T 91: Higgs Boson: Rare Decays

Time: Thursday 16:15–17:45 Location: T-H22

T 91.1 Thu 16:15 T-H22

Search for the Higgs Boson decay to a Z boson and a photon — •Ming-Yan Lee — RWTH III. Physikalisches Institut A, Aachen, Germany

The results of the search for the Higgs boson decays to Zγ will be presented. In the search for this rare Higgs boson decay, the leptonic channel is most promising as it has relatively low background and can be fully reconstructed in the CMS detector. A few analysis techniques such as multivariate analysis methods, kinematic fit and final state radiation recovery are introduced to improve the sensitivity. The combination of the Run 2 data results in an observed (expected) upper limit on the signal strength of 4.1 (1.8) at 95% confidence level.

T 91.2 Thu 16:30 T-H22

Higher order QCD corrections and effective operators in Higgs boson pair production — Gudrun Heinrich[1], •Jannis Lang[1], and Ludovic Scyboz[2] — [1]Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany — [2]University of Oxford, Oxford, United Kingdom

We present results for Higgs boson pair production in gluon fusion including both, NLO (2-loop) QCD corrections with full top quark mass dependence as well as anomalous couplings related to operators describing effects of physics beyond the Standard Model. The latter can be realized in non-linear (HEFT) or linear (SMEFT) Effective Field Theory frameworks. We show results for both and discuss the impact of different approximations within the SMEFT description.

T 91.3 Thu 16:45 T-H22

Employing Matrix Elements with Neural Networks to Search for Higgs Self-coupling — •Christoph Ames, Otmar Biebel, and Lars Linden — Ludwigs-Maximillians-Universität, Munich

The Higgs boson was discovered in 2012 as predicted by the Standard Model, however, not all of its predicted couplings have been measured yet. One such coupling is the Higgs self-coupling, in which a Higgs boson decays into two further Higgs bosons. By integrating over all possible initial states and by using the details of the end state, the matrix element method evaluates the weight of an event for the specific production cross section. In this work, machine learning is combined with the matrix element method to search for $HH \to b\bar{b}W^+W^-$ using simulated data. A neural network is trained to calculate the matrix element weight of an event and to use this to determine whether the event contains a signal or a background decay.

T 91.4 Thu 17:00 T-H22

Investigating Sensitive Observables as Input Variables for Neural Networks in the Search for Higgs Self-Interaction — •Lars Linden, Christoph Ames, and Otmar Biebel — Ludwig-Maximilians-Universit\"at, M\"unchen

A precise measurement of Higgs boson self-interaction is important to determine the properties and the shape of the Higgs potential. Deviations of the expected shape may possibly hint to new physics phenomena. However, the cross-section of the Higgs self-interaction process is very small. So, neural networks are employed to enhance the experimental sensitivity for this process. These networks require a training using specific input observables sensitive to the Higgs self-interaction final states. This talk presents such observables for Higgs boson pair production via the process $gg \to HH$ with a special focus on $HH\to b\bar{b}W^+W^-$ final states.

T 91.5 Thu 17:15 T-H22

Search for Higgs boson pairs decaying to multilepton final states with the CMS experiment — •Tobias Kramer, Torben Lange, Marcel Rieger, and Peter Schleper — Institut für Experimentalphysik, Universität Hamburg

In this presentation, the first CMS analysis searching for Higgs boson pairs decaying into multilepton final states is presented. It uses the full Run 2 dataset corresponding to 138 fb^{-1} recorded by the CMS experiment at a center of mass energy $\sqrt{s} = 13\,\text{TeV}$. Several scenarios for producing events with SM Higgs boson pairs are considered, such as the decay of heavy resonances as well as non-resonant production via the SM as well as EFT modified couplings. The talk focuses on Higgs decays to pairs of W bosons and tau leptons. The analysis provides limits on the yet to be discovered trilinear Higgs self-coupling λ as well as cross section limits for different BSM scenarios, especially at high values for the coupling strength modifier κ_λ and low resonance masses.

T 91.6 Thu 17:30 T-H22

Search for di-Higgs Production with the CMS Experiment using the full Run 2 Dataset — •Marcel Rieger, Peter Schleper, and Tobias Kramer — Institut für Experimentalphysik, Universität Hamburg

After the discovery of the Higgs boson and measurements of its couplings to vector bosons as well as third generation fermions, the search for processes involving more than one Higgs boson will constitute one of the main goals of the global particle physics program in the coming years. The study of trilinear self-coupling will eventually give rise to the structure of the Higgs potential and can lead to profound theoretical consequences. Thereby, di-Higgs searches can gauge our understanding of electroweak symmetry breaking and probe a variety of scenarios that reach beyond the Standard Model.

The full Run 2 collision dataset recorded by the CMS experiment is analyzed in a wide range of potential di-Higgs final states to maximize the coverage of the available phase space. This talk highlights aspects of these searches with focus on final states involving two bottom quarks and two tau leptons. Prospects of the combination of channels, as far as available, are presented and constraints on the trilinear self-coupling as well as the coupling of two Higgs and two vector bosons are reported.