T 25: Higgs Physics IV (BSM Higgs)

Time: Tuesday 16:15–17:45 Location: ZHG105

T 25.1 Tue 16:15 ZHG105

Search for heavy neutral Higgs bosons in the $t\bar{t}Z$ channel at CMS — •Yannick Fischer, Matteo Bonanomi, Lukas Ebeling, Johannes Haller, Daniel Hundhausen, Matthias Schröder, and Bianca Weidner — Institut für Experimentalphysik, Universität Hamburg

All measurements of the Higgs boson at 125 GeV so far agree with the standard model (SM) prediction, however the observed resonance could still be part of an extended Higgs sector. Such an extended Higgs sector is predicted by many theories of physics beyond the SM. Two Higgs Doublet Models (2HDM) assume the existence of a second Higgs doublet, giving rise to a total of five physical Higgs bosons. This talk will present a search for a hypothetical CP-odd Higgs boson A decaying into a hypothetical CP-even heavy Higgs boson H and a Z boson, with the H decaying into a top anti-top quark pair. This channel has been dubbed the smoking gun channel for various 2HDMs in the context of electroweak baryogenesis. We will focus on the fully hadronic decay of the $t\bar{t}$ pair, presenting improvements of the analysis strategy and first results with data measured by CMS at 13.6 TeV.

T 25.2 Tue 16:30 ZHG105

Improving the search for heavy neutral Higgs bosons in the $t\bar{t}Z$ channel at CMS using parameterized neural networks — •Bianca Weidner, Matteo Bonanomi, Lukas Ebeling, Yannick Fischer, Johannes Haller, Daniel Hundhausen, and Matthias Schröder — Institut für Experimentalphysik, Universität Hamburg

Many theories of physics beyond the Standard Model, such as Two Higgs Doublet Models (2HDM), suggest that the Higgs boson measured at 125 GeV might be part of an extended Higgs sector with five physical Higgs bosons. In this talk, we will explore a promising decay channel involving a hypothetical CP-odd heavy Higgs boson (A), which decays into a CP-even heavy Higgs boson (H) and a Z boson. The H boson then decays into a top quark-antiquark pair. Current analyses exclude signals of up to approximately 1.2 TeV for these hypothetical particles. We will focus on optimizing the analysis by investigating the impact of a parameterized neural network to separate signal events from the background. This approach improves the sensitivity to a potential signal and thus allows probing a larger region of the 2HDM parameter space.

T 25.3 Tue 16:45 ZHG105

Search for a light CP-odd Higgs boson decaying into a pair of τ-leptons in proton–proton collisions at $\sqrt{s} = 13\,\text{TeV}$ with the ATLAS detector — •Manuel Gutsche, Asma Hadef, Tom Kresse, Christian Schmidt, and Arno Straessner — Technische Universität Dresden

The two-Higgs-doublet model (2HDM) continues to be one of the most well-motivated extensions of the Standard Model. The theory postulates a second Higgs doublet, thus predicting the existence of in total five Higgs bosons h, H, $H^{\pm}$, A, of which the latter A boson is electrically neutral and CP-odd. A certain choice of the model's parameters leads to the flavour-aligned 2HDM, which is able to explain discrepancies in the anomalous magnetic moment of the muon for an A boson mass of less than m_Z as well as large couplings to leptons and up-type quarks.

This talk presents a search for a CP-odd Higgs boson which is produced via gluon fusion and decays into two τ-leptons in the mass range of 20 GeV to 90 GeV. For this, the analysis uses 140 fb^{-1} of data recorded by the ATLAS detector at $\sqrt{s} = 13$ TeV, focusing on the leptonic decays of the τ-leptons to exactly one electron and one muon.

After explaining the analysis strategy and event selection, an overview of fake-lepton estimation and most impactful systematic uncertainties is given. The expected and observed exclusion limits for the model-independent production cross-section, as well as for the coupling parameter to up-type quarks interpreted in the flavour-aligned 2HDM, are presented.

