T 52: Top quark decay and top properties II

Time: Wednesday 16:00–18:00   Location: Tb

T 52.1   Wed 16:00   Tb
Measurement of observables sensitive to color reconnection effects in $t\bar{t}$ dilepton events — Dominic Hirschbuehl, Wolfgang Wagner, and •Shayma Wahdan — Bergische Universität Wuppertal

The color reconnection (CR) modelling uncertainty could become one of the dominant sources of systematic uncertainties in the top mass determination. Ongoing top-quark mass analyses use the PYTHIA 8 MC generator for parton showering and hadronization. PYTHIA 8 comes with several alternative CR models which should be explored to estimate the CR modelling uncertainty. At the same time, the models should be confronted with collision data to test their validity. Only models which are in agreement with data in general are suitable to define the corresponding modelling uncertainty. This analysis presents a measurement of three of the most discriminating observables between these models in $t\bar{t}$ dilepton events. The sensitive observables use tracks associated to the vertex of the hard scattering (primary vertex). The selected tracks are diluted with pile-up tracks and tracks of secondary particles. Therefore, a procedure is developed for correcting the pile-up contribution. After the correction the observables are unfolded to the particle-level and the unfolded spectrum is compared to the different CR models.

T 52.2   Wed 16:15   Tb
Improving the Heavy Object Tagger with Variable R with soft-drop grooming — •Anna Albrecht, Johannes Haller, Roman Kogler, Christopher Matthies, and Matthias Schröder — Institut für Experimentalphysik, Universität Hamburg

The Heavy Object Tagger with Variable R (HOTVR) is an algorithm for the clustering and identification of boosted, hadronically decaying, heavy particles in high energy particle collisions. The central feature of the HOTVR algorithm is a variable distance parameter R that decreases with increasing transverse momentum p_T of the jet.

In this study, the original mass-jump grooming of HOTVR is replaced by the soft-drop criterion, that results in a jet grooming with a rejection criterion based on a single proximity scale. Subjets are defined through a mass criterion, such that the algorithm can perform clustering, grooming and subjet finding in a single sequence. As a result, the top tagging performance is improved in comparison to the original tagger.

T 52.3   Wed 16:30   Tb
Study of fake tau leptons in rare top quark production processes using deep neural networks — •Chris M. Staude and Ian C. Brock — Physikalisches Institut, Universität Bonn

Fake tau leptons in Higgs and Z boson decays arise mainly from jets as well as from electrons that mimic the signature of a hadronically decaying tau lepton. QCD events can sometimes appear to be tau lepton decays. This problem is magnified as the cross-section of such QCD events is orders of magnitude higher than our desired production.

In this work, rare top quark production processes where a single top quark is produced in association with a Z boson as well as the associated production with a Higgs boson are investigated.

Deep Neural Networks (DNNs) are used to discriminate real from fake tau leptons using fully labelled simulated events. However, the simulations are often not perfect or have sufficient statistics. Therefore a new method called CWoLa (Classification Without Labels) is also used to differentiate between real and fake tau leptons using only mixtures of events instead of true labels. The classifier is trained on the enriched with fakes $t\bar{t}$ data and compared to the optimal classifier in the fully-supervised case.

T 52.4   Wed 16:45   Tb
Search for FCNC in strong interactions with the ATLAS detector — •Gunnar Jäkel, Wolfgang Wagner, and Dominic Hirschbühl — Bergische Universität Wuppertal

Flavor changing neutral currents (FCNC) are forbidden at tree level and highly suppressed at higher orders in the standard model. In some new physics models leading order contributions could enhance cross sections for FCNC processes by many orders of magnitude. A search for direct top quark production is presented. In this process a u(c)-quark interacts with a gluon and produces a top quark. Different cuts and neural networks are studied to increase the sensitivity of the

search.

T 52.5   Wed 17:00   Tb
Search for flavour-changing photon interactions in top-quark production and decay at $\sqrt{s} = 13$ TeV with the ATLAS experiment — Tomas Dado, Johannes Erdmann, •Benedikt Gocke, Florian Mausolf, and Olaf Nackenhorst — TU Dortmund, Lehrstuhl für Experimentelle Physik IV

In the Standard Model of particle physics, flavour-changing neutral currents (FCNC) are forbidden at tree level and are highly suppressed by the GIM mechanism at higher orders of perturbation theory. However, several extensions of the Standard Model predict larger branching ratios for FCNC processes.

