T 68: Standard Model Physics III

Time: Thursday 16:15–17:45 Location: KH 00.014

T 68.1 Thu 16:15 KH 00.014

Study of sensitivity of VBS VZjj semi-leptonic final states to vector boson polarisation observables — •Aryan Borkar, Thomas Trefzger, Raimund Ströhmer, and Gia Khoriauli — University of Würzburg

The electroweak symmetry breaking mechanism can be experimentally tested in the electroweak vector boson scattering (VBS) processes that occur in proton-proton collisions at the LHC.

The unitarity of VBS cross sections of longitudinally polarised bosons $V_{1,L}V_{2,L} \rightarrow V_{3,L}V_{4,L}$, where $(V = W^{\pm}, Z)$, in the Standard Model are preserved due to inclusion of the Feynman diagrams with the Higgs boson propagator in calculations.Thus, precise measurements of VBS processes of longitudinally polarised vector bosons are important experimental tests of the validity of the Brout-Englert-Higgs mechanism.

We present the preliminary study of the potential of measurements of VZ VBS polarisation observables, in the fiducial phase space as defined by the geometry of ATLAS detector. VBS processes with semi-leptonic final states, where Z decays to a pair of same-flavour oppositely charged leptons and V decays hadronically, are considered in the study.

T 68.2 Thu 16:30 KH 00.014

Measurement of the differential di-boson cross-section in semileptonic final states at $\sqrt{s} = 13$ TeV in $140\,\text{fb}^{-1}$ of pp collisions with the ATLAS detector — •Anubhav Gupta, Chris M. Delitzsch, and Amartya Rej — TU Dortmund University, Otto-Hahn-Str. 4A 44227 Dortmund

The measurement of electroweak vector boson pair (VV) production cross-sections is a critical test of the Standard Model (SM), probing electroweak boson self-interactions and the electroweak theory. While VV production has been well-studied in fully leptonic decay channels at $\sqrt{s} = 13\,\text{TeV}$, semileptonic channels have only been measured at $\sqrt{s} = 8\,\text{TeV}$.

This analysis presents the first measurement of di-boson production in the semileptonic channel (leptons and a large radius jet) at $\sqrt{s} = 13\,\text{TeV}$, taking advantage of its higher branching fraction compared to fully leptonic decays and a cleaner signature than fully hadronic decays. The semileptonic channel is particularly sensitive at high energies, offering strong potential for detecting new physics beyond the SM in the tails of kinematic distributions.

The study includes particle-level inclusive and differential cross-section measurements, along with constraints on dimension-6 Effective Field Theory (EFT) operators in the Warsaw basis, affecting electroweak triple gauge couplings, at the folded level.

T 68.3 Thu 16:45 KH 00.014

Analysis of multi-τ final states of diboson processes with the ATLAS detector — Philip Bechtle, Yann Buchholzer, Klaus Desch, Christian Grefe, and •Simon Thiele — Rheinische Friedrich-Wilhelms Universität Bonn

The process $ZZ \rightarrow 4\tau$ is a theoretically well understood standard model process but has never been observed. In addition to the small cross section and branching ratio there are several challenges posed by this channel. Among them are the fake estimation of combinations of up to four hadronic tau-candidates, the mass reconstruction in final states with at least four neutrinos, the pair-wise combination of the τ's, and the selection of triggers to use.

Additionally to being itself an interesting discovery, the work on multi-τ final states can serve as a template for future $HH \rightarrow 4\tau$ searches, which could add to the discovery potential for triple Higgs couplings at the LHC. Furthermore there is the potential to discover other heavy scalars in the 4τ final state if there is resonant $A \rightarrow HH$ production as opposed to merely the off-shell standard model production.

In this talk I will present an overview of previous efforts and the initial work already done in this analysis, going over theoretical expectations and the analysis strategy.

T 68.4 Thu 17:00 KH 00.014

Sensitivity and background studies related to the measurement of the tau-lepton's anomalous magnetic moment in proton collisions with the ATLAS detector. — •Ruben Bies, Valerie Lang, and Markus Schumacher — University of Freiburg

Anomalous magnetic moments are a property of leptons that modify their behaviour in electromagnetic fields through higher order corrections in quantum field theory. These quantities have been measured with great precision for electrons and muons and have shown some tensions with the predictions in the Standard Model (SM). Measurements of the tau-lepton's anomalous magnetic moment are predicted to be most sensitive to beyond SM effects, but the tau-lepton's lifetime is too short for similar experiments as for electrons and muons. In recent years, measurements of the anomalous magnetic moment for the tau-lepton have been successfully performed using ultra-peripheral heavy-ion collisions as well as proton collisions at the Large Hadron Collider (LHC).

This presentation will outline the analysis strategy of the ATLAS collaboration to perform a measurement of the tau-lepton's anomalous magnetic moment in proton collisions using the datasets from the second and third running periods of the LHC. Initial studies on the selection optimization and improvements of the signal to background ratio, as well as first background estimates will be shown.

T 68.5 Thu 17:15 KH 00.014

Measuring the τ Lepton Polarization in $Z \rightarrow \tau_{\text{lep}}\tau_{\text{had}}$ Decays with ATLAS Run 2 Data — •Laman Guliyeva[1], Philip Bechtle[2], and Christian Grefe[2] — [1]Bergische Universität Wuppertal, Gaußstr. 20, D-42119 Wuppertal — [2]Physikalisches Institut der Universität Bonn, Nußallee 12, D-53115 Bonn

The polarization of leptons produced in Z-boson decays is a key parameter of the electroweak sector, as it provides direct insight into the parity-violating structure of the $Z\ell\ell$ coupling. In particular, τ leptons constitute a sensitive probe of electroweak interactions due to their short lifetime and decays occurring within the detector volume. Their hadronic decay modes are especially sensitive to spin-dependent observables, enabling a precise determination of their polarization in Z-boson decays.

This contribution presents a new measurement of the τ-lepton polarization in $Z \rightarrow \tau_{\text{lep}}\tau_{\text{had}}$ decays using ATLAS Run-2 data collected in 2018 at $\sqrt{s} = 13$ TeV. This measurement is based on a statistically independent and substantially larger dataset than the Run 1 analysis, making it fully complementary to the previous ATLAS result.

T 68.6 Thu 17:30 KH 00.014

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 $Z \rightarrow e\tau_{\mu}$ and $Z \rightarrow \mu\tau_{e}$, 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 $L_{\text{int}} = 140\,\text{fb}^{-1}$. The talk presents the data-driven estimate and a new methodology to construct and implement a robust statistical model.