T 33: Higgs II

Zeit: Dienstag 16:30–19:00 Raum: Z6 - HS 0.004

T 33.1 Di 16:30 Z6 - HS 0.004

Search for additional Higgs Bosons in Final States with b-Quarks with the LHC Run II data — •Rostyslav Shevchenko and Rainer Mankel — DESY, Hamburg, Germany

The discovery of a Higgs boson with the mass of 125 GeV in July 2012 was a huge breakthrough for particle physics. After the 5 years of a successful data taking at LHC, the properties of this particle are in good agreement with the predictions of the Standard Model (SM). However, the current precision of these measurements, allows models, such as Supersymmetry, with extended Higgs sectors, in which the discovered Higgs boson is only one of several Higgs bosons. This work focuses on the search for high mass Higgs bosons in a final state with b-quarks. The analysis was performed with data collected by the CMS experiment at a center-of-mass energy of 13 TeV in the year 2016, corresponding to an integrated luminosity of 36.9 fb-1. The results are interpreted within models, including the Minimal Supersymmetric Standard Model and Two Higgs Doublets Model.

T 33.2 Di 16:45 Z6 - HS 0.004

Modelling of the W+jets background in the 1-lepton channel for the VH, H → bb analysis — •Simona Gargiulo and Christian Weiser — Albert-Ludwigs-Universität Freiburg

The search for the decay of the Standard Model Higgs boson into a $b\bar{b}$ pair produced in association with a W or Z boson with the Atlas detector is presented. The analysed dataset corresponds to an integrated luminosity of 36.1 fb^{-1} collected in proton-proton collisions in Run 2 of the Large Hadron Collider at a centre-of-mass energy of 13 TeV. Final states containing zero, one and two charged leptons are considered targeting the decay channels $Z \to \nu\nu$, $W \to l\nu$ and $Z \to ll$.

The overall systematic uncertainty has significant contributions from the ones on the dominating background processes $t\bar{t}$ and W+jets. The focus of this talk will be on the estimation of the systematic uncertainties on the theoretical prediction of W+jets background in the 1-lepton channel. This estimation relies on the comparison of two different generators and on studies of their variations due to different parameters settings.

New developments allowing to use generators based studies more efficiently in the context of the analysis will also be discussed.

T 33.3 Di 17:00 Z6 - HS 0.004

Higgs tagging calibration in $g \to b\bar{b}$ events with the ATLAS experiment — •Ruth Jacobs, Tatjana Lenz, and Norbert Wermes — Physikalisches Institut, Universität Bonn

The most likely decay of the SM Higgs boson is into two b-quarks. A recent result from the ATLAS collaboration showed evidence for the $H \to b\bar{b}$ decay in the vector boson associated production mode. To access other production modes, such as gluon gluon fusion, in connection with the $H \to b\bar{b}$ decay, it is useful to consider Higgs bosons with a large transverse momentum, as the relative background contribution is reduced in this kinematic regime. Other possible sources for these so-called boosted Higgs bosons are decays of heavy resonances, predicted by theories beyond the SM.
In the case of a boosted $H \to b\bar{b}$ decay, the b-quark fragmentation products are reconstructed using a single large-R jet. A Higgs boson identification algorithm ("Higgs tagging") can be used to decide whether a jet originated from a Higgs boson decay, based on the large-R jet properties. Since the Higgs tagging algorithm is optimized on simulated events, it is important to study whether the large-R jet properties are well described in the simulation. One possibility is to use data events of gluons splitting into b-quark pairs, which are available in sufficient amount at the LHC, compared to $Z \to b\bar{b}$ or $H \to b\bar{b}$. The $g \to b\bar{b}$ data sample is used to validate the modelling of different large-R jet properties in Monte Carlo simulation. It can also be used to derive a data-based calibration for a Higgs tagging algorithm in close-by b-jet events.

T 33.4 Di 17:15 Z6 - HS 0.004

Search for the $H \to b\bar{b}$ and $H \to c\bar{c}$ decay — •Elisabeth Schopf, Tatjana Lenz, and Norbert Wermes — Physikalisches Institut, Nussallee 12, 53115 Bonn

Since the discovery of the Higgs boson in 2012 many of its properties have been mainly measured in bosonic final states. The measurement of the Higgs boson couplings to fermions is still a very challenging task. The Higgs boson decay to bottom quarks has the largest branching ratio of 58%, but was not discovered yet. A measurement of the couplings to lighter, second generation fermions is even more difficult given smaller branching ratios and the overhelming amount of background events.

