the electroweak gauge bosons is one of the fundamental axioms of the Standard Model (SM) of particle physics. At LEP, the branching fractions of the W boson into charged leptons have been precisely measured, however, the uncertainty on the ratio of $\mathcal{BR}(W \to \tau\nu)/\mathcal{BR}(W \to \mu\nu)$ still remains at approximately 2.4%. The PDG combined measurement of $\mathcal{BR}(W \to \tau\nu)/\mathcal{BR}(W \to \mu\nu)$ shows a 2.7σ deviation from the SM prediction, motivating an independent measurement of this ratio at the LHC. ATLAS recently performed a measurement of this quantity using 139 fb^{-1} of pp collision data recorded during LHC Run 2. To obtain a large unbiased sample of W bosons, di-leptonic $t\bar{t}$ events are selected. Muons originating from W bosons and those originating from an intermediate tau lepton are distinguished through the muon transverse impact parameter and the muon transverse momentum spectra. The result is in agreement with a universal coupling as postulated in the SM and the measurement is the most precise one to date.

T 78.3 Thu 16:30 Tc

Measurement of aτ at the ATLAS Experiment — •Birte Sauer, Jakub Kremer, and Matthias Schott — Johannes Gutenberg-Unitersity Mainz

The anomalous magnetic moment, being the difference to the value predicted by Dirac's theory, is used since long to probe the limits of the Standard Model. Both the electronic and muonic anomalous magnetic moment have been studied to a great extent, while the anomalous magnetic moment of tau lepton is missing a precise measurement. The short lifetime of tauons makes it experimentally challenging to measure their properties. This talk discusses the sensitivity of the $\gamma\gamma \to \tau\tau$ process in ultraperipheral Pb+Pb collisions on the anomalous magnetic (aτ) and electric (dτ) moments of τ lepton at the LHC. We also present preliminary results on this measurement using the di-muon final state with data collected by the ATLAS detector with a special focus on the relevant detector performance.

T 78.4 Thu 16:45 Tc

Search for Lepton flavor Violation in Tau leptons — •Marton Nemeth-Csoka, Felix Meggendorfer, and Christian Kiesling — Max-Planck-Institut für Physik

With the start of data taking using the Belle II detector at the SuperKEKB electron-positron collider a new era in searches for New Physics is on the horizon.

We report here on plans and first Monte Carlo studies to search for lepton flavor violation (LFV) in tau leptons. In particular, we investigate the decay $\tau- > l\ \pi^0$, which is highly forbidden in the Standard Model, but could possibly become observable in certain scenarios of New Physics. Using the improved detector capabilities of Belle II, estimates of the efficiency and backgrounds for the above LFV decay are presented.

T 78.5 Thu 17:00 Tc

The muX experiment at the Paul Scherrer Institute — •Frederik Wauters — PRISMA+ Cluster of Excellence and Institute of Nuclear Physics, Johannes Gutenberg University Mainz

When a negative muon comes to rest in matter, an exotic atom is quickly formed. During the formation process, muonic X-rays, which can have energies up to several MeV, are emitted until the 1s orbital is reached. The muon wave function in the lower orbits has a large overlap with the nucleus, making this system an excellent laboratory to study short range interactions between the muon and the atomic nucleus. The muX project at the Paul Scherrer Institute is performing muonic X-ray measurements on medium and high-Z nuclei, thereby fully exploiting the coverage and multiplicity of a full high-purity germanium array in combination with muon, electron and neutron detectors. A new technique was developed utilizing transfer reaction in a H2/D2 gas cell to stop a standard muon beam in a few ug of target material. The physics program is focusing on atomic parity violation (APV). A measurement of the charge radius of 226Ra will serve as an important input for an upcoming APV experiment with Ra in a Paul trap. We are also pursuing measuring APV directly in muonic atoms in the 2s-1s transition. As a short term goal, we want to significantly improve the signal to noise for this low intensity transition. In this talk I will present the preliminary results of the 2017, 2018, and 2019 experimental campaigns.

