T 10: Higgs: Erweiterte Modelle I

Zeit: Montag 16:00–18:30 Raum: Z6 - HS 0.004

T 10.1 Mo 16:00 Z6 - HS 0.004

Absorbing corrections due to supersymmetric particles to Higgs couplings in effective parameters in the decay $H \to hh$ — •Max Stadelmaier[1], Margarete Mühlleitner[1], Michael Spira[2], and Stefan Liebler[1] — [1]Institut für Theoretische Physik (ITP), KIT, Karlsruhe, Deutschland — [2]Labor für Teilchenphsik (LTP), PSI, Villigen, Schweiz

Since the Large Hadron Collider (LHC) has not discovered any supersymmetric (SUSY) partners to Standard Model (SM) particles yet, they are likely to exist at higher mass scales. The SUSY particles also contribute indirectly in higher-order corrections to the Higgs boson observables of the extended Higgs sector of the minimal supersymmetric extension of the SM (MSSM), namely to the partial decay widths of Higgs-to-Higgs decays. We compute the higher order corrections to the decay $H \to hh$ of the heavier of the two CP-even Higgs bosons, H, into a pair of lighter SM-like Higgs bosons, h. Assuming the SUSY particles to be very heavy we use an effective 2-Higgs-doublet model. We thoroughly investigate the correct matching conditions to the underlying full theory of the MSSM with heavy superpartners and compare the effective 2HDM-like calculation with the full MSSM result. We delineate the parameter regions where this approximation is valid.

T 10.2 Mo 16:15 Z6 - HS 0.004

Searching for new light higgs bosons at the ILC — •Yan Wang[1,2] and Jenny List[1] — [1]DESY, Hamburg, Germany — [2]IHEP, Beijing, China

In many new physics models with additional Higgs sectors, e.g. 2HDM, NMSSM, there exist one or more light scalars h. Thereby, the coupling of such scalars to the Z boson can be small, as expected if the 125 GeV Higgs boson remains Standard-Model-like as measurements of uncertainties shrink. Light higgs bosons with suppressed couplings to the Z boson would in turn have escaped from the detection at LEP, due to LEP's limited luminosity. With a factor 1000 higher luminosity and polarized beams, the International Linear Collider (ILC) is expected to have substantial discovery potential for such states. Furthermore, searching additional scalars at LEP and LHC are usually dependent on the model details, such as decay channels, so it is necessary to have a more general analysis with model-independent assumptions.

In this work, we perform a search for light scalars produced in association with the Z boson at the ILC with a center-of-mass energy of 250 GeV, using the full Geant4-based simulation of the ILD detector concept. For a model-independent consideration, the analysis is performed using the recoil technique, in particular with the Z boson decaying into a pair of muons. As a preliminary result, the ILC's discovery and exclusion potential will be shown for different higgs masses between 10 and 115 GeV.

T 10.3 Mo 16:30 Z6 - HS 0.004

Search for heavy Higgs bosons in the $H \to \tau_{\text{had}}\tau_{\text{had}}$ channel with the ATLAS detector — •Lino Gerlach, Michel Janus, and Stan Lai — II. Physikalisches Institut, Georg-August-Universität Göttingen

In 2012, a scalar boson was found at CERN that is consistent with the properties of the Higgs boson predicted by the Standard Model of particle physics. Some theories, in particular supersymmetric models, also predict the existence of additional heavier neutral Higgs bosons. The decays of these heavy Higgs bosons to a pair of τ leptons can be siginificant because of the high mass of the τ lepton and additional effects of two-Higgs-doublet models that can enhance the coupling to down-type fermions.

In this talk, details of the search for $H \to \tau\tau$ in the fully hadronic channel using 36.1 fb^{-1} of proton-proton collision data taken with the ATLAS experiment at a centre-of-mass energy of $\sqrt{s} = 13$ TeV will be presented. Special emphasis will be placed on the background estimation of jets that are falsely identified as hadronically decaying τ leptons, which play an important role in many different analyses. This universal approach in determining the misidentification probability will also be presented.

