T 57: Higgs III

Zeit: Mittwoch 16:30–19:00 Raum: Z6 - HS 0.004

T 57.1 Mi 16:30 Z6 - HS 0.004

Search for Higgs boson pair production in the $b\bar{b}\tau^+\tau^-$ fully hadronic final state at $\sqrt{s} = 13$ TeV with the ATLAS detector — •Alessandra Betti, Florian Beisiegel, Tatjana Lenz, Alexander Melzer, and Norbert Wermes — Physikalisches Institut, Universität Bonn

In the Standard Model (SM) Higgs bosons can be produced in pairs via top quark loops or the Higgs trilinear self-interaction. Although the SM cross-section for Higgs pair production is very small, in several extensions of the SM this cross-section can be enhanced. Non-resonant Higgs pair production can be significantly enhanced by modifications of the triple Higgs self-coupling λ_{hhh}. Other theories predict heavy resonances that could decay into a pair of Higgs bosons, such as a neutral scalar heavy Higgs in the two Higgs doublet model and spin-2 Kaluza-Klein excitations of the graviton in the bulk Randall-Sundrum model. In the assumption of Higgs bosons with m=125 GeV decaying with branching fractions according to the SM predictions, the $b\bar{b}\tau^+\tau^-$ channel of the di-Higgs decay has the third largest branching fraction (7.4%). The status of the search for resonant and non-resonant Higgs boson pair production in the $b\bar{b}\tau^+\tau^-$ final state with the ATLAS detector will be presented in this talk. Main focus will be on the fully hadronic final state $b\bar{b}\tau^+_{had}\tau^-_{had}$.

T 57.2 Mi 16:45 Z6 - HS 0.004

Evidence for the associated production of the Higgs boson and a top quark pair with the ATLAS detector: same-charge lepton pair plus tau channel — •Andre Sopczak[1], Babar Ali[1], Simonetta Gentile[2], and Marine Kuna[2] — [1]IEAP CTU in Prague — [2]Dipartimento di Fisica "G.Marconi" Universita di Roma, Sapienza

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 thus a probe for physics beyond the Standard Model. Recently evidence for the coupling has been established.

The ttH production was analysed in the final state with two same-sign light leptions (electrons or muons) and a hadronically decaying tau lepton: ttH $\rightarrow 2\ell + 1\tau_{\mathrm{had}}$. The analysis was based on data taken by the ATLAS experiment recorded from 13 TeV proton-proton collisions. It contributed to the combined ATLAS results of the multi-lepton final state analyses. These results were further combined with other ATLAS ttH analyses where H $\rightarrow \gamma\gamma$ and H $\rightarrow b\bar{b}$. The combined results are consistent with the Standard Model (SM) expectation allowing models beyond the SM to be constrained.

T 57.3 Mi 17:00 Z6 - HS 0.004

Measuring the branching ratio of $h \rightarrow \mu^+\mu^-$ at the International Linear Collider — •Shin-ichi Kawada, Jenny List, and Mikael Berggren — DESY, Notkestrasse 85, 22607 Hamburg, Germany

After the discovery of a Higgs boson at the LHC, the precise characterization of this particle is one of the most important topics in particle physics. Any deviation from the Standard Model (SM) prediction of its properties would indicate the existence of physics beyond the SM. In this talk, we will present the prospects measuring the branching ratio of $h \rightarrow \mu^+\mu^-$ at the International Linear Collider (ILC). The analysis is performed using Geant4-based full detector simulation assuming 2 ab^{-1} at the center-of-mass energy of 250 GeV and 4 ab^{-1} at 500 GeV, as foreseen in the official running scenario. The results will be discussed with the prospects for operating the HL-LHC. We will also discuss the impact of detector design and its effect for this study.

T 57.4 Mi 17:15 Z6 - HS 0.004

Search for dimuon Higgs decays in the SM — Adrian Perieanu, •Oliver Rieger, and Peter Schleper — Universität Hamburg

A search for the standard model Higgs boson decaying into two muons is described. The analysis is based on 2016 LHC data recorded by the CMS detector in proton-proton collisions at a center-of-mass energy of 13 TeV. The dataset corresponds to an integrated luminosity of 35.9 fb^{-1}. A Boosted Decision Tree (BDT) is used to distinguish the kinematics of signal and background events. All events are categorized according to their BDT response and dimuon mass resolution. Limits are set on the cross section of the Higgs boson decaying into two muons for mass hypotheses between 120 and 130 GeV. Furthermore, first studies of the 2017 dataset are presented.

