T 28: Top quarks: mass and jets

Time: Tuesday 17:00–18:30 Location: H-HS XI

T 28.1 Tue 17:00 H-HS XI

Investigation of the top-quark mass precision using machine-learning techniques at the ATLAS experiment — •Steffen Ludwig, Andrea Knue, and Gregor Herten — University of Freiburg, Institute of Physics

The top quark is the heaviest known elementary particle in the Standard Model (SM) and its mass is a fundamental parameter. Its value is close to the scale of electroweak symmetry breaking and hence the top quark might serve as a window to physics beyond the SM.

Due to the high collision rate of the LHC, the ATLAS collaboration was able to measure the top-quark mass at subpercent level at $\sqrt{s} = 8$ TeV. Removing badly reconstructed events has shown to reduce the dominant signal modelling uncertainties using $t\bar{t}$ events in the lepton + jets channel.

Exploring this decay channel using pp collision data at $\sqrt{s} = 13$ TeV, the talk focuses on the influence of deep neural networks for event reconstruction in comparison to a likelihood-based reconstruction algorithm (KLFitter) on the event reconstruction efficiency and purity, while studying the impact on the systematic uncertainties on the top-quark mass measurement.

T 28.2 Tue 17:15 H-HS XI

Measurement of the top quark pole mass using $t\bar{t}$+1 jet events with the CMS experiment — Matteo Defranchis, Katerina Lipka, and •Sebastian Wuchterl — DESY, Hamburg

The top quark is the most massive elementary particle known. Its mass, m_t, is a fundamental parameter of the Standard Model (SM), and its value needs to be determined experimentally. Therefore, a precision measurement of m_t, together with the masses of the W and Higgs bosons, allows for stringent tests of self-consistency of the SM. Furthermore, the value and the uncertainty of m_t are driving predictions for the energy dependence of the Higgs quartic coupling, which determines the stability of the electroweak vacuum. In proton-proton collisions at the LHC, top quark-antiquark ($t\bar{t}$) pair production can be used to extract m_t in different renormalization schemes.

In this work, the pole mass of the top quark is measured using events in which the $t\bar{t}$ pair is produced in association with one additional jet. This analysis is performed using proton-proton collision data collected by the CMS experiment at the LHC in 2016-2018 with $\sqrt{s} = 13$ TeV, corresponding to a total integrated luminosity of 137 fb^{-1}. Events with two opposite sign leptons in the final state are analyzed to measure the normalized differential cross section as a function of the inverse of the invariant mass of the $t\bar{t}+1$ jet system. This observable has been chosen due to strongest sensitivity to m_t at the threshold of the $t\bar{t}$ pair production.

T 28.3 Tue 17:30 H-HS XI

A nuisance parameter fit for the top quark mass measurement — •Christoph Garbers, Johannes Lange, Peter Schleper, David Spataro und Hartmut Stadie — Universität Hamburg, Hamburg, Germany

The top quark is the heaviest known particle in the standard model.
It plays a crucial role in consistency checks of the Standard Model and in search for new physics.
In the $t\bar{t}$ to lepton+jets channel a top quark mass of 172.25±0.63 GeV was measured. With the $35.9 fb^{-1}$ data recorded by CMS in 2016 this measurement was limited by systematic uncertainties, especially the correction of jet energies and the description of color reconnection in simulation.
A method to improve this measurement by inserting systematic uncertainties as nuisance parameters into a profiled likelihood fit will be presented.

T 28.4 Tue 17:45 H-HS XI

Determination of the jet energy scale and jet momentum resolution at the CMS experiment using Z+jet events — Tabea Fessenbecker, •Christoph Heidecker, Günter Quast, Klaus Rabbertz, and Daniel Savoiu — Karlsruhe Institute of Technology

Accurately measured jets are mandatory for precision measurements of the Standard Model of particle physics as well as for searches for new physics. The increased instantaneous luminosity and center-of-mass energy at LHC Run 2 poses challenges for pileup mitigation and for the measurement of jet characteristics.

At CMS, jets are calibrated using a multi-stage approach in order to correct for effects of pileup, uniformity of the detector response, and residual differences between data and simulation.

A well-established calibration approach to extract residual corrections is based on balancing a jet against a precisely reconstructed Z boson. In this contribution we summarize how Z($\rightarrow \mu\mu$/ee)+jets events are used in CMS to derive data-based corrections to the jet energy scale. Furthermore, we demonstrate that the same Z+jet balancing approach can also be used to adjust the jet momentum resolution in simulation to that in data.

T 28.5 Tue 18:00 H-HS XI

Pileup mitigation in jets with CMS — Anna Benecke, •Ksenia de Leo, Johannes Haller, Andreas Hinzmann, and Roman Kogler — Institut für Experimentalphysik, Universität Hamburg

The high instantaneous luminosity reached by the LHC during Run 2 has led to a large amount of data to analyse, at the cost of an increased number of additional collisions at each bunch crossing (pileup). An important challenge is the separation of particles produced in the interaction of interest from those resulting from pileup interactions.

This talk will present studies of the Pile Up Per Particle Identification (PUPPI) technique to mitigate effects from pileup on hadronic jets. The algorithm will be described together with challenges in its application. In addition, the latest tuning and validation studies will be presented in detail.

T 28.6 Tue 18:15 H-HS XI

Using CWoLa on all-jets final state at $\sqrt{s} = 13$ TeV for top quark mass measurements — Christoph Garbers, Johannes Lange, Peter Schleper, •David Spataro, and Hartmut Stadie — Institut für Experimentalphysik, Universität Hamburg

Top quarks are copiously produced in pairs in the CMS experiment at the LHC. The most likely decay channel results in all-jet final states. The selection of these final states is a challenge due to the huge amount of QCD multi-jet events and Inaccuracies of the simulation in modeling this background.

The CWoLa method (**C**lassification **W**ith**o**ut **La**bels) bypasses this difficulty by using only not labeled data events to train a Neural Network. The received binary classifier separates $t\bar{t}$ from QCD and is compared to a classifier, which was trained on MC simulated labeled $t\bar{t}$ and QCD events. The application of the CWoLa classifier on data is discussed.