T 101: BSM Higgs 4

Time: Thursday 16:00–18:00 Location: Geb. 30.41: HS 3

T 101.1 Thu 16:00 Geb. 30.41: HS 3

Analysis of interference effects in the di-top final state for CP-mixed scalars in extended Higgs sectors — Henning Bahl[1], •Romal Kumar[2], and Georg Weiglein[2,3] — [1]Institut für Theoretische Physik, Philosophenweg 16, 69120 Heidelberg, Germany — [2]Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, 22607 Hamburg, Germany — [3]Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany

Various extensions of the Standard Model predict the existence of additional Higgs bosons. If these additional Higgs bosons are sufficiently heavy, an important search channel is the di-top final state. In this channel, interference contributions between the signal and the corresponding QCD background process are expected to be important. If more than one heavy scalar is present, besides the signal-background interference effects associated with each Higgs boson also important signal-signal interference effects are possible. We perform a comprehensive model-independent analysis of the various interference contributions within a simplified model framework considering two heavy scalars that can mix with each other, taking into account large resonance-type effects arising from loop-level mixing between the scalars. The interference effects are studied with Monte Carlo simulations for the di-top production process at the LHC. We demonstrate that signatures can emerge from these searches that may be unexpected or difficult to interpret.

T 101.2 Thu 16:15 Geb. 30.41: HS 3

Search for heavy Higgs bosons and Axion-Like Particles in the $t\bar{t}$ final state at CMS — •Jörn Bach[1,2,3], Christian Schwanenberger[1,2], Alexander Grohsjean[2], Laurids Jeppe[1], Samuel Baxter[1], and Afiq Anuar[4] — [1]Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany — [2]Universität Hamburg, Hamburg, Germany — [3]HAW Hamburg, Hamburg, Germany — [4]CERN, Geneva, Switzerland

The Standard Model of particle physics is very successful in predicting the processes we observe at modern colliders such as the Large Hadron Collider (LHC). It is however incomplete and remaining questions, such as the nature of dark matter, are motivating searches for new particles.

A CMS search for a heavy Higgs boson in the $t\bar{t}$ final state in 2016 data has observed a local excess of 3.5σ (1.9σ global) for a pseudoscalar with a mass of 400 GeV and a width of 4%. Motivated by this result, we present a search for a scalar and pseudoscalar heavy Higgs boson decaying to $t\bar{t}$ with the full Run 2 CMS dataset. We exploit spin correlation information and the invariant mass of the $t\bar{t}$ system. Additionally to the scalar and pseudoscalar heavy Higgs bosons, we interpret the search in terms of a more general pseudoscalar Axion-like particle (ALP) by also allowing for direct couplings to the gluon.

T 101.3 Thu 16:30 Geb. 30.41: HS 3

Distinguishing Axion-Like Particles from Extended Higgs Sector Models in $t\bar{t}$ production at the LHC — Anke Biekötter[1], Thomas Biekötter[2], Alexander Grohsjean[3], Sven Heinemeyer[4], •Laurids Jeppe[5], Christian Schwanenberger[5,3], and Georg Weiglein[5,3] — [1]PRISMA+ Cluster of Excellence & Institute of Physics (THEP) & Mainz Institute for Theoretical Physics, Johannes Gutenberg University, Mainz, Germany — [2]Institute for Theoretical Physics, Karlsruhe Institute of Technology, Karlsruhe, Germany — [3]Universität Hamburg, Hamburg, Germany — [4]Instituto de Física Teórica UAM-CSIC, Madrid, Spain — [5]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany

We present an analysis of the sensitivity of LHC searches for new spin-0 particles produced via gluon-fusion and decaying into top quark-antiquark ($t\bar{t}$) final states to generic axion-like particles (ALPs) coupled to top-quarks and gluons. We derive new limits on the effective ALP Lagrangian in the linear representation in terms of the Wilson coefficients c_t and c_G based on the existing CMS search using 35 fb^{-1} collected at $\sqrt{s} = 13$ TeV. We further investigate posssible distinctions between ALPs and pseudoscalar Higgs bosons as predicted by the two-Higgs-doublet model (2HDM), and find that distinction is possible with data anticipated to be collected during the high-luminosity of the LHC for a significant range of the effective ALP-gluon coupling.

T 101.4 Thu 16:45 Geb. 30.41: HS 3

Search for long-lived axion-like particles produced in Higgs boson decays at the ATLAS Experiment — •Lukas Bauckhage — Physikalisches Institut, Universität Bonn, Bonn; Germany

Preliminary results of a search for long-lived axion-like particles produced in a Higgs decay in association with a Z boson and decaying into a pair of photons are presented. Exotic Higgs decays to long-lived particles are featured in theories beyond the standard model related to hidden sectors, while (long-lived) axion-like particles are not only a prime candidate to dark matter but also part of hidden and dark sector theories. This analysis uses Run 2 and 3 data collected with the ATLAS detector and follows a previous search for promptly decaying axion-like particles. The ALP decay's displacement challenge the standard photon reconstruction and call for new techniques, such as machine learning and a new tagger utilising shower shape information. Detailed studies of the ALP identification and reconstruction efficiency as a function of its radial and longitudinal displacement will be discussed.

