T 38: Standard model 1 (electroweak/bosons)

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

T 38.1 Tue 16:00 Geb. 30.23: 2/0

Determination of the tau polarization in hadronic $Z \to \tau^+\tau^-$ decays from pp collisions at the ATLAS detector — •Florian Harz, Adrián Álvarez Fernández, and Stefan Tapprogge — Institut für Physik, Johannes Gutenberg-Universität, Mainz, Germany

The Z boson arises from the unification of the electromagnetism and weak forces, coupling differently to left- and right-handed particles as indicated by the effective weak mixing angle. Precisely measuring the tau polarization in $Z \to \tau^+\tau^-$ decays provides a means to extract the weak mixing angle. This is accomplished by fitting templates to sensitive kinematic observables derived from decays of purely left-handed or right-handed taus. This method can be verified using simulated samples. The study considers various hadronic tau decay channels and assesses their sensitivity to the tau polarization. The status of these studies is presented, highlighting their potential application to real data, particularly focusing on proton-proton data collected at the ATLAS detector.

T 38.2 Tue 16:15 Geb. 30.23: 2/0

Studies of the τ polarization in leptonic Z $\to \tau^-\tau^+$ decays using $\sqrt{s} = 13$ TeV pp collision data — •Sabrina Saul, Florian Harz, Adrián Álvarez Fernández, and Stefan Tapprogge — Johannes-Gutenberg Universität Mainz, Institut für Physik

This study examines the leptonic τ decays from Z boson resonant production in pp collisions at LHC with $\sqrt{s} = 13$ TeV measured with the ATLAS detector. As a result of the electroweak interaction, τ leptons from Z decays are polarized and the degree of polarization is connected to the weak mixing angle. Kinematic properties of the visible decay products of the τ (muons and electrons in this case) allow to infer the polarization of the parent particle. First, the kinematic properties are investigated without detector effects. Second, detector effects such as resolution, as well as the impact of cuts necessary to suppress background are studied. This contribution will summarize the current status and outlook of the study.

T 38.3 Tue 16:30 Geb. 30.23: 2/0

Prospects of the longitudinally polarised vector boson scattering processes at the ATLAS detector — •Aryan Borkar, Thomas Trefzger, Raimund Ströhmer, and Gia Khoriauli — Julius-Maximilians-Universität 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 $V_{1,L}V_{2,L} \to V_{3,L}V_{4,L}$, where $(V = W^{\pm}, Z)$, in the Standard Model are preserved by including 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 polarisation observables in the combined Run-2 and Run-3 data sets collected by the ATLAS detector. VBS processes with different heavy vector boson final states are considered in the study.

T 38.4 Tue 16:45 Geb. 30.23: 2/0

Polarization Measurement in Same-Charged WW Scattering Within the ATLAS Experiment — •Max Stange, Frank Siegert, Erik Bachmann, Mareen Hoppe, and Tim Herrmann — TU Dresden, Dresden, Germany

In 2023, the ATLAS experiment marked the first differential cross-section measurement of same-charged W boson scattering, a process crucial for understanding electroweak symmetry breaking. Since the W bosons obtain their mass and thus their longitudinal polarization directly from the Higgs mechanism, the longitudinal parts of the W boson scattering are particularly promising for studying the Higgs mechanism and finding physics beyond the Standard Model. As these bosons decay into a charged lepton and a neutrino, directly reconstructing their original polarizations is impossible. To address this, the analysis uses neural networks to separate the background and the polarizations within the same charged W boson signal. The talk gives an overview of the applied machine learning techniques and the study of next-to-leading-order corrections applied for the polarization.

