T 14: Elektroschwache Wechselwirkung

Zeit: Montag 16:00–18:35 Raum: S14

Gruppenbericht T 14.1 Mo 16:00 S14

Evidence for electroweak triboson production with the ATLAS detector at LHC — Carlo A. Gottardo, Sebastian Heer, Vadim Kostyukhin, Ö. Oğul Öncel, Keshava Prasad, Andrea Sciandra, and •Markus Cristinziani — Physikalisches Institut, Universität Bonn

A search for the production of three massive vector bosons is performed using proton–proton collision data recorded with the ATLAS detector at the Large Hadron Collider at $\sqrt{s} = 13$ TeV in the years 2015–2017, corresponding to an integrated luminosity of 79.8 fb^{-1}. Events with two, three or four reconstructed leptons (electrons or muons) are selected. Boosted decision tree classifiers are employed to distinguish the triboson signal from the background. An expected sensitivity of 3.1 standard deviations for the combination of the WWW, WWZ and WZZ channels is attained.

T 14.2 Mo 16:20 S14

Testing the lepton universality in the W-boson decay with the ATLAS detector — Philip Bechtle[1], Klaus Desch[1], Andreas Düdder[2], •Philipp König[1], and Matthias Schott[2] — [1]Rheinische Friedrich-Wilhelms-Universität Bonn — [2]Johannes Gutenberg Universität Mainz

Lepton universality is preserved by the electroweak interaction in the Standard Model (SM). The Higgs mechanism breaks this universality, and thus many new physics models yield small deviations in the predictions for precision tests on lepton universality. A measured deviation of the branching fraction $BR(W \to \tau\nu)$ from the SM prediction would therefore be an indicator for new physics which is expected to couple predominantly to heavier particles. Experimentally, it is preferable to measure the ratio of the branching fractions of the tau lepton decay compared to the decay to the lighter leptons. The analysis presented here goes one step further and measures $BR(W \to \tau\nu_\tau \to \mu\nu_\mu\nu_\tau\nu_\tau)/BR(W \to \mu\nu_\mu)$. This allows to cancel many systematic uncertainties by using the same final state. However, it implies that enumerator and denominator only differ in kinematic distributions from which the result is extracted in a fit. Characteristic observables being important for the fitting procedure will be introduced as well as possibilities to further increase the sensitivity of the measurement. Finally, it is investigated how competitive the obtained sensitivity is compared to previous measurements by other experiments.

T 14.3 Mo 16:35 S14

Observations of massive gauge boson scattering in the like-charged WWjj final state and the WZjj final state with the ATLAS detector at the LHC — •Tim Herrmann, Carsten Bittrich, Stefanie Todt, Franziska Iltzsche, Abhishek Nag, Joany Manjarres, and Michael Kobel — TU Dresden, Germany

Scattering of massive gauge bosons (VBS) is predicted by the Standard Model but was not observed by independent experiments before. There are new observations from the ATLAS experiment at LHC of VBS in the WZjj ($5.35\,\sigma$) and WWjj ($6.9\,\sigma$) same sign final state. It is the first observation of VBS in the WZjj final state.

VBS gives insights into and probes the electroweak symmetry breaking of the SM. It is sensitive to quartic and triple gauge couplings and s- and t-channel gauge boson exchanges. The measured differential cross sections are sensitive to the strengths of these contributions.

Data taken in 2015 and 2016 at a center of mass energy of $\sqrt{s} = 13\,\text{TeV}$ at the ATLAS detector at the LHC with a total luminosity of $36.1\,\text{fb}^{-1}$ are analyzed.

For the WZjj final state multivariate methods (BDT) together with a template fit to the BDT shape are used to separate signal from backgrounds and to determine the significance.

The WWjj same sign final state has the best signal to background ratio. A cut-based selection involving data driven background estimation methods for non-prompt leptons and charge flips is applied to establish the signal. The significance is determined with a template fit involving seven control regions and 25 bins in the signal region.

