T 74: Top physics 3 (single top)

Time: Wednesday 16:00–17:45 Location: Geb. 30.95: Audimax

T 74.1 Wed 16:00 Geb. 30.95: Audimax

Measurement of total and differential t-channel production cross-sections 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 — Benedikt Gocke[2], Dominic Hirschbühl[1], Lukas Kretschmann[1], Adrian Miemczyk[1], Olaf Nackenhorst[2], Joshua Reidelstürz[1], •Maren Stratmann[1], and Wolfgang Wagner[1] — [1]Bergische Universität Wuppertal, Wuppertal, Deutschland — [2]Technische Universität Dortmund, Dortmund, Deutschland

The t-channel production is the dominant process for single top quark and single top antiquark production at the LHC. The presented analysis measures the total cross-sections for top-quark and top-antiquark production $\sigma(tq)$ and $\sigma(\bar{t}q)$ as well as the combined cross-section $\sigma(tq+\bar{t}q)$ and the cross-section ratio $R_t = \sigma(tq)/\sigma(\bar{t}q)$. The differential production cross-sections are measured as a function of the transverse momentum p_{T} and rapidity |Y| of the top-quark and top-antiquark respectively. The full Run 2 dataset recorded with the ATLAS detector in the years 2015-2018 is used.

T 74.2 Wed 16:15 Geb. 30.95: Audimax

Measurement of differential cross-sections of associated production of a top-quark and a Z-boson — •Nilima Akolkar and Ian Brock — Physikalisches Institut, Universität Bonn

The associated production of a single top-quark with a Z-boson (tZq) is a rare process at the LHC. This process is of special interest, as it allows one to probe the couplings of the Z-boson to the quark sector and to the W-boson simultaneously.

This talk will focus on the differential cross-section measurement of the tZq process, analyzed in the trilepton decay channel. The data used were collected with the ATLAS detector during Run 2 of the LHC, corresponding to an integrated luminosity of 140 fb^{-1} . The tZq differential cross-section is measured using profile likelihood unfolding. The presentation will include the outcomes of tests conducted to assess the method's robustness in addition to Asimov fit results.

T 74.3 Wed 16:30 Geb. 30.95: Audimax

Measurement of top quark involved CKM matrix elements in single top-quark t-channel processes — Tomas Dado, •Benedikt Gocke, and Kevin Kröninger — Technische Universität Dortmund, AG Kröninger

Measuring top quark properties is one of the main purposes of the ATLAS experiment at the LHC. Since the top quark is the heaviest quark and thus decays before it hadronises, it can be seen as a quasi free quark. Therefore, its properties and especially its couplings are crucial to test the Standard model.

In general, all flavour-changing quark couplings are described by the Cabbibo-Kobayashi-Maskawa (CKM) matrix. There are no theoretical predictions for any CKM matrix elements. Thus, these need to be measured. For the small CKM matrix-elements Vts and Vtd, a measurement is especially challenging.

Single top-quark t-channel cross section measurements can be used to extract V_{tb}. In this talk, the CKM interpretation of the single top-quark t-channel cross-section measurement at $\sqrt{s} = 13$ TeV with the ATLAS experiment is presented. For this purpose, all possible top quark production and decay vertices are considered. The measurement exploits the full Run2 dataset corresponding to an integrated luminosity of 140 fb^{-1}. For the first time, two-dimensional profile-likelihood scans are used to also set limits on V_{td} and V_{ts}.

