T 50: Top physics 2 (top pair cross section)

Time: Tuesday 16:00–18:15 Location: Geb. 30.95: Audimax

T 50.1 Tue 16:00 Geb. 30.95: Audimax

Observation of top-quark pair production in proton-lead collisions in the ATLAS experiment at the LHC — Petr Baroň[1], Iwona Grabowska-Bołd[2], Jiří Kvita[1], Santu Mondal[3], •Patrycja Potepa[1,4], and Yuriy Volkotrub[5] — [1]Palacký University Olomouc, Czech Republic — [2]AGH University of Krakow, Poland — [3]Czech Technical University in Prague, Czech Republic — [4]Johannes Gutenberg University Mainz, Germany — [5]Jagiellonian University, Kraków, Poland

Top quarks, the heaviest elementary particles carrying colour charges, are considered to be promising probes of the quark-gluon plasma produced in heavy-ion collisions at LHC energies. In proton-lead collisions, top-quark production is expected to be sensitive to nuclear modifications of parton distribution functions at high Bjorken-x values, which is a region poorly constrained by other available probes. In 2016, the ATLAS experiment collected proton-lead collisions at centre-of-mass energy of 8.16 TeV per nucleon pair, corresponding to a total integrated luminosity of 165 nb^{-1}. In this talk, we present the first measurement of the top-quark pair production cross section in dilepton and lepton+jet channels with the ATLAS experiment. The significance of the measured signal in both decay modes exceeds 5 standard deviations, resulting in the first observation of top-quark pair production in the dilepton channel in proton-lead collisions. The total relative uncertainty amounts to 9%, which makes it the most precise top-quark pair cross-section measurement in heavy-ion collisions at the LHC.

T 50.2 Tue 16:15 Geb. 30.95: Audimax

Presicion measurement of the top quark pair production cross-section at CMS in Run-2 — Laurids Jeppe, Andreas Meyer, Evan Ranken, and •Konstantin Sharko — Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany

A precision measurement of the top quark pair production cross section at 13.0 TeV is presented. The data were recorded at the CMS experiment and correspond to an integrated luminosity of 59.8 fb^{-1}. Events are selected with one or two charged leptons (electrons or muons) and at least one additional jet in the final state. A maximum likelihood fit is performed to event categories defined by the number and flavors of the leptons, the number of jets and the number jets originating from b hadrons. The currently expected systematic uncertainty, excluding that of the luminosity, is 1.5%.

T 50.3 Tue 16:30 Geb. 30.95: Audimax

$t\bar{t}$ cross-sections measurement at 13.6 TeV collision energy and its ratio to the 13 TeV result using the ATLAS detector — •Cédrine Alexandra Hügli — DESY, Zeuthen, Germany

The inclusive $t\bar{t}$ cross-section using proton-proton collisions at 13.6 TeV collision energy using 29 fb^{-1} of data collected with the ATLAS detector in 2022 is measured. This is achieved through the employment of the b-jet counting method, using events with an opposite-charge electron-muon pair and b-tagged jets. It is interesting to calculate the ratio between this measurement and the 13 TeV result since several uncertainties are correlated. This is particularly true for the theoretical uncertainties. As a consequence, the total uncertainty on the ratio, for measured and predicted values, is smaller than on the individual values. This allows to check the agreement between the measured ratio and the different predictions using various PDF sets. In this talk, the 13.6 TeV measurement and its ratio to the 13 TeV one are presented and the details, how the uncertainty on the ratio is estimated are explained.

T 50.4 Tue 16:45 Geb. 30.95: Audimax

Extracting the Top Yukawa coupling from the $t\bar{t}$ differential cross section using ATLAS data — •Sadia Marium — DESY, Zeuthen, Germany

The aim of this analysis is to extract the top-Yukawa coupling (Y_t) from the $t\bar{t}$ cross-section. There are loop corrections due to Higgs exchange between the $t\bar{t}$ pair. This virtual Higgs exchange affects the distribution of the mass of the $t\bar{t}$ system $M_{t\bar{t}}$ and the top quark production angle $\cos\theta_t^*$ in the $t\bar{t}$ rest frame. These kinematic variables are therefore sensitive to Y_t, and hence, their distributions are used to extract its value. The main focus of this talk is to analyse these kinematic variables. The dileptonic and lepton+jets final states are analysed. In the dileptonic channel, due to missing neutrinos, the full $t\bar{t}$ system cannot be reconstructed, therefore, possible proxy observables are studied. The aim is to use the full Run-II data with an integrated luminosity of 140 fb^{-1} taken by the ATLAS experiment at 13 TeV collision energy.

T 50.5 Tue 17:00 Geb. 30.95: Audimax

Measurement of the dileptonic $\text{t}\bar{\text{t}}$ differential cross section in a BSM phase space at CMS — Valeria Botta, Lutz Feld, •Danilo Meuser, Philipp Nattland, and Marius Teroerde — I. Physikalisches Insitut B, RWTH Aachen University

Measurements of the $\text{t}\bar{\text{t}}$ production cross section yield important precision tests of the Standard Model (SM), while also probing scenarios for physics beyond the SM (BSM). This analysis aims to measure the $\text{t}\bar{\text{t}}$ cross section in a phase space where additional contributions from BSM scenarios could be present. It is based on the data set recorded by CMS in the years 2016 to 2018 at a center-of-mass energy of 13 TeV, corresponding to an integrated luminosity of 138 fb^{-1}. The BSM scenarios considered include supersymmetric and dark matter models, where, similarly to the dileptonic $\text{t}\bar{\text{t}}$ channel, two leptons, b jets and undetected particles are produced.

