T 5: Electroweak Interactions (Exp.) 1

Time: Monday 16:15–18:20 Location: T-H18

Group Report T 5.1 Mon 16:15 T-H18

Measuring mass and width of the W-boson with the ATLAS detector — Philip Bechtle[1], Klaus Desch[1], Philip Kennedy[2], Oleh Kivernyik[1], Jakub Kremer[2], •Philipp König[1], and Matthias Schott[2] — [1]Rheinische-Friedrich-Wilhelms-Universität Bonn — [2]Johannes Gutenberg-Universität Mainz

In 2017, the ATLAS collaboration measured the W-boson mass using *pp*-collision data taken at $\sqrt{s} = 7$ TeV in 2011, resulting in the most precise single measurement with a precision of 19 MeV. We present a revised analysis of the same dataset, improving the fit methods and including a measurement of the width of the W-boson. A precise measurement of these quantities in the decay of the W-boson represent an excellent precision test of the Standard Model (SM).

A detailed comparison of the analysis design between the reanalysis and the 2017 analysis is carried out. Improvements are made in the estimation of the multijet background and the description of some systematic uncertainties. The new fitting method of a profile likelihood fit is studied carefully and cross-checked against the results of the revised analysis.

T 5.2 Mon 16:35 T-H18

Measurement of the mass and width of the W-boson at the ATLAS experiment — •Philip David Kennedy[1], Jakub Kremer[1], Philipp König[2], and Matthias Schott[1] — [1]Institute of Physics, Johannes Gutenberg Universität, D-55099 Mainz, Germany — [2]Institute of Physics, Rheinische Friedrich-Wilhelms-Universität Bonn, D-53115 Bonn, Germany

We discuss the status of the W-boson mass and width measurements using data from the ATLAS experiment at the LHC. This work utilises a profile-likelihood fit to re-analyse the Run-1 dataset. This method provides an advantage over a χ^2 approach used in the original analysis as the likelihood is minimised over the whole parameter space, including all systematic uncertainties. It is then used to perform the first fit of Γ_W at the LHC. These results are of crucial importance for the EW-fit which bounds possible new physics scenarios. Comparison is then made between these results and those from other experiments. Particular emphasis will be placed on the performance of the profile-likelihood fit and its impact on the uncertainties of parton density functions.

T 5.3 Mon 16:50 T-H18

Measurement of the differential $W \to e + \nu$ cross-section at high transverse masses at $\sqrt{s} = 13$ TeV with the ATLAS detector — Frank Ellinghaus and •Frederic Schröder — Bergische Universität Wuppertal

The charged-current Drell-Yan (DY) cross-section is measured for the leptonic decay of the W boson $W \to e\nu$. While the cross-section at the peak of the W boson mass is known very well, the measurement of the differential cross-section for transverse masses up to $\mathcal{O}(1\,\text{TeV})$ is measured for the first time. In addition, the double-differential cross-section will be measured as a function of the transverse mass of the W boson and 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.

An overview of the cross-section measurement focused on issues related to the reconstruction of the missing transverse momentum in the fake lepton background estimation will be presented. The data has been taken at the ATLAS experiment during Run-2 based on *pp*-collisions at a center-of-mass energy of $\sqrt{s} = 13$ TeV at the LHC.

T 5.4 Mon 17:05 T-H18

Measurement of the differential $W \to \mu + \nu$ cross section at high transverse masses at $\sqrt{s} = 13$ TeV with the ATLAS detector. — Frank Ellinghaus, Frederic Schröder, and •Johanna Wanda Kraus — Bergische Universität Wuppertal

The cross section of the charged-current Drell-Yan process in the decay $W \to \mu + \nu$ is measured with data taken with the ATLAS detector from pp-collisions at a center-of-mass energy of $\sqrt{s} = 13$ TeV. The full run 2 dataset of $\mathcal{L} = 139\,\text{fb}^{-1}$ is analyzed.

While the inclusive cross-section is well-known, a differential measurement at very high transverse masses is done for the first time. The cross-section will also be measured double-differentially in the transverse mass of the W-boson m_T^W and the pseudorapidity of the lepton. This measurement is important since it can be used to constrain the parton distribution function of the proton as well as electroweak parameters.

A quick overview of the complete analysis will be given while the main focus is on the unfolding strategy via Iterative Bayesian Unfolding.

