T 58: Top-Quarks: Eigenschaften II

Zeit: Mittwoch 16:30–18:35 Raum: Z6 - SR 1.002

T 58.1 Mi 16:30 Z6 - SR 1.002

Studien zur Klassifikation von Photonen im Prozess der Produktion von Top-Quark-Paaren in Assoziation mit einem Photon — •Andreas Kirchhoff, Thomas Peiffer, Arnulf Quadt, Elizaveta Shabalina, Joshua Wyatt Smith, Royer Edson Ticse Torres und Knut Zoch — II. Physikalisches Institut, Georg-August-Universität Göttingen

Um die elektrische Ladung des Top-Quarks direkt zu messen, muss die Kopplung des Photons an das Top-Quark untersucht werden. Am ATLAS-Experiment am LHC erfolgt dies durch die Messung des Wirkungsquerschnitts der Produktion von Top-Quark-Paaren in Assoziation mit einem Photon. Das Teilchen, von dem das Photon abgestrahlt wird, kann in einem einzelnen Ereignis aber nicht mit absoluter Sicherheit bestimmt werden. Eine mögliche Unterscheidung ist allerdings von großer Wichtigkeit, da nur so irreduzibler Untergrund (Photonen, die nicht vom Top-Quark stammen) unterdrückt werden kann. Bisher werden lediglich die vom W-Boson und seiner geladenen leptonischen Zerfallsprodukte emittierten Photonen durch Isolationskriterien, die einen Mindestabstand zwischen Photon und Lepton fordern, unterdrückt. Um diese Photonen auf statistischer Basis unterscheidbar zu machen, können multivariate Analysemethoden genutzt werden. In diesem Vortrag werden Ergebnisse von Studien präsentiert, in denen überwachtes Lernen von tiefen neuronalen Netzen zur Unterscheidung eingesetzt wird.

T 58.2 Mi 16:45 Z6 - SR 1.002

Constraining dimension-six effective operators through the combination of top quark measurements using EFTfitter — •Cornelius Grunwald, Johannes Erdmann, and Kevin Kröninger — TU Dortmund, Experimentelle Physik IV

In the search for physics beyond the Standard Model, effective field theories allow for model-independent probes of large energy scales by introducing higher dimensional operators. The coupling strengths of these effective operators are expressed by the so-called Wilson coefficients.

In this talk, a multidimensional fit constraining the Wilson coefficients of five dimension-six operators is presented. The model describing the observables in terms of Wilson coefficients is determined from Monte Carlo computations. Measurements of top quark cross sections and W boson helicity fractions, performed by the ATLAS collaboration, are combined using the EFTfitter tool. It is demonstrated that correlations between the uncertainties of measurements need to be taken into account in the fit, since they might significantly impact the resulting constraints.

T 58.3 Mi 17:00 Z6 - SR 1.002

Probing the $t\bar{t}\gamma$ process at $\sqrt{s} = 13$ TeV with ATLAS using object and event based neural networks — Andreas Kirchhoff, Thomas Peiffer, Arnulf Quadt, Elizaveta Shabalina, •Joshua Wyatt Smith, Royer Edson Ticse Torres, and Knut Zoch — II. Physikalisches Institut, Georg-August-Universität Göttingen

Through the associated production of the $t\bar{t} + \gamma$ process we can measure the strength of the electromagnetic coupling of the top quark and the photon. Any deviation from the Standard Model (SM) prediction would be an indication of Beyond SM physics. Evidence of this process was seen at CDF with $\sqrt{s} = 1.96$ TeV, while observation occurred at the LHC at $\sqrt{s} = 7$ and $\sqrt{s} = 8$ TeV, with increasing precision. In the 13 TeV analysis a requirement that photons be isolated is introduced. Thus, the most significant backgrounds in the single lepton channels come from electrons misidentified as prompt photons, as well as misidentified photons from hadrons or hadronic decays. In the dilepton channels the largest backgrounds are prompt photons from single top processes and $Z \to l^+l^-\gamma$ decays. A neural network is trained on signal and the sum of backgrounds using object and event level information to maximise the separation. This response is used as the discriminating variable in the maximum likelihood fit to extract the $t\bar{t}\gamma$ cross-section. The event and object based neural network is presented, with initial fit results and a discussion on the largest systematic uncertainties.

Gruppenbericht T 58.4 Mi 17:15 Z6 - SR 1.002

Determination of the top-quark mass and the strong coupling constant using tt events with the CMS experiment at 13 TeV — Till Arndt[1], •Matteo Defranchis[1], Jan Kieseler[2], Katerina Lipka[1], and Andreas Meyer[1] — [1]DESY, Hamburg, Germany — [2]CERN, Geneva, Switzerland

A determination of the top-quark mass and the strong coupling constant is performed using proton-proton collisions data recorded by the CMS detector during 2016 data taking at the centre-of-mass energy of 13 TeV, corresponding to an integrated luminosity of 36/fb. A chi square fit to multiple differential distributions of final state observables is performed to constrain systematic uncertainties in situ and to extract the visible tt production cross section simultaneously with the top MC mass. The observed cross section is then compared to theory predictions at next-to-next-to-leading order in order to extract the top-quark mass in the MS and on-shell schemes and the strong coupling constant.