T 74.4 Wed 16:45 Geb. 30.95: Audimax

Search for the $tW\gamma$ process with the CMS experiment — •Michele Mormile[1], Ulrich Husemann[1], Abideh Jafari[1], and Michael Wassmer[2] — [1]Karlsruhe Institute of Technology — [2]Deutsches Elektronen-Synchrotron (DESY)

We present an ongoing search for the production of a top quark in association with a W boson and a photon ($tW\gamma$). The analysis is based on proton-proton collision data at a center-of-mass energy of 13 TeV recorded by the CMS experiment at the CERN LHC. $tW\gamma$ is a rare process, with cross section in the order of 100 fb and it poses the experimental challenge of discriminating the signal from the large background of top quark pair production in association with a photon ($t\bar{t}\gamma$). The analysis is performed in the double lepton channel, where both the top quark and the W boson decay leptonically. This talk will focus on the difficulties in reliably modeling the signal, due to the overlap of Feynman diagrams contributing to the production amplitudes of $tW\gamma$ and $t\bar{t}\gamma$, and on the Machine Learning algorithms used for the discrimination of the signal from the background.

T 74.5 Wed 17:00 Geb. 30.95: Audimax

EFT interpretations of single top quark and Z boson production at the ATLAS experiment with run-2 data — Ian Brock, Nilima Nilesh Akolkar, and •Can Süslü — University of Bonn, Bonn, Germany

Although the Standard model (SM) of particle physics has been successful to explain the observed phenomena, there are indications of new physics beyond the SM, such as dark matter and neutrino oscillations and masses. The Standard Model Effective Field Theory (SMEFT) is a framework for parametrizing the phenomena occuring at the high energies, and contains additional operators in the Lagrangian with dimensions larger than the SM. These operators from a basis, describing all possible interactions and couplings where the new physics can hide.

Single top quark and Z boson production is a convenient channel for EFT interpretations as it contains the couplings of the top quark and W and Z boson, and is thus quite sensitive to many SMEFT operators. In this analysis, using a kinematic distribution, the Wilson coefficients of the dimension six operators sensitive to the tZq channel have been constrained at the detector level via profile likelihood fits. The constraints obtained via the detector-level approach and the further plans for optimizing the EFT-sensitive regions will be presented in this talk.

T 74.6 Wed 17:15 Geb. 30.95: Audimax

Estimation of the background contributions of non-prompt or misidentified photons from hadronic activity to the differential cross-section measurements of single-top quark production in association with a photon with the ATLAS experiment at $\sqrt{s} = 13$ TeV — •Nils J. Abicht, Lucas Cremer, Tomas Dado, and Andrea H. Knue — TU Dortmund, Experimentelle Physik

The differential cross-section measurements of single-top quark production in association with a photon represent a test of the standard model, particularly of the coupling between the top quark and the photon.

A significant background for the process arises from non-prompt or misidentified photons from hadronic activity. Since this background contribution is not necessarily well-modeled in Monte Carlo simulations, a data-driven approach is employed. Four orthogonal selections are constructed in order to exploit the weak correlation between certain photon identification variables and photon track isolation. One of these selections matches the requirements of the photons used in the differential cross-section measurements and the other three selections are enriched with non-prompt or misidentified photons. The data contributions in the latter selections are used to extrapolate to the misidentification efficiency in the former selection. A description of the data-driven method, systematic uncertainties as well as an estimation obtained using the complete ATLAS LHC Run-2 dataset, corresponding to an integrated luminosity of 140 fb^{-1}, are presented.

T 74.7 Wed 17:30 Geb. 30.95: Audimax

Event classification of t-channel single top-quark production in proton-proton collisions at a centre-of-mass energy of 13 TeV with the ATLAS detector using Graph Neural Networks. — •Lukas Kretschmann, Joshua Reidelstürz, Dominic Hirschbühl, and Wolfgang Wagner — Bergische Universität Wuppertal, Wuppertal, Germany

For the differential cross section of single top-quark t-channel production, a high-purity signal region with high statistics in single top t-channel production events and low statistics in background processes is necessary. The definition of the signal region for the total t-channel cross section analysis is used as a starting point for defining the high-purity signal region. An additional cut on the NN distribution produced by the neural network trained for the total cross section analysis is applied to define the high-purity signal region.

To improve the separation between signal and background events, we investigate the use of Graph Neural Networks (GNNs) as an al-

ternative to traditional feed forward networks for constructing a final discriminant. Studies on the separation power and signal over background ratios for various cuts on the output values will be presented using simulated data.