T 96: Higgs: Decay into fermions III

Time: Friday 11:00–13:00 Location: H-HS X

T 96.1 Fri 11:00 H-HS X

Search for the Higgs boson decay to a pair of charm quarks at CMS — •Andrey Pozdnyakov[1], Xavier Coubez[1,2], Luca Mastrolorenzo[1], Spandan Mondal[1], Andrzej Novak[1], and Alexander Schmidt[1] — [1]RWTH, Aachen, Germany — [2]Brown University, Providence, USA

Coupling of the Higgs boson to top and bottom quarks has been firmly established. It is now time to determine its coupling to second generation fermions. In this talk the coupling of the Higgs boson to charm quarks is probed in a direct search for H -> cc decay, where H boson is produced in association with a W or Z boson. Key feature of the analysis is the ability to tag jets from Higgs boson decay as charm-quark jets and distinguish them from gluon or light-quark initiated jets. This is done using sophisticated jet tagging algorithms employing Deep Neural Network techniques.

T 96.2 Fri 11:15 H-HS X

modelling of the W+jets and $t\bar{t}$ backgrounds for the VH, H → bb analysis — •Simona Gargiulo, Stephen Jiggins, and Christian Weiser for the ATLAS-Collaboration — Albert-Ludwigs-Universitaet Freiburg

The measurement of the decay of the 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 139 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 with 0, 1 and 2 charged leptons are considered targeting the decay channels $Z \to \bar{\nu}\nu$, $W \to l\nu$ and $Z \to l^+l^-$. The $t\bar{t}$ and the W+jets processes are two leading backgrounds and their uncertainties contribute significantly to the overall systematic uncertainty on the signal strength. The focus of this talk will be on the estimation of the systematic uncertainties on the theoretical prediction of these two backgrounds. In this contex, a new technique to derive the shape uncertainties based on an n-dimensional reweighting approach is explored. A Boosted Decision Tree (BDT) is trained to separate the nominal Monte Carlo prediction from the alternative one for both backgrounds. The parametrized ratio between the nominal and the alternative classifier responses is used to map the nominal prediction to look like the alternative. The potential of this methodology lies in the ability to simultaneously map the two generators into each other in all n-dimensions of the analysis and examples of this will be presented.

T 96.3 Fri 11:30 H-HS X

Improved reconstruction methods for $H \to b\bar{b}/c\bar{c}$ at future e^+e^- colliders — •Yasser Radkhorrami[1,2] and Jenny List[1] — [1]DESY, Hamburg — [2]Hamburg University

The reconstruction of b- and c-jets is essential for the physics program of the future e^+e^- colliders. For instance, $H \to b\bar{b}$ is the most frequently occuring decay mode of the Higgs boson and measuring the $H \to c\bar{c}$ decay mode will be possible for the first time at an e^+e^- collider. The presence of semileptonic decays in b- and c-jets causes missing energy due to the undetectable neutrinos. A correction for the missing neutrino energy based on the presence of a lepton in a jet and the reconstructed decay vertex will be presented. In the case of the International Large Detector (ILD) proposed for the International Linear Collider (ILC), the Time Projection Chamber allows to identify kaons and protons by their specific energy loss. As a new component of the reconstruction, it has been studied to use the correct mass of kaons and protons in the track fit. This improves the impact parameter and p_T resolution considerably. The impact of these improvements on the vertex reconstruction, the neutrino correction, the jet energy resolution as well as the Higgs mass reconstruction will be investigated.

T 96.4 Fri 11:45 H-HS X

Search for Higgs-boson pair production in the $bb\ell\ell$+MET decay channel with the ATLAS detector — •Benjamin Rottler, Benoit Roland, and Markus Schumacher — Albert-Ludwigs-Universität Freiburg

The determination of the triple Higgs-boson self-coupling λ is one of the key goals of the physics program at current and future colliders. It will allow to reconstruct the Higgs potential. The self-coupling can be measured via non-resonant Higgs-boson pair production, which can happen at the LHC via the destructively interfering top-loop and Higgs self-interaction diagrams. Furthermore, this process is sensitive to new heavy particles.

The goal of this analysis is to measure the cross-section of the non-resonant Higgs-boson pair production σ_{HH} using the full Run-2 dataset collected by the ATLAS experiment corresponding to an integrated luminosity of $\sim$140 fb^{-1} at $\sqrt{s} = 13$ TeV. This is done via the $bb\ell\ell$ + MET final state, which combines the high branching ratio of the $H \to bb$ decay and the good trigger efficiency of lepton triggers. Our focus is on a combined search for the $HH \to bb(WW \to 2\ell 2\nu)$, $HH \to bb(\tau\tau \to 2\ell 4\nu)$, and $HH \to bb(ZZ \to 2\ell 2\nu)$ processes.

