# T 73: Top-Quarks: Eigenschaften und Zerfälle III

Zeit: Donnerstag 16:30–18:35 Raum: Philo-HS1

**Gruppenbericht** T 73.1 Do 16:30 Philo-HS1

**Die Messung des $t\bar{t}Z$- und $t\bar{t}W$-Wirkungsquerschnitts im 2-, 3- und 4-Leptonen-Endzustand mit dem ATLAS-Experiment** — Katharina Bierwagen[1], Volker Büscher[1], Markus Cristinziani[2], Michal Dubovsky[3], Sebastian Herr[2], Clara Nellist[4], Nils-Arne Rosien[4], •Alexandra Schulte[1], Elizaveta Shabalina[4] und Arnulf Quadt[4] — [1]Institut für Physik, JGU Mainz — [2]Physikalisches Institut, Universität Bonn — [3]Comenius University, Slovakia — [4]Universität Göttingen

Die Messung des $t\bar{t}V$-Wirkungsquerschnitts erlaubt Informationen über die Top-V-Kopplung zu extrahieren. Neue Physik jenseits des Standardmodells kann die Produktionsrate von Top-Quark-Paaren mit assoziierten Vektor-Bosonen modifizieren. Erste Messungen wurden bereits bei 7 und 8 TeV durchgeführt.

In diesem Vortrag wird der aktuelle Stand der $t\bar{t}Z$- und $t\bar{t}W$-Wirkungsquerschnittsmessung mit dem Datensatz von 36 $\text{fb}^{-1}$ vorgestellt. Mit dem erhöhten Wirkungsquerschnitt bei 13 TeV ist erstmals eine Messung mit Signifikanzen von deutlich über $5\sigma$ möglich. Bei der Messung werden Analysen in 2-,3- und 4-Leptonen-Endzuständen kombiniert. Die Ergebnisse der Wirkungsquerschnittsmessung werden zur Einschrängung von Beiträgen neuer Physik im Rahmen einer effektiven Feldtheorie interpretiert.

T 73.2 Do 16:50 Philo-HS1

**Top quark mass measurement in $t\bar{t}$ all-jets events with CMS at $\sqrt{s} = 13\,\text{TeV}$** — Christoph Garbers, Nataliia Kovalchuk, •Johannes Lange, Peter Schleper, Hartmut Stadie, and Fred Stober — Institut für Experimentalphysik, Universität Hamburg

The top quark is the heaviest known elementary particle and its mass is an important parameter of the standard model (SM) of particle physics. In conjunction with the W and Higgs boson masses and other precision observables, it provides a self-consistency check of the SM and is responsible for the largest part of higher-order corrections to the Higgs boson mass.

A measurement of the top quark mass in the $t\bar{t}$ all-jets decay channel is presented. The pp collision data used for the analysis have been collected with the CMS experiment at the LHC in 2016 at $\sqrt{s} = 13\,\text{TeV}$. Events containing at least six jets are selected, requiring at least two jets to be tagged as originating from a b quark. To resolve the ambiguity in the jet assignments and improve the mass resolution a kinematic fit is employed. The background arising from QCD multijet production is estimated with a data driven method and validated using simulation. For the mass extraction the ideogram method is applied and the uncertainties are evaluated by performing pseudo experiments.

T 73.3 Do 17:05 Philo-HS1

**Measurement of the jet mass distribution in boosted top quark decays** — Johannes Haller, Roman Kogler, and •Dennis Schwarz — Institut für Experimentalphysik, Universität Hamburg

At the LHC, top quarks with high momenta play an important role in both precision measurements and searches for new physics. In these cases, the top quark decay products merge into a single hadronic jet and jet substructure techniques become important to resolve and identify the top quark. The presented analysis aims at a measurement of the jet mass distribution of highly boosted top quarks at $\sqrt{s} = 13$ TeV, which is not only a crucial jet substructure variable but also shows sensitivity to the top quark mass. The measured distribution is unfolded to particle level to be comparable to analytical calculations that are now available for the LHC. The differential $t\bar{t}$ production cross section and the top quark mass can be extracted. In studies of several jet clustering algorithms the XCone algorithm was found to give the best performance.

T 73.4 Do 17:20 Philo-HS1

**Measurement of Top Tagging Efficiencies in CMS** — •Torben Dreyer, Roman Kogler, and Johannes Haller — Institut für Experimentalphysik, Universität Hamburg

High Lorentz boosts pose a challenge to the reconstruction of hadronically decaying top quarks (t → bW → bqq') as the decay products of the top quark are collimated and a reconstruction in three separate jets is no longer possible. Instead, the decay products merge and are reconstructed in one large jet. Top tagging uses the substructure of large jets for top quark identification, which opens the high momentum phase space for standard model measurements of the top quark and increases the sensitivity in searches for heavy new particles.

This contribution presents measurements of top tagging efficiencies with the CMS detector at a center of mass energy of 13 TeV. The performance of established algorithms and new approaches is studied in simulation and data, and correction factors are derived for the use of these algorithms in physics analyses.

