T 90: Higgs Boson: Associated Production 2

Time: Thursday 16:15–18:15 Location: T-H21

T 90.1 Thu 16:15 T-H21

Search for the standard model Higgs boson in association-with a bottom-quark pair (bbH) — •Maryam Bayat Makou — CMS-DESY, Hamburg, Germany

One of the main goals of the LHC experiment is the precise measurement of the Higgs boson production mechanisms to clarify its coupling structure. In the Standard Model of particle physics, the coupling of the Higgs boson to fermions is introduced via the Yukawa interaction. Up to now the Yukawa coupling to b-quarks (y_b) was measured only in the decay process, and not yet in the production mechanism due to the low cross-section and the overwhelming background processes.

This measurement aims at measuring the b-associated Higgs production (bbH) using data collected by the CMS experiment during Run 2. The study covers events where the Higgs boson is produced through the bbH channel and further decays into two tau leptons, subsequently fully leptonically ($\tau_e\tau_\mu$) or fully hadronically ($\tau_h\tau_h$). A machine learning approach has been used to classify the events into two Higgs signal classes and several background classes. First results on the sensitivity on the bbH production channel will be shown.

T 90.2 Thu 16:30 T-H21

Higgsstrahlung with H→bb decay at NNLO+PS — •Silvia Zanoli[1], Mauro Chiesa[2], Emanuele Re[3,4], Marius Wiesemann[1], and Giulia Zanderighi[1,5] — [1]Max-Planck-Institut für Physik, Föhringer Ring 6, 80805 München, Germany — [2]Dipartimento di Fisica, Università di Pavia, and INFN, Sezione di Pavia, Via A. Bassi 6, 27100 Pavia, Italy — [3]INFN, Sezione di Milano - Bicocca, and Università di Milano - Bicocca, Piazza della Scienza 3, 20126 Milano, Italy — [4]LAPTh, Université Grenoble Alpes, Université Savoie Mont Blanc, CNRS, 74940 Annecy, France — [5]Physik-Department, Technische Universität München, James-Franck-Strasse 1, 85748 Garching, Germany

I present the computation of HZ and HW production followed by the Higgs boson decay into a pair of bottom quarks within the MiNNLO$_{\rm PS}$ framework. Both the production and the decay of the Higgs boson are evaluated at NNLO+PS accuracy, consistently combined and then matched to the parton shower by means of a vetoed shower. This MiNNLO$_{\rm PS}$ calculation supersedes the previous NNLOPS results, obtained through MiNLO'+reweighting. I will show and discuss phenomenological results for LHC collisions at 13 TeV.

T 90.3 Thu 16:45 T-H21

Back to the Formula - LHC Edition — Anja Butter[1], Tilman Plehn[1], •Nathalie Soybelman[2], and Johann Brehmer[3] — [1]Institut für Theoretische Physik, Heidelberg, Deutschland — [2]Weizmann Institute of Science, Rehovot, Israel — [3]New York University, New York, USA

While neural networks offer an attractive way to numerically encode functions, actual formulas remain the language of theoretical particle physics. We use symbolic regression trained on matrix-element information to extract, for instance, optimal LHC observables. This way we invert the usual simulation paradigm and extract easily interpretable formulas from complex simulated data. We introduce the method using the effect of a dimension-6 coefficient on associated ZH production. We then validate it for the known case of CP-violation in weak-boson-fusion Higgs production, including detector effects.

T 90.4 Thu 17:00 T-H21

Deep-Learning driven Signal Extraction in the Associated VH-Production with the CMS Experiment — •Niclas Eich, Svenja Diekmann, and Martin Erdmann — RWTH Aachen

The Higgs Boson production in association with a Vector Boson known as "Higgs-Strahlung" (VH) is one of the four main production modes of the Higgs at the LHC. The VH-production can be divided into two modes, being produced by quark-annihilation and gluon-fusion for a Z boson respectively. In our analysis, we aim to measure the gluon-fusion process in the final states with the Higgs decaying to a b-quark pair and the W/Z decaying leptonically. We make use of the symmetries between the quark and gluon induced processes and deploy Deep Learning techniques to maximize the sensitivity of the measurement. Finally, we present first results towards the signal extraction using the data-taking period 2017 of the CMS experiment.

