T 60: Theorie: Higgs / BSM I

Zeit: Mittwoch 16:30–19:00 Raum: Z6 - SR 1.010

T 60.1 Mi 16:30 Z6 - SR 1.010

Searching for BSM physics with top quarks using an effective field theory approach — •Stefan Bissmann — Fakultät Physik, TU Dortmund, Otto-Hahn-Str.4, D-44221 Dortmund, Germany

We perform a model-independent analysis of t-channel single top production at the LHC (ATLAS and CMS). We investigate the influence of correlations of the experimental uncertainties and determine the individual impacts of different datasets (differential and total cross sections). The constraints on the Wilson coefficient are currently in good agreement with the Standard Model, but with all statistical uncertainties scaled to the luminosity of future scenarios (LHC Run 3, HL-LHC, FCC) the bounds can show significant deviations.

T 60.2 Mi 16:45 Z6 - SR 1.010

Higgs boson pair production in the Electroweak Chiral Langrangian framework — •Matteo Capozi — Max-Planck-Institut für Physik, Föhringer Ring 6 D-80805 München, Germany

We calculate the full NLO QCD corrections to Higgs boson pair production within the Electroweak Chiral Langrangian framework, parametrizing BSM effects in a non linear EFT description. We show the effects of BSM-couplings in the Higgs sector on various distributions.

T 60.3 Mi 17:00 Z6 - SR 1.010

Probing New Physics in the Higgs sector — •Simone Blasi[1], Florian Goertz[1], Tommi Alanne[1], Stefania De Curtis[2], and Kei Yagyu[2] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Deutschland — [2]INFN - Sezione di Firenze, Via G. Sansone 1, 50019 Sesto Fiorentino, Italy

The discovery of the $h(125)$ Higgs boson confirms the Standard Model picture of a scalar particle in charge of the electroweak symmetry breaking. However, the structure of the Higgs sector and its actual role are still unknown. In the spirit of the High Luminosity program at the LHC, we first constrain New Physics scenarios with an extended Higgs sector by inputting a deviation in the $h(125)$ couplings to Standard Model particles. Our aim is to consistently extract the mass scale of the new scalars by imposing theoretical and experimental constraints in three benchmark models: the Higgs Singlet Model, the Two Higgs Doublet Model and the Georgi Machacek Model. Finally, we elaborate on the possible connection between the scalar sector and some of the most compelling open questions in the Standard Model: Dark Matter, strong CP problem and Flavour puzzle.

T 60.4 Mi 17:15 Z6 - SR 1.010

The charged Higgs decay $H^\pm \to W^\pm h$ at one-loop order in the NMSSM — Thi Nhung Dao[1], •Lukas Fritz[2], Margarete Mühlleitner[2], and Shruti Patel[2] — [1]IFIRSE, Quy Nhon, Vietnam — [2]KIT, Karlsruhe, Deutschland

Charged Higgs bosons appear in extended Higgs sectors beyond the Standard Model (SM) like e.g. the Next-to-Minimal Supersymmetric extension (NMSSM). They are of special phenomenological interest because their detection would be an immediate sign of beyond-the-SM physics. Depending on the parameter choice the decay of the charged Higgs boson into a W-Boson and a neutral Higgs boson, $H^\pm \to W^\pm h$, is one of dominant decay channels and be exploited to search for the charged Higgs boson at the LHC. The NMSSM belongs to the most intensely studied supersymmetric models and is motivated, besides the solution of the μ-problem, by its interesting phenomenology and the possibility of generating a 125 GeV SM-like Higgs boson without the need of very heavy stops or large stop mixing. We compute the one-loop corrections to the decay $H^\pm \to W^\pm h$ in the NMSSM. We investigate the numerical impact of the higher order corrections and give an estimate of the remaining theoretical uncertainty. We compare our findings to the case of the Minimal Supersymmetric Extension (MSSM) and discuss the implications for LHC phenomenology.

T 60.5 Mi 17:30 Z6 - SR 1.010

NLO Matching Conditions in Extended Higgs Sectors — •Martin Gabelmann, Margarete Mühlleitner, and Florian Staub — Karlsruhe Institute of Technology, ITP

The absence of new physics in current LHC searches leads to increasing interest in a variety of non-minimal extensions of the Standard Model (SM). Also the scale of new physics in widely studied models is pushed to higher energies. Automation tools such as SARAH allow for comprehensive studies of a wider class of models with potentially complicated mass spectra and couplings. Not only the tree level values but also NLO and NNLO corrections to mass spectra can be studied within a reasonable amount of time. However, large mass gaps can lead to problematic large logarithms increasing the uncertainty in fixed order calculations. The use of effective field theories (EFTs) is a common tool to resum these large logs. Thus, precise matching conditions between an EFT and UV complete -or intermediate- theories are needed. I discuss various aspects important for a generic implementation of NLO matching conditions to scalar couplings such as systematic cancellations of infrared divergences and contributions from mixed loops containing heavy and light fields.