T 25.4 Tue 17:00 ZHG105

Updates on the Yukawa Type I for 2HDMS with a 95 GeV Higgs boson — •Dominik Heintz[1], Sven Heinemeyer[3], Cheng Li[4], and Gudrid Moortgat-Pick[1,2] — [1]II. Institut für Theoretische Physik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany — [2]DESY, Notkestraße 85, 22607 Hamburg, Germany — [3]Instituto de Física Teórica UAM-CSIC, Cantoblanco, 28049, Madrid, Spain — [4]School of Science, Sun Yat-Sen University, Gongchang Road 66, 518107 Shenzhen, China

The **2HDM** (Two-Higgs-Doublet Model) can be extended by a real singlet, **N2HDM**, or a complex singlet, **2HDMS**. Both models are promising candidates to describe the excess at $\sim 95\,\text{GeV}$ observed both at **CMS** and at **ATLAS** in the $\gamma\gamma$ channel with $\sim 2.9\sigma$ and $\sim 1.7\sigma$, respectively, as well as in the $b\bar{b}$ decay channel at **LEP** with $\sim 2.3\sigma$. The lightest Higgs boson in the models, h_1 was interpreted as a new particle at $\sim 95\,\text{GeV}$. Studies so far focused on the Yukawa types II and IV. However, the signal strength in the $\gamma\gamma$ channel went down substantially over the last years. This allows a greater freedom for $\frac{c_{h_1 bb}}{c_{h_1 tt}}$, the ratio of the coupling modifiers of the light Higgs to bottom and top quarks, respectively. This motivates the phenomenological study of the **2HDMS** in the Yukawa type I. The study includes current theoretical and experimental constraints using **HiggsTools** (**HiggsBounds** and **HiggsSignals**) and incorporates the most recent signal rates from **ATLAS**.

T 25.5 Tue 17:15 ZHG105

Searches for charged Higgs bosons in $H^{\pm} \to W^{\pm}h$ decays with the ATLAS detector — Dominik Duda[2], •Simon Grewe[1], Sandra Kortner[1], and Hubert Kroha[1] — [1]Max Planck Institut für Physik — [2]University of Edinburg

Many theories beyond the Standard Model predict the existence of charged Higgs bosons. The main production mode of these new particles depends on their mass. For large $H^{\pm}$ masses, the dominant mode of production is in association with a top quark and a bottom quark ($tbH^{\pm}$). In the alignment limit of the Two-Higgs-Doublet Model, heavy charged Higgs bosons decay almost exclusively via $H^{\pm} \to tb$. In other models such as the Georgi-Machacek model, however, significant branching ratios for $H^{\pm} \to W^{\pm}h$ are possible.
A search for charged Higgs bosons in $H^{\pm} \to W^{\pm}h$ (m_h=125 GeV) decays produced in association with a top and bottom quark is presented, based on the full Run-2 dataset of the ATLAS experiment. This is the first search for this decay at the LHC.
Two analysis strategies are employed to ensure high sensitivity for both low and high $H^{\pm}$ masses. For low $H^{\pm}$ masses the decay products have a relatively low Lorentz-boost and the $h \to b\bar{b}$ can be resolved by two small-radius jets. For high $H^{\pm}$ masses the final state particles acquire a lot of Lorentz-boost and the neutral Higgs boson decay has to be reconstructed via a single large-radius jet. The invariant mass of the charged Higgs boson is reconstructed and used as the discriminating variable. No significant deviation from the SM expectation is observed and upper limits are set on $\sigma(pp \to tbH^{\pm}) \times BR(H^{\pm} \to W^{\pm}h)$.

T 25.6 Tue 17:30 ZHG105

tbH$^+$ Analysis with Multileptons Using Run-2 ATLAS Data — •Azad Afandizada and Andre Sopczak — Czech Technical University in Prague

The latest results with Run-2 ATLAS data are presented for the search tbH$^+$ in the multilepton channel.