T 55: Search for new particles III

Time: Wednesday 16:30–19:00 Location: H-HS XVI

T 55.1 Wed 16:30 H-HS XVI

Search for high mass lepton flavour violating processes with CMS — •Sebastian Wiedenbeck, Thomas Hebbeker, Arnd Meyer, and Swagata Mukherjee — III. Physikalisches Institut A, RWTH Aachen University

Lepton flavour is a conserved quantity in the standard model of particle physics, but it does not follow from an underlying symmetry. Neutrino oscillations imply that lepton flavour is not conserved in the neutral sector. Lepton flavour violating processes are common in several models of physics beyond the standard model (e.g. supersymmetry with R-parity violation, black hole production, and leptoquarks). Some models predict objects at the TeV mass scale that can decay into two standard model leptons of different flavours: electron + muon, muon + tau, or electron + tau. The challenges in a search for such phenomena are to achieve a high mass resolution, good rejection of standard model backgrounds, and efficient lepton identification at the same time. The status of the analysis is presented, based on the latest CMS data taken in Run 2.

T 55.2 Wed 16:45 H-HS XVI

Search for new Physics in Boosted $HH \to bb\tau\tau$ Decays — •David Kirchmeier, Wolfgang Mader, and Arno Straessner for the ATLAS-Collaboration — TU Dresden

The resonant and non-resonant production of two Higgs bosons play an important role in the investigation of the Higgs self-coupling and in searches for physics beyond the Standard Model. Due to the relatively high Higgs mass and its narrow width, decays into two Higgs bosons are ideal e.g. in searches for heavy Higgs bosons. Furthermore the $HH \to bb\tau\tau$ decay channel is promising as the Higgs decay into a pair of b quarks has the highest branching ratio, while the decay into $\tau\tau$ final states has still a moderately high branching ratio and allows good separation against multi-jet background.

In particular the regime of very high mass resonances above 1 TeV is experimentally challenging. The high boost of the two b quarks and the two τ leptons lead to signatures with close-by pairs of b jets and τ decays in the ATLAS detector and requires dedicated experimental techniques to tag those topologies. This talk presents how the search for new physics in the $bb\tau\tau$ final state is extended to the regime of high mass resonances above 1 TeV. For that purpose the latest developments in the identification of highly boosted τ pairs in the fully hadronic decay channel are presented. It will be shown how these new techniques are applied in a search for new physics in the $bb\tau\tau$ final state. The latest results using the full Run-2 dataset of 139 fb^{-1} will be shown.

T 55.3 Wed 17:00 H-HS XVI

A multi-dimensional search for new heavy resonances decaying to boosted WW, WZ, ZZ, WH or ZH boson pairs in the dijet final state at 13 TeV — •Irene Zoi[1], Anna Benecke[1], Andreas Hinzmann[1], Robin Aggleton[1], and Daniela Schaefer[2] — [1]University of Hamburg — [2]KIT

The standard model, the best to date description of elementary particles and their interactions, still has open questions, such as the hierarchy problem. In the attempt to solve this issue, extensions of the standard model predict the existence of new massive resonances. Here a search for such new resonances decaying to two bosons (WW, WZ, ZZ, WH or ZH), where the vector bosons decay hadronically and the Higgs boson decays into pairs of bottom quarks is presented. Multiple resonance production modes are investigated, for the first time also vector-boson fusion is considered with this final state. The analysis is performed on data corresponding to an integrated luminosity of 137.2 fb^{-1} recorded with the CMS experiment at the LHC at a centre-of-mass energy of 13 TeV. The signal extraction method is based on a three-dimensional maximum likelihood fit of the dijet invariant mass and the mass of both jets. This approach has proven to increase the sensitivity and to be applicable to a diverse set of final states. As the search is focused on heavy resonances, where the decay products of each boson are expected to be collimated into one single jet, substructure techniques are exploited to significantly reduce the standard model background. Improvements in boson tagging techniques and sensitivity estimates with the full dataset will be presented.