T 73.5 Do 17:35 Philo-HS1

**Measurement of the $t\bar{t}Z$ cross section in the $4\ell$ channel with the ATLAS experiment at 13 TeV** — 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

In the Standard Model the $tZ$ coupling is predicted via the weak interaction and can be tested by measuring the cross section of the $t\bar{t}Z$ process. The decay channel with 4 leptons in the final state has the smallest branching ratio (0.5% of all $t\bar{t}Z$ decays) but is the region with the highest purity. In the Standard Model, the available processes that also have 4 leptons in the final state are few, with the $ZZ$, the $tWZ$ and the $t\bar{t}H$ processes being the dominant backgrounds.

This talk will present the latest results, using the full 2015 and 2016 dataset of 36.1 $\text{fb}^{-1}$ taken by the ATLAS detector at a centre-of-mass energy of 13 TeV, using proton–proton collisions. In total 48 events have been observed. Performing a profile likelihood fit in the $4\ell$-channel alone yields a signal strength compatible with the Standard Model prediction with an expected significance of $5.0\sigma$ and an observed significance of $5.3\sigma$. The uncertainties in this analysis are driven by the available statistics, while the dominant systematic uncertainties are related to flavour tagging and signal modelling.

T 73.6 Do 17:50 Philo-HS1

**Towards a differential measurement of the $t\bar{t}Z$ cross section with the CMS experiment** — •Joscha Knolle and Andreas B. Meyer — DESY, Hamburg, Germany

The production of a top quark pair in association with a $Z$ boson is a direct probe of the top quark–$Z$ boson coupling and can now, as the LHC collects more and more data, be measured precisely.

The CMS collaboration has reported a measurement of the $t\bar{t}Z$ cross section at $\sqrt{s} = 13\,\text{TeV}$ with $35.9\,\text{fb}^{-1}$ of data recorded in 2016 that is in agreement with the Standard Model prediction. Extending this measurement with data (to be) recorded in 2017 and 2018, a first differential measurement will be possible. With differential cross sections, the weak dipole moments of the top quark–$Z$ boson interaction can be probed, thus allowing to constrain contributions from New Physics.

In my talk, I will present first studies on the $t\bar{t}Z$ measurement in the three-lepton channel, where an opposite-sign same-flavour lepton pair comes from the $Z$ boson decay and the third lepton from the semi-leptonically decaying top quark pair, using full 2017 data.

T 73.7 Do 18:05 Philo-HS1

**Auswirkungen von höheren Ordnungen in $t\bar{t}$- und $Wt$-Ereignisgeneratoren auf eine direkte Top Quark Zerfallsbreitenmessung** — Tomas Dado[1,2], •Marcel Niemeyer[1], Thomas Peiffer[1], Arnulf Quadt[1] und Royer Ticse Torres[1] — [1]II. Physikalisches Institut, Georg-August-Universität Göttingen — [2]Institute of Physics, Comenius University Bratislava

Die meisten verfügbaren Monte-Carlo-Generatoren für die $t\bar{t}$-Produktion verfügen nur über Präzision führender Ordnung im Zerfall des Top-Quarks oder approximieren die $t\bar{t}$- und $Wt$-Interferenz- und $t\bar{t}$-Off-Shell-Effekte. Der kürzlich veröffentlichte $b\bar{b}4\ell$-Monte-Carlo-Generator ordnet exakte QCD-Matrixelemente nächstführender Ordnung des Prozesses $pp \to \ell^+\nu_\ell l^-\bar{\nu}_l b\bar{b}$ den Partonschauern zu. Dies ermöglicht eine exakte Beschreibung der Interferenz und der $t\bar{t}$-Off-Shell-Effekte.

Diese Präsentation wird einen Überblick über den neuen $b\bar{b}4\ell$-Monte-Carlo-Generator und die Untersuchungen zu diesem Generator im Kontext einer direkten Top-Quark-Zerfallsbreitenmessung geben. Der $b\bar{b}4\ell$-Generator wird mit verschiedenen beim ATLAS-Experiment verwendeten Generatoren verglichen, welche den Top-Quark-Zerfall entweder

nur in führender Ordnung wiedergeben bzw. Off-Shell- und Interferenzeffekte approximieren. Es werden ebenfalls die gemachten Schritte zum Tuning des $b\bar{b}4\ell$-Generators beschrieben.

T 73.8 Do 18:20 Philo-HS1

**Constraining systematic effects of top quark mass measurements from data** — Hartmut Stadie, Christoph Garbers, Fred Stober, Johannes Lange, Nataliia Kovalchuk, Peter Schleper, and •Colin Frunder — Universität Hamburg, Institut für Experimentalphysik

The mass of the top quark is an important parameter of the standard model of particle physics. It precise measurement is of particular importance for consistency tests of the standard model.

The presented study is based on the CMS measurement of the top quark mass in the $t\bar{t}$-semileptonic channel using 2016 data. The result for the top quark mass was $m_t = 172.25 \pm 0.08(\text{stat.} + \text{JSF}) \pm 0.62(\text{syst.})$ GeV. The precision of this measurement is limited by systematic uncertainties, especially from b-jet modelling. Here additional observables are studied in order to constrain these model uncertainties. The impact of an extended mass measurement including this observable is estimated.