T 6: Top Quarks: Production (Exp.) 1

Time: Monday 16:15–18:30 Location: T-H19

T 6.1 Mon 16:15 T-H19

Measurement of the Single-Top production cross section in the s-channel at $\sqrt{s}$=13 TeV with the ATLAS detector — •Kreul Ken — Humboldt-Universität zu Berlin

The production of single top-quarks in electroweak processes (Single-Top) is an important part for the study of the Standard Model and possible extensions. Single-Top production is possible in three channels: t-channel, s-channel and via associated production of a W-boson. In proton-proton collisions at the Large Hadron Collider (LHC), the s-channel has the lowest production cross section and is dominated by many background processes. During the LHC run at 8 TeV, the s-channel was already observed with a significance of 3.2σ using the Matrix Element Method. In this method, the matrix elements for the most important signal and background processes are integrated over the available phase space to compute process likelihoods, which can then be combined to a discriminant. The method is now applied to current ATLAS data at $\sqrt{s}$=13 TeV to improve the previous result using the higher luminosity of up to 139 fb^{-1}.

T 6.2 Mon 16:30 T-H19

Measurement of the t-channel single top-quark production cross-section in proton-proton collisions at a centre-of-mass energy of 13 TeV with the ATLAS detector — Olga Bessidskaia Bylund[1], Dominic Hirschbühl[1], •Joshua Reidelstürz[1], Mohsen Rezaei Estabragh[1], Wolfgang Wagner[1], Johannes Erdmann[2], and Benedikt Gocke[2] — [1]Bergische Universität Wuppertal, Wuppertal, Deutschland — [2]Technische Universität Dortmund, Dortmund, Deutschland

The measurement of the single top-quark t-channel production cross sections σ_{tq} and $\sigma_{\bar{t}q}$ and their fraction R_t as well as the total cross section $\sigma_{tq,\bar{t}q}$ is presented. These measurements provide a precise test of the standard model and are sensitive to new-physics phenomena by probing the properties of the Wtb vertex and placing limits on the CKM matrix element $|V_{tb}|$. Data taken with the ATLAS detector from 2015 to 2018 corresponding to an integrated luminosity of $\mathcal{L} = 139\,\mathrm{fb}^{-1}$ at a center-of-mass energy of 13 TeV is analyzed using corresponding samples of simulated events. Requirements are applied to the data selecting events with the signature expected for the signal process. To further enhance the separation between signal and background events a neural network is trained using the Monte Carlo simulated data combining several kinematic variables. The neural network output distribution is then used in a binned profile maximum likelihood fit including all systematic uncertainties to determine the cross sections.

T 6.3 Mon 16:45 T-H19

Measurement of W-boson-associated single-top-quark production in boosted lepton-plus-jets final states with CMS — •Christopher Matthies[1], Johannes Haller[1], Roman Kogler[2], and Matthias Schröder[1] — [1]Institut für Experimentalphysik, Universität Hamburg — [2]Deutsches Elektronen-Synchrotron DESY, Hamburg

We present a differential cross section measurement of the associated production of a single top quark and a W boson (tW) in boosted lepton-plus-jets final states in pp collisions at $\sqrt{s} = 13\,\mathrm{TeV}$ with the CMS experiment. Boosted hadronic decays of both the W boson or the top quark are reconstructed as large-radius jets, using the Heavy Object Tagger with Variable R (HOTVR). Deep learning techniques are employed to discriminate tW from top quark pair production and other background processes. It is shown that a measurement up to a transverse momentum of several hundred GeV of the top quark or associated W boson is feasible, extending the phase space covered by previous measurements considerably.

T 6.4 Mon 17:00 T-H19

Measurements of differential cross sections and spin asymmetry in tZq — •David Walter and Abideh Jafari — DESY, Hamburg, Germany

The associated production of a single top quark and a Z boson in pp collisions at the LHC includes the tZ coupling as well as the coupling of three vector bosons (WWZ) and is therefore a unique process to study the couplings of heavy particles in the SM. The top quark in this process is polarized due to its production through the weak interaction. Since the top quark decays before it hadronizes, the spin information is conserved in the leptonic decay products and can be measured. In this talk the first differential measurement of the tZq cross section is presented where the full Run-2 data of 138 /fb is used. The tZq cross section is measured at parton and particle level as a function of various kinematic observables including leptons and jets. A maximum likelihood unfolding procedure is exploited to correct for detector and hadronization effects. Also presented is the first measurement of the spin asymmetry in tZq, which is proportional to the top quark polarization.

