# T 98: Electroweak Physics III (W/Z Production and Properties)

Time: Friday 9:00–10:30 Location: VG 2.103

T 98.1 Fri 9:00 VG 2.103

**Sensitivity to lepton-flavour-violating decays of the $Z$ boson using a data-driven background estimate with the ATLAS Experiment** — •Naman Kumar Bhalla, Valerie Lang, and Markus Schumacher — Albert-Ludwigs-Universität Freiburg

One of the primary goals of the Large Hadron Collider (Lhc) program is to look for phenomena beyond the Standard Model (SM) of particle physics. One such phenomenon is lepton flavour violation (LFV), which has already been observed in neutrino oscillations, but not in processes involving charged leptons. A search for LFV in decays of the $Z$ boson with charged leptons in the final state, such as $Z \to e\tau_\mu$ and $Z \to \mu\tau_e$, is of high interest and well motivated by various beyond-SM theories. This search can be performed using a data-driven background estimate, which takes advantage of the idempotency of SM backgrounds under the exchange of an electron and a muon. The symmetry is broken only by the difference in branching ratios between LFV decays with $e\tau$ and $\mu\tau$ final states.

This talk discusses the achievable sensitivities for the search of LFV decays of the $Z$ boson using this data-driven background estimate. The full Run-2 data set is used, which was collected by the Atlas detector in $pp$ collisions at $\sqrt{s} = 13\,\text{TeV}$, corresponding to an integrated luminosity of $140\,\text{fb}^{-1}$. The data-driven estimate, the neural network used to classify the LFV signal against other background processes along with the statistical model used for the analysis are presented.

T 98.2 Fri 9:15 VG 2.103

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

A measurement of the double-differential cross section of the process $W \to \ell\nu$ at high transverse masses is shown. The data set analyzed is based on data from pp-collisions at a center-of-mass energy of $\sqrt{s} = 13\,\text{TeV}$, 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 pseudorapidity of the lepton. It focuses on the region of high transverse masses between 200 GeV and 5000 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. The talk will focus on the interpretation of the final results.

T 98.3 Fri 9:30 VG 2.103

**Production of hadronically-decaying boosted vector bosons in association with jets at the ATLAS experiment** — •Donna Maria Mattern and Chris Malena Delitzsch — TU Dortmund, Fakultät Physik

Due to the unprecedented energy of the proton-proton collisions at the Large Hadron Collider (LHC), massive electroweak vector bosons (W and Z bosons) are frequently produced with energies much larger than their masses, thus receiving a Lorentz boost. When these particles decay hadronically, their decay products are collimated and can be reconstructed as single large-radius jets (R=1.0). These high-transverse momentum large-radius jets have distinctive properties like their mass, and jet-substructure, which describes the internal structure of the jet. Signal events have to be distinguished from large sources of background events produced from quantum-chromodynamic processes at the LHC, which have similar, multi-jet signatures. Studies of the large-radius-jet substructure are useful to discriminate between these signal and background processes to be able to measure the production of the boosted-vector bosons. Studies on the production of W and Z bosons in association with jets in LHC Run-2 data collected with the ATLAS detector, and Monte Carlo simulated samples are presented.

T 98.4 Fri 9:45 VG 2.103

**Exploring the effects of a boosted vector boson's polarisation on the jet reconstructed from their hadronic decay products** — •Maren Bühring[1], Max Lehmann[1], Frank Siegert[1], Karolos Potamianos[2], Amartya Rej[3], Donna Maria Mattern[3], and Chris Malena Delitzsch[3] — [1]IKTP, Technische Universität Dresden — [2]University of Warwick — [3]Technische Universität Dortmund, Fakultät Physik

The production of W or Z bosons in association with additional jets at the Large Hadron Collider (LHC) facilitates precision tests of the Standard Model, while also constituting an important background for other vector boson related processes and new physics searches. One of the challenges in the case of hadronically decaying vector bosons is to identify the bosons' decay products among all of the other hadronic activity at the LHC. If the transverse momentum of the boson is especially high, then its decay products are likely to be reconstructed as one large radius jet, which makes the substructure of that jet one of the most useful tools in identifying them. This study explores the impact of the boson's polarisation on the resulting jet's kinematics and substructure using events simulated with Sherpa 3.0.0, with the goal of applying the results in an ATLAS analysis aiming to measure the cross section of vector boson plus jets production in the LHC Run 2 data set.

T 98.5 Fri 10:00 VG 2.103

**Validating the Hadronic Recoil Calibration in the ATLAS low-$\langle\mu\rangle$ $W$ Mass Analysis** — •Mathias Backes — Kirchhoff-Institut für Physik

The measurement of the mass of the $W$-boson is one of the fundamental tests of the Standard Model. ATLAS (2024) and CMS (2024) published measurements presenting results for the $W$-mass which are in agreement with the Standard Model. These measurements are in more than $5\sigma$ tension with the value obtained by the CDF collaboration (2022). In order to investigate this tension ATLAS is currently performing an additional measurement.

The $W$ mass is most accurately measured using the leptonic decay channel $W \to l\nu_l$ with $l \in (e, \mu)$. The low-pileup dataset of ATLAS (taken in Run-2) is especially useful because a central aspect of this analysis is the precise estimation of the hadronic recoil to infer the energy and direction of the neutrino. Since the W mass cannot be measured directly it has to be inferred through comparisons with Monte Carlo simulations in a Profile Likelihood Fit. The success of such a fit strongly depends on the quality of the simulation. It is therefore necessary to explicitly calibrate the hadronic recoil estimation in the simulation to ensure it is modeled properly. The calibration can be validated by using $Z$-boson events, which can also be extracted from the low-pileup dataset.

T 98.6 Fri 10:15 VG 2.103

**Heavy-meson reconstruction at the FCC-ee** — Kevin Kröninger[1], Romain Madar[2], Stéphane Monteil[2], and •Willy Weber[1,2] — [1]TU Dortmund University, Department of Physics, Dortmund — [2]Université Clermont-Auvergne, Laboratoire de Physique de Clermont, Clermont-Ferrand

The Future Circular Collider (FCC-ee) is a proposed electron-positron collider designed to enable high-energy collisions at unmatched scales. It is expected to produce approximately $\mathcal{O}(10^{12})$ $Z \to \bar{q}q$ events, significantly enhancing our ability to perform precision measurements of electroweak observables.

This talk presents the first steps of a study focusing on decays of charmed $D$-mesons, which are produced as a result of the hadronization process. $D$-mesons have a short lifetime (up to $10^{-12}$ seconds) before they decay into other particles. In particular, $D^+ \to \pi^+\nu\bar{\nu}$ and $D^0 \to \pi^0\pi^0$ are considered. Challenges of this final states are the non-detectable neutrinos $\nu$ and the hard-to-detect neutral pions $\pi^0$. To identify the two photons coming from the $\pi^0$ decay, high energy and angular resolution are required, which makes the reconstruction and then the tagging of this final state difficult.
The results of this study may contribute to the study of CP violation in the charm sector. Additionally, the insights gained from this research can contribute to design decisions of the calorimeter to be developed for the FCC-ee.