T 10.4 Mo 16:45 Z6 - HS 0.004

Search for additional Higgs bosons in WW final states with CMS — 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

One of the most promising models beyond the Standard Model is the Minimal Supersymmetric extension to the Standard Model (MSSM). Setting limits on the parameter space of the MSSM is mandatory in order to provide constraints for further experimental and theoretical studies. As with any 2HDM, five different Higgs bosons are predicted. In various scenarios of the MSSM the decay of the heavy scalar Higgs boson H into two W bosons provides sensitivity on two important parameters in the Higgs sector, $\tan\beta$ and m_A, in a region where analyses of other final states are less sensitive.
In this talk the results of this BSM $H \to WW$ analysis are presented, which show limits in the parameter space of a general 2HDM, as well as model dependent limits of MSSM scenarios. The data used was recorded in 2016 by CMS at a center-of-mass energy of 13 TeV, which corresponds to an intergrated luminosity of 35.9 fb^{-1}.

T 10.5 Mo 17:00 Z6 - HS 0.004

Search for Higgs boson pair production in the $\gamma\gamma WW^*$ final state with a boosted topology using ATLAS data — •Kira Abeling, Joshua Beirer, Jason Veatch, and Stan Lai — II. Physikalisches Institut, Georg-August-Universität Göttingen

Since the discovery of the Higgs boson in 2012, many studies have been performed to compare its properties with Standard Model (SM) predictions. In particular, a direct measurement of the Higgs self-coupling is important to characterise the Higgs potential.

Furthermore, it is known that there must be physics beyond the SM. One set of extensions, known as two Higgs doublet models (2HDMs), predicts five Higgs bosons in total, of which two are CP-even and neutrally charged differing by their mass. The heavy Higgs boson, H, can decay in two light Higgs bosons, h, which have the properties of the discovered Higgs boson. The mass of the heavy Higgs is a free parameter and can exist within a large range.

In this talk, a search for di-Higgs production in the $\gamma\gamma WW^*$ decay channel using $\sqrt{s} = 13$ TeV pp collision data collected by the ATLAS experiment in 2015 and 2016 is discussed. This channel combines the clean signal of the di-photon system and the high branching ratio of $h \to WW^*$. Since only large resonant masses are considered, the jets from the W boson decay cannot be resolved completely. This yields a boosted topology and the W boson decay products are collected in a single large-R jet. This talk covers analyses in both the fully hadronic and the 1-lepton final states.

T 10.6 Mo 17:15 Z6 - HS 0.004

Interference modelling of the heavy Higgs boson decaying into $t\bar{t}$ final states at the ATLAS experiment — Katharina Behr[1], •Yu-Heng Chen[1], Klaus Mönig[1], and Jike Wang[2] — [1]DESY, Hamburg, Germany — [2]Heidelberg PI, Heidelberg, Germany

The first search for heavy (pseudo)scalar Higgs bosons A/H decaying into a top-antitop-quark pair ($t\bar{t}$) including interference effects at the Large Hadron Collider (LHC) has been performed by the ATLAS collaboration on 20.3 fb^{-1} of $\sqrt{s} = 8$ TeV proton-proton collision data. The interference between the signal and the dominant background from standard model $t\bar{t}$ production significantly distorts the signal shape from a simple Breit-Wigner peak to a peak-dip structure; hence, the potential to observe such a signal relies on a precise understanding and modelling of the lineshape of both the signal and the background.

The contribution introduces the major challenges and techniques including model implementation, fitting and efficient MC signal sample production/recycling via reweighting used at the ATLAS experiment. The results are interpreted in terms of the framework of the Type-II two-Higgs-doublet models (2HDM) as well as an extension to dark matter models.

T 10.7 Mo 17:30 Z6 - HS 0.004

Combination of di-Higgs searches using 13 TeV data collected by the ATLAS detector — •Florian Beisiegel, Alessandra Betti, Jochen Dingfelder, Tatjana Lenz, Alexander Melzer, and Norbert Wermes — University of Bonn