I will present an evidence for the $H \to b\bar{b}$ decay in the $(W/Z)H$ production channel. This result was obtained with 36.1 fb^{-1} of LHC data collected by the ATLAS experiment. Furthermore I will present a novel search for the $H \to c\bar{c}$ decay using the same data set. I will discuss the challenges of this decay channel, such as the identification of c-jets and the suppression of background processes.

T 33.5 Di 17:30 Z6 - HS 0.004

Verbesserung der Sensitivität der HH->4b Analyse mit einer multivariaten b-Jet Kalibration — •Alexander Melzer, Alessandra Betti, Florian Beisiegel, Stephan Hageböck, Tatjana Lenz und Norbert Wermes — Universität Bonn

Mit höherer Schwerpunktsenergie und steigender Datenmenge können in Run2 zunehmend Prozesse untersucht werden, die in Run1 unzugänglich waren. Einer dieser Prozesse ist der Zerfall eines Higgs-Paares in 4 b-Quarks. Eine großes Herausforderung dieser Analyse ist die Energieauflösung der b-Jets und ihre Unsicherheit. Die Standardkalibration konzentriert sich auf den dominanten Anteil leichter Jets. Fundamental anderen Eigenschaften der b-jets wie z.B. Sekundärvertices, Energieverlust durch Myonen und Neutrinos finden dabei keine Beachtung. Durch die Kombination, der Informationsflüsse aller Detektorsysteme, ist es möglich mit maschinell optimierten Algorithmen die Energieauflösung von b-Jets signifikant zu verbessern und die Sensitivität der Analysen und insbesondere der 4b-Analyse zu erhöhen.

T 33.6 Di 17:45 Z6 - HS 0.004

Boosted Higgs tagging algorithms for the CMS Experiment — •Andrzej Novak, Luca Mastrolorenzo, Xavier Coubez, and Alexander Schmidt — RWTH Aachen, Aachen, Germany

Algorithms for the identification of two b-quarks within one jet have been applied successfully in the CMS Experiment. Deep neural networks facilitated the tagging of boosted Higgs jets with improved performance compared to classical methods. This improvement builds on previous results showing that for the specific topology of a fat jet with two subjets there is a considerable performance to be gained by using a dedicated tagger as opposed to either separately tagging the flavour of two standard jets or tagging the flavour of subjets within the fat jets. We are pursuing the application of such methods to the H->cc decay as well. The two main challenges are lower statistics in comparison to H->bb as well as lower efficiency, due to the properties of charm quarks.

T 33.7 Di 18:00 Z6 - HS 0.004

Fake-Abschätzung in der $t\bar{t}H(H \to b\bar{b})$ Analyse im Mono-Lepton-Kanal mit dem ATLAS-Experiment — •Johannes Mellenthin, Clara Nellist, Thomas Pfeiffer, Arnulf Quadt und Elizaveta Shabalina — II. Physikalisches Institut, Georg-August-Universität Göttingen

Das Top-Quark ist das schwerste Elementarteilchen des Standardmodells und koppelt dadurch besonders stark an das Higgs-Boson. Ein theoretisch präzise vorhergesagter, jedoch noch nicht beobachteter Produktionsmechanismus, ist die Erzeugung eines Higgs-Bosons in Assoziation mit Top-Quarks ($t\bar{t}H$). Dabei ist es möglich, die Top-Yukawa-Kopplung, welche von großer Bedeutung für theoretische Vorhersagen und die Wechselwirkung von Elementarteilchen ist, direkt zu bestimmen. Hierzu werden Daten des ATLAS-Experimentes bei einer Schwerpunktsenergie von 13 TeV verwendet. In der vorgestellten Analyse wird der semileptonische Zerfall des Top-Quark-Paares mit einem Elektron oder Myon im Endzustand betrachtet. Für den Kanal mit der höchsten Zerfallswahrscheinlichkeit $t\bar{t}H(H \to b\bar{b})$ ist der dominierende Untergrund $t\bar{t}b\bar{b}$. Ein weiterer Untergrund entsteht durch sekundäre Leptonen, die u.a. durch semi-leptonische c- und b-Quarkzerfälle und Photonkonversion entstehen können, und durch als Leptonen fehlidentifizierte Jets. Dieser Untergrund benötigt eine gesonderte Behandlung für Ereignisse mit vielen Jets und b-Jets. In diesem Vortrag wird die Modellierung dieses Untergrundes mittels einer datengestützten Methode vorgestellt.

