T 23: Top Physics I

Time: Tuesday 16:15–18:15 Location: KH 00.011

T 23.1 Tue 16:15 KH 00.011

Measurement of differential cross sections in the process $pp \to WWbb$ with the ATLAS experiment — •Johannes Hessler — Max-Planck-Institut für Physik, Boltzmannstr. 8, 85748 Garching

Precise measurements of differential cross sections in the process $pp \to WWbb$ offer an outstandingly rich physics potential at highest precision. Although the process is theoretically and experimentally well defined, dedicated measurements of $WWbb$ production cross sections were not (extensively) performed in the past at the LHC.

I will report on recently published measurements in the single-lepton channel with Run-II data taken by the ATLAS experiment. The analysis comprises three signal regions, focusing on the interference between $t\bar{t}$ and tW processes, the explicit reconstruction of the kinematics of the $WWbb$ system and on phase spaces motivated by BSM searches.

T 23.2 Tue 16:30 KH 00.011

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

Top quark, being the heaviest Standard Model fermion, has the highest value of Yukawa coupling with the Higgs field. This contribution presents an extraction of the top-quark Yukawa coupling, (Y_t), from the $t\bar{t}$ differential cross-section in the dilepton final state. Near the $t\bar{t}$ production threshold, electroweak virtual corrections, including Higgs-boson exchange, modify the kinematic distributions of the invariant 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. In the dilepton channel, the presence of two neutrinos prevents full event reconstruction, motivating the use of proxy observables that retain sensitivity to these effects. The analysis uses proton*proton collision data at $\sqrt{s} = 13$ TeV corresponding to an integrated luminosity of 140 fb^{-1}, collected with the ATLAS detector at the Large Hadron Collider.

T 23.3 Tue 16:45 KH 00.011

NNLO soft function for 0-jettiness in (associated) $t\bar{t}$ production — Guido Bell[1], Alessandro Broggio[2], •Sebastian Edelmann[1], Matthew A. Lim[3], and Rudi Rahn[2] — [1]Theoretische Physik 1, Center for Particle Physics Siegen, Universität Siegen, Germany — [2]Faculty of Physics, University of Vienna, Austria — [3]Leonardo UK, Luton LU1 3PG, United Kingdom

Given the exceptional precision of LHC data, a detailed theoretical understanding of $t\bar{t}$ and $t\bar{t}X$ cross sections, where $X = \gamma$, W, Z, H, is required to better probe the top and the Higgs sectors of the Standard Model and search for new physics.

One promissing method to achieve precise QCD calculations is N-jettiness slicing. It was shown that the $t\bar{t}$ production cross section factorizes into hard, beam and soft functions at small values of the 0-jettiness variable. At NNLO only the relevant soft functions are currently missing for processes with two heavy quarks in the final state. By extending the SoftSERVE program to incorporate massive final-state partons, we were able to automate the numerical computation of the renormalized $t\bar{t}$ soft function for various observables and verify its pole structure using the renormalization group equation.

The produced grids can be used to implement associated $t\bar{t}$ production processes in the Monte-Carlo event generator GENEVA.

T 23.4 Tue 17:00 KH 00.011

Studies of the $t\bar{t}$+heavy flavour jets using the ATLAS data — •Abderahmane Maiza, Mahsana Haleem, and Raimund Ströhmer — Universität Würzburg, Germany

The top-quark pair production in association with heavy-flavour jets provides an essential test of quantum chromodynamics (QCD) predictions. These processes are challenging to model and constitute large irreducible background to rare SM processes such as $t\bar{t}H$ and tH productions as well as to the processes predicted by several extensions of the Standard Model.

The fiducial and differential cross-sections of $t\bar{t}$+b-jets have been measured using the ATLAS Run-2 data with precision ranging from 8.5% − 20%. Inclusive cross-section of $t\bar{t}$+c-jets has been measured with the precision of 15%−20% in given phase space. Further improvements in these measurements are expected through exploitation of the full ATLAS Run-2 and Run-3 datasets, improved MC simulations, advanced background estimation techniques and enhanced b-/c-jet origin classification leading to better event construction.

This talk will present the ongoing developments on the b-jets classifications in $t\bar{t}bb$ events using a transformer network. Furthermore, the method for the simultaneous estimation of flavour composition of additional jets in $t\bar{t}$+jets events will be presented.

