T 87: Electroweak Interactions (Exp.) 2

Time: Thursday 16:15–18:20 Location: T-H18

Group Report T 87.1 Thu 16:15 T-H18

Latest results on vector boson scattering studies from CMS — •Ankita Mehta, Andreas Hinzmann, and Steffen Albrecht — UHH, Hamburg, Germany

Vector boson scattering (VBS) is a key production process to probe the electroweak symmetry breaking sector of the standard model and to look for new physics phenomena beyond the standard model indirectly. VBS measurements have entered into a precision era with availability of larger dataset from LHC runII and recent developments in the field of machine learning. A summary of the latest VBS cross section measurements in different channels from the CMS experiment will be presented. A future outlook for the measurement of longitudinally polarized scattering of the W and Z bosons in the HL-LHC scenario and a combination of ATLAS and CMS measurements will also be presented.

T 87.2 Thu 16:35 T-H18

Measurement of same-sign WW Production at 13 TeV with the ATLAS Experiment — •Shalu Solomon — Albert-Ludwigs University of Freiburg, Germany

The electroweak production of same-sign W boson pairs is one of the pivotal processes to experimentally probe the electroweak symmetry breaking mechanism. With the Standard Model Higgs boson playing a key role in regularising the scattering amplitude of longitudinally polarised W bosons, and thanks to the large electroweak to strong production mode ratio, measuring same-sign WW production is an important tool to understand the electroweak sector.

The analysis of 2015-2016 LHC data at $\sqrt{s} = 13$ TeV by the ATLAS experiment resulted in the observation of electroweak WW production with a signal significance of 6.5 σ. With the entire Run 2 dataset, corresponding to an integrated luminosity of 139 fb^{-1}, the signal event yield has increased approximately by a factor of four, which gives the potential for the first differential cross-section measurement of this process.

The talk aims to present a summary of the analysis. The estimations of all the major backgrounds along with their uncertainties and behaviour in different validation regions are discussed. Fitting and unfolding methods including closure tests are presented. The expected event yields and the largest uncertainties on the cross-section are also shown.

T 87.3 Thu 16:50 T-H18

Study of polarization fractions in same-sign W boson scattering — •Prasham Jain, Beate Heinemann, and Oleg Kuprash — Albert-Ludwigs-Universität Freiburg, Freiburg, 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, $W_L^{\pm}W_L^{\pm}$, directly probes the unitarization mechanism of the vector boson scattering amplitude through Higgs boson contributions, and is sensitive to potential new physics effects. This talk presents the validation of Monte Carlo samples for polarized WW production at the LHC and shows first results of applying machine learning methods for extracting the longitudinal polarization fraction.

T 87.4 Thu 17:05 T-H18

Polarized same-sign W boson scattering 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) — [2]Deutsches Elektronen-Synchrotron (DESY), Hamburg

Polarized vector boson scattering (VBS) provides an opportunity for testing the Higgs mechanism in the electroweak sector of the standard model. At the LHC, the scattering of the weak gauge bosons can reveal the actual process by which they get their masses. In particular, the longitudinal polarized state of these bosons can reveal new information about the goldstone bosons of the electroweak symmetry breaking sector.

The most promising VBS channel for this type of study is same-sign WW scattering, which has a good balance between signal and backgrounds. In particular, the semi-leptonic decay channel provides a larger cross section than the fully leptonic decay channel; however, this channel faces large background contributions from V + jets process.

To increase the signal extraction, our study aims for advancements in the boosted W-jet tagging techniques to identify the W jet decaying into hadrons along with its charge and polarization. In this talk, I will discuss about the ongoing work to identify the W jet charge via ParticleNet algorithm.

T 87.5 Thu 17:20 T-H18

A Search for anomalous couplings in the hadronic decay channel of Vector Boson Scattering at the CMS experiment — Steffen Albrecht[2], Thorsten Chwalek[1], Nils Faltermann[1], Thomas Müller[1], and •Max Neukum[1] — [1]Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Institut für Technologie (KIT) — [2]Institut für Experimentalphysik, Universität Hamburg

Vector boson scattering (VBS) is the dominating process to investigate the quartic vertex of electroweak theory at the LHC. Additionally, cancellations with contributions from the Higgs boson are required to ensure unitarity. New physics in the Higgs sector may thus alter the cross section noticeably even if it is currently out of reach of direct measurements.

