T 7: Higgs, Di-Higgs I

Time: Monday 16:30–18:00 Location: HSZ/0105

T 7.1 Mon 16:30 HSZ/0105

Strong first-order EWPTs in a Type-II 2HDM-EFT and their implications on Higgs pair production — Anisha[1,3], •Lisa Biermann[2], Milada Margarete Mühlleitner[2], and Christoph Englert[3] — [1]Indian Inst. Tech., Kanpur, India — [2]ITP, KIT, Karlsruhe, Germany — [3]Glasgow U., Glasgow, United Kingdom

We study the scalar dimension six effective field theory (EFT) extended 2HDM-Type-II in its possibility to promote the strength of the electroweak phase transition to a strong first-order electroweak phase transition (SFOEWPT). Therefore, a global minimization of the one-loop daisy-resummed effective potential at finite temperature is performed with the C++ code BSMPT. Our special focus lies on investigating the connection between Wilson coefficient constellations that enable an SFOEWPT and their phenomenological implications on Higgs pair production (resonant and non-resonant) in top final states.

T 7.2 Mon 16:45 HSZ/0105

Higgs Pair Production in a Composite 2HDM — Stefania De Curtis[1], Luigi Delle Rose[2], •Felix Egle[3], Stefano Moretti[4], Margarete Mühlleitner[3], and Kodai Sakurai[5] — [1]INFN sezione di Firenze and Dipartimento di Fisica e Astronomia, Università di Firenze, Via G. Sansone 1, I-50019, Sesto Fiorentino, Italy — [2]Dipartimento di Fisica, Università della Calabria, I-8703 Arcavacata di Rende, Cosenza, Italy — [3]Institute for Theoretical Physics, Karlsruhe Institute of Technology, 76131 Karlsruhe, Germany — [4]School of Physics and Astronomy, University of Southampton, Southampton, SO17 1BJ, United Kingdom — [5]Department of Physics, Tohoku University, Sendai, Miyagi 980-8578, Japan

In composite Higgs models the scalar particles in the Higgs sector are not elementary particles, but of composite nature, arising as pseudo Nambu-Goldstone bosons from higher broken symmetries. In a composite 2-Higgs-Doublet Model thus a 2HDM-like structure is generated but with couplings already predetermined by the composite nature of the model. In this talk we present Higgs Pair production in this model via gluon fusion. We give a brief introduction into the model and an overview over the calculation, highlighting the contributing couplings and diagrams. We apply current experimental limits for Di-Higgs production on our results and study differential distributions for specific benchmark scenarios.

T 7.3 Mon 17:00 HSZ/0105

The reconstruction of the $\tau\tau$ invariant mass in $H \to \tau\tau$ decays as a machine learning task — •Moritz Molch, Ulrich Husemann, Nikita Shadskiy, Lars Sowa, Michael Wassmer, and Roger Wolf — Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology

Analyses that deal with Higgs boson decays into a pair of τ leptons often rely on a good reconstruction of the $\tau\tau$ invariant mass. As the decay of two τ leptons involves at least two neutrinos, the reconstruction of $m_{\tau\tau}$ is a challenging part of such analyses.

In many analyses at the CMS experiment the SVfit algorithm, which is a likelihood method on an event-by-event basis, is utilized for that task. First studies have shown that $m_{\tau\tau}$ can also be reconstructed using a deep neural network.

In this talk the applicability of deep neural networks to reconstruct $m_{\tau\tau}$ is further investigated and a comparison to current methods is made.

T 7.4 Mon 17:15 HSZ/0105

Probing high p_{T} Higgs boson production in the di-τ decay channel — •Steffen Ludwig, Christopher Young, Karsten Köneke, and Karl Jakobs for the ATLAS-Collaboration — University of Freiburg, Institute of Physics, Freiburg im Breisgau, Germany

The Higgs boson was observed first in 2012 by the ATLAS and CMS experiments at the Large Hadron Collider at CERN. Even more than 10 years after its discovery, more precise measurements of the Higgs boson decay are desired to search for physics beyond the Standard Model.
One particularly interesting measurement is the transverse momentum (p_{T}) spectrum of the Higgs boson where deviations at high values could be a sign of new physics. I will discuss the prospects for selecting such events in the channel where the Higgs boson decays to τ leptons. At high p_{T} the two τ leptons are close to each other in $\eta - \phi$, making this a uniquely interesting final state.

T 7.5 Mon 17:30 HSZ/0105

Test of CP invariance in Higgs boson production via vector boson fusion exploiting the $H \to \tau_{\mathrm{had}}\tau_{\mathrm{had}}$ decay mode — •Daniel Bahner, Ö. Oğul Öncel, and Markus Schumacher — Albert-Ludwigs-Universität, Freiburg, Deutschland

In the universe, an asymmetry exists between the number of baryons and the anti-baryons. Three Sakharov conditions need to be fulfilled in order to explain this observed baryon asymmetry. One of those is the violation of the CP invariance. Its amount in the Standard Model is not enough to explain the asymmetry. The discovery of the Higgs boson has opened a new window to search for additional sources of CP violation. The vector-boson fusion (VBF) production of the Higgs boson is one of them. In the VBF production topology, it is possible to probe CP-violating contributions to the HVV coupling vertex.

In this talk the fully hadronic decay channel, where VBF-produced Higgs boson decays into two hadronically decaying tau leptons, is presented. The dominant background process in this decay channel is the irreducible $Z \to \tau\tau$ process. A data-driven Fake Factor method is used to estimate the sizeable contribution from events in which jets are misidentified as hadronically decaying tau leptons. A neural network is exploited to discriminate signal from background processes.

CP-odd observables are used in a profile-likelihood fit to perform a test of CP invariance and to constrain the strength of new CP-violating interactions. The talk will discuss the analysis strategy, CP-odd observables, and first results based on $\sqrt{s} = 13\,\mathrm{TeV}$ proton-proton collision data collected by the ATLAS detector with $\mathcal{L}_{\mathrm{int}} = 139\,\mathrm{fb}^{-1}$.

T 7.6 Mon 17:45 HSZ/0105

Precision measurements of the τ-identification efficiency of CMS — •Olha Lavoryk, Sebastian Brommer, Maximilian Burkart, Roger Wolf, Markus Klute, and Günter Quast — Karlsruhe Institute of Technology(ETP), Karlsruhe, Germany

τ-leptons play an important role in Higgs physics because the scalar coupling to the fermions is proportional to their mass. Standard model (SM) as well as Beyond the SM (BSM) analyses require precise reconstruction of the hadronic τ-lepton decays. Discriminators based on Deep Neural Networks (DNN) provide a fast and efficient solution to this task.

In this talk, precision measurements of the τ-identification efficiency on the ultra-legacy Run-2 data taken from 2016–2018 are presented, and an appropriate uncertainty model for future Run-2+Run-3 measurements with τ-leptons in the final state is presented.