T 46: Top Physics II

Time: Wednesday 16:15–18:00 Location: KH 00.011

T 46.1 Wed 16:15 KH 00.011

Measurement of the differential t-channel production cross-section of single top quarks and top antiquarks in proton-proton collisions at 13 TeV using the full Run 2 dataset recorded with the ATLAS detector — Dominic Hirschbühl, Lukas Kretschmann, •Maren Stratmann, and Wolfgang Wagner — Bergische Universität Wuppertal

The t-channel production is the dominant process for single top quark and single top antiquark production at the LHC. The measurement of the differential cross section can contribute to constraining proton PDFs and has not been measured with the full Run 2 dataset up to date. This measurement uses the full Run 2 dataset recorded with the ATLAS detector in the years 2015-2018. The differential production cross-sections of the top-quark and top-antiquark as well as their ratio are measured as a function of their transverse momentum p_{T} and rapidity $|y|$.

T 46.2 Wed 16:30 KH 00.011

Investigating systematic uncertainties in the search for single-top s-channel production — •Alfredo Manente and Andrea Knue — TU Dortmund, Otto-Hahn Str. 4a, 44227 Dortmund

An analysis of single top-quark production in the s-channel at a centre-of-mass energy of 13 TeV will be presented, using simulated proton–proton collision data corresponding to the Run 2 dataset recorded by the ATLAS detector at the Large Hadron Collider. The single top quark s-channel production mode is characterised by a relatively small production cross section and large backgrounds. To enhance the separation between signal and background processes, a Deep Neural Network (DNN) classifier is employed and used as the discriminant in a binned profile likelihood fit. The analysis focuses on the leptonic decay mode of the top quark, resulting in a final state consisting of one charged lepton, missing transverse momentum and two b-tagged jets. The signal strength of the single top-quark s-channel process is measured using an Asimov dataset and a detailed investigation of the statistical and systematic uncertainties will be shown.

T 46.3 Wed 16:45 KH 00.011

Using Machine Learning Techniques for a Search for Single Top Quark Production — •Niklas Düser and Andrea Knue — TU Dortmund

The search for single-top-quark production in the s-channel is experimentally challenging due to its small cross-section and similarity to dominant background processes. This analysis investigates two machine-learning approaches to enhance signal discrimination: a deep neural network (DNN) using high-level kinematic variables, and a graph neural network (GNN) encoding event topology through particle-object correlations. Both models were trained and evaluated on simulated proton-proton collisions at a center-of-mass energy of 13 TeV, corresponding to the Run 2 dataset at ATLAS with an integrated luminosity of 140 fb-1. The performance of the DNN and GNN is compared with a focus on signal and background modelling uncertainties.

T 46.4 Wed 17:00 KH 00.011

Measurement of differential cross-sections of single-top-quark production in association with a photon at the ATLAS experiment with $\sqrt{s}$ = 13 TeV — •Lucas Cremer[1], Nils Julius Abicht[1], Andrea Helen Knue[1], Tomas Dado[2], and Marina Andress[3] — [1]TU Dortmund — [2]CERN — [3]Bergische Universität Wuppertal

The inclusive measurement of single-top-quark production in association with a photon at the ATLAS experiment yielded an increased cross-section compared to the Standard Model prediction. As the analysis was not statistically limited, a measurement of differential cross-sections is performed to further investigate the excess.

A signal region enriched with $tq\gamma$ events is defined using machine learning techniques to separate signal and background events. Corresponding distributions sensitive to physics beyond the Standard Model are unfolded to particle level utilising a profile likelihood unfolding approach. An approach for the optimisation of the binning as well as the stability of the unfolding is investigated. The results estimated on the complete ATLAS Run-2 dataset, corresponding to an integrated luminosity of 140 fb^{-1}, are presented.

T 46.5 Wed 17:15 KH 00.011

Using Neural Networks to Identify Pure Signal Regions for $tq\gamma$ Production at the ATLAS Experiment — •Marina Andress[1], Andrea Knue[2], and Lucas Cremer[2] — [1]Bergische Universität Wuppertal — [2]TU Dortmund

Following the observation of single-top production in association with a photon at the ATLAS experiment, a differential cross-section measurement is performed. An event classification strategy for $tq\gamma$ events is developed, with the goal of defining a pure signal region suitable for a subsequent unfolding measurement. Such a region is essential to enable differential studies of this rare process, which directly probe the electroweak coupling of the top quark. Therefore, two machine learning approaches are investigated: a deep neural network with a conventional feed-forward structure and a graph neural network that incorporates event topology. The results are estimated using the full ATLAS Run-2 dataset, corresponding to an integrated luminosity of 140 fb^{-1}.

T 46.6 Wed 17:30 KH 00.011

Search for tWZ in proton-proton colisions at $\sqrt{s}$ = 13 and = 13.6 TeV with the ATLAS Experiment — Diptaparna Biswas, •Carolina Costa, Markus Cristinziani, Carmen Diez Pardos, Ivor Fleck, Gabriel Gomes, Jan Joachim Hahn, Nikolaos Kamaras, Vadim Kostyukhin, Nils Benedikt Krengel, Austin Olson, Inês Pinto, Sebastian Rentschler, Elisabeth Schopf, Katharina Voss, Wolfgang Walkowiak, and Adam Warnerbring — Experimentelle Teilchenphysik, Center for Particle Physics Siegen, Universität Siegen

The production of top quarks in association with bosons are important Standard Model processes that allow tests of the electroweak couplings of the top quark to bosons. Any deviations of these couplings from Standard Model expectations could indicate the presence of new physics, which could be probed in the context of, e.g. Effective Field Theory interpretations. The associated production of a single top quark together with a W and a Z boson (tWZ) is one of the rarest processes accessible at the LHC, benefiting from the large proton-proton collision datasets collected at centre-of-mass energies of 13 TeV and 13.6 TeV. In this contribution, the ongoing effort to measure tWZ with the ATLAS detector using Run 2 and Run 3 data is presented. The measurement focuses on multilepton final states, where the Z boson and at least one of the two W bosons decay to leptons, yielding a final state with three or four leptons.

T 46.7 Wed 17:45 KH 00.011

Measurement of tWZ production with full Run 2 and 3 data at CMS — •Florent Préau, Roman Kogler, Alberto Belvedere, and Dennis Schwarz — Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, D-22607 Hamburg

The production of a single top quark in association with a W boson and a Z boson, also referred to as tWZ production, is a very rare process of high energy proton-proton collisions. It presents unique and important features when it comes to probing the Standard Model of particle physics and looking for physics beyond this model. This process offers the possibility to probe the electroweak couplings of the top quark, as well as its coupling to the Higgs field.

In this talk I will present the current state-of-the-art of the CMS tWZ analysis and will discuss some of the important extensions that I will explore during my PhD project. These extensions include performing an analysis with the full Run 2 and Run 3 datasets of CMS, performing a differential measurement of the process, and extracting top quark couplings using the Standard Model Effective Field Theory (SMEFT) framework.