T 38.5 Tue 17:00 Geb. 30.23: 2/0

Search for scattering of same-sign WW boson pairs in the semi-leptonic channel at the CMS experiment. — Thorsten Chwalek[1], Nils Faltermann[1], Abideh Jafari[2], Thomas Müller[1], and •Komal Tauqeer[1] — [1]Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Institut für Technologie (KIT), Germany — [2]Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany

Vector Boson Scattering (VBS) at the LHC is a key process to probe the electroweak symmetry breaking of the standard model (SM). Deviations in VBS cross section measurements point to physics phenomena beyond the SM. Same-sign WW scattering is known as the golden channel to study VBS as it has the best σ_{EW}/σ_{QCD} ratio. Studying this process in semi-leptonic channel will broaden the search as it provides a much larger branching ratio. The biggest challenge here is to identify the correct bosons (W^+, W^-, Z) in the final state that are decaying into quarks.

To distinguish jets in the final state that are coming from the hadronic decay of the bosons, we have developed a method to identify the charge of the jet using state-of-art machine learning techniques. With the help of this method, we are able to distinguish between jets originating from W^+, W^-, or Z bosons. In this talk, I will present the techniques used for doing the jet charge tagging and how we are implementing these techniques to study the same-sign WW VBS process in the semi-leptonic channel.

T 38.6 Tue 17:15 Geb. 30.23: 2/0

Study of polarization fractions in same-sign W boson scattering with the ATLAS detector — •Prasham Jain[1], Beate Heinemann[2,3], and Oleg Kuprash[1] — [1]University of Freiburg, Freiburg im Breisgau, Germany — [2]DESY, Hamburg, Germany — [3]University of Hamburg, Hamburg, Germany

Polarized same-sign W boson pair production is a crucial process to examine the electroweak symmetry breaking mechanism. A measurement of the fraction of longitudinally polarized W bosons, $W_L^{\pm}W_L^{\pm}$, tests the unitarization mechanism of the vector boson scattering amplitude through Higgs boson contributions, and is sensitive to potential new physics effects. This talk presents machine learning (ML) methods for classification of $W^{\pm}W^{\pm}$ polarization modes studied with the ATLAS detector using Run 2 LHC data. Results are shown of applying the ML for the extraction of longitudinal polarization fraction.

T 38.7 Tue 17:30 Geb. 30.23: 2/0

Search for photon-induced semileptonic WW production at the ATLAS Experiment — •Varsiha Sothilingam — Kirchhoff-Institut für Physik, Universität Heidelberg

This talk will focus on the coupling between W bosons and photons where the W bosons decay semileptonically. They interact via the triple ($\gamma \to WW$) and quartic ($\gamma\gamma \to WW$) gauge boson couplings of the SM. This process can be produced via Centrally Exclusive Production at the LHC, where non-colliding protons produce a non-linear electromagnetic field which creates a photon pair. The photons couple to the W bosons, providing the signal of interest while the protons remain intact. These protons can be detected using the ATLAS Forward Proton (AFP) spectrometers, which are located around 200m away from the ATLAS detector, on both sides. Kinematic information from both the AFP and ATLAS central detector can be used to constrain the signal process. Additionally, the final state of this process favours boosted topologies which can also be exploited in the signal optimisation. With the use of the AFP detectors, such a process can be used to search for model independent extensions of the SM. This is done in the Effective Field Theory (EFT) formalisation, which the quartic coupling process is sensitive to. The anomalous quartic coupling is sensitivity to dimension-8 operators of the EFT model. This talk will provide insight to the measurement of this rare process and the methods used to optimise this search. The EFT operators which the process is sensitive to will be studied and expected experimental limits will be set.

T 38.8 Tue 17:45 Geb. 30.23: 2/0

Measurement of the electroweak production of a W boson accompanied by two jets with the ATLAS experiment — •Lisa

Marie Baltes — Kirchhoff-Institute for Physics, University Heidelberg, Germany

The observation and measurement of electroweak gauge boson self-interaction provides an indirect search for physics beyond the Standard Model. The electroweak production of a W boson in association with two jets includes the vector-boson-fusion (VBF) production of a W boson and is thus sensitive to the triple gauge boson vertices WWγ and WWZ. In proton-proton collisions, the characteristic signature of 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. This unique signature provides kinematic discrimination from backgrounds such as strongly produced jets associated with a W boson, $t\bar{t}$ and dijet. In this talk, the current status of the electroweak Wjj analysis including event selection and background estimation is presented.