T 60.6 Mi 17:45 Z6 - SR 1.010

Precision prediction of the Higgs mass in the MSSM at three-loop level — Robert V. Harlander, •Jonas Klappert, and Alexander Voigt — RWTH Aachen University, Aachen, Germany

In the MSSM, sizable corrections to the light Higgs mass can be observed up to three-loop order. Since the latter are not implemented in most spectrum generators, we present a `C++` implementation of these contributions into the package `Himalaya`. `Himalaya` can be linked to existing codes, thus allowing for the elevation of these codes to the three-loop level. We present the first full $\overline{\text{DR}}$ study of the three-loop effects by linking `Himalaya` to `FlexibleSUSY` and compare our results to fixed-order two-loop calculations, as well as to the result based on an EFT approach. We also present a result for the Higgs mass with consistent matching between the three-loop fixed-order expression and an EFT approach.

T 60.7 Mi 18:00 Z6 - SR 1.010

The CP-Violating 2HDM in Light of a Strong First Order Electroweak Phase Transition and Implications for Higgs Pair Production — •Philipp Basler[1], Margarete Mühlleitner[1], and Jonas Wittbrodt[2] — [1]Karlsruher Institut für Technologie, ITP, Karlsruhe, Deutschland — [2]DESY, Hamburg, Deutschland

The generation of the observed matter-antimatter asymmetry in the universe through baryogenesis cannot be explained in the Standard Model. We therefore investigate the possibility of a strong first order phase transition in the CP-Violating 2-Higgs-Doublet Model (C2HDM) after imposing theoretical and experimental constraints. We study the type I and II C2HDM where one of the neutral Higgs bosons can be the Standard Model-like Higgs boson. Our results show that there is a strong interplay between the requirement of a strong phase transition and collider phenomenology with testable implications for searches at the LHC. We find additional preferred mass hierarchies compared to those of the CP-conserving 2HDM. We also use our results to investigate the interplay between a strong phase transition and the size of the trilinear Higgs self-couplings.

T 60.8 Mi 18:15 Z6 - SR 1.010

Impact of CP-violating phases on MSSM Higgs searches — •Shruti Patel — ITP and IKP, Karlsruhe Institute of Technology

We study the effects of CP-violating phases on the phenomenology of the MSSM Higgs sector. Complex parameters in the MSSM give rise to CP-violating mixing between the tree-level neutral Higgs mass eigenstates, leading to three new CP-admixed loop-corrected mass eigenstates $\{h_1, h_2, h_3\}$. In scenarios where the lightest Higgs h_1 is SM-like and the two other Higgs states are much heavier and nearly mass degenerate, complex parameters induce a large admixture between the two heavy Higgs states. In this talk, we study the impact of CP-violating interference effects between h_2 and h_3 in an example process of $b\bar{b} \to \tau^+\tau^-$. We demonstrate that large destructive interference effects modify the LHC exclusion bounds such that parts of the parameter space that would be excluded by MSSM Higgs searches under the assumption of CP-conservation open up when the possibility of CP-violation in the Higgs sector is accounted for.

T 60.9 Mi 18:30 Z6 - SR 1.010

Phenomenological Implications of the Dark Phases of the

N2HDM — •Isabell Engeln[1], Margarete Mühlleitner[1], Rui Santos[2,3,4], and Jonas Wittbrodt[5] — [1]ITP, Karlsruher Institut für Technologie (KIT), Karlsruhe, Germany — [2]ISEL, Instituto Politécnico de Lisboa, Lisboa, Portugal — [3]CFTC, Universidade de Lisboa, Lisboa, Portugal — [4]LIP, Departamento de Física, Universidade do Minho, Braga, Portugal — [5]Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany

The N2HDM is based on the CP-conserving 2HDM extended by a real scalar singlet field. This model allows for three different dark phases with either one of the two doublets or the singlet being inert, or both. This gives rise to dark matter candidates that originate from different sectors. In this talk, we compare the phenomenology of the inert doublet and the inert singlet phase based on parameter scans of both phases, considering all applicable theoretical and experimental constraints. We discuss differences and similarities and point out possible ways to distinguish between the phases at current or future collider experiments.

T 60.10 Mi 18:45 Z6 - SR 1.010

Modelling of the interference between New Physics and Standard Model processes — •Didier Alexandre — Humboldt Universität zu Berlin

In searches for new physics (NP), one important consideration is the interference of the theoretical processes with Standard Model (SM) processes that yield the same final states. The effect of an interference wave on the shape of the invariant mass is to distort the distribution asymetrically, shifting the peak with respect to the value of the mass of the particle. It is important to take this effect into account in the Monte Carlo modelling of the NP signals. In this talk, we discuss the interference effect related to the searches for the vector-like quark decays $T(2/3)\rightarrow Wb$ and $Y(4/3)\rightarrow W\bar{b}$, which alters the signal distributions significantly. With the help of simulations performed with MadGraph, an overview of the sizes of the effect according to different model parameter settings is presented. We discuss a strategy for taking into account the interference with the SM in the cross-section limit setting procedure. Finally, a general procedure is proposed for NP searches.