T 27: Higgs: Decay into fermions I

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

T 27.1 Tue 17:00 H-HS X

Charm tagging and search for $ZH \to llc\bar{c}$ decay with ATLAS data — •Supriya Sinha[1], Tatjana Lenz[2], and Jochen Dingfelder[3] — [1]DESY-Zeuthen — [2]Uni Bonn — [3]Uni Bonn

The discovery of Higgs boson in 2012 opened the gates to many new analyses with the aim to understand its properties. Analyses have been performed to study various Higgs boson decay channels. Boldly, it decays to a pair of fermions or bosons. From theoretical understanding, Higgs is more likely to couple to a pair of heavier fermions as compared to the lighter ones, which is the reason its decay to third generation fermions have been studied rigorously. More interestingly, Higgs also couples to second generation fermions, but no such decays could be established up to now. Additionally, the small decay fraction into charm quarks makes it susceptible to BSM modifications, if they exist. A measurement of this charm decay fraction would either unfold new physics or help in constraining BSM scenarios.

To detect the Higgs decay to charm quarks, one has to develop a method to identify charm jets. A direct method of the so-called "charm tagging" utilises common b-tagging algorithms trained on charm jets. Instead of using multivariate analysis techniques, one can identify them using the reconstruction of charm meson decay: $D^{*+} \to D^0(\to K^-\pi^+)\pi^+$. This talk will focus on the description of D^*-based identification method. In addition, both charm identification methods are used to evaluate limits on the $ZH(H \to c\bar{c}, Z \to ll)$ cross section. The analysis is performed on 2017 data with a centre of mass energy of 13 TeV and a luminosity of 43.6 fb^{-1}.

T 27.2 Tue 17:15 H-HS X

Search for a SM Higgs boson decaying to a pair of muons in associated production with a gauge boson — •Tobias Kramer, Torben Lange, Oliver Rieger, and Peter Schleper — Universität Hamburg

Studies on developing a search for Higgs decays into muons in VH associated production are presented. The full Run 2 data collected at the CMS experiment from 2016-2018 at a center of mass energy of 13 TeV are used. Events with at least two oppositely charged muons as well as at least one additional lepton, identified as originating from the gauge boson, are selected. These requirements efficiently select signal events and reduce the initially dominant Drell-Yan background events, which typically do not contain a prompt third lepton. The search strategy, including multivariate prompt lepton identification, BDT optimization, and categorization is presented. Estimates of the sensitivity, derived using a data driven background estimation, are given.

T 27.3 Tue 17:30 H-HS X

Fake-Rate Determination for the ttH and ttW Production with a Signature of Two Same Electric Charge Light Leptons Associated with a Tau Using the ATLAS Detector at the LHC — •Santu Mondal[1], Babar Ali[1], Simonetta Gentile[2], Nazim Huseynov[3], Antonio Policicchio[2], and Andre Sopczak[1] — [1]IEAP CTU in Prague — [2]Universita di Roma Sapienza — [3]JINR Dubna

After the discovery of a Higgs boson, the measurements of its properties are at the forefront of research. The determination of the associated production of a Higgs boson and a pair of top quarks is of particular importance as the ttH Yukawa coupling is large and can probe for physics beyond the Standard Model. The analysis is based on data taken by the ATLAS experiment recorded from 13 TeV proton-proton collisions. The ttH and ttW production was analysed in various final states. The focus of this presentation is on the fake rate determination in the final state with two light leptons of same electric charge and one hadronically decaying tau lepton.

T 27.4 Tue 17:45 H-HS X

Mass reconstruction with neural networks for a lepton-flavour violating Higgs boson with the ATLAS experiment at $\sqrt{s}$=13 TeV — •Emanuel Dorbath, Valerie Lang, Katharina Schleicher, and Markus Schumacher — Albert-Ludwigs-Universität Freiburg

The discovery of the Higgs boson allows to search for lepton-flavour violating (LFV) processes in the Higgs-boson sector. Many extensions of the standard model predict this violation, for instance supersymmetric extensions. The general existence of LFV processes in nature has been demonstrated with the observation of neutrino oscillations.