T 90.5 Thu 17:15 T-H21

Extracting the Gluon Fusion Component of the Associated ZH Production with the CMS Experiment — •Svenja Diekmann, Niclas Eich, and Martin Erdmann — III. Physikalisches Institut A, RWTH Aachen University

The gluon fusion production mechanism of the associated ZH production ($gg \to ZH$) is a yet unmeasured Standard Model process sensitive to various new physics scenarios. The considered final state of two leptons and two b-jets is not only populated by large backgrounds arising from other processes, but also by the dominant quark initiated ZH production ($q\bar{q} \to ZH$). In order to separate these two production mechanisms, the total ZH production can be utilised in combination with the WH production to extract the gluon fusion component by analysing the ratio of their cross sections. The strategy of this analysis to extract the gluon fusion component of the ZH production is demonstrated using the data-taking period 2017 of the CMS experiment.

T 90.6 Thu 17:30 T-H21

Extraction of the gluon-initiated component of the associated production of the Higgs boson and a vector boson with the CMS experiment — •Alena Dodonova[1], Alexander Schmidt[1], Xavier Coubez[1,2], Luca Mastrolorenzo[1], Andrey Pozdnyakov[1], Andrzej Novak[1], Spandan Mondal[1], and Ming-Yan Lee[1] — [1]III. Physikalisches Institut A, RWTH Aachen University, Aachen, Germany — [2]Brown University, Providence, USA

Associated Higgs boson production with a Z boson (ZH) contains quark- and gluon-initiated components. The gluon-initiated component ($gg \to ZH$) could be a good probe for the physics beyond the Standard Model (SM) since the effects of the new physics for the loop-induced processes would be of the same order as the SM process. Due to destructive interference between box and triangle contributions at the leading order, this component is suppressed with respect to the dominant quark-initiated contribution to ZH production.

In this talk, I will present the prospects to measure the upper limit on the $gg \to ZH$ component in the $H \to b\bar{b}$ decay channel using multivariate analysis. The study is performed with the full Run 2 dataset collected with the CMS detector at the LHC at $\sqrt{s} = 13\ TeV$.

T 90.7 Thu 17:45 T-H21

Simplified Template Cross Section Measurement of $pp \to WH \to WWW \to l\nu l\nu l\nu$ — •Moritz Hesping, Volker Büscher, Ralf Gugel, and Christian Schmitt — Johannes Gutenberg Universität Mainz

The measurement of the couplings of the Higgs boson is of great scientific interest, since it has the potential of testing possible extensions to the Standard Model. The decay of a Higgs boson into a pair of W bosons after production in association with a W boson is especially useful, since in this process the Higgs boson exclusively couples to W bosons.

In addition to the inclusive analysis of the full run 2 dataset of the ATLAS experiment, the $pp \to WH \to WWW \to l\nu l\nu l\nu$ process was measured in the scheme of Simplified Template Cross Sections (STXS). The STXS mesurement of this process requires access to the transverse momentum of the associated W boson, which due to the presence of three neutrinos in the final state cannot be fully reconstructed. In this talk the analysis strategy will be presented, with a focus on the regression neural network for the W momentum reconstruction and the multiclassifier network for signal-background separation.

T 90.8 Thu 18:00 T-H21

Prospects of measuring the Higgs self-coupling at the ILC — •Julie Torndal[1,2], Jenny List[1], and Yasser Radkhorrami[1,2] — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg — [2]Universität Hamburg, Hamburg, Germany

The Higgs-self coupling is a key feature in understanding the Higgs potential and hence the underlying mechanism that provides mass to the elementary particles. Any deviations from the Standard Model (SM) could indicate new physics beyond the SM.

Experimentally, the measurement of the Higgs self-coupling poses many challenges due to the very small production cross sections and multi-jet final states. The International Linear Collider offers a clean

experimental environment at energies above the threshold of double Higgs-strahlung. Since the Higgs self-coupling was last studied (5-8 years ago) there have been tremendous progress for high-level reconstruction tools which could lead to a large improvements in the sensitivity.

In this contribution, we revisit the projections made for the Higgs self-coupling measurement at the ILC at a center-of-mass energy of 500 GeV and study the effects of improvements made in the high-level reconstruction tools.