T 57.5 Mi 17:30 Z6 - HS 0.004

Measurement of Higgs CP properties in fermionic couplings with the CMS Detector — David Brunner, Jordy Degens, Peter Fackeldey, Olena Hlushchenko, Wolfgang Lohmann, Johannes Merz, Thomas Müller, Alexander Nehrkorn, Claudia Pistone, Dennis Roy, Hale Sert, Achim Stahl, and •Dominik Wolfschläger — III. Physikalisches Institut B, RWTH Aachen University

The discovery of CP violation in the Higgs sector would be a clear indication for physics beyond the standard model. While recent results exclude that the Higgs boson of mass 125 GeV is a pure pseudoscalar particle, a small admixture of scalar and pseudoscalar contributions is still a valid scenario. This talk presents an analysis dedicated to the measurement of the scalar and pseudoscalar couplings of the discovered Higgs boson. The search for small pseudoscalar contributions is motivated in terms of an effective field theory where scalar and pseudoscalar contributions enter at the same pertubative order in gluon-gluon-fusion Higgs production. The azimuthal angle difference $\Delta\phi_{jj}$ between initial state jets produced in $gg \rightarrow Hjj$ events is sensitive to the underlying pseudoscalar γ^5 tensor structure. A statistical analysis based on $\Delta\phi_{jj}$ is performed, providing an expected analysis sensitivity to CP properties for an integrated luminosity of $\mathcal{L} = 35.9\,\mathrm{fb}^{-1}$ at $\sqrt{s} = 13\,\mathrm{TeV}$ collected with the CMS Detector in 2016.

T 57.6 Mi 17:45 Z6 - HS 0.004

Test of CP Invariance in vector-boson fusion production of the Higgs boson using the Optimal Observable method in the decay $H \rightarrow \tau_l\tau_h$ with the ATLAS detector at $\sqrt{s} = 13$ TeV — Elias Coniavitis, •Dirk Sammel, and Markus Schumacher — Albert-Ludwigs-Universität Freiburg

C and CP violation are one of the three Sakharov conditions needed to explain the observed baryon asymmetry of the universe. The amount of CP violation in the quark sector, introduced via the CKM matrix, is however not sufficient to explain the baryon asymmetry in the context of the Standard Model.
Additional sources of CP violation could be present in the production and decay of the Higgs boson. The production via vector-boson fusion allows to study the CP structure of the Higgs-boson coupling to electroweak gauge bosons. In this talk, first studies performed with the CP-odd *Optimale Observable* with Run-2 LHC data are presented.
The analyis uses the decay $H \rightarrow \tau_l\tau_h$ and data collected with the ATLAS detector in 2015 and 2016 at $\sqrt{s} = 13\,\mathrm{TeV}$, corresponding to an integrated luminosity of $\int \mathcal{L} = 36.5\,\mathrm{fb}^{-1}$.

T 57.7 Mi 18:00 Z6 - HS 0.004

Test of CP invariance in vector-boson fusion production of the Higgs boson in $H \rightarrow \tau_{lep}\tau_{lep}$ decays at $\sqrt{s} = 13$ TeV with the ATLAS detector — Elias Coniavitis[1], •Alena Lösle[1], Ulrike Schnoor[2], and Markus Schumacher[1] — [1]Physikalisches Institut, Universität Freiburg — [2]CERN

Violation of CP invariance is one of the Sakharov conditions to explain the observed baryon asymmetry in our universe. While CP violation is already realised in the Standard Model via the CKM matrix, it is not sufficient to explain the amount of observed baryon asymmetry. Hence, it is interesting to search for new sources of CP violation in the Higgs sector. The vector-boson fusion production allows to investigate the CP structure of the Higgs-boson coupling to electroweak gauge bosons and to test CP invariance in this interaction.
The analysis discussed in this talk is performed in the $H \rightarrow \tau_{lep}\tau_{lep}$ decay channel and uses the CP-odd *Optimal Observable*. First studies based on data taken by the ATLAS detector in 2015 and 2016 at $\sqrt{s} = 13\,\mathrm{TeV}$ corresponding to an integrated luminosity of $36.1\,\mathrm{fb}^{-1}$ are presented.

T 57.8 Mi 18:15 Z6 - HS 0.004

Search for lepton-flavour violating decays of the Higgs-boson using the asymmetry method with the ATLAS experiment

at $\sqrt{s} = 13$ TeV — •Katharina Schleicher[1], Duc Bao Ta[2], and Markus Schumacher[1] — [1]Albert-Ludwigs-Universität Freiburg — [2]Johannes Gutenberg-Universität Mainz

One interesting topic after the discovery of the Higgs-boson is the search for lepton-flavour violating (LFV) couplings. These are predicted in several models, including supersymmetric extensions of the standard model (SM) and the general two-higgs-dublet model. In nature, LFV was already observed in form of neutrino oscillations.

