T 82: Higgs, Di-Higgs II

Time: Wednesday 17:30–19:00 Location: HSZ/0105

T 82.1 Wed 17:30 HSZ/0105

Constraints on the Higgs boson self-coupling, κ_λ, and the di-vector boson di-Higgs boson coupling, κ_{2V}, via Higgs boson pair production with the ATLAS detector — Jochen Dingfelder[1], Tatjana Lenz[1], Christopher Deutsch[1], and •Fiona Ann Jolly[2] — [1]Physikalisches Institut, Universitat Bonn, Germany — [2]Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg

After the discovery of the Higgs boson in 2012, searches for Higgs boson pair production have become valuable in probing the Higgs boson self-coupling, κ_λ. The dominant mode for Higgs boson pair production is gluon-gluon fusion (ggF) followed by vector boson fusion (VBF), which produces two additional jets in the final state. Both production modes provide access to κ_λ. In addition, the VBF mode provides access to two other couplings: the quartic $HHVV$ coupling (κ_{2V}) and the Higgs boson-vector boson coupling (κ_V) with $V = W, Z$.

In this talk, a search for Higgs boson pair production via ggF and VBF in the $bb\tau\tau$ final state (both τ leptons decay hadronically) using 139 fb^{-1} of proton-proton collisions at 13 TeV recorded with the ATLAS detector, is presented. Expected constraints on κ_λ and κ_{2V} are obtained after employing a categorisation strategy that separates the VBF and ggF modes in the statistical analysis. In addition, extrapolated results for an integrated luminosity of 3000 fb^{-1} are given.

T 82.2 Wed 17:45 HSZ/0105

Search for non-resonant Higgs boson pair production in the lepton+jets final state of the bbWW decay mode at CMS — •Mathis Frahm, Johannes Haller, Alexander Paasch, and Matthias Schröder — Institut für Experimentalphysik, Universität Hamburg

The Higgs boson self-coupling is an important parameter of the Standard Model (SM), since it is related to the shape of the Higgs potential. At the LHC, this parameter can be probed by measuring the Higgs boson pair production (HH) cross section. The sensitivity of current HH searches is limited by the small SM production cross-section of only 33 fb at 13 TeV. The analysis of data from Run 3 of the LHC promises a further leap in sensitivity.

In this talk, preparation studies towards a search for non-resonant HH production in the lepton+jets final states of the bbWW decay mode with Run 3 data of the CMS experiment are presented. They benefit from a new analysis framework that relies on the novel 'columnar analysis' paradigm.

T 82.3 Wed 18:00 HSZ/0105

NMSSM di-Higgs search in bb$\tau\tau$ final states — •Nikita Shadskiy, Ulrich Husemann, Moritz Molch, Michael Wassmer, and Roger Wolf — Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology (KIT)

The Next-to-Minimal Supersymmetric Standard Model (NMSSM) introduces additional Higgs bosons with different masses next to the already known SM-like Higgs boson. A full CMS run II data analysis (JHEP 11 (2021) 057), which focuses on such a beyond Standard Model search, was previously performed for the decay of a heavy Higgs boson into two lighter Higgs bosons i.e. $\mathrm{H} \rightarrow \mathrm{h_S(bb)h_{SM}}(\tau\tau)$, with $\mathrm{h_{SM}}$ being the SM-like Higgs boson with a mass of 125 GeV.

The new analysis presented in this talk introduces some changes to the previous analysis to improve the results. One of the improvements is to consider both possible Higgs boson decay channels $\mathrm{h_S(bb)h_{SM}}(\tau\tau)$ and $\mathrm{h_S}(\tau\tau)\mathrm{h_{SM}(bb)}$, another is to improve the sensitivity of the measurement, especially in high mass regions of H, by considering boosted topologies. Besides that, the newest CMS reconstruction of run II data will be used, which also includes updates of the data-driven background estimation methods.

