T 135: Top Mass, Top BSM

Time: Thursday 17:30–19:00 Location: HSZ/0201

T 135.1 Thu 17:30 HSZ/0201

Measurement of the top-quark mass in the $t\bar{t} \to$ lepton + jets channel with a template method, using the full Run 2 dataset in ATLAS — •Dimbiniaina Rafanoharana and Andrea Knue for the ATLAS-Collaboration — Albert-Ludwigs-Universität Freiburg

The top-quark mass is a free parameter of the Standard Model (SM) and is playing a key role in the test of the consistency of the SM. Its precise determination is therefore of paramount importance. Several measurements of the top-quark mass in different final states using various methods were performed at the Tevatron and the Large Hadron Collider.

The combined measurement of the top-quark mass using different ATLAS Run 1 measurements achieved a relative overall uncertainty of 0.28%. The combination is limited by the systematic uncertainty as the relative statistical and systematic uncertainties are 0.14% and 0.23%, respectively.

The measurement of the top-quark mass with the template method in the $t\bar{t} \to$ lepton + jets channel using the full Run 2 dataset in ATLAS will be shown. Given the large amount of data collected during Run 2, the measurement is mainly limited by systematic effects. The presentation will discuss the dominating systematic uncertainties and studies aimed at reducing those uncertainties in the top-quark mass.

T 135.2 Thu 17:45 HSZ/0201

Messung der Masse des Topquark mit einer Likelihood-Anpassung mit Störparametern im vollhadronischen Kanal — •Yannek Gruel, Johannes Lange, Patrick Connor, Hartmut Stadie und Peter Schleper — Institut für Experimentalphysik, Universität Hamburg

Die Genauigkeit der Messung von der Masse des Topquarks hängt vor allem von unterschiedlichen systematischen Unsicherheiten ab. Um den Einfluss dieser Unsicherheiten auf die Masse zu verringern wird eine Likelihood-Anpassung angewendet, in der diese als freie Störparameter behandelt werden. Bisher wurde die Methode für die Messung im semileptonischen Zerfallskanal angewendet. Die hier präsentierten Ergebnisse zeigen die potentiellen Verbesserungen im vollhadronischen Kanal im Vergleich zur klassischen Messung ohne Störparameter.

T 135.3 Thu 18:00 HSZ/0201

Measurement of the jet mass distribution of boosted top quarks and the top quark mass with CMS — •Alexander Paasch[1], Johannes Haller[1], Roman Kogler[2], and Dennis Schwarz[3] — [1]Institut für Experimentalphysik, Universität Hamburg — [2]DESY, Hamburg — [3]Austrian Academy of Sciences, Wien

We present a measurement of the jet mass distribution in fully hadronic decays of boosted top quarks in pp collisions recorded by the CMS experiment in Run-2 of the LHC. The measurement is performed in the lepton+jets channel of top quark pair production. The top quark decay products of the all-hadronic decay cascade are reconstructed with a single large-radius jet with transverse momentum greater than 400 GeV. The top quark mass is extracted from the normalised differential top quark pair production cross section at particle level. The uncertainties arising from the calibration of the jet mass scale and modelling of the final state radiation in simulation are improved by dedicated studies of the jet substructure. This results in a significant increase in precision in the top quark mass with respect to an earlier measurement, now reaching a precision below 1 GeV.

T 135.4 Thu 18:15 HSZ/0201

Measurement of the top quark pole mass using $t\bar{t}$ +1 jet events with the CMS experiment — •Ana Ventura Barroso, Sebastian Wuchterl, Roman Kogler, and Katerina Lipka — Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, D-22607 Hamburg

The top quark is the most massive elementary particle known. Its mass,m_t, is a fundamental parameter of the Standard Model, and its value needs to be determined experimentally. However, direct top quark mass measurements suffer from ambiguities in their interpretation because of nonperturbative effects.

In this work, the pole mass of the top quark is extracted from a precise measurement of the distribution in ρ, in events where the $t\bar{t}$ system is produced in association with at least one additional jet. The variable ρ is defined as the inverse of the invariant mass of the $t\bar{t}$+jet system. This observable has been chosen due to strongest sensitivity to m_t at the threshold of the $t\bar{t}$+jet production. The analysis is performed using proton-proton collision data collected by the CMS experiment in 2016-2018 with $\sqrt{s}$=13 TeV, corresponding to a total integrated luminosity of 138 fb^{-1}. Events with two opposite-sign leptons in the final state are analyzed and the cross section is measured at the parton level using a likelihood unfolding method.

T 135.5 Thu 18:30 HSZ/0201

Prospects for a Measurement of Quantum Entanglement in Top Quark Pair Production in the Lepton+Jets Final State — Marcel Niemeyer, Arnulf Quadt, Baptiste Ravina, •Theresa Reisch, and Elizaveta Shabalina — II. Physikalisches Institut, Georg-August-Universität Göttingen

Quantum entanglement is a fundamental prediction of quantum mechanics. Experimental achievements with electrons and photons were recognised by the Nobel Prize in Physics 2022. At the LHC, quantum entanglement could be observed for the first time in quarks, testing quantum mechanics at high energies. Therefore, a sensitivity study for a possible measurement of quantum entanglement in the top quark pair production in the lepton+jets final state is presented. The angular separation between the decay products of the top quarks can act as a marker of quantum entanglement, when the two top quarks are produced near threshold. To take advantage of the presence of c-quarks in W decays in l+jets channel, c-tagging is used based on the working points of the current b-tagging algorithm. The result is then unfolded using Profile Likelihood Unfolding to remove detector effects. The study is performed with ATLAS Monte Carlo simulations under Run 2 conditions.

T 135.6 Thu 18:45 HSZ/0201

Search for heavy right-handed Majorana neutrinos in $t\bar{t}$ decays — •Tongbin Zhao[1,2], Binish Batool[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], Buddhadeb Mondal[1], Amartya Rej[1], Katharina Voss[1], and Wolfgang Walkowiak[1] — [1]Center for Particle Physics Siegen, Experimentelle Teilchenphysik, Universität Siegen — [2]Shandong University, China

A search for heavy right-handed Majorana neutrinos is performed with the Run-2 dataset recorded from 2015 to 2018 with the ATLAS detector at the CERN Large Hadron Collider and is based on $\sqrt{s} = 13\,\text{TeV}$ proton–proton collision data with an integrated luminosity of $139\,\text{fb}^{-1}$. The targeted process is $t\bar{t}$: one of the top quarks decays into a pair of same-sign same-flavour leptons (electrons or muons), a b-quark and two light quarks, while the other decays into a b-quark and two light quarks. The final states feature same-sign dilepton signatures. This analysis is the first search for heavy neutrinos using $t\bar{t}$ events.

A multivariate analysis is employed in order to improve the sensitivity. Several control regions are defined to estimate the main backgrounds. With profile likelihood fits using the ee and $\mu\mu$ channels, we expect to reach good sensitivities for the mixing parameters in the mass region 15–80 GeV.