T 6.5 Mon 17:15 T-H19

Differential cross-section measurement of the tZq process with the ATLAS detector — •Nilima Akolkar and Ian Brock — Physikalisches Institut, Universität Bonn

The production of a single top quark in association with a Z boson (tZq) is a rare process that has been discovered by the CMS and ATLAS Collaborations. This process is of special interest, as it allows one to probe the couplings of the Z boson to the quark sector and to 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 was collected with the ATLAS detector during Run 2 of the LHC, corresponding to an integrated luminosity of 139 fb^{-1}. The tZq differential cross-section is measured using different methods of unfolding and the preliminary results will be presented in the talk.

T 6.6 Mon 17:30 T-H19

Towards a WbWb differential cross-section measurement — •Thomas Mclachlan — DESY

Top quark pair production is a widely studied process at the Large Hadron Collider (LHC) and is a significant background in many searches beyond the Standard Model (BSM). The WWbb final states of this process interfere with the production of a single top quark in association with a W boson and a b-quark (tWb). Using data from Run-2, I will measure the WbWb production cross-section in a phase space that is maximally sensitive to the interference effects with the goal of improving the modelling of SM processes for BSM searches. An event selection using single lepton events is being developed. In this context, I will present a range of quantities and theoretical parameters that will be used in the differential cross-section measurement.

T 6.7 Mon 17:45 T-H19

Search for single production of top quarks in association with a photon with the ATLAS detector at $\sqrt{s} = 13\,\mathrm{TeV}$ — •Björn Wendland, Johannes Erdmann, and Kevin Kröninger — Technische Universität Dortmund, Fakultät Physik

Analyses of top quark production in association with a photon are important tests of the Standard Model. They probe top quark properties with respect to the electroweak interaction, such as the top quark charge or the structure of the top quark and photon vertex. Top quark pair production with a photon in leptonic final states was observed and investigated extensively by the ATLAS and CMS collaborations. No significant deviations from the Standard Model expectations were found by now.

With the rich datasets collected by the ATLAS and CMS experiments during Run 2 of the LHC programme, it is feasible to observe single production of top quarks in association with a photon. The CMS collaboration reported evidence corresponding to $4.4\,\sigma$ for this process using a partial Run 2 dataset.

In this talk, studies of t-channel single production of top quarks with a photon using the full Run 2 dataset collected by the ATLAS detector are presented. As the leptonic decay channel of the top quark is used in this analysis, the final state consists of either an electron or a muon, a jet containing B hadrons, missing transverse energy, a photon and an additional jet produced in the forward direction.

T 6.8 Mon 18:00 T-H19

First studies on the Monte Carlo simulation of single-top quark production in association with a photon using effective field theory samples — •Nils Julius Abicht, Johannes Erd-

MANN, and BJÖRN WENDLAND — Technische Universität Dortmund, Fakultät Physik

The observation of Standard Model (SM) single-top quark production in association with a photon with the ATLAS detector is expected to be possible with the full Run-2 dataset. A differential measurement of the process can be used to further test the SM. In particular, the interaction between the photon and the top quark is sensitive to modifications of the electroweak couplings of the top quark. An effective field theory (EFT) approach, with variations of the relevant parameters c_{tW} and c_{tB} is employed in order to further constrain current limits on the respective EFT operators. For a better understanding of the influence of these parameters on the simulation of the process in MADGRAPH, preliminary studies for future EFT interpretations are presented.

T 6.9 Mon 18:15 T-H19

Search for flavour-changing neutral-current interactions of a top quark and a gluon in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector — •WOLFGANG WAGNER, GUNNAR JÄKEL, and DOMINIC HIRSCHBÜHL — Bergische Universität Wuppertal

In the standard model, flavour-changing neutral currents (FCNCs) are strongly suppressed, in particular in the top-quark sector. Any observation of top-quark-related FCNCs will thus be a clear sign of physics beyond the standard model. A search is presented for the production of a single top quark via left-handed flavour-changing neutral-current (FCNC) interactions of a top quark, a gluon and an up or charm quark. Two production processes are considered: $u+g \to t$ and $c+g \to t$. The analysis is based on proton–proton collision data taken at a centre-of-mass energy of 13 TeV with the ATLAS detector at the LHC. The data set corresponds to an integrated luminosity of 139 fb^{-1}. Events with exactly one electron or one muon, exactly one b-tagged jet and missing transverse momentum are selected, resembling the decay products of a singly produced top quark. Neural networks based on kinematic variables differentiate between events from the two signal processes and events from background processes. The measured data are consistent with the background-only hypothesis, and limits are set on the production cross-sections of the signal processes. Based on the framework of an effective field theory, the cross-section limits are translated into limits on the strengths of the tug and tcg couplings occurring in the theory.