T 101.5 Thu 17:00 Geb. 30.41: HS 3

Search for long-lived particles produced in Higgs boson decays with b-quark like signature — Lisa Benato, •Karim El Morabit, Mascha Hackmann, Gregor Kasieczka, and Sriya Madarapu — Institut für Experimentalphysik, Universität Hamburg

New particles predicted by theories of physics beyond the standard model (BSM) can have relatively long lifetimes and decay after macroscopic flight distances. Such long-lived particles (LLPs) can occur, for example, in Higgs-portal models in which a dark sector of particles, that are neutral under the SM gauge groups, is accessible via mixing of the standard model and dark sector Higgs bosons. With this, a SM Higgs boson could then decay to a pair of dark sector particles π which could then decay back to SM particles. In case these new particles π are long-lived particles, it would result in experimental signatures of displaced tracks or jets.

This talk discusses a search for LLPs with data recorded at the CMS experiment. It targets LLPs with comparably short lifetimes $c\tau$ on the order of cm and decays into bottom quark-antiquark pairs. The decays of the LLPs result in b-jets with displacements only slightly larger than those of SM b-jets, leading to challenges regarding the background suppression and modeling. Machine learning methods are used to address those challenges.

T 101.6 Thu 17:15 Geb. 30.41: HS 3

Search for Higgs boson decays into long-lived particles with displaced vertices — Lisa Benato, Karim El Morabit, Gregor Kasieczka, and •Karla Peña — Institut für Experimentalphysik, Universität Hamburg

Higgs-portal models propose the existence of a dark sector, neutral under all Standard Model (SM) gauge groups. Interaction between the dark sector and the SM is mediated solely by the Higgs boson, which mixes with its dark partner. As a consequence of this, the Higgs boson is predicted to decay also in the dark sector. Scenarios are considered where the Higgs boson decays into a pair of dark long-lived particles (LLPs), each of which travels a macroscopic distance before decaying back to a pair of SM particles—predominantly b quarks.

Decays occurring within the CMS tracking system result on displaced-vertex signatures, which can be observed with almost no background from the SM. However, as conventional tracking and vertex finding algorithms are optimized for prompt decays, these signatures are challenging to find and advanced reconstruction techniques are required. This talk presents a search for LLPs using data collected by the CMS detector in pp collisions at a center-of-mass energy of 13 GeV.

T 101.7 Thu 17:30 Geb. 30.41: HS 3

Search for flavour-changing neutral current couplings between the top quark and the Higgs boson in multilepton final states — •Marvin Emin Geyik and Wolfgang Wagner — University of Wuppertal

Flavour-changing neutral current interactions are strongly suppressed in the Standard Model. Still, some extensions of the Standard Model

predict tree-level FCNC couplings between the top quark, other up-type quarks and neutral bosons, including the Higgs boson. These anomalous couplings can be parametrised in the framework of effective field theories (EFT). The presented analysis searches for the production of a single top-quark in association with a Higgs boson and for top-quark-antiquark production with one of the top quarks decaying to an up quark or a charm quark and a Higgs boson. Higgs decays to WW^*, ZZ^* and two taus leading to leptonic final states are considered in the event selection. Two analysis channels are defined: one with two leptons (electrons or muons) of the same electric charge and a second channel with three leptons. The results obtained by the analysis will be presented in the form of upper exclusion limits on the relevant coefficients of EFT operators and the ensuing branching ratios.

T 101.8 Thu 17:45 Geb. 30.41: HS 3

Double Sliced Event Generation: A novel method for multijet background generation for forward jet sensitive Physics searches — •Gediminas Glemža and Christian Sander — DESY, Notkestr. 85, 22607 Hamburg, Germany

Beyond Standard Model searches with significant reliance on forward jets, such as invisible Higgs decay in vector boson fusion topology, are sensitive to various effects stemming from multijet background events. These forward jets can be faked by pile-up jets. Conventionally generated multijet background events may have a leading jet stemming from pileup interaction resulting in unphysically large event weights. Typical selection cuts can negate these effects to some extent at the cost of aggressively reducing the statistics of multijet samples. Hence, a new method of generating multijet background events enriched in a particular region of interest, called Double Sliced Event Generation, is presented.

The method generates hard scatter and leading pileup interactions in sliced kinematic phase-space, employs full truth jet smearing, considers all possible pile-up tagged jet combinations, and repeatedly samples jet responses and invisible jet energy fractions. The produced backgrounds are enriched in signal regions with correctly calculated physical event weights, hence able to survive the selection cuts and are resistant to the aforementioned negative effects. For the validation of the method, a generated double-sliced event generation multijet background is compared to its conventional MC counterpart for invisible Higgs decay in vector boson fusion topology.