One possible process with an FCNC includes a top quark that interacts with an up-type quark and a photon ($tq\gamma$ coupling with $q = u, c$). A distinction is made between the production mode, in which a single top quark is produced via an FCNC interaction, and the decay mode, in which one of the top quarks of a $t\bar{t}$ system decays through an FCNC interaction.

Improvements of an ATLAS search that focused on the production mode with a partial Run-2 dataset (Phys. Lett. B 800 (2019) 135082) are shown. These include in particular, that decay and production mode are considered in the optimisation of the analysis, the full Run-2 data is used, and the background estimations are revisited.

T 52.6   Wed 17:15   Tb
Neural network optimisation in the search for flavour-changing neutral currents in processes with a top quark and a photon at the ATLAS experiment — Tomas Dado, Johannes Erdmann, Benedikt Gocke, •Florian Mausolf, and Olaf Nackenhorst — Experimentelle Physik IV, TU Dortmund, Germany

A search for flavour-changing neutral currents (FCNC) in processes with a top quark and a photon is presented. In the Standard Model (SM) of particle physics these processes are highly suppressed, so that an observation would be a direct hint to physics beyond the SM. Proton-proton collision data taken with the ATLAS detector at a centre-of-mass energy of $\sqrt{s} = 13$ TeV are used. The signal region targets two possible signal modes, the FCNC production of a single top quark and the decay of a top quark via an FCNC process.

A neural network is used to maximise the separation between signal events and the SM background. Two different network architectures are tested: A binary classifier that discriminates between signal and background, and a multiclass network that evaluates if events originate from the production mode, the decay mode or a background process. Studies for the optimisation of the neural networks as well as the resulting expected upper limits on the signal strength are presented.

T 52.7   Wed 17:30   Tb
Search for FCNC-couplings between the top-quark and the Higgs-boson in multilepton final states — •Marvin Geyik, Oliver Thielmann, and Wolfgang Wagner — Bergische Universität Wuppertal

Flavor-changing neutral current interactions are strongly suppressed in the Standard Model. Still, some extensions of the Standard Model predict tree-level FCNC-couplings between the top quark, other up-type quarks and neutral bosons, including the Higgs boson. These anomalous couplings can be parameterised in the framework of effective field theories (EFT). The presented analysis searches for the production of a single top-quark in association with a Higgs boson and for top-quark-antiquark production with one of the top quarks decaying to an up quark or a charm quark and a Higgs boson. Higgs decays to WW*, ZZ* and two taus leading to leptonic final states are considered in the event selection. Two analysis channels are defined: one with two leptons (electrons or muons) of the same electric charge and a second channel with three leptons. The sensitivity of the analysis in setting limits to relevant coefficients of EFT operators will be presented.

T 52.8   Wed 17:45   Tb
Search for flavour-changing neutral current couplings between the top-quark and the Higgs boson in the $H \to b\bar{b}$ decay channel with the ATLAS detector at the LHC — •Oliver Thielmann, Geoffrey Gilles, and Wolfgang Wagner — Bergis-

che Universität Wuppertal

A search for flavour-changing neutral current (FCNC) couplings between the top-quark and the Higgs boson in the $H \to b\bar{b}$ decay channel is presented. The search for FCNC couplings in the top-quark-Higgs-boson sector is a promising search for a theory beyond the SM. Proton-proton collision data produced by the LHC at a centre-of-mass energy of $\sqrt{s} = 13 TeV$ and collected by the ATLAS experiment during 2015, 2016, 2017 and 2018, and corresponding to an integrated luminosity of $139 fb^{-}1$, are used. Data is analysed in three different final states, characterised by one isolated electron or muon, missing transverse energy and three, four or more than five jets where three of them are identified as b-jets. A machine learning analysis based on neural networks is conducted to improve the discrimination between the signal and the backgrounds. Preliminary results on the expected signal cross section exclusion limits are derived using the CLs method. Further interpretation is performed in the context of an effective field theory for FCNC where additional exclusion limits on the qtH effective coupling are derived.