T 5.5 Mon 17:20 T-H18

A data-driven multijet background estimation method for the measurement of the electroweak Wjj production with the ATLAS experiment — •Lisa Marie Baltes — Kirchhoff-Institute for Physics, University Heidelberg, Germany

The observation and measurement of self-interactions of weak gauge bosons provide an indirect search for physics beyond the Standard Model. The electroweak production of a W boson in association with two jets includes the triple gauge boson vertices WWγ and WWZ and is thus sensitive to the vector-boson-fusion (VBF) production of a W boson. In proton-proton collisions, the characteristic signature of a VBF includes two high-momentum jets at small angles with respect to the incoming beams and a centrally produced lepton-neutrino pair originating from the W boson decay. A significant background for this analysis is the multijet production via the strong interaction where a jet is misidentified as a lepton. It is difficult to model this background since it strongly depends on detector-related quantities such as lepton identification and isolation criteria. Therefore, data-driven techniques are used to estimate this background. In this talk, the results of the multijet background estimation using the matrix method are presented.

T 5.6 Mon 17:35 T-H18

Measurement of angular coefficients of the Z boson production at ATLAS — •Julian Blumenthal and Stefan Tapprogge — Institut für Physik, Johannes Gutenberg-Universität, Mainz

A better understanding of QCD production processes at hadron colliders is a key aspect for theoretical predictions of perturbative QCD at higher accuracy. It allows for more precise measurements of Standard Model parameters and background estimations for searches. This contribution focusses on the measurement of angular coefficients that are used to describe the differential cross section of the Z boson production and subsequent decay into leptons in the Collins-Soper-frame. These angular coefficients can be used to probe QCD contributions in Z production processes in detail. Two of the coefficients in particular can also be used to make inferences about the effective weak mixing angle. For the measurement the full Run 2 ATLAS dataset with an integrated luminosity of L $\approx 139\,\text{fb}^{-1}$ at $\sqrt{s}$ =13 TeV is used, which increases the statistical accuracy significantly at a higher centre-of-mass energy than previous analyses. Major challenges of the measurement using centrally produced charged lepton pairs will be described and expected uncertainties discussed.

T 5.7 Mon 17:50 T-H18

Measurement of the anomalous magnetic moment of the tau lepton in heavy ion collisions with the ATLAS experiment — •Leonie Hermann, Valerie Lang, and Markus Schumacher — Albert-Ludwigs-Universität Freiburg

The anomalous magnetic moment of leptons is an important property in the Standard Model of particle physics and is highly sensitive to new physics beyond the Standard Model. At the LHC the anomalous magnetic moment of the tau lepton (a_τ) can be measured in ultra-peripheral PbPb collisions exploiting the large photon flux via the partonic process $\gamma\gamma \to \tau\tau$. Anomalous values of a_τ change the total cross-section and differential cross-sections in various kinematic observables. The analysis is based on PbPb collision data with a center-of-mass energy of 5.02 TeV collected with the ATLAS experiment in 2018 with an integrated luminosity of 1.33 nb^{-1}. Events with one leptonically decaying tau lepton, i.e. an electron or muon in the final state, and the other decaying hadronically or leptonically are exploited

in the analysis. The sensitivity of the measurement is determined by a maximum likelihood fit to the number of selected events, the shape of kinematic distributions and a combination of both in several signal regions corresponding to different final states. Studies of the expected sensitivity quantified by the length of the confidence interval for a_τ will be presented.

T 5.8 Mon 18:05 T-H18

Measurement of $Z\gamma\gamma$ and $ZZ\gamma$ final states with the ATLAS detector at the LHC — •Anke Ackermann and Philipp Ott — Kirchhoff-Institute for Physics, Heidelberg University

The Standard Model of Particle Physics (SM) predicts the rare production of triboson states, in which three gauge bosons are produced simultaneously. Although suffering from small cross sections and hence a limited amount of signal events, such triboson states can be studied with the vast amount of data that is collected by the ATLAS detector in Run 2. In addition to validating the predictions of the SM for rare processes, sensitivity to New Physics is given via anomalous quartic couplings of e.g. four neutral gauge bosons. This talk will focus on the analysis of the simultaneous production of $ZZ\gamma$ as well as $Z\gamma\gamma$. In order to determine the cross sections of those processes, it is crucial to separate signal events from events arising through background processes mimicking the signal topology. The most dominant background process contains fake photons, which are non-prompt photons within jets. Different data-driven methods are used to estimate the amount of fake photons in the signal region. After giving a general introduction about the triboson production of the processes $Z\gamma\gamma$ and $ZZ\gamma$, a short summary of the two analyses, including the event selection, the background estimation and a study for effects of New Physics, is presented.