T 62: Standard model 2 (electroweak/bosons)

Time: Wednesday 16:00–18:00 Location: Geb. 30.23: 2/0

T 62.1 Wed 16:00 Geb. 30.23: 2/0

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

A measurement of the differential cross section of the process $W \to \ell\nu$ is shown. The data set analyzed is based on data from pp-collisions at a center-of-mass energy of $\sqrt{s} = 13$ TeV, corresponding to an integrated luminosity of $\mathcal{L} = 140\,\text{fb}^{-1}$. It is taken with the ATLAS detector during LHC Run-2. The measurement is done double-differentially in the transverse mass of the W boson and the absolute of the pseudorapidity of the lepton. It focuses on the region of high transverse masses between 200 GeV and 2000 GeV. The results will allow for constraints on effective field theories and parton distribution functions of the proton. An overview of the complete analysis will be presented.

T 62.2 Wed 16:15 Geb. 30.23: 2/0

$W\gamma\gamma$ analysis in Run 3 with the ATLAS detector at the LHC — •Isabel Sainz Saenz-Diez — Kirchhoff Institute for Physics, Heidelberg University

The production of a W boson in association with two photons from proton-proton collisions, among other triboson final states, is predicted by the Standard Model of Particle Physics (SM). The observation of this process was possible with the data collected by the ATLAS detector during the Run 2 of the LHC. This opened the possibility for testing the SM predictions, in particular the quartic gauge couplings. The focus of this talk is the analysis of $W\gamma\gamma$ final states in Run 3. Due to the higher centre of mass energy and the large dataset, more events are expected with respect to the previous observation and dedicated triggers are now used. A study of the efficiencies of these triggers is presented, followed by the background estimation of some processes that can be misreconstructed as signal. The most relevant backgrounds come from misidentified photons, for which a data-driven estimation method is used. Additionally, results of the estimation through Monte Carlo simulations of other backgrounds are shown.

T 62.3 Wed 16:30 Geb. 30.23: 2/0

Measurement of $\gamma\gamma jj$ final states from Vector Boson Scattering at the ATLAS experiment — •Orcun Kolay and Frank Siegert — Technische Universität Dresden, Germany

Vector boson scattering (VBS) offers an opportunity to study triple and quartic gauge couplings, which are relatively uncommon occurrences. This provides us with a means to examine the Standard Model (SM), the electroweak (EW) symmetry-breaking mechanism, and to explore potential new physics phenomena.

This study focuses on the final state involving two photons and two jets, denoted as $\gamma\gamma jj$. The $\gamma\gamma jj$ process has a crucial role not only for new physics anomalies such as the coupling of four neutral gauge bosons but also for understanding the background of the two-photon final state of the Higgs boson produced via vector boson fusion.

The measurement of the VBS $\gamma\gamma jj$ process comes along with two main challenges: The background coming from QCD induced $\gamma\gamma jj$ and misidentified jets as photons. This presentation covers an ongoing work focusing on the phase space strategy discriminating EW $\gamma\gamma jj$ processes from the background, the estimation of backgrounds from misidentified jets, and the treatment of the systematics.

T 62.4 Wed 16:45 Geb. 30.23: 2/0

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

The Standard Model of Particle Physics (SM) predicts the rare production of triboson final states. 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 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 $ZZ\gamma$. In order to determine the cross sections of this process, 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. Due to the limited statistics a new approach with jet ratios is applied to estimate the amount of fake photons in the signal region. Additionally, processes with misidentified leptons contribute to the background. Their contribution is estimated with the likelihood matrix method. After giving a general introduction about the triboson production of the $ZZ\gamma$ process, a summary of the analysis, including the event selection and the background estimation, is presented.

T 62.5 Wed 17:00 Geb. 30.23: 2/0

Estimation of the photon contribution from mis-identified electrons to the differential cross-section measurements of single-top quark production in association with a photon with the ATLAS experiment at $\sqrt{s} = 13$ TeV — •Lucas Cremer, Nils Julius Abicht, Tomas Dado, and Andrea Helen Knue — TU Dortmund, Experimentelle Physik

Measuring the differential production cross-sections of single top quarks in association with a photon provides a unique opportunity to probe the electroweak interaction of the top quark with the photon.

