T 87: Extended Higgs Models III

Time: Thursday 16:00–18:15 Location: Tl

T 87.1 Thu 16:00 Tl

Search for invisible Higgs boson decays with vector boson fusion signatures with the ATLAS detector using an integrated luminosity of 139 fb^*1 — •Pablo Rivadeneira — DESY, Hamburg

Several Beyond Standard Models consider the Higgs boson as the mediator between the Standard Model and Dark Matter. At the LHC, it is possible to probe these Higgs portal Dark Matter models searching for the production of Dark Matter through large values of missing transverse energy generated by the DM particles escaping the detector. Using 139fb^-1 of pp collision at a center-of-mass energy of 13 TeV recorded by the ATLAS detector, a search for Higgs bosons produced via vector boson fusion and subsequently decay into invisible particles was developed. The observed number of events was found to be in agreement with the background expectation from the Standard Model. Observed and expected upper limits on the branching fraction of Higgs boson decaying to invisible were derived to be at 0.13 at 95% confidence level. These results were used to set limits on the scattering cross-section of weakly interacting massive particles and nucleons. The invisible decays of additional scalar bosons with masses from 50 GeV up to 1TeV were also studied, and upper limits on the cross section times branching fraction were evaluated to be 0.97 pb for a scalar boson of a mass of 50 GeV, which falls with increasing mass to become 0.12 pb at a mass of 1TeV.

T 87.2 Thu 16:15 Tl

Identification of Collinear Photons in the Context of a search for anomalous Higgs Boson Decays — Bernard Brickwedde, Peter Krämer, •Marten Mildeberger, Kristof Schmieden, Matthias Schott, and Olivera Vujinovic — Johannes Gutenberg Universität Mainz

New physics models that predict couplings of axion-like-particles (ALPs) to the Higgs boson could explain the famous discrepancy between experimental value and measurement of the muon anomalous magnetic moment $(g-2)_\mu$. These models assume an ALPs decay into highly collinear photons. Hence special photon reconstruction algorithms have to be developed in order to distinguish $H \to aa \to \gamma\gamma\gamma\gamma$ from normal $H \to \gamma\gamma$ signatures. In this talk, the performance of a neural network based approach for the photon identification and reconstruction will be presented.

T 87.3 Thu 16:30 Tl

Search for charged Higgs bosons in $H^+ \to W^+h$ decays to a merged event topology with the ATLAS detector — •Patrick Bongratz, Dominik Duda, Simon Grewe, Sandra Kortner, and Hubert Kroha — Max-Planck-Institut für Physik, München

Various theories predicting an extended Higgs sector predict also the existence of at least one set of charged Higgs bosons. The main production mode of these new particles depends on their mass. For charged Higgs boson masses larger than the sum of the top and the bottom quark mass, the dominant production mode is expected to be in association with a top quark and a bottom quark.

In the alignment limit of the two Higgs-Doublet model (2HDM), heavy charged Higgs bosons with $m(H^+) > m(t) + m(b)$ decay almost exclusively via $H^+ \to tb$. However, in other models such as the N2HDM or in Higgs-triplet models e.g. the Georgi-Machacek model, significant branching ratios of $H^+ \to W^+h$ are possible. The latter decay mode has so far been covered neither by ATLAS nor CMS.

We present first studies on the search for heavy charged Higgs bosons decaying via $H^+ \to W^+h$ in final states with at least one large-R jet, one charged lepton and missing transverse momentum.

T 87.4 Thu 16:45 Tl

Search for a light CP-odd Higgs boson decaying into a pair of taus with ATLAS — •Xynia-Magdalena Sonntag, Tom Kresse, Wolfgang Mader, and Arno Straessner — IKTP, Dresden, Germany

Even though theoretical predictions of the SM are corresponding to experimental results to an incredible degree, there are still some phenomena unexplained, for example the deviation of the measured anomalous magnetic moment of the muon from SM calculations. This deviation could be explained by the flavor-aligned two-Higgs-doublet model (2HDM). The introduction of a second Higgs doublet leads to four additional Higgs bosons, one of which being CP-odd and electrically neutral. Parameters of interest in this model are the mass of the CP-odd Higgs boson and the couplings to charged leptons and up type quarks.

In this talk, the search for such a light CP-odd Higgs boson produced via gluon fusion and decaying into a pair of tau leptons is presented, looking at final states with one electron and one muon. The mass range of the CP-odd Higgs boson analyzed lies between 40 GeV and 90 GeV. The search is based on Monte Carlo simulations and data to Monte Carlo comparisons in background control regions using 139 fb^{-1} of data collected by the ATLAS experiment at 13 TeV. Results will be presented, focussing on a refined event selection optimized according to the expected limit for the production of such a CP-odd Higgs boson.

T 87.5 Thu 17:00 Tl

A search for resonances decaying into a Higgs boson and a new particle X with the ATLAS detector — •Nicola de Biase[1,2], Vincenzo Canale[2], Francesco Conventi[2], Francesco Cirotto[2], Silvia Auricchio[2], and Antonio Giannini[2] — [1]DESY Hamburg — [2]Università Federico II e sezione INFN di Napoli

Several theories beyond the Standard Model (SM) are theoretically well motivated and predict the existence of high mass particles that are likely to produce a Higgs boson when decaying.