Unlike previous measurements, where the differential cross sections were mainly measured as a function of kinematic variables of the leptons or top quarks, this analysis focuses on observables related to the neutrinos, like the missing transverse momentum and the angular distance between the missing transverse momentum and the nearest lepton, to separate BSM from SM $\text{t}\bar{\text{t}}$ events. In order to increase the sensitivity of the analysis multivariant techniques are used which improve the resolution of the missing transverse momentum in SM $\text{t}\bar{\text{t}}$ events. The final results of the differential cross section measurements are compared to monte carlo simulations and fixed order theory predictions.

T 50.6 Tue 17:15 Geb. 30.95: Audimax

Towards a WbWb differential cross-section measurement — •Eleonora Loiacono — DESY

The production of a top quark pair is extensively studied at the Large Hadron Collider (LHC). It constitutes a significant background in many searches for physics Beyond the Standard Model (BSM). The final state of this process, WWbb, interferes with the production of a single top quark in association with a W boson at Next Leading Order (tWb).

In this contribution, I will focus on presenting different techniques that are used to correct the data for inefficiencies and limited geometric acceptance for the WWbb single lepton channel, with the goal of improving the modelling of Standard Model (SM) processes for BSM searches.

First differential cross-section measurements in variables that are maximally sensitive to the interference, using data from second run of the LHC, will be presented.

T 50.7 Tue 17:30 Geb. 30.95: Audimax

Towards a WbWb differential cross-section measurement in a search-like phase space — •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 WbWb 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). Inspired by searches for supersymmetry and dark matter, I will measure the WbWb production cross-section in a search-like phase space that is maximally sensitive to the interference effects. Performing such a measurement can allow for new constraints on new physics and improve the sensitivity of future searches through improved background modelling. An event selection using single lepton events has been developed and will be used on the entire Run 2 dataset. In this context, I will present a range of quantities and theoretical parameters that will be used in the differential cross-section measurement.

T 50.8 Tue 17:45 Geb. 30.95: Audimax

$t\bar{t}\gamma$ production cross section measurements in single-lepton

and dilepton final states in proton-proton collisions at $\sqrt{s}$ = 13 TeV with the ATLAS detector — Diptaparna Biswas[1], Beatrice Cervato[1], Markus Cristinziani[1], Carmen Diez Pardos[1], Ivor Fleck[1], Arpan Ghosal[1], Gabriel Gomes[1], Jan Joachim Hahn[1], Vadim Kostyukhin[1], Nils Krengel[1], Buddhadeb Mondal[1], •Stefanie Müller[1], Katharina Voss[1], Wolfgang Walkowiak[1], Adam Warnerbring[1], and Tongbin Zhao[1,2] — [1]Experimentelle Teilchenphysik, Center for Particle Physics Siegen, Universität Siegen — [2]Shandong University, China

Top quark pair production ($t\bar{t}$) in association with an additional photon ($t\bar{t}\gamma$) is the leading process for measuring the coupling strength of the top quark-photon interaction. Precise measurements of the $t\bar{t}\gamma$ process are relevant to test the Standard Model and probing for new physics effects at very high energy scale.

In this contribution $t\bar{t}\gamma$ cross section measurements will be presented using a luminosity of 140 fb^{-1} of data collected by the ATLAS detector in pp collisions at $\sqrt{s}$ = 13 TeV. The studies are performed focussing on $t\bar{t}\gamma$ processes where the γ is radiated from initial state production. The toolkit RIVET (Robust Independent Validation of Experiment and Theory) is employed to perform studies with Monte Carlo simulations in the single-lepton and dilepton $t\bar{t}$ decay channels.

T 50.9 Tue 18:00 Geb. 30.95: Audimax

Simulation of on- and off-shell $t\bar{t}$ production with the MC generator `bb4l` at CMS — Simone Amoroso[1], Alexander Grohsjean[2], •Laurids Jeppe[1], and Christian Schwanenberger[1,2] — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [2]Universität Hamburg, Hamburg, Germany

Top quark pair production processes at the LHC are important for precision measurements of observables such as the top quark mass or top quark pair spin correlations and as a background for BSM searches. As such, it is crucial that MC simulation of this process is available for experimental analyses at the highest level of precision possible.

Here, we show an investigation of the NLO MC generator `bb4l` interfaced to Pythia 8 for parton showering. This program not only models top quark pair production, but also single top quark production in association with a W boson, as well as their interference, and correctly takes into account effects from the finite top width. We compare it to simulations using the `hvq` and `ST_wtch` generators for different interference handling schemes, as well as the `ttb_NLO_dec` generator, with possible implications for future top mass measurements.