T 3: Higgs Physics II (BSM Higgs)

Time: Monday 16:45–18:30 Location: ZHG105

T 3.1 Mon 16:45 ZHG105

Search for light pseudoscalar Higgs bosons in the four-kaon final state with the CMS detector — Nils Faltermann[1], •Johannes Hornung[1], Markus Klute[1], and Benedikt Maier[2] — [1]Karlsruhe Institute of Technologie, Karlsruhe, Germany — [2]Imperial College, London, United Kingdom

Since the discovery of the Higgs boson, extensive measurements of its properties have set upper limits on the branching ratio of its yet undetected decay modes. The branching ratio encompasses immediate decays into SM particles that are not detectable, as well as decays into BSM particles. This talk focuses on a search for Higgs boson decays into pairs of hypothetical pseudoscalar Higgs bosons a, as predicted in models like the NMSSM. Specifically, the search strategy, current status, and expected limits of an analysis targeting prompt decays H -> aa -> KKKK using data collected by the CMS detector during Run 2 of the LHC will be discussed.

T 3.2 Mon 17:00 ZHG105

Higgs Mass Predictions in the CP-Violating High-Scale NMSSM — •Christoph Borschensky[1], Thi Nhung Dao[2], Martin Gabelmann[3], Margarete Mühlleitner[1], and Heidi Rzehak[3] — [1]Karlsruher Institut für Technologie, Germany — [2]PHENIKAA University, Hanoi, Vietnam — [3]Albert-Ludwigs-Universität Freiburg, Germany

In a supersymmetric theory, large mass hierarchies can lead to large uncertainties in fixed-order calculations of the SM-like Higgs mass. A reliable prediction is then obtained by performing the calculation in an effective field theory (EFT) framework, involving the matching to the full supersymmetric theory at the high scale to include contributions from the heavy particles, and a subsequent renormalization-group running down to the low scale.

In my talk, I report on the prediction of the SM-like Higgs mass within the CP-violating Next-to-Minimal Supersymmetric extension of the SM (NMSSM) in a scenario where all non-SM particles feature TeV-scale masses. The matching conditions are calculated at full one-loop order using two approaches. These are the matching of the quartic Higgs couplings as well as of the SM-like Higgs pole masses of the low- and high-scale theory. A comparison between the two methods allows for an estimate of the size of terms suppressed by the heavy mass scale that are neglected in a pure EFT calculation as given by the quartic-coupling matching. The calculation is implemented in a new version of the public program package NMSSMCALC.

T 3.3 Mon 17:15 ZHG105

Planck Safe Phase Transitions in a Complex Singlet Model — •Moritz Bosse and Gudrun Hiller — TU Dormund University, Dortmund, Germany

In this work, we investigate the implications of Beyond the Standard Model Higgs portal couplings on vacuum metastability and strong first-order electroweak phase transitions (SFOEWPT), which are necessary for electroweak baryogenesis. The analysis focuses on the minimal but phenomenologically rich complex singlet model (CxSM) that also provides potential dark matter candidates. It is shown that portal couplings allow for the stabilization of the vacuum up to the Planck scale while simultaneously enhancing the strength of the phase transition to become a SFOEWPT. By adopting Planck safety as a guiding principle for bottom-up model building, we derive new bounds for different dark matter scenarios compatible with SFOEWPTs. The results show that there is significant parameter space available for Planck-safe phase transitions in the CxSM and we explore how this parameter space can be probed at the LHC and beyond.