T 33.8 Di 18:15 Z6 - HS 0.004

Search for single top + Higgs (H→ b$\bar{b}$) at the CMS experiment at $\sqrt{s} = 13$ TeV — •Kevin Flöh, Thorsten Chwalek, Nils Faltermann, Denise Müller, Thomas Müller, and David Seith — Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Institut für Technologie (KIT)

The production of a single top quark in association with a Higgs boson can be used to lift the degeneracy regarding the sign of the top quark Yukawa coupling. The t-channel and tW-channel single top + Higgs production with the Higgs boson decaying into a b$\bar{b}$ pair are analyzed. The Higgs boson can be radiated off by the top quark (coupling constant κ_t) or by the W boson (coupling constant κ_V). The interference between these two processes allows the access to the ratio of coupling constants. Boosted decision trees are used to reconstruct the signal processes and the t$\bar{t}$ background process as well as for the classification of the events. Exclusion limits are set on various κ_V-κ_t scenarios and models with CP-violation.

T 33.9 Di 18:30 Z6 - HS 0.004

Suche nach Top-Quark-Antiquark-Paar-Produktion in Assoziation mit einem Higgs-Boson im H→ b$\bar{b}$-Kanal im Bereich hoher transversaler Impulse am CMS-Experiment — •Karim El Morabit, Ulrich Husemann, Philip Keicher, Matthias Schröder und Michael Wassmer — Institut für Experimentelle Teilchenphysik, Karlsruher Institut für Technologie

Eine Messung des Wirkungsquerschnittes für die Higgs-Boson-Produktion in Assoziation mit einem Top-Quark-Antiquark-Paar (t$\bar{t}$H) ermöglicht eine direkte Bestimmung der Top-Higgs-Yukawa-Kopplung. Mit der erhöhten Schwerpunktsenergie des LHC-Run-2 wird ein deutlicher Anstieg der Produktionsrate dieses Prozesses und somit eine höhere Präzision der Messung erwartet. Bisher konnte der Prozess bei dieser Schwerpunktsenergie jedoch nicht entdeckt werden.

Hierbei machen der sehr kleine Wirkungsquerschnitt und die große Anzahl an schwer zu trennenden Untergrundereignissen die Suche zu einer Herausforderung.

In Ereignissen, in denen Top-Quarks und Higgs-Bosonen hohe Transversalimpulse aufweisen, treten die Zerfallsprodukte dieser schweren Teilchen kollimiert auf. Dies ermöglicht die Nutzung spezialisierter *Fat-Jet-* und Substrukturalgorithmen für die Identifizierung von Top-Quarks und Higgs-Bosonen.

In diesem Vortrag wird deren Anwendung zur Suche nach t$\bar{t}$H-Produktion im semileptonischen t$\bar{t}$- und H→ b$\bar{b}$-Kanal im Bereich hoher transversaler Impulse vorgestellt.

T 33.10 Di 18:45 Z6 - HS 0.004

Verification of Deep Learning Methods for t$\bar{t}$H(H → b$\bar{b}$) with the CMS Experiment — •Yannik Rath, Martin Erdmann, Benjamin Fischer, Erik Geiser, Dennis Noll, Marcel Rieger, and David Schmidt — III. Physikalisches Institut A, RWTH Aachen University

The analysis of top-quark associated Higgs production allows for a direct measurement of the top-Higgs Yukawa coupling. In the t$\bar{t}$H(H → b$\bar{b}$) channel, one of the main challenges is the separation of background events, in particular the irreducible background of t$\bar{t}$ + b$\bar{b}$.

In our analysis, we make use of deep neural networks in order to categorize events into the different underlying physics processes. The aim is to separate all processes to improve the simultaneous constraint of both the signal and the background.

While neural networks are a natural choice for this kind of multi-classification, it is often difficult to understand what happens internally in a neural network. This concerns both the interpretation of what information is used by the network and the verification of the results. In this talk, we discuss these questions in the context of our t$\bar{t}$H analysis.