The discovery of the SM Higgs boson in 2012 was a great success of

modern particle physics since it served as a proof of the Higgs mechanism introduced in 1964.
One focus of the current particle physics experiments at the LHC is the measurement of the Higgs properties, such as its coupling strengths to fundamental particles. In addition to the coupling of the Higgs boson to fermions and gauge bosons, the Higgs mechanism also predicts a coupling to itself. In the SM, there exist 3-Higgs couplings, leading to di-Higgs production. Searches for Higgs boson pair-production are thus a promising way to measure the triple Higgs boson coupling strength. Another important part of di-Higgs analyses is the search for new physics by looking for resonances where a new particle X decays into two Higgs bosons. For these, upper limits on the cross section times branching ratio of the considered processes can be calculated. In addition, the results can be interpreted in various BSM models to determine constraints on the model parameters.
By combining di-Higgs searches with different final states like $b\bar{b}b\bar{b}$, $b\bar{b}\tau\tau$ and $b\bar{b}\gamma\gamma$, the upper limits can be further improved. This talk presents such a combination of different di-Higgs analyses using $36.5\,\mathrm{fb}^{-1}$ of $\sqrt{s} = 13\,\mathrm{TeV}$ data collected with the ATLAS detector.

T 10.8 Mo 17:45 Z6 - HS 0.004

Extension of searches for additional MSSM Higgs boson with the CMS experiment towards the NMSSM — Roger Wolf, René Caspart, •Irina Fateeva, and Günter Quast — Karlsruhe Institute of Technology, Karlsruhe

The MSSM predicts the existence of five Higgs bosons, two charged ($H^{\pm}$) and three neutral (h, H, A). In the Next to Minimal Supersymmetric Standard Model (NMSSM), additionally to the Higgs boson fields of the MSSM, one complex SU(2) singlet field $\hat{S}$ is added, which leads to overall 7 Higgs bosons. For the work presented in this talk the results of the search for additional neutral MSSM Higgs bosons in the di-τ final state by CMS are re-interpreted in an NMSSM scenario, which allows for high values of $tan\beta$. The studies are based on the most recent publication of the search for additional neutral MSSM Higgs bosons with CMS.

T 10.9 Mo 18:00 Z6 - HS 0.004

Search for heavy Higgs resonances in the boosted $H \to hh \to WW\tau\tau \to$ 1 lepton + jets channel — •Nils Gillwald, Jason Veatch, and Stan Lai — II. Physikalisches Institut, Georg-August-Universität Göttingen

With the discovery of the Higgs boson in 2012, the final elementary particle of the Standard Model was discovered. The observation of Higgs boson pair production would allow a direct measurement of the Higgs potential, which is an important parameter to understand the nature of the Higgs field. Additionally, several BSM models such as two Higgs doublet models and Kaluza-Klein theories predict heavy resonances that can decay into a pair of Higgs bosons.

With a branching ratio of 1.3%, the hh to $WW\tau\tau$ channel is the sixth largest di-Higgs decay channel and has never been investigated before. This talk covers an analysis-in-progress on the prospects for searching for boosted di-Higgs events produced via a heavy BSM Higgs resonance in the $H \to hh \to WW\tau\tau \to 1$ lepton + jets channel with the current ATLAS data. The boosted topology is sensitive to high heavy higgs masses and provides excellent suppression of QCD jet background, compensating the small branching ratio of the channel.

T 10.10 Mo 18:15 Z6 - HS 0.004

Probing CP Properties of the Higgs boson with Higgs signal rates from Tevatron and LHC data — •Tobias Klingl[1], Philip Bechtle[1], Tim Stefaniak[2], Sven Heinemeyer[4], Georg Weiglein[2], and Daniel Dercks[3] — [1]Universität Bonn — [2]Deutsches Elektronen-Synchrotron Hamburg — [3]Universität Hamburg — [4]Instituto de Física Teórica Madrid

The Higgs boson found at the LHC is experimentally in agreement with the SM prediction. However, it is still a possibility that it consists of an admixture of a CP-even Higgs-like scalar h and a CP-odd pseudoscalar A as described by the general parametrization $\phi = h\cos\alpha + A\sin\alpha$. Using the program `HiggsSignals` we investigate the scope of possible deviations of the mixing α from its SM prediction $\alpha = 0$. To this end, we consider Higgs coupling benchmark scenarios with scalar and pseudoscalar scale factors for the couplings to fermions and one common scale factor for the coupling of h to the SU(2) gauge bosons. The latter is assumed to be ≤ 1 as predicted in many models such as SUSY or 2HDM. Although there are no renormalizable couplings of A to the SM gauge bosons at tree level such couplings might be induced through loop corrections of new heavy fields. We investigate this possibility with an effective field theory formulation using higher-dimensional operators. We obtain constraints on α from χ^2 fits to the official signal rates from a combined ATLAS and CMS analysis.