At the ATLAS experiment, interesting LFV Higgs decays are $H \to e\tau$ and $H \to \mu\tau$. Leptonic tau-lepton decays are considered yielding the final state $e\mu 2\nu$. Both neutrinos leave the ATLAS detector without detection, making the reconstruction of the Higgs-boson mass challenging. Non-detected particles broaden the mass resolution and thus complicate the separation of the LFV signal from standard model background processes. Improving the resolution of the mass reconstruction will therefore increase the sensitivity to small branching ratios for LFV decays.

A deep neuronal network is trained in order to reconstruct the mass of a spin 0 boson decaying to $\tau e \to e\mu 2\nu$. The talk describes the optimization of the network architecture and training process. The results in terms of bias and resolution will be compared to standard methods for mass reconstruction.

T 27.5 Tue 18:00 H-HS X

Search for lepton-flavour violating decays of the Higgs boson using the symmetry method for background estimation with the ATLAS experiment at $\sqrt{s} = 13$ TeV — •Katharina Schleicher[1], Kathrin Becker[1,2], Valerie Lang[1], and Markus Schumacher[1] — [1]University of Freiburg — [2]University of Warwick

The discovery of the Higgs boson opened the window to a variety of interesting probes to physics beyond the standard model (SM), including searches for lepton-flavour violating (LFV) Higgs-boson decays. These are predicted in several models, including supersymmetric extensions of the SM and general two-higgs-dublet models. In nature, LFV was already observed in form of neutrino oscillations. In this analysis the decays of $H \to e\tau$ and $H \to \mu\tau$ with leptonic τ-decays leading to $e\mu + X$ final states are considered. A central part of the analysis is the precise estimation of the SM backgrounds. Therefore, a data-driven method is used - the so-called symmetry method. It exploits two principles: First, SM backgrounds with prompt leptons are symmetric w.r.t. electrons and muons. And second, this symmetry is broken if the branching ratios of the two LFV decays are of different magnitude. The first principle implicates the challenge of restoring this symmetry since electrons and muons are experimentally different. The second principle is well motivated by the upper limit on $\mu \to e\gamma$. To obtain the best possible sensitivity, a dedicated statistical model was developed and a neural network for classification is deployed. The analysis is performed using the full LHC Run-2 dataset recorded with the ATLAS detector in proton-proton collisions at $\sqrt{s} = 13$ TeV.

T 27.6 Tue 18:15 H-HS X

Search for pair production of Higgs bosons decaying to $b\bar{b}\tau^+\tau^-$ with the ATLAS detector — •Christopher Deutsch, Jochen Dingfelder, and Tatjana Lenz for the ATLAS-Collaboration — Physikalisches Institut, Bonn

The discovery of the Higgs boson and the measurement of its properties confirming the Standard Model (SM) is a major step towards the understanding of electroweak symmetry breaking. As a result, the potential of the Higgs field, and therefore the trilinear self-coupling of the Higgs boson, is precisely predicted in the SM. It can be probed by measuring the cross section of Higgs boson pair production, offering an additional test of the SM. In the SM such measurements are difficult due to the destructive interference of processes containing the self-coupling and processes with Yukawa couplings to top quarks, leading to a small production cross section at the Large Hadron Collider (LHC). An enhancement would indicate the presence of physics beyond the Standard Model (BSM), since heavy resonances decaying into pairs of Higgs bosons are predicted by several BSM models.

A search for non-resonant and resonant Higgs boson pair production in the $b\bar{b}\tau^+\tau^-$ channel is presented. This channel is one of the most sensitive for probing the Higgs self-coupling. The talk will focus on the subchannel with two hadronically decaying tau leptons. New developments towards the analysis of the $\sim 139\,\mathrm{fb}^{-1}$ dataset collected by the ATLAS experiment in Run 2 of the LHC are presented. These include improvements in object selection with new particle identification algorithms and using multivariate methods for signal selection.