T 14.4 Mo 16:50 S14

Observation and measurement of the electroweak $W^\pm W^\pm jj$ process with the ATLAS detector — •Giulia Gonella and Karsten Köneke — Albert-Ludwigs-Universität Freiburg

Measurements of the electroweak sector of the Standard Model (SM) are a way to probe the mechanism of electroweak symmetry breaking at the LHC, and to detect small deviations from the SM predictions, through which the effect of new physics could manifest itself. In this context the scattering of vector bosons (VBS) is a key process. In particular the production of W bosons pairs is a vital test of the mechanism, since its scattering amplitude would increase at high energies violating unitarity, without cancellations of divergences due to exchange involving Z or Higgs bosons.

This talk will present an overview of the measurement of the electroweak production of two W bosons with the same electric charge in the signature of two leptons, missing transverse energy and two jets using data recorded by the ATLAS experiment during proton-proton collisionsat $\sqrt{s} = 13$ TeV at the LHC corresponding to an integrated luminosity of 36.1 fb^{-1}. The main analysis techniques will be shown, with a focus on the estimation of the background due to the contributions from opposite-charge di-lepton production processes, where the charge of one electron is wrongly reconstructed. An overview of the optimisation procedure will be presented, together with the fit technique that led to the observation of the $W^\pm W^\pm jj$ electroweak process and the measurement of its fiducial cross-section.

T 14.5 Mo 17:05 S14

Measurement of the τ Lepton Polarisation in $Z \to \tau\tau$ events with CMS — Jordy Degens[1], Günter Flügge[1], Olena Hlushchenko[1], Wolfgang Lohmann[1], Johannes Merz[1], •Thomas Müller[1], Dennis Roy[1], Hale Sert[1], Achim Stahl[1], Alexander Zotz[1], and Vladimir Cherepanov[2] — [1]RWTH Aachen University — [2]IPHC Strasbourg

In this talk a measurement of the τ lepton polarisation in $Z \to \tau\tau$ events is presented. Data corresponding to an integrated luminosity of $35.9\,\text{fb}^{-1}$ taken at $\sqrt{s} = 13\,\text{TeV}$ by the CMS detector in 2016 is analysed. From the τ lepton polarisation the ratio of the neutral-current vector to axial-vector couplings of the τ lepton and the weak mixing angle, $\sin\theta_W^{\text{eff}}$, is determined. This measurement allows for internal consistency checks of the Standard Model as well as for the indirect search for BSM effects in the electroweak sector.

T 14.6 Mo 17:20 S14

Approaching the Schwinger Critical Field with the LUXE experiment — •Marius Hoffmann[1] and Beate Heinemann[1,2] — [1]DESY, Hamburg, Germany — [2]University of Freiburg, Germany

The theory of quantum electro dynamics (QED) is one the most precise theories mankind has ever developed. It has however not yet been tested in the regime above the so called Schwinger critical field, which is theoretically predicted to be $1.32 \times 10^{18}\,V\,m^{-1}$.

The LUXE experiment which is currently developed, aims to test the QED in the regime of the Schwinger critical field and even determine the value of the Schwinger critical field at a linear electron accelerator such as the European XFEL with a 17.5 GeV electron beam. LUXE is a two-scenario experiment aiming to use a high intensity laser system whose pulses are collided nearly head-on with the electron beam of the XFEL (scenario 1) or a beam of bremsstrahlung gamma rays produced by the electron beam in a foil before the interaction (scenario 2). The production rate of the e^+/e^- pairs in this interactions for various laser intensities is sensitive to the Schwinger critical field.

The talk will feature detector design studies outlining possible layouts of the experiment for a location at European XFEL, as well as simulation studies showing the sensitivity of the experiment on the Schwinger critical field.

T 14.7 Mo 17:35 S14

Probing anomalous quartic gauge couplings at the International Linear Collider — •Jakob Beyer[1,2], Michael Kobel[3], and Jenny List[1] — [1]DESY Hamburg — [2]Universität Hamburg — [3]Technische Universität Dresden

Precision measurements of the electroweak sector are sensitive probes for physics beyond the Standard Model. With the future International Linear Collider (ILC) such measurements can be performed in the low-background environment of e^+e^- collisions at center-of-mass energies up to 1 TeV. At these high-energy collisions the process of vector boson

scattering can tested for signs of anomalous quartic gauge couplings. The potential of this measurement has been recently studied in an updated EFT framework on theory level. Such results assume detector and analysis performances which must be validated using detector simulations.