T 23.5 Tue 17:15 KH 00.011

First measurement of the CKM matrix element $|V_{cb}|$ in $t\bar{t}$ decays with the ATLAS detector — 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 CKM matrix element $|V_{cb}|$ is one of the free parameters of the Standard Model. Until now, all determinations of $|V_{cb}|$ have relied on B-hadron decays, using either inclusive measurements, which include all possible final states, or exclusive measurements that focus on specific decay channels. Between these methods, a tension of about 3σ is observed. However, $|V_{cb}|$ can also be determined from on-shell W boson decays, as the branching ratio of $W \to cb$ is proportional to $|V_{cb}|^2$. This talk presents the first ATLAS measurement to determine $|V_{cb}|$ from hadronic W boson decays in $t\bar{t}$ production, targeting events in which one W boson decays leptonically and the other hadronically. The talk will cover the data analysis strategy, including the multivariate classifier used to separate signal from background and the use of flavour tagging, along with the dominant systematic uncertainties. The measurement is the first determination of this CKM matrix element at the electroweak scale and provides an orthogonal determination of $|V_{cb}|$ compared to previous measurements.

T 23.6 Tue 17:30 KH 00.011

Flavour Changing Neutral Current decays of the top quark to a Higgs boson and a charm or up quark 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

Top-quarks can decay to lighter quarks with the same charge by emitting a neutral boson in processes called Flavour Changing Neutral Current (FCNC). These are forbidden at the lowest order, and highly suppressed at higher orders, by the Glashow–Iliopoulos–Maiani mechanism.

We aim to search for FCNC decays of a top quark to a Higgs boson, and either a charm or an up quark, with data collected by the ATLAS detector during Run 2 and the ongoing Run 3 of the LHC. These decay modes are extremely rare, with expected branching ratios of about 10^{-15} for $t \to Hc$ and 10^{-17} for $t \to Hu$, far beyond the sensitivity of current detectors. As such, observing these decays at a significant rate would be a clear indication of New Physics. The search will aim to exploit the highest branching ratio decay mode of the Higgs boson, $H \to b\bar{b}$, taking advantage of the latest machine learning developments in jet flavour tagging in the ATLAS experiment.

T 23.7 Tue 17:45 KH 00.011

FCNC in the Top Sector — •Maurice Schüssler[1], Pedro Miguel Ferreira[2], and Milada Margarete Mühlleitner[1] — [1]Karlsruhe Institute of Technology, Karlsruhe, Germany — [2]Universidade de Lisboa, Lisboa, Portugal

Several observations give access to physics beyond the Standard Model. Among these are flavor-changing neutral currents, which are suppressed within the Standard Model. While flavor-changing neutral current processes in the bottom sector are strongly constrained experimentally even in beyond Standard Model theories, those involving the top quark remain less explored due to its short lifetime. In our work, we

extend the Standard Model by an additional Higgs doublet and study the flavor-changing neutral currents of these Higgs bosons, focusing on the top sector. Within this framework a scan of the possible parameter space is done after taking into account experimental constraints. Then the cross section of flavor violating final states originating from gluon fusion is calculated and discussed.

T 23.8 Tue 18:00 KH 00.011

Measurement prospects for the top-antitop energy asymmetry in the production with an additional jet in the resolved topology with ATLAS — •Jessica Höfner, Annika Stein, Frederic Fischer, and Lucia Masetti — University Mainz, Insitute for physics

The top quark is the heaviest particle in the Standard Model (SM) of particle physics and the only quark which decays before hadronization can happen. The top quark is suitable for the search of physics beyond the SM of particle physics (BSM). There could be even heavier particles and they might become observable at higher center-of-mass energies, and the top quark could potentially interact with them. At the currently reachable center-of-mass energies, however, the impact of BSM physics might only be indirectly observable via the variation of properties of the production or decay of SM particles. In the production of a top-antitop pair with an additional jet at the LHC the energy asymmetry, complementary to the rapidity asymmetry, can be measured. The energy asymmetry is expected in the SM, but also sensitive to physics beyond the SM and therefore it is of high interest to measure this observable. The measurement is performed in the single lepton and jets resolved topology, in which the quarks are reconstructed separately in small-R jets. The challenge in the event reconstruction is to assign the jets to the correct mother particle, which is done using a neural network. This presentation will show the performance of the neural network and the impact of the event reconstruction on the energy asymmetry measurement.