T 78.6 Thu 17:15 Tc

Search for $B \to K^{(*)}\nu\overline{\nu}$ at the Belle II experiment with machine learning techniques — •Cyrille Praz — Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany

The Belle II experiment, located in Tsukuba, Japan along the SuperKEKB e^+e^- collider, has started to collect data in 2018 and offers many opportunities to improve our understanding of the B-meson decays. In particular, the $B \to K^{(*)}\nu\overline{\nu}$ decay has not been observed yet, it can be computed with accuracy in the Standard Model and is sensitive to new physics models. This presentation gives a brief overview of a novel approach to search for this decay and focuses on the machine learning techniques that are used to reject the background and select the signal.

T 78.7 Thu 17:30 Tc

Measurement of the Branching Fractions and Differential Kinematic Distributions of $B^{+/0} \to XJ/\psi$ with Hadronic Tagging — Florian Bernlochner[1], William Sutcliffe[1], Sviat Bilokin[2], Thomas Khur[2], and •Martin Angelsmark[1] for the Belle II-Collaboration — [1]Physikalisches Institut der Rheinischen, Friedrich-Wilhelms-Universität Bonn, 53115 Bonn, Germany — [2]Fakultät für Physik, Ludwig Maximilians University Munich, D-80539 München, Germany

We measure for the first time the individual branching fractions of $B^+ \to XJ/\psi$ and $B^0 \to XJ/\psi$ to be X and Y, respectively, using hadronic tagging in $74\,\text{fb}^{-1}$ of Belle II data. In addition, the employment of hadronic tagging allows for a novel determination of the differential distributions of the mass of the X system, the helicity angle for the decay and the momentum magnitudes of the J/ψ and X in the B rest frame. These fully inclusive measurements of $B \to XJ/\psi$ represent an important benchmark towards a fully inclusive analysis of $B \to X_s\ell\ell$ with tag-side reconstruction.

T 78.8 Thu 17:45 Tc

Bremsstrahlung Measurements for the LUXE Experiment — •Marius Hoffmann[1], Ruth Jacobs[1], Louis Helary[1], and Beate Heinemann[1,2] — [1]DESY, Hamburg — [2]Universität Freiburg

While Quantum Electrodynamics has been tested with a superb precision in the perturbative regime, there is a regime of very strong fields where it becomes non-perturbative and which has not yet been explored experimentally. The LUXE (Laser Und European XFEL-) Experiment aims to use the high-quality electron beam of the XFEL accelerator to probe this strong-field regime. Colliding high energy photons

produced via bremsstrahlung (photon-photon mode) with a high intensity laser leads to field strengths above the Schwinger limit. This opens up the possibility to measure nonlinear Breit-Wheeler pair production, a process that takes place also in nature, for example around heavy astronomic objects, or in future particle colliders.

To create photon-photon collisions, the electrons from the XFEL beam are converted to high energy photons via bremsstrahlung in a target foil. A good understanding of this process, which has not been studied in detail at the energy scale relevant for LUXE before, is therefore necessary. To achieve this understanding testbeam experiments and simulations thereof are performed. The testbeam experiment presented aims to analyse the properties of a bremsstrahlung photon beam produced at the DESY testbeam.

After a short introduction to the LUXE experiment, this talk focuses on those testbeam experiments conducted to analyse high-energy bremsstrahlung properties.

T 78.9 Thu 18:00 Tc

Measuring the 2s-1s transition in Muonic atoms — •Nilesh Deokar — Johannes Gutenberg University of Mainz, Germany

2s-1s muonic X-rays are a potential observable to study Atomic Parity Violation (APV) in muonic atoms. Muonic X-rays are produced when negative muons are stopped in matter and cascade down the different energy levels of an atom. To detect the 2s-1s X-rays, a krypton target (2018) and a zinc target (2019) were placed in a negative muon beam from the piE1 beamline at the Paul Scherrer Institute, Switzerland. The targets were surrounded by High Purity Germanium (HPGe) detectors on two sides which detected the outgoing muonic X-rays. The beam momenta ranged from around 28 MeV/c (for krypton) and 33 MeV/c to 35 MeV/c (for zinc) during the run. The 2s-1s transition in krypton corresponds to an energy value of ~2222 keV which in zinc is ~1640 keV. These transitions are overshadowed by background transitions and also the X-rays scattered between the HPGe detectors which give rise to satellite peaks. X-ray-X-ray coincidences can help to suppress this background. The analysis of the data acquired revolves around separating the 2s-1s transitions from the background. A clear observation of the 2s-1s transition opens up to the possibility for an APV experiment with muonic atoms.