T 55.4 Wed 17:15 H-HS XVI

Search for a long-lived particle in $b \to s$ transitions at Belle II — •Sascha Dreyer for the Belle II-Collaboration — DESY Hamburg

The Belle II experiment at the asymmetric e+ e- SuperKEKB collider in Tsukuba, Japan can be used for B-physics studies as well as searches for dark sectors. A hypothetical new long-lived scalar particle that mixes with the Standard Model Higgs boson could serve as a mediator to dark sectors. This scalar particle could be produced in $b \to s$ transitions and decay to a pair of charged Standard Model particles with a vertex displaced from the interaction point. Photons interacting with the detector material and converting to an e+ e- pair before reaching the calorimeter feature a similar topology. Studying this process is important to understand possible backgrounds as well as reconstruction efficiencies for this search. This talk gives an overview of the search for a new long-lived scalar particle at Belle II including a study of photon conversions.

T 55.5 Wed 17:30 H-HS XVI

Sensitivity studies for the search for heavy neutral leptons in decays of W bosons produced in 13 TeV pp collisions using displaced signatures with the ATLAS detector — •Christian Appelt and Heiko Lacker for the ATLAS-Collaboration — Humboldt University, Berlin, Germany

The existence of right-handed neutrinos with Majorana masses below the electroweak energy scale can address ongoing problems of neutrino masses, matter-antimatter asymmetry of the universe and dark matter. In this work, we present a sensitivity study in the search of heavy neutral leptons (HNLs) in the mass range of 4.5-10 GeV. The HNLs are produced in leptonic decays of on-shell W bosons formed in 13 TeV pp collisions at the Large Hadron Collider. We are focusing on unique displaced signatures captured by the ATLAS detector. The displaced signatures are characterized by a prompt muon originating from the W boson decay and a secondary vertex displaced in the radial direction by 4-300mm from the beam line. The displaced HNL search considers data with an integrated luminosity of up to 139/fb and results are given as exclusion contours in the HNL coupling strength versus mass plane.

T 55.6 Wed 17:45 H-HS XVI

Search for Excited Leptons in the 2-Lepton + 2-Jet Final State with CMS — •Jonas Roemer, Thomas Hebbeker, and Kerstin Hoepfner — III. Physikalisches Institut A, RWTH Aachen University

This talk presents a new search for excited leptons using data collected by the CMS detector. The theory is based on compositeness models and allows the production of excited leptons via contact interactions in conjunction with a Standard Model lepton. It would provide an explanation for the observed hierarchy of three generations of fermions. This search features a new decay mode of the excited leptons into one lepton and two jets via a contact interaction.

We present limits based on the full 2016 and 2017 proton-proton dataset corresponding to a luminosity of 77.4 fb^{-1} at a center of mass energy of $\sqrt{s} = 13$ TeV and compare if with recent search results in other channels.

T 55.7 Wed 18:00 H-HS XVI

Search for heavy Vh resonances with the ATLAS detector in the final state with boosted $h \to b\bar{b}$ decays — •Andreas Hönle, Dominik Duda, Sandra Kortner, Hubert Kroha, and Stefan Maschek — Max-Planck-Institut für Physik

Many extensions of the Standard Model (SM) predict the existence of heavy resonances that decay into boson pairs. A process with promising search prospects is the decay of a heavy particle into a SM vector boson V ($\equiv W, Z$) and the SM Higgs boson h with a subsequent leptonic V decay and a Higgs boson decay into a pair of b quarks.

With the final Run 2 ATLAS dataset of 139 fb^{-1}, recorded at $\sqrt{s} = 13$ TeV, this process can be probed in new regions of phase space which were not accessible before.

This talk presents most recent results from the search for Vh resonances in the semileptonic decay channel based on the full Run 2 ATLAS dataset.