T 3.4 Mon 17:30 ZHG105

Electroweak spin-1 resonances in Composite Higgs models, pt. 1 — Rosy Caliri[1], •Jan Hadlik[1], Manuel Kunkel[1], Werner Porod[1], and Christian Verollet[2] — [1]Institut für Theoretische Physik und Astrophysik, Universität Würzburg, Germany — [2]Institut de Physique des 2 Infinis de Lyon (IP2I), 69100 Villeurbanne Cedex, France

Composite Higgs models offer an elegant solution to the hierarchy problem by assuming that the Higgs boson is not an elementary particle but a composite state. The Higgs emerges as a pseudo-Nambu-Goldstone boson due to spontaneous symmetry breaking within a new strongly interacting sector. The resulting low-energy dynamics are described by the Coleman-Callan-Wess-Zumino (CCWZ) formalism. These models predict a rich spectrum of additional bound states, including vector resonances, which can arise naturally from an extended hidden global symmetry that is fully gauged. We investigate models where the unbroken subgroup of the strong sector contains $SU(2)_L \times SU(2)_R$ and demonstrate that a generic prediction of these models is the existence of two neutral and one charged spin-1 resonance that mix significantly with the electroweak gauge bosons. Consequently, these states are of considerable interest for phenomenological studies.

T 3.5 Mon 17:45 ZHG105

Electroweak spin-1 resonances in composite Higgs models pt.2 — •Rosy Caliri[1], Jan Hadlik[1], Manuel Kunkel[1], Werner Porod[1], and Christian Verollet[2] — [1]Institut für Theoretische Physik und Astrophysik, Uni Würzburg, D-97074 Würzburg, Germany — [2]Institut de Physique des 2 Infinis de Lyon (IP2I), 69100 Villeurbanne Cedex, France

Composite Higgs theories with partial compositeness are gauge theories, where the Higgs boson arises as a pseudo-Nambu-Goldstone boson (pNGB) and top-partners appear as bound states of three hyperfermions coming from a UV completion. These models offer a promising solution to the Higgs sector's Naturalness problem and predict extra pNGBs and spin-1 resonances. Our focus is on the electroweak spin-1 resonances. We find that three of those states have an important mixing with the SM gauge bosons, allowing their single production in Drell-Yan like processes at LHC. We explore the rich LHC phenomenology of these states and find scenarios where their masses could be as low as 1.5 TeV.

T 3.6 Mon 18:00 ZHG105

Seesaw mechanism in the Georgi-Machacek model — •Colin Heckmeyer[1], Heidi Rzehak[2], and Emilia Welte[1] — [1]Institut für theoretische Physik, Universität Tübingen — [2]Physikalisches Institut, Universität Freiburg

The current experimental measurements of the Higgs properties conform so far with the Standard Model (SM), however allow also for a more complex Higgs sector than the SM one. This opens the door for various extensions, one of which is the Georgi-Machacek model (GM). This model includes a complex SU(2) Higgs triplet state, a real SU(2) Higgs triplet state, and a real SU(2) Higgs doublet state. It is particularly appealing because it allows for the introduction of a type II seesaw mechanism term, an interaction term between the complex triplet and the leptons, generating a mass term for neutrinos. In this model, the neutrinos are assumed to be Majorana particles.

In this talk, a model combining the GM and the seesaw mechanism is introduced. Within this model, the leading-order (LO) decay of an SM-like Higgs boson is presented. One of the key features of the GM is maintaining the rho parameter at unity at LO. The rho parameter is a conserved quantity of custodial symmetry. This symmetry, however is violated at next-to-leading order (NLO) and requires taking custodial symmetry violating terms at LO into account for a proper renormalization procedure. Using this approach, a NLO analysis of the decay of the SM-like Higgs boson is discussed.

T 3.7 Mon 18:15 ZHG105

A note on the Brout-Englert-Higgs mechanism — •Jochum van der Bij — Albert-Ludwigs Universitaet Freiburg, Deutschland

To generate masses for the particles in the standard model a Brout-Englert-Higgs (BEH) field is necessary. However a field is not a particle. I present here a construction whereby the BEH-field has a partly continuous spectrum. The theory is a renormalizable theory beyond the textbook examples. It is only mildly constrained by the LHC data. In order to fully test the theory both an e+e- collider and a muon collider are needed. These experiments can give us information about extra dimensions beyond the three known ones, that are not accessible to charged particles.