Modern machine learning (ML) technologies like multi-class deep neural networks will be used to separate background and signal processes. The ML classifier will be trained on top of a loose preselection. The statistical analysis will use the shape information provided by the output distribution of the ML classifier in order to extract the HH cross-section.

T 96.5 Fri 12:00 H-HS X

Simplified template cross section measurement of Higgs bosons produced in association with vector bosons decaying to b quark pairs. — •Aliya Nigamova — University of Hamburg, Hamburg, Germany

Since the discovery of the Higgs boson in 2012 the field of related studies has expanded extraordinarily, with the precision measurements of Higgs production modes gaining more attention. To increase the measurement sensitivity and reduce its dependence on theory the simplified template cross section (STXS) framework has been developed. The most prominent decay mode of Higgs boson, $H \to b\bar{b}$, was observed in 2018 when only part of the Run 2 data was available. Consequent STXS measurement of this channel using full Run 2 with the Higgs boson produced in the most sensitive mode, i.e. in association with vector bosons (VH), will provide an important input for further interpretation in terms of EFT SM operators. This report will focus on the STXS measurement of VH ($H \to b\bar{b}$) process, and the evaluation of related STXS theory uncertainties.

T 96.6 Fri 12:15 H-HS X

Search for additional Higgs bosons produced in association with b quarks and decaying into two b quarks — •Paul Assmuss — DESY Hamburg

A huge breakthrough in particle physics was achieved with the discovery of the Higgs boson in 2012, which was followed by precision measurements of its properties. So far, the discovered particle is found to be in good agreement with the predictions of the Standard Model, but there is still sizable room for theories with extended Higgs sectors, like Supersymmetry or general Two Higgs Doublet Models. Besides additional Higgs bosons, these models may also feature a significant enhancement of the Higgs boson coupling to b quarks. In this analysis, heavy neutral Higgs bosons are targeted which decay into two b quarks and are produced in association with one or two further b quarks, resulting in a fully hadronic final state and focused on masses between 250 GeV and 1.6 TeV. The search is performed with data collected in 2017 and 2018 with the CMS detector at the LHC at a center-of-mass energy of 13 TeV.

T 96.7 Fri 12:30 H-HS X

Development of a jet substructure based multivariate Higgs tagger and its calibration using $g \to b\bar{b}$ events with the ATLAS experiment. — •Shubham Bansal, Tatjana Lenz, and Norbert Wermes — Physikalisches Institut, Universität Bonn

Within the ATLAS collaboration, the most recent algorithm to separate *boosted* $H \to b\bar{b}$ from dominant backgrounds like multijets and jets originating from hadronically decaying top-quarks, employs a cut based approach using jet kinematics, b-tagging and jet substructure. Jet substructure variables in particular, gave an additional multijet background rejection over mass and b-tagging requirement, which are the most powerful variables, in some regions of phase space. This sensitivity from individual jet substructure variables can be seen as a motivation to combine many jet substructure variables in a multivariate discriminant to tag a *boosted* object like Higgs, in order to gain a larger improvement in the performance.

This talk presents a jet substructure based multivariate algorithm which is designed to separate 2-prong jets (two track-jets of $R = 0.2$ associated to a large-$R = 1.0$ jet, e.g. $H \to b\bar{b}$) from 1-prong jets (a single track-jet associated to a large-R jet, e.g. QCD jets). This multivariate Higgs tagger is optimised in multijet simulated events and the modelling of the tagger and its input variables is examined in 15.4 fb^{-1} of data collected in 2016 at $\sqrt{s} = 13$ TeV using $g \to b\bar{b}$ event selection in data. The calibration of the tagger is carried out in both $g \to b\bar{b}$ and $H \to b\bar{b}$ simulated events and a comparison between these two topologies is made.

T 96.8 Fri 12:45 H-HS X

Full Run 2 analysis of Higgs boson decay to b-quarks in CMS

— •hessamoddin kaveh — DESY, Hamburg, Germany

After the discovery of the 125 GeV Higgs boson in July 2012, the data collected at the LHC during 2016 and 2017 has lead to the discovery of the Higgs decaying to b-quarks. The focus is now changed to precision measurements in this decay channel. The measurement of the Higgs boson properties in the vector boson associated production mode, with the Higgs boson decaying to a pair of b-quarks using the full pp collision dataset collected by the CMS experiment during Run 2 will be reported. The talk will focus on the statistical and systematic power of the analysis, improving essential analysis methods such as kinematic reconstruction and machine learning approaches, both for the inclusive and simplified template cross-section measurements.