T 55.8 Wed 18:15 H-HS XVI

Resonanz-Suchen im Zwei-Boson-Zerfallskanal mit vollhadronischem Endzustand mit dem CMS-Experiment — Thomas Müller und •Daniela Schäfer — Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Intstitut für Technologie (KIT)

Viele Erweiterungen des Standardmodells sagen die Existenz neuer Teilchen mit Massen im TeV-Bereich voraus, die zum Beispiel über ihren resonanten Zerfall in zwei Vektor-Bosonen nachgewiesen werden könnten. Die hier präsentierte Suche benutzt bei einer Schwerpunktsenergie von 13 TeV mit dem CMS-Detektor aufgenommene Daten, um im vollhadronischen Endzustand nach exotischen Zwei-Boson-Resonanzen zu suchen. Aufgrund der großen Masse der gesuchten Resonanzen sind ihre Zerfallsprodukte stark geboostet. Ein solches geboostetes Vektor-Boson kann nicht mehr über zwei einzelne Jets rekonstruiert werden, sondern seine Zerfallsprodukte werden stattdessen in einen einzigen "fetten" Jet geclustert. Um zwischen solchen Jets, die von stark geboosteten Vektor-Bosonen stammen, und Untergrund-Jets zu unterscheiden, werden Methoden basierend auf der Substruktur der Jets verwendet (*V-tagging*). Eine weitere Herausforderung ist die Modellierung des von QCD-Multijet Ereignissen dominierten Untergrundes. Hierfür wird eine neue Strategie verwendet, die auf einem multidimensionalen Fit im Zwei-Jet-Massenspektrum m_{jj} und den zwei Jet-Massen m_{jet1} und m_{jet2} beruht.

T 55.9 Wed 18:30 H-HS XVI

Search for Diboson Resonances ($X \longrightarrow Zh, Wh$) produced via Vector Boson Fusion with the ATLAS Detector. — •Stefan Maschek, Dominik Duda, Andreas Hönle, Sandra Kortner und Hubert Kroha für die ATLAS-Kollaboration — Max-Planck-Institut für Physik, München

The heavy vector triplet (HVT) model summarizes several extensions of the Standard Model into one phenomenological Lagrangian and predicts heavy vector bosons Z' and W', which can decay into the Standard Model Higgs boson h and SM vector boson Z or W. In some regions of the model parameter space, the couplings to fermions are forbidden such that the production of these new hypothetical particles via the fusion of two vector bosons (VBF) becomes the dominant production process.

In this production mode, the two quarks that each irradiate a vector boson, will form hadron showers in opposite hemispheres in the forward region of the ATLAS detector, resulting in a large gap in the pseudorapidity of those two jets.

This talk will present the results of a search for the Vh ($V = W, Z$) resonances produced via the vector boson fusion. The studies in this final state are performend for the first time in ATLAS.

T 55.10 Wed 18:45 H-HS XVI

Search for FCNC coupling between the top quark and the Higgs boson in the H→ $b\bar{b}$ decay channel — •Arunika Sahu for the ATLAS-Collaboration — Bergische Universitaet Wuppertal

Processes involving flavour-changing neutral currents (FCNC) are highly suppressed in the top-quark sector. Any observations of such processes would therefore be a signal for physics beyond the Standard Model. The FCNC contributions in pp→tH process comes from qtH and qtg interactions at leading order. We assume the qtg coupling contributions to be negligible and consider only qtH coupling contributions. In the presented analysis, we search for the pp→tH process, involving ctH and utH FCNC vertices. Final states are considered in which the top quark decays semi-leptonically and the Higgs boson decays into a $b\bar{b}$ pair. A serious background to $tH(H \to b\bar{b})$ are events featuring two b-jets from top decays and one or two heavy flavour jets from gluon splitting. $t\bar{t}$ with 3 b-tagged jets are expected to be underestimated. We develop a data-driven approach to correct this $t\bar{t}$+ Heavy Flavor underestimation in our signal regions. This challenging $t\bar{t}+b\bar{b}(c\bar{c})$ background is estimated via dedicated control regions. Neural networks are employed to separate signal and background events in the signal region.