An important background to this process arises from events with an electron that is mis-identified as a photon. Due to the difficulty to model this process from Monte Carlo simulations, a data-driven method is used to estimate the contribution of this background to the selected events. Corrections are derived from two control regions enriched with $Z \to ee$ and $Z \to e\gamma$ events, respectively. Distributions of the invarivant-mass of the electron pair m_{ee} and the electron and the photon $m_{e\gamma}$ obtained from Monte Carlo simulations are fitted to the data in bins of the pseudorapidity of the photon as well as its conversion type to extract the corrections. The results estimated on the complete ATLAS Run-2 dataset, corresponding to an integrated luminosity of 140 fb^{-1}, are presented.

T 62.6 Wed 17:15 Geb. 30.23: 2/0

Fake photon background estimate with the template fit method at ATLAS — •Tobias Heintz — Kirchhoff Institute for Physics, Heidelberg University

Photons are an important signature in the final state of proton-proton collisions at the Large Hadron Collider. A background contribution to these final states are so-called fake photons, which are not promptly produced in the *pp* collision, but arise within the fragmentation of jets, mainly via $\pi^0 \to \gamma\gamma$. This study deals with a template fit method to estimate the background contribution of fake photons. As established in various multi-boson analyses at ATLAS, templates for the isolation energy distribution are extracted using Monte Carlo simulations. The templates are currently extracted for each final state separately, so this study aims to extract generic templates that can be used for photons in different final states. Therefore, the dependence of the isolation templates on the transverse momentum of the photon, p_{T}, is investigated. Considering the correlations between the isolation energy and p_{T} and taking into account the p_{T} distribution of the investigated phase space, the same templates can be used for photons in the $Z\gamma$ and $Z\gamma\gamma$ process.

T 62.7 Wed 17:30 Geb. 30.23: 2/0

Towards a measurement of the Z boson mass in proton-proton collisions with the ATLAS experiment — •Dionysios Fakoudis[1,2], Stefan Tapprogge[1], and Emilien Chapon[2] — [1]Institute of Physics, Johannes Gutenberg University, Mainz, Germany — [2]CEA,Paris,France

The precise measurement of the Z boson mass is an important foundation of the Standard Model. This talk presents an analysis of the challenges encountered in the Z boson mass measurement using ATLAS data having recorded about 10^8 Z boson decays to $\mu^+\mu^-$ in proton - proton collisions at 13 TeV centre-of-mass energy. Di-muon final states are considered and specific emphasis is given to the associated uncertainties. To allow a precision determination of Z boson mass an excellent understanding of the detection and the measurement of the muon kinematics is required, therefore the focus is on the crucial aspect of calibration. The presentation delves into the intricacies of calibration techniques, exploring the methods employed, their efficacy, and the challenges associated with achieving the desired precision.

T 62.8 Wed 17:45 Geb. 30.23: 2/0

Electroweak Parameters from Yang-Mills Thermodynamics — Ralf Hofmann[1] and •Janning Meinert[1,2] — [1]ITP Universität Heidelberg, Philosophenweg 16, 69120 Heidelberg, Germany — [2]Bergische Universität Wuppertal, Gaußstraße 20, 42119 Wuppertal, Germany

Based on the thermal phase structure of pure SU(2) quantum Yang-Mills theory, we describe the electron at rest as an extended particle, a so-called blob. Utilizing a mirror-charge construction, we compute the mixing angle θ_W for the bulk thermodynamics and the charge of the blob as seen by a soft external probe field. It is shown that the blob does not exhibit an electric dipole or quadrupole moment. Within this model, we calculate the Weinberg angle to be $\theta_W \sim 30^\circ$ and the fine-structure constant to be $\alpha^{-1} \sim 134$, which is close to the experimental values. The ratio of blob radius r_0 and the reduced Compton radius r_c is computed from a quantum-thermodynamical mass formula and coincides with $\alpha_{\rm exp}^{-1}$. This identifies r_0 with the Bohr radius a_0. In this talk, I will briefly review Yang-Mills thermodynamics and sketch the calculation of the Weinberg angle within this model.

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