T 82.4 Wed 18:15 HSZ/0105

Search for a light CP-odd Higgs boson with ATLAS — •Tom Kresse, Arno Straessner, Manuel Gutsche, Hannah Jacobi, and Christian Schmidt — IKTP, Dresden, Germany

Even though theoretical predictions of the SM are corresponding to experimental results to an incredible degree, there are still some phenomena unexplained, for example the deviation of the measured anomalous magnetic moment, g-2, of the muon from SM calculations. This deviation could be explained by the flavor-aligned two-Higgs-doublet model. The introduction of a second Higgs doublet leads to four additional Higgs bosons, one of which being CP-odd and electrically neutral. The muon g-2 deviation is best explained with a light CP-odd Higgs boson which couples nearly exclusively to top quarks and tau leptons.

This talk presents the search of such a light CP-odd Higgs boson produced via gluon fusion. The decay into two tau leptons is analyzed by requiring one electron and one muon in the final state. The search is carried out in the mass range between 20 GeV and 110 GeV. It is based on 139 fb-1 of data collected by the ATLAS experiment at 13 TeV center-of-mass energy.

The analysis strategy as well as the various validation regions to check the background estimation are presented. An overview over the most relevant systematic uncertainties is given. Even though the analysis is still blinded, expected limits for the production cross-section and model-dependent coupling parameters can be calculated and the fits can be checked for consistency. An outline for the further steps towards the unblinding and the publication of the analysis is given.

T 82.5 Wed 18:30 HSZ/0105

Optimisation and systematic uncertainties in the search for a light CP-odd Higgs boson with ATLAS — •Hannah Jacobi, Tom Kresse, Manuel Gutsche, Christian Schmidt, and Arno Straessner — IKTP, Dresden, Germany

The Standard Model of particle physics is a very successful theory as its predictions are in most cases compatible with experimental results. One example for deviations between the Standard Model and experimental measurements is the value of the anomalous magnetic moment g-2 of the muon. To resolve this problem expansions to the Standard Model, like the 2HDM, are proposed. This theory predicts two Higgs doublets and therefore a total of five Higgs bosons, including the CP-odd and neutral A boson. Assuming the A boson has a light mass and couples strongly to leptons and top quarks it is possible to predict a value for the g-2 that is compatible with the measured one.

This talk focuses on the experimental search for such a light CP-odd Higgs boson with a mass between 20 GeV and 110 GeV produced via gluon fusion. It is examined by looking at final states that contain one electron and one muon, which originated from the decay of the A boson to two τ leptons. The analysis uses 139 fb^{-1} of data recorded by the ATLAS detector at a centre of mass energy of 13 TeV. Before being able to unblind the data in the signal region it is important to ensure the correct modelling of the relevant background processes, like Z bosons decaying into two τ leptons. This talk presents the investigation and correction of mismodelling between measured data and Monte Carlo predictions in dedicated validation regions.

T 82.6 Wed 18:45 HSZ/0105

Top background estimation in the search for a light CP-odd Higgs boson with ATLAS — •Christian Schmidt, Tom Kresse, Manuel Gutsche, Hannah Jacobi, and Arno Straessner — IKTP, Dresden, Germany

Even though predictions of the Standard Model correspond to experimental results to an incredible degree, there are some deviations, for example between the measured anomalous magnetic moment g-2 of the muon and SM calculations.

To resolve this problem expansions to the Standard Model, like the 2HDM, are proposed. This theory predicts two Higgs doublets and therefore a total of five Higgs bosons with one of them being the CP-odd and neutral A boson. Assuming the A boson has a light mass and couples strongly to leptons and top-quarks, the model can predict a value for g-2 compatible with the measured one.

This talk describes the experimental search for such a light CP-odd Higgs boson with a mass of 20 to 110 GeV. The analysis aims to detect this A-boson by its production from gluon fusion and its decay via two tau-leptons into a final state containing one electron and one muon.

To be able to spot the extra events caused by A-boson decay, it is necessary to know the rate of background events very precisely. Background events have the same detector signature as signal events, but are caused by Standard Model processes. Their rate can be estimated by the Monte Carlo method. The talk focuses on the background caused by the decay of top quark-antiquark pairs, and the associated uncertainties due to approximations in the Monte Carlo generator.