Possible LFV decays in the Higgs-sector are $H \to e\mu$, $H \to \tau e$ and $H \to \tau\mu$. In this analysis only the decays of $H \to \tau e$ and $H \to \tau\mu$ with leptonic τ-decays leading to $e\mu + X$ final states are considered. For background estimation the asymmetry method is utilized. It exploits two facts. First, SM backgrounds with prompt leptons are symmetric w.r.t. a replacement of electrons with muons and vice versa. And second, this symmetry is broken when assuming that the branching ratios of the two considered LFV decays are of different orders of magnitude.

One challenge is to maintain this symmetry despite experimental differences of electrons and muons. Another challenge is to enhance the sensitivity. Therefore, a multivariate analysis is developed by training boosted decision trees.

The analysis is performed on the full 2015 and 2016 run-2 data set in proton-proton collisions ($L = 36.07\text{fb}^{-1}$) taken with the ATLAS detector at $\sqrt{s} = 13$ TeV.

T 57.9 Mi 18:30 Z6 - HS 0.004

Messung der Higgs–Gluon–Tensorkopplung in Zerfällen $H \to ZZ^* \to 4\ell$ mit dem ATLAS–Detektor — •Maxim Sinner, Katharina Ecker, Oliver Kortner, Sandra Kortner, Hubert Kroha und Verena Walbrecht — Max–Planck–Institut für Physik, München

Das Standardmodell der Teilchenphysik beschreibt das Higgsteilchen als skalares Boson mit positiven Ladungskonjugations– und Paritätsquantenzahlen: $J^{PC} = 0^{++}$. In vielen Modellen jenseits des Standardmodells wird ein erweiterter Higgssektor angenommen, wodurch kleine CP–ungerade Beimischungen in der Higgskopplung entstehen können. Diese sind durch die Run–1–Messungen nicht ausgeschlossen. Ein sensitiver Kanal zur Untersuchung CP–ungerader Beimischungen in der Higgs–Gluon–Kopplung bei der dominanten Higgs–Produktion durch Gluon–Fusion ist der Higgs–Zerfall in zwei Z–Bosonen, die jeweils in ein e^+e^-– oder $\mu^+\mu^-$–Paar zerfallen.
In diesem Vortrag wird die Untersuchung der Tensorstruktur der Higgs–Gluon–Kopplung im Zerfallskanal $pp \to H \to ZZ^* \to 4\ell$ mit den Run–2–Daten des ATLAS–Detektors vorgestellt. Insbesondere werden für die Messung die Eigenschaften der Jets eingesetzt, die durch reelle Emissionskorrekturen zur Gluon–Fusion erzeugt werden.

T 57.10 Mi 18:45 Z6 - HS 0.004

Messung der HZZ-Tensor-Kopplung in $pp \to H \to ZZ^* \to 4\ell$ - Zerfällen mit dem ATLAS-Detektor — •Verena Walbrecht, Katharina Ecker, Maxim Sinner, Sandra Kortner, Oliver Kortner und Hubert Kroha — Max-Planck-Institut für Physik

Nach der Entdeckung des Higgs-Bosons am LHC ist es wichtig, die Eigenschaften dieses Teilchens präzise zu vermessen und somit nach möglichen Abweichungen von den Vorhersagen des Standardmodells zu suchen. Ein wichtiger Zerfallsprozess für die Entdeckung und Messung der Eigenschaften des Higgs-Bosons ist der in zwei Z-Bosonen, die jeweils in ein e^+e^-- oder $\mu^+\mu^-$-Paar zerfallen, $pp \to H \to ZZ^* \to 4\ell$.

Im Standardmodell wird das Higgs-Boson als Spin-0-Teilchen mit positiver CP-Quantenzahl vorhergesagt. Diese Hypothese wird auch von den Run-I-Daten bevorzugt. Dabei sind kleine Beimischungen anomaler, möglicherweise auch CP-verletzender Kopplungen mit geänderter Tensorstruktur nicht ausgeschlossen, die von Theorien jenseits des Standardmodells vorhergesagt werden. In diesem Vortrag wird die Messung der Higgs-Boson-Produktion und der Tensorstruktur der Higgs-Bosonkopplung an Z-Bosonen mit den Run-II-Daten des ATLAS-Detektors im Kanal $pp \to H \to ZZ^* \to 4\ell$ vorgestellt.