T 58.5 Mi 17:35 Z6 - SR 1.002

Precision measurement of W helicity fractions from top-quark decays in $\sqrt{s} = 13$ TeV with the ATLAS detector — Thomas Peiffer, •Ishan Pokharel, Arnulf Quadt, Elizaveta Shabalina, and Royer Ticse Torres — II. Physikalisches Institut, Georg-August-Universität Göttingen

The top quark, the heaviest quark in the Standard Model (SM), was discovered at the Tevatron in 1995. Due to its large mass, the top quark decays before hadronisation. This provides a unique opportunity to study the properties of a bare quark. The top quark decays almost exclusively into a bottom quark and a W boson (Wtb vertex), with the W boson decaying leptonically or hadronically. Due to the large mass difference between the top and the bottom quark and the V-A structure of the interaction, the W boson from top quark decays are highly polarized in the SM.
This analysis focuses on the leptonic decay of the W boson from top quark decays. To this end, the single lepton and di-lepton channels of $t\bar{t}$ decays are considered. The neutrino and b-jet reconstruction plays a very important role in the reconstruction of the top quark. The observable $\cos\theta^*$ defined as the angle between the momentum direction of the charged lepton and the reverse direction of the b-quark, is used to distinguish the different helicity fractions. To extract helicity fractions of the W boson from top decays, a template fit to the $\cos\theta^*$ distribution is performed.

T 58.6 Mi 17:50 Z6 - SR 1.002

Studien zur Ereignisselektion mit maschinellem Lernen zur Verbesserung der $t\bar{t}$-Rekonstruktion mit dem KLFitter-Algorithmus — •Stella Oppermann, Johannes Erdmann, Olaf Nackenhorst und Kevin Kröninger — TU Dortmund, Experimentelle Physik IV

Am Large Hadron Collider (LHC) werden Protonen mit einer Schwerpunktsenergie von $\sqrt{s} = 13$ TeV zur Kollision gebracht und produzierte Teilchen mit dem ATLAS-Experiment detektiert, wobei Top-Quarks im Wesentlichen in Paaren erzeugt werden. Das KLFitter-Framework verwendet einen auf der Maximum-Likelihood-Methode basierenden Algorithmus für die Rekonstruktion solcher $t\bar{t}$-Ereignisse. Es gibt verschiedene mögliche Zuordnungen von gemessenen Jets zu den Endzustandsteilchen aus dem $t\bar{t}$-Zerfall, wobei bei der Rekonstruktion mit KLFitter die Zuordnung mit dem maximalen Likelihoodwert gewählt wird. KLFitter hat für Ereignisse, bei denen jedem Teilchen auf Generator-Level ein Jet zugeordnet werden kann, eine hohe Rekonstruktionseffizienz. Vorgestellt werden Studien mit dem Ziel, den Anteil solcher Ereignisse durch maschinelles Lernen zu erhöhen, um die Rekonstruktion auf diese Ereignisse zu beschränken und somit die Rekonstruktionseffizienz insgesamt zu verbessern.

T 58.7 Mi 18:05 Z6 - SR 1.002

Search for charged lepton flavour violation in top quark decays — Julien Caudron[1], Markus Cristinziani[1], Mazuza Ghneimat[1], •Carlo A. Gottardo[1], Sebastian Heer[1], Vadim Kostyukhin[1], Ö. Oğul Öncel[1,2], Arshia Ruina[1], and Andrea Sciandra[1] — [1]Physikalisches Institut, Universität Bonn — [2]Institut für Kernphysik, Universität zu Köln

Lepton flavour violation is not allowed by the Standard Model (SM), yet it has been observed in neutrinos. The physics responsible for

neutrino oscillations and masses is still unknown and it may allow charged lepton flavour violation (CLFV). Evidence for CLFV processes, strongly suppressed according to the SM, would shed light on the nature of New Physics.
Studies towards a search for CLFV will be presented using 13 TeV data collected between 2015 and 2017 by the ATLAS detector.
The analysis investigates the decay of a top quark into a pair of opposite-sign different-flavour leptons and a up-type quark. The search, never performed before in this channel, benefits from the clear signature and the large top-quark pair production cross section in proton–proton collision at the Large Hadron Collider. The theoretical description is given in the framework of an effective field theory, allowing for a model-independent search.

T 58.8 Mi 18:20 Z6 - SR 1.002

Constraints on EFT operators through a measurement of top pair spin density matrix in the dileptonic channel by the CMS experiment — •Afiq Anuar, Kelly Beernaert, Alexander Grohsjean, Gerrit Van Onsem, and Christian Schwanenberger — Deutsches Elektronen Synchrotron (DESY), Notkestraße 85, D-22607 Hamburg

The negative results obtained by searches for heavy new resonances are excluding ever more of the potential phase space where they could be directly produced at the LHC, hinting that they might be out of reach given our current facilities. This in turn makes the Effective Field Theory (EFT) description increasingly attractive as a way to explore the physics beyond the Standard Model (SM). In this approach the focus is on precision measurements and constraints are set on the EFT operators in terms of deviations with respect to SM predictions. In this talk, the basics of the EFT approach and operators will be discussed, with an emphasis on those affecting the top pair production process and how are they constrained through a measurement of the top pair spin density matrix in the dileptonic channel by the CMS experiment.