Deviations of couplings at high energies are formulated in an effective field theory, a bottom-up approach, which parametrizes a multitude of explicit theories. Limits on introduced parameters allow to draw conclusions regarding the strength and energy scale of new physics.

A search for anomalous couplings in the hadronic decay channel of VBS based on proton-proton collisions at a center-of-mass energy of 13 TeV is presented. Jet substructure techniques are used to distinguish between signal and background events and a three-dimensional fit supresses contributions from QCD events.

T 87.6 Thu 17:35 T-H18

Search for $\gamma\gamma \to WW(jj l\nu)$ coupling in pp collisions at $\sqrt{s} =$ 13 TeV with the ATLAS detector — •Varsiha Sothilingam — Kirchhoff-Institut für Physik, Heidelberg

Due to the non-abelian nature of the electroweak sector of the Standard Model of Particle Physics (SM), direct interactions between gauge couplings is possible. Measurements of its cross section allow for validation of the SM and potential deviations opens possibilities for physics beyond the SM. This talk is focused on the coupling between W bosons and photons where the W bosons decay semileptonically. They interact via the triple (γW^+W^-) and quartic ($\gamma\gamma W^+W^-$) gauge couplings of the SM. This process can be produced via centrally exclusive production at the LHC, which provides the signal while keeping the protons 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. Using the central detector to measure the WW decay and protons measured using AFP, the four momenta of the final state is known. This talk gives a deeper overview of this rare process and the methods used to define a mass signal region of interest to perform the searches for this process. Additionally it will provide an overview of the pile up and background challenges which have to be managed in this analysis.

T 87.7 Thu 17:50 T-H18

Automated Resummation of Electroweak Sudakov logarithms using SCET$_{\mathbf{EW}}$ — •Stefan Rode — Julius-Maximilians-Universität Würzburg

The search for new physics at the LHC necessitates the precise comparison between theoretical predictions in the Standard Model and experimental data. The calculation of electroweak radiative corrections, required to reach a sub-percent accuracy on the theory side, yields potentially large logarithmic corrections of the form $\alpha \log(s/M_W^2)$ to each order in perturbation theory. While at the LHC these corrections can already reach several tens of percent, this problem will be even more relevant at future colliders, where a resummation of these corrections will be inevitable to maintain the predictive power of the calculation.

We present a framework for the automated calulation of observables including the resummation of large logarithmic corrections using a generalisation of Soft-Collinear Effective Theory (SCET) to spontaneously

broken gauge theories. We present results for W-boson pair production at the LHC and compare with the well-known results obtained using fixed-order methods.

T 87.8 Thu 18:05 T-H18

Upper limits on tri nucleon decays from GERDA — •Sean Sullivan for the GERDA-Collaboration — MPIK, Heidelberg, Germany

Tri-nucleon decay is a hypothetical process violating baryon number conservation allowed for in the standard model with an extension for light neutrino masses [1,2]. The GERDA search for neutrinoless double-beta decay employs HPGe detectors enriched in ^{76}Ge which could undergo tri-nucleon decay to unstable daughter nuclei. This work investigates the tri-nucleon decay chain of ^{76}Ge to ^{73}Ga and the subsequent beta decay and gamma cascade to the stable daughter ^{73}Ge. This allows setting limits on the tri-nucleon decay channels without the need to consider the exotic physics of the initial decay.

[1]S.I. Alvis et al. (Majorana Collaboration), 2019. Search for Tri-Nucleon Decay in the Majorana Demonstrator Phys. Rev. D 99, 072004

[2] Babu, K.S., Gogoladze, I. and Wang, K., 2003. Gauged baryon parity and nucleon stability. Physics Letters B, 570(1-2), pp.32-38.