T 30: Top Physics II (Properties)

Time: Tuesday 16:15–17:45 Location: VG 1.103

T 30.1 Tue 16:15 VG 1.103

Towards Top Quark Mass Measurements in the Fully Hadronic $t\bar{t}$ Decay Channel using the Full Run 2 Dataset — •Tom Davids, Johannes Lange, Peter Schleper, and Hartmut Stadie — Institute of Experimental Physics, University Hamburg, Germany

Precision measurements of the mass of the top quark are an important test of Standard Model predictions. In this talk, the current progress towards a top quark mass measurement in the fully hadronic top quark pair ($t\bar{t}$) decay channel is presented. The fully hadronic decay channel of $t\bar{t}$-pairs has the largest branching ratio of the three dominant decay channels and has no undetectable neutrino in its final state. However, it has a large multijet background. The aim of this analysis is to evaluate data taken by the CMS detector at the LHC during Run 2 at $\sqrt{s} = 13\,\text{TeV}$ from 2016 to 2018. This dataset corresponds to an integrated luminosity of $115.13\,\text{fb}^{-1}$ considering only data recorded with the selected triggers for this final state. This talk presents studies of these triggers and discusses the background prediction for the multijet background by making use of Columnflow, a highly parallelized Python-based analysis framework.

T 30.2 Tue 16:30 VG 1.103

Optimizing Jet-Parton Assignments in Fully Hadronic Top-Quark Decays: A Comparison of SPANet and Traditional Methods — •Nico Rehberg, Johannes Lange, Hartmut Stadie, and Peter Schleper — Institute of Experimental Physics, Hamburg University, Germany

Accurate jet-parton assignments in fully hadronic top-quark decays are crucial for the precise reconstruction of the top-quark mass. Traditional approaches, such as applying a kinematic fit, provide reliable results but are limited by the rapid increase in possible permutations as the number of jets grows. These methods become less efficient due to combinatorics in case of high jet multiplicities, and they do not make use of dynamical properties of $t\bar{t}$ processes. The Symmetry Preserving Attention Network (SPANet), a machine learning-based approach, addresses these challenges by exploiting the inherent symmetries of the assignment problem, resulting in improved scaling during inference. This talk provides a brief overview of the network's structure and presents a comparison of assignment results between SPANet and traditional approaches, including the χ^2-method and kinematic fit.

T 30.3 Tue 16:45 VG 1.103

Measurement of the top-quark mass using singly produced top-quarks in the t-channel — •Lukas Kretschmann, Dominic Hirschbühl, and Wolfgang Wagner — Bergische UniversitätWuppertal, Wuppertal, Germany

Almost all measurements of the top-quark mass have been performed using top-quark-antiquark pair-production events, measurements in other channels can be important inputs for a global combination. First studies for a measurement of the top-quark mass using t-channel single top-quark events are shown. This channel is statistically independent to the top-quark-antiquark pair-production measurements and has different systematic uncertainties associated to it, e.g. modelling uncertainties from Monte Carlo event generators. The high rate of background-events is a major challenge in this channel, for this a Graph Neural Network (GNN) is trained to enrich the selection in single top-quark t-channel events. For the determination of the top-quark mass the invariant mass of the charged lepton and the b-quark jet is used as a sensitive observable employing a maximum likelihood fit.

T 30.4 Tue 17:00 VG 1.103

Using improved $bb4\ell$ predictions for the simultaneous extraction of the top-quark mass and decay width — 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], Sebastian Rentschler[1], Elisabeth Schopf[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

The sensitivity of the simultaneous measurement of the top-quark mass and decay width using the full Run-2 $\sqrt{s} = 13\,\text{TeV}$ ATLAS dataset depends critically on the accurate modeling of the $WWbb$ final state in Monte Carlo simulations. In particular, a precise description of the $t\bar{t}/tW$ interference and of the off-shell effects of the top-quark is essential. These effects are modelled at next-to-leading-order accuracy by the $bb4\ell$ POWHEG generator. We present the nominal $bb4\ell$ signal sample used in ATLAS, which is generated with a new, improved $bb4\ell$ process version, as well as a prescription to evaluate modelling uncertainties associated with this sample.

Finally, the influence of the updated $bb4\ell$ signal sample on the top-quark mass and width analysis, which targets the $WWbb$ final state in dileptonic $e\mu$ decay, is discussed.

T 30.5 Tue 17:15 VG 1.103

Measurement of top quark CKM elements at FCC-ee — Sarah Alshamaily, Sofia Giappichini, Simon Keilbach, Jan Kieseler, Markus Klute, Matteo Presilla, and •Xunwu Zuo — KIT, Karlsruhe, Germany

The CKM matrix is a central piece for the understanding of electroweak physics. Particularly, the CKM element |Vts| is not directly measurable at tree level in current experiments in a precise manner. The current most precise value, indirectly determined via Bs meson mixing, is highly model-dependent and dominated by theory uncertainties. The FCC-ee experiment expects to produce 2M $t\bar{t}$ events with a very clean environment, providing an excellent opportunity to probe the |Vts| through $t \to Ws$ decay directly and in a model-independent way. This contribution summarizes the recent study on the |Vts| measurement at FCC-ee and discuss its theory impacts.

T 30.6 Tue 17:30 VG 1.103

Searching for CPT violation with top quarks — •Nathaniel Sherrill — Leibniz University Hannover

We present the first model-independent sensitivity to CPT violation in the top sector of the Standard Model. ATLAS and CMS measurements of the top-antitop kinematical mass difference constrain the temporal component of a CPT-violating background field to the interval [-0.13, 0.29] GeV at 95% confidence level.