In this talk, a search for a new narrow resonance Y at the TeV scale, decaying into a Higgs boson and a new boson (X), with a completely hadronic $XH \to q\bar{q}'b\bar{b}$ final state is presented. The search uses data from proton-proton collisions at a center of mass energy $\sqrt{s} = 13$ TeV and corresponding to a 139 fb^{-1} integrated luminosity, collected by the ATLAS experiment at CERN.

The X boson decay can have two different signatures: for low momenta of the X, the quarks $q\bar{q}'$ hadronize into a pair of well separated jets, while for high momenta they merge into a single large radius jet.

A new tagging algorithm, based on a feed forward Deep Neural Network, is used to identify the Higgs decay.

A set of signal hypotheses, characterized by two continuous parameters, the masses of the new particles, is investigated. A machine learning algorithm (parametrized Deep Neural Network) that takes into account this dependence is used to enhance the discovery sensitivity for new signals over SM background processes.

T 87.6 Thu 17:15 Tl

Optimization of the Search for New Physics in boosted $HH \to b\bar{b}\tau^+\tau^-$ Decays in ATLAS — •Merle Schröder, David Kirchmeier, Wolfgang Mader, and Arno Straessner — IKTP, Dresden, Germany

In searches for physics beyond the Standard Model the resonant production of two Higgs bosons plays an important role. The decay into the $b\bar{b}\tau^+\tau^-$ final state is especially promising. While on the one hand, the decay of the Higgs boson into two b quarks has a high branching ratio, on the other hand, the signal from the decay into two τ leptons can be well distinguished from the multi-jet background whilst maintaining a large enough branching ratio. However, the reconstruction of highly boosted di-tau final states from decays of high-mass resonaces above 1 TeV is challenging. Therefore, dedicated algorithms for reconstruction and identification have been developed in the past. The optimization of the analysis and the resulting improvements using the full Run-2 dataset of 139 fb^{-1} will be shown in this talk.

T 87.7 Thu 17:30 Tl

Search for charged Higgs bosons in $H^+ \to Wh \to l\nu bb$ decays with resolved event topology with the ATLAS detector — Patrick Bongratz, Dominik Duda, •Simon Grewe, Sandra Kortner, and Hubert Kroha — Max-Planck-Institut für Physik, München

Various theories predicting an extended Higgs sector predict also the existence of at least one set of charged Higgs bosons. The main production mode of these new particles depends on their mass. For charged Higgs boson masses larger than the sum of the top and the bottom quark mass, the dominant production mode is expected to be in association with a top quark and a bottom quark (tbH^+).

In the alignment limit of the two Higgs-Doublet model (2HDM),

heavy charged Higgs bosons with m(H^+)>m(t)+m(b) decay almost exclusively via $H^+ \to tb$. However, in other models such as the N2HDM or in Higgs triplet models e.g Georgi-Machacek model, significant branching ratios for $H^+ \to W^+h$ are possible. The latter decay mode has so far been covered neither by ATLAS nor CMS.

We present first studies on the search for $H^+ \to W^+h \to \ell\nu bb$ decays in final states with the resolved topology containing four or more, well separated jets, one charged lepton and missing transverse momentum. Boosted decision trees (BDTs) are used to solve the jet combinatorics, thus reconstructing the charged Higgs boson decay.

T 87.8 Thu 17:45 Tl

Search for Dark Matter produced in association with a Standard Model Higgs boson decaying to b-quarks with 139 fb^{-1} **of pp collision data with the ATLAS detector** — •Janik von Ahnen — DESY, Hamburg, Germany

Many extensions of the Standard Model predict the production of Dark Matter in association with Higgs bosons. This search examines the final state of missing transverse momentum accompanied by a $b\bar{b}$ pair coming from a Higgs boson decay. For this matter proton-proton collision data is used which is produced at 13 TeV centre-of-mass energy and recorded by the ATLAS experiment at the LHC, amounting to an integrated luminosity of 139 fb^{-1}. The increase in integrated luminosity in conjunction with many analysis optimizations result in a better sensitivity in comparison to previous iterations. No significant deviations from the Standard Model are observed and the results are interpreted in the context of the 2-Higgs doublet models with an additional vector or pseudoscalar mediator.

T 87.9 Thu 18:00 Tl

Exploring the 0L channel in the search for dark matter produced in association with a single top quark — •Paul Moder[1], Claudia Seitz[1], Ben Brüers[2], and Alvaro Lopez Solis[2] — [1]DESY Hamburg — [2]DESY Zeuthen

While the Standard Model (SM) is very effective in describing most of the observations in particle physics, there are still effects that remain unexplained. One of these mysteries is the existence of dark matter (DM) in the universe although it is assumed to make up around 80% of the existing matter. With the construction of the LHC and the discovery of the Higgs boson in 2012, completing the SM, a lot of searches were focused on possible final states with DM, which can only be detected indirectly through missing transverse energy. One particular scenario of interest is a model where a mediator is added to the 2 Higgs doublet model (2HDM). The 2HDM assumes a second Higgs doublet in addition to the one in the SM, resulting in a total of five Higgs bosons. The additional mediator couples both to the 2HDM and the DM sector, making it possible to create dark matter at the LHC. A number of final states is explored in this model, one of them containing a top quark, a W-boson and dark matter. This final state was previously explored in two analysis channels, one with 1 lepton and one with 2 leptons in the final state. This talk presents a new, orthogonal 0 lepton channel in the same final state and will focus on its challenges and possiblities, discuss a preliminary signal region and compare its sensitivity to the already existing analysis.