A study of the reconstruction of the fully hadronic $\nu\bar{\nu} + 4$jets final state is performed to investigate the challenges to this analysis. Data sets from a full, GEANT4-based simulation of the International Large Detector at the 1 TeV ILC are used to accurately predict its measurement capability.

T 14.8 Mo 17:50 S14

Study of anomalous gauge couplings using WZ channel in ATLAS — •Lilly Wuest — IKTP; TU Dresden, Germany

Studies of anomalous quartic gauge couplings assuming an insignificant impact of triple gauge couplings in the sensitive phase space of aQGC. To study aQGC without calculations of aTGC it's needed to test the sensitivity of this couplings in the VBS phase space.

The triple and quartic gauge couplings are part of the standard model. A direct test of the standard model and an indirect search of new physics is given by studies of gauge couplings. The expansion of the standard model with an effective field theory would describe deviations in the cross section and kinematic distributions of gauge couplings. Samples of aTGC α_W^4, aTGC α_W^6 and aQGC are simulated. Simulations and data taken in 2015/16 at a center of mass energy of $\sqrt{s} = 13\,TeV$ at the ATLAS detector at the LHC with a total luminosity of 36.1 fb^{-1} for the WZ channel are analyzed. The limits of aTGC are extracted in the inclusive WZ phase space. The sensitivity of aTGC in it's limits is tested in the VBS phase space. And it is investigated if the impact of aTGC is significant for the calculation of the limits of aQGC in the VBS phase space.

T 14.9 Mo 18:05 S14

Measurement of the charged-current Drell-Yan differential cross-section at high transverse masses at $\sqrt{s} = 13$ TeV with the ATLAS detector — Frank Ellinghaus, •Frederic Schröder, and Christian Zeitnitz — Bergische Universität Wuppertal

The charged-current Drell-Yan (DY) cross-section is measured for the leptonic decay of the W boson $W \to l\nu$ with $l = e, \mu$. While the cross-section at the peak of the W boson mass is known very well, the measurement of the differential cross-section above the peak is measured for the first time. The cross-section will be measured differentially in the transverse mass m_T^W and in the pseudorapidity of the lepton.
The charged-current DY can be used to constrain the density function that describes the partonic content of the proton and to measure fundamental parameters of the Standard Model. In particular, the high m_T^W region of the charged-current DY allows probing new physics by constraining effective field theory parameters, because these parameters are sensitive to small deviations in the cross-section with respect to the theory prediction.
The analysis strategy and status of the measurement will be presented. The data has been taken at the ATLAS experiment based on pp-collisions at a center-of-mass energy of $\sqrt{s} = 13$ TeV at the LHC.

T 14.10 Mo 18:20 S14

Towards detecting new physics with photon-photon collisions with the ATLAS Forward Proton (AFP) detector — Vlasios Petousis and •André Sopczak — Institute of Experimental and Applied Physics, Czech Technical University in Prague

The quantum-mechanical process Light-by-Light (LbyL) scattering ($\gamma\gamma \to \gamma\gamma$) is forbidden in the classical theory of electrodynamics. In the Standard Model of particle physics, the virtual particles that mediate the LbyL coupling are electrically charged fermions or W bosons. This reaction is accessible at the Large Hadron Collider (LHC) owing to the large electromagnetic field strengths generated by ultra-relativistic proton-proton reactions in elastic interactions. A novel detector (AFP) was installed ±200 m from the central interaction point (IP) which took successfully data in 2017 and 2018 to tag deflected protons from the elastic interactions. While determining the rate of the produced exclusive photon pairs in the IP in coincidence with the detected protons and comparison with the Standard Model expectation, any excess would be an indication of new physics beyond the Standard Model. At the LHC, the photon-photon interactions achieve an energy never achieved before. First, a performance study with $\gamma\gamma \to \mu\mu$ which has a higher rate than LbyL, was performed to demonstrate the functionality of the AFP detector and the analysis method.