T 46: Higgs Physics VI (top-Higgs Coupling)

Time: Wednesday 16:15–18:15 Location: ZHG105

T 46.1 Wed 16:15 ZHG105

Significance Studies in the Dileptonic ttH(bb) Channel Using Run 3 CMS Simulation — •Philipp Nattland[1], Danyer Perez Adan[1], Kai Adamowicz[1], Lutz Feld[1], Valeria Botta[1], Kilian Krasenbrink[1], Matin Torkian[2], and Maria Aldaya Martin[2] — [1]RWTH Aachen University — [2]DESY, Hamburg

The associated production of a top-quark pair with a Higgs boson (ttH) directly probes the top-Higgs Yukawa coupling, a key parameter in the Standard Model. This study focuses on the ttH(bb) channel with dileptonic top decays, using Run 3 CMS simulation. Building on previous measurements with Run 2 data, we optimize event selection and background suppression to enhance signal significance. A binned maximum likelihood fit is employed to extract the expected signal significance, serving as a figure of merit for the optimization.

T 46.2 Wed 16:30 ZHG105

Preliminary Studies of the ttH(bb) Process in the Dileptonic Channel with SPANet, using CMS Run3 data — •Matin Torkian[1], Maria Aldaya martin[2], Dina Leyva Pernia[2], and Henriette Petersen[2] — [1]DESY, Hamburg University, Germany — [2]DESY, Hamburg, Germany

The Standard Model (SM) of particle physics predicts that the Higgs boson couples to fermions via a Yukawa-type interaction, with a strength proportional to the fermion mass. This makes the associated production of a Higgs boson with a top-quark pair ($t\bar{t}H$) a crucial process to directly probe the top-Higgs Yukawa coupling, an essential parameter for confirming the SM nature of the Higgs boson. Among Higgs boson decays, the channel into a $b\bar{b}$ quark pair has the largest branching fraction, offering an experimentally promising final state. However, ttH(bb) process faces significant challenges regarding backgrounds, especially $t\bar{t}$+jets production, with the $t\bar{t}b\bar{b}$ background being irreducible with respect to the $t\bar{t}H, H \to b\bar{b}$ signal. Advance Machine Learning techniques are essential to improve the sensitivity to the signal process.

This work focuses on the analysis of the $t\bar{t}H, H \to b\bar{b}$ process in events with two leptons, using proton-proton collision data collected by the CMS experiment at the LHC during Run3 at $\sqrt{s} = 13.6\,\text{TeV}$. ML methods are explored to significantly enhance the sensitivity to the $t\bar{t}H$ signal. For the first time in this final state we are exploring the potential of SPANet for jet-parton assignment and neutrino kinematic regressions and finally signal and background classification.

T 46.3 Wed 16:45 ZHG105

Kinematic reconstruction of $t\bar{t}H$ ($H \to b\bar{b}$) events in semileptonic $t\bar{t}$ final states using Run 2 CMS Simulation — •Kai Adamowicz, Lutz Feld, Danyer Perez Adan, Valeria Botta, and Philipp Nattland — RWTH Aachen

The $t\bar{t}H$ process provides a direct probe of the top-Higgs Yukawa coupling, an important parameter of the Standard Model. Due to a large and difficult to accurately model $t\bar{t}b\bar{b}$ background, its measurement in the $H \to b\bar{b}$ channel proved complicated. Using the transformer-based neural network architecture "SPANet", the prospect of a kinematic reconstruction of the final states is studied on Run 2 CMS simulation. This technique may form the basis of a signal extraction via the standard "bump hunt" approach using the invariant mass of the Higgs candidate, which has been proven succesful in many searches and cross section measurements of the SM Higgs boson in various decay modes.

T 46.4 Wed 17:00 ZHG105

Analysis of tH(bb) production with ATLAS Run-2 data — Andre Sopczak and •Roman Tomchik — Czech Technical University in Prague

The latest results of the analysis tH(bb) are presented with focus on machine learning using ATLAS Run-2 data.

T 46.5 Wed 17:15 ZHG105

ttH analysis with two light leptons and one hadronically decaying tau lepton with Run-2 ATLAS data — •Alina Haitota and Andre Sopczak — Czech Technical University in Prague

The latest results of the analysis ttH in the 2lSS1tau channel are presented with focus on machine learning using ATLAS Run-2 data.

T 46.6 Wed 17:30 ZHG105

Associated production of a Higgs boson and a single top quark from t-channel production (tHq) in channels with hadronically decaying tau leptons at ATLAS — •Florian Kirfel and Ian C. Brock — Physikalisches Institut der Universtiät Bonn, Deutschland

A measurement of single top-quark production in association with a Higgs boson and a spectator light-quark (tHq) gives insight into the properties of not only the top quark but also the Higgs boson. The associated production is uniquely sensitive to the relative sign of the top quark-Higgs boson Yukawa coupling.

The decay of the Higgs boson into two tau leptons is covered by the presented analysis. Both cases in which one or two taus decay hadronically are considered and analysed based on the Run 2 LHC dataset from ATLAS.

The complete analysis workflow is covered, ranging from the treatment of light lepton and tau lepton misidentification, over the application of a categorical neural network for signal isolation with a k-fold training approach to a binned maximum likelihood estimation for the purpose of cross section estimation.

T 46.7 Wed 17:45 ZHG105

Higgs boson mass reconstruction in the analysis of tH($\tau\tau$) production with ATLAS Run-2 data — •Jiri Javora and Andre Sopczak — Czech Technical University in Prague

The latest results on the mass reconstruction in the analysis tH($\tau\tau$) are presented with focus on machine learning using ATLAS Run-2 data.

T 46.8 Wed 18:00 ZHG105

Application of the JAX-based Statistical Tool Evermore to a CMS Higgs Analysis — Peter Fackeldey[2], •Felix Zinn[1], Benjamin Fischer[1], and Martin Erdmann[1] — [1]RWTH Aachen University — [2]Princeton University

For precise measurements of the Higgs boson cross sections and coupling strengths, a likelihood based approach is typically needed for statistical inference. We introduce the python software package `evermore` which allows to define corresponding likelihood functions.

It is purely based on JAX and thus enables novel computing concepts such as automatic differentation and vectorization in the context of likelihood fitting.

We show how to build and evaluate a likelihood function in evermore with the example of an analysis of the tH and ttH production channel.

Furthermore we present how to set an upper limit on a parameter of interest. This procedure often requires the generation of pseudo data. We show how vectorized computation in `evermore` can be used for a toy-based approach.