T 21: Electroweak physics I

Time: Monday 16:30–18:00 Location: L-3.016

T 21.1 Mon 16:30 L-3.016

Determination of the weak mixing angle using angular coefficients of Z boson production at ATLAS — •Julian Fischer and Stefan Tapprogge — Institut für Physik, Johannes Gutenberg-Universität, Mainz

The weak mixing angle θ_W is one of the fundamental parameters in the electroweak sector of the Standard Model. A measurement of this parameter serves as a fundamental test of this theory and could thus also provide a gateway to physics beyond the Standard Model. Different approaches can be taken to determine this parameter experimentally. In this contribution the focus is on the extraction of the weak mixing angle using 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'. Recent results from ATLAS are reviewed and strategies for a full Run 2 measurement using an integrated luminosity of $L \approx 147\,\mathrm{fb}^{-1}$ at $\sqrt{s} = 13\,\mathrm{TeV}$ are discussed. Expectations on the accuracy will be formulated and challenges will be addressed based on the experience from the 8 TeV measurement.

T 21.2 Mon 16:45 L-3.016

Electroweak precision fits at future electron positron colliders — •Jakob Beyer[1,2] and Jenny List[1] — [1]DESY Hamburg — [2]Universität Hamburg

A precise determination of electroweak parameters is an essential part of future high-$\sqrt{s}$ e^+e^- collider programs. The collider parameters most relevant for the physics case of such a machine are its energy, luminosity and the availability of beam polarisation. All three can be used to maximize the expected signal of interest. In addition, beam polarisation is expected to disentangle systematic uncertainties from fundamental physics. How the extraction of electroweak parameters is affected by the collider parameters must be well understood. This can be investigated through a realistic analysis of electroweak processes at such a collider setup. In this study, charged triple gauge couplings and chiral cross sections are extracted from differential distribution of two- and four-fermion final states. A χ^2-fit to toy measurements is performed for varying initial collision conditions. Selection efficiencies and purities are adapted from full detector simulation analyses. Systematic uncertainties are parameterised and included in the fit. Sensitivities to each fit parameter are extracted from this fit. The importance of the collider parameters for this analysis is seen from their influence on the uncertainties. In particular, the effectiveness of beam polarisation as a tool to suppress systematic uncertainties is assessed. Other analyses at e^+e^- colliders may experience qualitatively similar behaviour of systematic uncertainties. Future collider efforts can use this knowledge in their design studies to maximize their physics potential.

T 21.3 Mon 17:00 L-3.016

Measurement of the differential $W \to \mu + \nu$ cross section at high transverse masses at $\sqrt{s} = 13\,\mathrm{TeV}$ with the ATLAS detector. — •Johanna Wanda Kraus, Frederic Schröder, and Frank Ellinghaus — 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 $\sqrt{s} = 13\,\mathrm{TeV}$.
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.
An overview over the analysis strategy and progress will be given.

T 21.4 Mon 17:15 L-3.016

Measuring the lepton universality, the mass and the width in the W-boson decay with the ATLAS detector — Lennart Adam[2], Nassim Ainouz[1], Philip Bechtle[1], Klaus Desch[1], Jakub Kremer[2], •Philipp König[1], and Matthias Schott[2] — [1]Rheinische Friedrich-Wilhelms-Universität Bonn — [2]Johannes Gutenberg-Universität Mainz

The ATLAS collaboration measured the W-boson mass based on data taken with 7 TeV in 2017 in the most precise single measurement with a precision of 19 MeV. The analysis presented goes one step further and tries to improving the fitting methods and by measuring also the width of the W-boson. These quantities and the test of the lepton universality in the decay of the W-boson are an excellent precision test of the Standard Model (SM).

A measured deviation of the branching fraction $BR(W \to \tau\nu)$ from the SM prediction would 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 ratios of the tau lepton decay into light leptons compared to the direct W decay into light leptons. 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 21.5 Mon 17:30 L-3.016

Using impact parameter information for leptonic tau lepton decays in the measurement of the $W \to \tau\nu$ decay — •Nassim Ainouz[1], Philipp König[1], Matthias Schott[2], Lennart Adam[2], Jakub Kremer[2], Philip Bechtle[1], and Klaus Desch[1] — [1]Rheinische Friedrich-Wilhemls-Universität Bonn — [2]Johannes Gutenberg Universität Mainz

The measurement of the mass of the W-Boson from the ATLAS experiment has been a highly acknowledged result in the past year. It's the most precise single measurement of the W-mass which has been studied in leptonic final states. The SM predicts an equal coupling of the W-Boson to the different lepton flavours, leading to only a small difference in the branching ratios due to the different masses. The presented analysis follows a new approach to look at lepton universality by considering the ratio $BR(W \to \tau\nu_\tau \to \mu\nu_\mu\nu_\tau\nu_\tau)/BR(W \to \mu\nu_\mu)$ as many systematic uncertainties cancel. Any deviation from the SM value could hint at new physics.

To further increase the sensitivity, we aim to make use of the life time of the tau lepton resulting in a given decay length. The measurement of the impact parameter and its correct calibration in Z->ll events is a crucial task to use it in the final measurement.

T 21.6 Mon 17:45 L-3.016

Measurement of $W + \gamma$ production via electroweak vector boson scattering in pp collisions at $\sqrt{s} = 13\,\mathrm{TeV}$ at ATLAS — •Burkhard Böhm, Gia Khoriauli, and Raimund Ströhmer — Universität Würzburg

Electro-weak vector boson scattering (VBS) processes provide a way to search for deviations from the Standard Model (SM) electroweak theory predictions by measuring the triple and quartic couplings between gauge bosons. The cross sections of the VBS processes are predicted to be relatively small in the SM and most of them are not yet measured by the ATLAS experiment in proton-proton collisions with $\sqrt{s} = 13$ TeV. Thus, studying the VBS processes can yield interesting new results.

This work presents an on-going test of the SM by measuring the VBS process when two initial vector bosons radiate from the colliding quarks inside protons and result to a production of $W + \gamma$ and two hadronic jets with large separation in pseudo-rapidity as a final state. The W boson further decays into a muon and a neutrino. ATLAS data from 2018 collected at $\sqrt{s} = 13$ TeV of proton-proton collisions and the corresponding Monte-Carlo simulation samples are used in the study. The goal of the study is to contribute to the ATLAS full analysis of the $W + \gamma$ production via the electroweak vector boson scattering.